Global Initiatives in Research, Innovation and Sustainable Development of Agriculture and Allied Sciences (GIRISDA- 2022)

1st International Conference

Book of Abstracts

Organized by

Agro Environmental Education and Farmer's Welfare Society (AEEFWS), Punjab
Guru Kashi University, Bathinda (ICAR Accredited)
and Just Agriculture- the Magazine

Editors

Mohit Bharadwaj
D. P. S. Badwal
Utkarsha P. Gaware
Himani Gautam
Piyush Choudhary

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on

06-08 June, 2022

at

Guru Kashi University, Talwandi Sabo, Bathinda, Punjab

Editors

Mohit Bharadwaj
Dr. D. P. S. Badwal
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Himani Gautam
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No. PS/VC/MPUAT/2022/ 602
Date: 27th July, 2022

Message

I am glad to learn that Just Agriculture has successfully organized International Conference on Global Initiative in Research, Innovation and Sustainable Development of Agriculture and Allied Sciences (GIRISDA02022) in association with AEEFWS, Punjab during 5th - 8th June 2022 at Guru Kashi University, Bathinda. Participation of about 600 delegates either physically or on virtual mode is a fair indication of the significance of this event. Though the history of Indian Agriculture dates back to 9000 BC but real thrust on agriculture as a policy matter was addressed in the decade of 1960. At the present crucial juncture when humanity is fighting against the curse of climate change, sustainable farming is a ferment issue. Having made significant advancements to achieve food security, we still need to address the productivity and quality issues to provide sufficient and safe food to the ever rising population underneath this curse. I believe that deliberations and discussions during different technical sessions must have oriented the participants in reaffirming their role as a researcher and innovator to sustain agriculture.

I am sure that papers must have been presented on technological advancements not only in the field of refining conventional technologies but also on emerging fields like role of digital technologies and artificial intelligence in agriculture and allied sector, precision agriculture to improve the overall harvest quality and accuracy, farm automation, good agricultural practices, vertical farming, hydroponics, aeroponics and marketing intelligence for economic empowerment of peasant etc. It is pleasing to note that the organizers are bringing out a volume of abstracts of the conference which will spread the proceeding in public and shall strengthen their endeavours in purposeful planning of future research and innovations. I congratulate Dr. D.P.S. Badwal, Founder & CEO, Just Agriculture-Magazine & Newsletter and all the members of Editorial Committee in compiling the abstracts and shaping the publication meticulously.

Rathore

(Narendra Singh Rathore)

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Message

Agriculture in India is highly diversified and crops are grown in diverse environments. Frequent occurrence of abiotic stresses have been identified as the key factors for the low productivity of rainfed ecosystems apart from the man made degradation of soils and environment. Rapid technological interventions coupled with value addition of produce is seen as the solution to upscale the productivity and sustainability of the small and marginal farmer holdings of India. It is heartening to see that significant changes are already happening to change the fate of the parched, hungry, degraded lands. I am happy to know that the 1st International Conference on Global Initiatives in Research, Innovative and Sustainable Development of Agriculture and Allied Sciences (GIRISDA-2022) was organized by the Agro Environmental Education and Farmers Welfare Society, Punjab in a hybrid mode (Online/ Offline) during 6-8 June, 2022. The efforts of Agro Environmental Education and Farmers Welfare Society, Punjab which has played a significant role in providing suitable forum for exchange of ideas, encouraging research and disseminating knowledge on innovative ideas for advances in agriculture and allied sciences to researchers are truly commendable.

I understand that the conference was organized by AEEFWS, Punjab in collaboration with Guru Kashi University, Bathinda, Punjab and Just Agriculture - the Magazine at Guru Kashi University, Talwandi Sabo, Bathinda, Punjab. The thematic areas of the conference were well chosen and I am sure the deliberations were very useful for the researchers, development agencies and farmers of the country to understand the practical problems in the agricultural development of the country. I congratulate Dr. D. P. S. Badwal, founder & CEO of Just Agriculture and his team for their hard work in making this kind of academic interface possible.

(Praveen Rao Velchala)

Date: 23-07-2022

महाराणा प्रताप बागवानी विश्वविद्यालय, करनाल-132001 (हरियाणा)
Maharana Pratap Horticultural University, Karnal,-132001 (Haryana)
(Established vide Haryana Act No. 32 of 2016)

Prof. Samar Singh
Vice-Chancellor

Foreword

It gives me immense pleasure to write that AEEFWS, Punjab , Just Agriculture- the Magazine and Guru Kashi University and AEEFWS, Punjab has organized 1st International conference on Global Initiative in Research , Innovation and Sustainable Development of Agriculture and allied science (GIRISDA -2022). Now organization is going to publish abstract book of the conference. This book will contain all abstracts of papers presented in all the session of the conference plus lead papers and keynote address. I learnt that many research papers having very useful and significant information were presented in the conference. This book will act as reference book for the topics of sustainable development of Agriculture and allied sciences viz Horticulture and Precision Farming, Food Security, Environment, alternative farming systems plant protection and climate change for scientist, academicians, professional, extension workers and students. The readers will find this very useful and detailed information related to the themes of conference. I wish success to the organization for organizing such a wonderful conference and editors to compile and publish the present 'Abstract Book".

9/8/22

(Samar Singh)

Dr.Pratap Mukhopadhyay,

Former Principal Scientist,ICAR-CIFA(www.cifa.in) &

FAO Consultant (Aquaculture Nutrition)in Kenya & Uganda

To Whom it may concern

Guru Kashi University(GKU) ,Talwandi Saho,Bathinda in association with JUST AGRICULTURE and AEEFWS ,Punjab organised the First International Conference on Global Initiatives in Research, Innovation & Sustainable Development in Agriculture and Allied Sciences (GIRISDA-2022) during July,6-8,2022.

It has been an enriching experience to participate in such a well planned subject matter conference. The organising members justifiably deserve a great compliment and I record my grateful thanks to the entire TEAM -Just Agriculture for the job, so well done.

My regards and best wishes to the TEAM once again including Madam Utkarsha for everything.

Pratap Mukhopadhyay

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Message

It is pleasure to share that Guru Kashi University, Talwandi Sabo, Bathinda, AEEFWS, Punjab and Just Agriculture had organized a three days International Conference on Global Initiatives in Research, Innovative and Sustainable Development of Agriculture and Allied Sciences (GIRISDA-2022) in a hybrid mode (Online/ Offline) during 06, 07 and 08 June, 2022 at Guru Kashi University, Talwandi Sabo, Bathinda (Punjab). The conference provided a broad platform to the students, academicians and research scholars where they were able to share their thoughts, innovative ideas, knowledge and experiences from the diversified fields of agriculture and allied sciences.

This era of technology is in high demand of innovation in the field of agriculture and allied sciences, hence widening the scope of application of the subject we are in need of ideas that would sync in and keep serenity and pristine character intact with nature. The conference had focused on the themes based on present scenarios of agriculture, innovations, animal genetics & breeding, advancement of technologies, etc. I found that the deliberation and interacting during the conference was beneficial, stimulating, productive and encouraging to the participants. I extend my sincere regards to the students, scholars and fellow participants of the conference and congratulate Dr. D. P. S. Badwal, founder & CEO, Just Agriculture- the Magazine and his team for their outstanding team work.

(S. J. Gahukar)

Gopal U. Shinde
Principal Investigator,
NAHEP-CAAST,
DFSRDA, VNMKV
Parbhani MS, India

Message

The researchers of digital agriculture society have been explored with an opportunistic platform to share and discuss about sustainable development in attending the precision agriculture. The groups of such digital agriculture handling community gathered at the Guru Kashi University, Talwandi Sabo, Bathinda with an association of Just Agriculture and AEEFWS, Punjab. This is a 1st International Conference on Global Initiatives in Research, Innovative and Sustainable Development of Agriculture and Allied Sciences (GIRISDA-2022) in a hybrid mode (Online/ Offline) during 06, 07 and 08 June, 2022.

It gives me an immense pleasure to see and participate in innovative research as a mechanization and precision agriculture by digital technology encloser with the farmer's friendly sustainable technology development in India. This conference was very well networked with a comfortable arrangement and co ordinations. The organizing members of Just Agriculture, AEEFWS and Guru Kashi University, Talwandi Sabo should organize such a event at least once in year with an exhibitory platform of digital technology innovators and producers at global level in both offline/online mode together.

I exalt with my deep gratitude to organizing team under the guidance of Hon. Vice chancellor, Dean, Registrar of GuruKashi University and especially to the Founder & CEO of Just Agriculture, Dr. D. P. S. Badwal and his team for their efforts.

Gopal U. Shinde

MESSAGE FROM CHIEF ORGANIZING SECRETARY

Firstly I would like to thank Scientists, researchers, policy makers and young professionals who contributed their immense presence and expertise to this awesome gathering at the 1st Internationa Conference **Global Initiatives in Research, Innovation and Sustainable Development of Agriculture and Allied Sciences (GIRISDA- 2022)** held at Guru Kashi University, Talwandi Sabo, Bathinda (Punjab). Through this the participants as a researcher, must have gained the vision, the knowledge, the resources and the experience to pave their way into the future technical activities regarding agri-innovation. The ability of people to modify their diets is fundamentally influenced by agriculture, which provides food for consumption and income that may be used to buy nutritious food. Given that, it supports the livelihood of half of the people, provides raw materials for industry, and assures the country's food and nutritional security. Agriculture is essential for the socio-economic development of the nation. The industry is currently under pressure from factors such as population growth, changing food patterns, the degradation and depletion of natural resources, climate change, a lack of skilled labour, and the continuous degradation of land, which is causing agrarian distress. Hence, diversification in nutrient-dense, climate-resilient, commercially viable, and locally accessible or adaptable species should be emphasised in improved agriculture and food systems. It is possible to increase the supply of a wider variety of plant and animal-based meals and ensure that people have year-round access to nutrient-dense diets through nutrition-sensitive agriculture, which supports integrated agricultural systems.

I hope the exchange of ideas presentated by scientists, research scholars and students on various themes of the conference would have served the participants with enormous knowledge on development in agriculture. I'm thankfull to all the respected guests and participants for making this conference successfull.

Mohit Bharadwaj
Vice- President, AEEFWS, Punjab
Chief Editor, Just Agriculture- the Magazine

MESSAGE FROM CONFERENCE DIRECTOR & ORGANIZING SOCIETY PRESIDENT

The development of innovations has played an important role in the improvement of the lives of millions of farmers over the country. Cognizing this fact and exploring ways to capitalise on this the 1st International Conference on **Global Initiatives in Research, Innovation and Sustainable Development of Agriculture and Allied Sciences (GIRISDA- 2022)** was planned. It was indeed a great privilege for AEEFWS, Punjab to collaboratively organize the conference with Guru Kashi University, Bathinda (ICAR Accredited) and Just Agriculture- the Magazine at Guru Kashi University, Talwandi Sabo, Bathinda. The conference was embellished by the presence of Chief Guests, Dr. Gurbachan Singh (Former Agriculture Commissioner, GOI and Chairman, ASRB), Dr. Jaspal Singh (Principal Scientist, Entomology) and Dr. Aman Keshav (Project Director, ATMA, Punjab). The grand success of this event was due to the joint efforts of respected guests and dignitaries, Dr. J.S. Dhiman (Registrar & Pro-VC, GKU, Talwandi Sabo), Dr Pushpinder S. Aulakh (Pro-VC, GKU, Talwandi Sabo & Former Director Horticulture Punjab), Dr. Gopal U. Shinde (PI, NAHEP- ICAR- DFSRDA, VNMKV, Parbhani), Dr. S. J. Gahukar (CEO, Agribusiness Incubation Centre for Maharashtra, MA & FW, GoI, Dr. PDKV, Akola) and Dr. Antarpreet S. Jutla (University of Florida, US), Dr. Prasad P Barunge (Assistant Professor, Dept. of Entomology, PAU), Dr. Naresh Singla (Assistant Professor, Dept. of Agricultural Economics, Central University, Punjab) and Dr. Deepinderpal Singh (Dean, University College of Agriculture, GKU, Talwandi Sabo).

Along with this enlightening conference the delegates had a chance to discover the beauty of city of lakes. We hope that all the delegates had returned with sweet memories of this conference and I give them best wishes for their future endeavours.I appeal to the research community and also participants to extend their continued support and cooperation to the future activities of AEEFWS, Punjab and Just Agriculture.

"Agriculture is the foundation of manufactures, since the productions of nature are the materials of art" – Edward Gibbon.

Dr. D. P. S. Badwal
President, AEEFWS, Punjab
Founder & CEO, Just Agriculture- Magazine

MESSAGE FROM ORGANZING CHAIRMAN

It gives me immense pleasure to share that AEEFWS, Punjab and Just Agriculture- the Magazine in collaboration with Guru Kashi University, Talwandi Sabo, Bathinda (ICAR Accredited) have successfully organized the 1st International Conference on **Global Initiatives in Research, Innovation and Sustainable Development of Agriculture and Allied Sciences (GIRISDA- 2022)** at Guru Kashi University, Bathinda during 06th to 08th June, 2022 in a hybrid mode. The conference was organzised as a constructive effort for providing a platform to the researchers, academicians and students to share their ideas about topics on recent innovations on agriculture and gain knowledge from the same. The conference had covered a wide spectrum of topics along with presentations, guest lectures and keynote addresses that helped to enlighten the participants with the latest development in agri-innovation and its sustainability with practical aspects.

I sincerely hope that the deliberation which took place during the conference will pave way to fruitful interventions in the field of Agriculture and Allied Sciences with significant positive impacts on the lives of our farmers. I thank all the participants for their positive participation and the organizing team for being supportive and making this event a milestone.

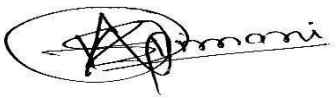
Dr. Utkarsha P. Gaware
Vice- President
Just Agriculture- the Magazine

MESSAGE FROM CO-ORGANIZING CHAIRMAN

I am very glad that **Just Agriculture, University College of Agriculture, Guru Kashi University, Talwandi Sabo & Agro Environmental Education and Farmer's Welfare Society, Punjab** has organized three days International conference on **"Global Initiatives in Research, Innovation, and Sustainable Development of Agriculture and Allied Sciences (GIRISDA-2022)"** from **June 6 to 8, 2022** at **Guru Kashi University, Talwandi Sabo (Punjab)**. It was my privilege to get the opportunity of inviting and welcome all the eminent speakers, invitees, delegates and participants to this conference.

This conference was exceptional in all respects because it was an attempt to bring together the leading scientists and scholars with the intent to have a discussion on the important issues of Modern Agriculture like Organic Farming, Role of Agrochemicals, biological & technological interventions, integrated nutrient, weed, diseases & pest management, application of biotechnology and genetic engineering etc. The conference had offered a diverse platform for invited talks, lead papers, oral presentations and poster sessions on the above-mentioned topics. It provided a unique opportunity to the participants to share information, exchange their ideas and develop new vistas for their future endeavors in the field of agriculture and allied sciences. I thank all the eminent speakers, invitees, delegates and participants to spare their valuable time and participating in this conference.

Meaningful discussions were made during the conference which would assist all of us to make better strategies to combat the issues of modern agriculture.



Himani Gautam
Executive Vice- President
Just Agriculture- the Magazine

MESSAGE FROM ORGANIZING COORDINATOR

I am very happy that **Just Agriculture, University College of Agriculture, Guru Kashi University, Talwandi Sabo & Agro Environmental Education and Farmer's Welfare Society, Punjab** has organized three days International conference on **"Global Initiatives in Research, Innovation, and Sustainable Development of Agriculture and Allied Sciences (GIRISDA-2022)"** from **June 6 to 8, 2022** at **Guru Kashi University, Talwandi Sabo (Punjab)**.

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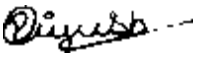
I sincerely hope that the deliberation which took place during the conference will pave way to fruitful interventions in the field of Agriculture and Allied Sciences with significant positive impacts on the lives of our farmers. I am looking forward for the best outcome from the International Conference and convey my best wishes for future upcoming events.



Dr. Piyush Choudhary
Chief Associate Editor
Just Agriculture- the Magazine

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GIRISDA/LP/001/2022

THE USE OF ALTERNATIVE FEED INGREDIENTS IN POULTRY - THE ROAD AHEAD

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Introduction

Poultry meat is currently the number one animal protein globally (overtaking the pig meat in 2019) and, this trend in consumption and poultry production will continue in the postCovid world. This expansion in the poultry industry, however, will come with multiple challenges. The most important constraint will be on the demand of raw materials. In particular, the biggest challenge is to find adequate supply of the „big two" (corn and soybean meal) to sustain the predicted growth of the industry. This challenge is further exacerbated by Covid interruptions in the supply chain of ingredients and rising shipping costs. We may expect a bumpy ride in the road ahead. It is not possible to predict the future supply of raw materials. This is a known „unknown" and depends on plethora of events beyond our control. Based on historical trends, the scenario is unpredictable and can change within very short periods. The obvious strategy to address this threat is to revisit the „known potential alternatives" that can replace or reduce the inclusions of corn and soybean meal. The search for alternative ingredients has a long history. We have been searching for and testing new ingredients for decades, ever since the commercialization of the poultry industry. Especially every time the price of the „big two" goes up, interest in alternative ingredients spikes up. Among others, the main attraction is that these are locally produced and locally available A simple definition of alternative ingredients would be as „not normally used in the country/region". This includes both non-traditional (locally available and already researched) and novel (those previously unknown and being developed). This definition is not fixed. An alternative ingredient in one country may be a common ingredient in another one and a current alternative ingredient may become a common component in the future. There are many examples, implying that the definition is location specific and time-specific. There are number of acknowledged limitations of alternative ingredients, which preclude their use by the commercial industry. These include socio-economic, technical and nutritional issues. Nutritional constraints in specific local ingredients are well known and discussed at various forums over the years. In this paper, selection of these ingredients is examined in the context of availability, price and ingredient quality. The term „quality" is not easy to define and include several aspects – variability (or uniformity), nutrient digestibility, apparent metabolizable energy (AME), antinutrient levels, nutritional imbalance etc. In this discussion, how these risks can be mitigated to improve feed formulations.

Alternatives to corn

Interest in the use of wheat and barley are increasing in Asia. These grains are generally considered as inferior in AME and feeding value to corn. On the other hand, however, these are the major energy sources for poultry in many regions of the world, including Australia and New Zealand. Their lower AME is related to the presence of viscous carbohydrates that also make the AME highly variable. However, the variability and quality issues could be efficiently mitigated by the use of feed enzymes. With exogenous replace corn and inclusions of barley can be increased. Sorghum is another possibility. Past problems in the feed value of sorghum are due largely to higher tannins in old cultivars. Today, tannin content has been vastly reduced and sorghum can totally replace corn.

Table 1: Alternatives to corn.

Interest in the use of WHEAT and BARLEY increasing in Asia – generally considered as inferior in AME and feeding value to corn.
They contain viscous NSP which negatively affect bird performance and also make the AME highly variable.
The variability and quality issues could be very effectively mitigated by use of feed enzymes. With enzymes, wheat can completely and barley partially replace corn.
Wheat is a major energy sources in many parts of the world, including Australia and New Zealand.
SORGHUM – past problems have been due to high tannins, but current cultivars are low in tannin.

Alternative strategies in protein nutrition

On the other hand, soybean meal (SBM) is difficult to replace completely. Thus, the target should be to reduce the dependence on SBM and the inclusion level of SBM. Strategies may include (i) reduced protein diets along with the use of synthetic amino acids (ii) low to moderate inclusions of alternative proteins (canola meal, DDGS) and, (iii) low level use of novel proteins (insect proteins, algal proteins, single cell proteins). Extensive research data and knowledge are already available in the region on a range of potential local ingredients. Technology options to enhance their feed value are also known, but ingredient supplies remain the greatest constraint.

Table 2: Alternative protein nutrition

Soybean meal is difficult to completely be replaced.
The target should be to reduce the dependence on SBM and the inclusion level of SBM: • Reduced protein diets with the use of synthetic amino acids. • Use of enzymes (proteases!). • Low to moderate inclusions of alternative proteins (canola meal, DDGS). • Use of novel proteins (insect proteins, algal proteins, single cell proteins).

Intestinal health

This could be a concern if alternative ingredients are not carefully used and will lower productivity with no one even realizing it. Most alternative ingredients are poorly digested and, undigested components and antinutrients may trigger mucosal inflammatory responses. Intestinal inflammation is a „hidden" health condition leading to compromised gut integrity, leaky gut, intestinal disturbances and, dysbiosis, which is exacerbated by moving away from the use of in-feed antibiotics. The mechanisms behind this problem and methods to counteract them are becoming available only recently.

Addressing the issue of variability in by-product feeds

Variation in the composition of ingredients is inherent and unavoidable. Rapid tests for gross nutrient contents in major ingredients have been available for decades, but tests for the AME and amino acid digestibility have become available only in recent times. The NIR technology provides a pathway to predict the nutritive value of ingredients on an on-going basis to improve feed formulations.

Managing the risks in alternative ingredients

The reluctance in using alternative ingredients is due, in part, to the risks involved and several approached may be used to manage these risks. First, inclusion limits identified in well-planned research trials must be used. When

deciding inclusion levels, two scenarios are relevant - whether the target is biological performance (optimum inclusion) or economic performance (maximum inclusion). The final decision will depend on local market conditions and local prices. In both cases, the savings must be balanced against returns. In specific cases, use of alternative ingredients is favored and inclusion thresholds could be fine-tuned. Alternative ingredients must be avoided in young birds, but inclusion levels can be gradually increased with advancing age. The popularity of slow growing broilers opens up another avenue; these birds are more tolerant to poorly digestible ingredients and higher inclusions can be used. Another recent trend is changing views on fiber nutrition. Fiber is now considered as an „essential" dietary component and low inclusions of fibrous ingredients are being promoted.

Six keys to successful risk management of alternative ingredients

In the future, we need to move away from the current „two ingredient focus" to a diverse basket of ingredients; the six keys listed below are relevant. If the availability is not restricted, the risks of alternative ingredient use may be managed by precise feed formulations through:

1. Routine ingredient evaluation
2. Use of digestible amino acids
3. Inclusion thresholds
4. Use of rapid prediction technology
5. Feed additive technology (exogenous enzymes, synthetic amino acids, gut flora modifiers, emulsifiers, etc.)
6. Feed processing technology (pelleting, extrusion, etc.)

With time, experience and knowledge, the risks associated with nutritional constraints will become minimal and manageable.

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LIVESTOCK FOR SUSTAINABLE DEVELOPMENT TOWARDS ONE HEALTH

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Introduction

Livestock and derived products are assets to human livelihood and nutrition and thereby to human health and wellbeing, providing essential noble, high-biological value proteins, fatty acids and various minerals and vitamins. Animals are a source of therapeutic compounds such as antimicrobial peptides, while porcine and bovine insulin have long been used to treat human diabetes. Farm animals supply traction and transport, raw materials (hides, wool, skin, feathers *etc*), cash and financial security through savings. Thus livestock provides all essential components in maintaining decent livelihoods and in building resilience to climate changes and associated natural disasters. Animals in general offer positive psychological, emotional and social benefits to humans in terms of companionship or effect of pets on autistic individuals and are of cultural value not only to their owners and their families but to society as a whole. However, animals pose risks to human health through the transmission of zoonotic pathogens, including emerging viral diseases, through the development of antimicrobial resistant bacteria, through increasing concentrations in the environment of the residues of medicines, supplements and contaminants. But their benefits to mankind in terms of nutrition, health, livelihoods, life expectancy and well-being largely exceed their negative aspects.

Livestock and Diseases

The majority of human pathogens have their origins in animals, which means that animals and animal products potentially present a recurrent and growing risk to human health. This risk can be reduced through proper prevention and control measures. The mass vaccination of livestock against zoonotic brucellosis benefits not only human health but the entire agricultural sector as well contributing to poverty alleviation in the process. Interventions on livestock to reduce gastrointestinal or respiratory illnesses may have a direct positive impact on human illness.

The risk of zoonotic diseases is overall higher in developing countries. The main groups at risk of exposure are women and children, who work closely with livestock due to the cultural and social division of labour. Women are involved with livestock in several ways: they clean cattle sheds, feed animals and are responsible for milking, processing and dairy sales. Because of their frequent contact with cows and calves during milking, women are often the first to detect sick animals. Children are mainly tasked with herding and watering animals or with egg collection. The children spend about nine hours a day herding and watering animals in these countries.

The human health burden of food-borne disease is significant throughout the world and that a large part of this burden is related to animals and/or foods of animal origin. Globally the most frequent causes of foodborne illness are diarrhoeal disease agents particularly *Norovirus* and *Campylobacter* spp. Non-typhoidal *Salmonella* spp. was the major causes of death. Children under five years of age were main sufferers. Even though the burden is higher in developing countries, foodborne diseases also have a significant impact in developed countries. Throughout the world, the human health burden of zoonotic diseases falls heavily on the poor. They cause morbidity and mortality, in particular in children, health care expenses and reduced income for the remainder of people‟s lives. Due to limitations in health services and surveillance systems in many developing countries, zoonotic diseases tend to be under-diagnosed and under-reported. They are not prioritized by national or international health systems, and most fall into the „neglected tropical disease‟ category. Due to globalization, growing international trade and climate change, the whole world is affected, particularly as concerns vector-borne diseases. With global warming issues, vectors and associated pathogens are moving geographically to previously free areas and it is reported that almost half of the world‟s population is now susceptible to vector-borne pathogens. Like zoonoses, these diseases affect mainly women and children in developing countries, who represent the most vulnerable social groups (women because of pregnancy and childbirth, children because their immune systems are not fully developed).

Increasing livestock numbers, intensified management, faster animal turnover, confinement of large numbers of animals in small spaces as well as habitat fragmentation through expansion of livestock production all increase the probability of outbreaks of emerging zoonoses, which may have pandemic potential. More than 70% of the infectious diseases to emerge in humans since the 1940s can be traced back to animals, above all wildlife and many of these are food-borne and resistant to antimicrobial medicines. A significant proportion of such microorganisms found in livestock and/or wildlife can be transmitted to humans directly, *via* the environment or through animal-source foods (ASF). Animals and ASF can also transmit to humans the residues of medicines, supplements and contaminants. They can affect health through a single exposure, resulting in acute poisoning or through long-term exposure, affecting the reproductive and immune systems (e.g. external hormone residues) or causing non-communicable diseases such as cancer.

Farm animals make many positive contributions to human health by producing medicines such as bovine and porcine insulin used in the treatment of diabetes. Horses produce antisera against snake venom and cationic antimicrobial peptides with a broad spectrum of activity against Gram-positive and Gram-negative bacteria. It should also be noted that animals in general have a positive effect on the well-being of humans at psychological and emotional levels and are culturally important in many communities. Human health risks associated with animals and ASF can be prevented by raising awareness, educating consumers and promoting hygienic livestock production and food preparation practices. Ensuring collaboration between animal production and health specialists, public health officials and the commercial sector, including the feed industry, through a One Health approach is crucial to achieving an integrated and preventive strategy on livestock associated human health risks.

Livestock and Antimicrobial Resistance

Inappropriate use, overuse and abuse of antimicrobials in animal production contribute to the increase in antimicrobial resistance (AMR) in pathogens causing human infections. It has been estimated that by 2050, ten million lives a year and USD 100 trillion of economic output are at risk from drug-resistant infections.

Today, approximately 7, 00,000 people die of drug-resistant infections every year. Low- and middle-income countries face the greatest burden from the growth in drug-resistant infections. FAO has developed an Action Plan on AMR in food, agriculture and the environment which addresses four major focus areas:

1. Improve awareness on AMR and related threats
2. Develop capacity for surveillance and monitoring of AMR in food and agriculture, including livestock
3. Strengthen governance relating to AMR in food and agriculture, including livestock
4. Promote good practices in food and livestock–agricultural systems and the prudent use of antimicrobials

The FAO Action Plan supports the WHO-led Global Action Plan on AMR and both highlight the necessity of applying a One Health approach, with the involvement of public health and veterinary authorities, the food and livestock-agricultural sectors and other concerned partners. Prevention is the best way of combating AMR. Intensive use of antimicrobial agents is recognized as one of the principal causes of AMR. The use of naturally disease-resistant animals (DRAs) has been advocated as a longer-term policy and strategy for reducing antimicrobial usage. This would diminish AMR in farm animals as the use of DRAs requires a lower number of treatments than for susceptible animals. In addition, as previously mentioned, cationic AMPs, which represent a new class of antibiotics derived from livestock species, have the ability to remain unaffected by classical resistance genes so that, to date, no cases of antimicrobial resistance have been recorded for AMPs.

Livestock, Water, Hygiene and Environment

Poor populations face several challenges regarding household hygiene conditions, access to clean water and access to sanitation facilities. Such problems together create ideal environments for pathogens to be transmitted via foodstuffs, particularly ASF. Lack of hygiene facilities might increase significantly the risk of transmission of bacteria and viruses. According to WHO, access to hygienic sanitation facilities has risen in the last decades and the proportion of the population able to use them has risen. However, 30 percent of the global population still lacks such access. In poor households with low hygienic conditions in low-income countries, diarrhoeal diseases cause deaths, mainly among

children and most are due to food-borne pathogens such as *Salmonella* and *Campylobacter*, transmitted in animal-derived foods. The most cases of food-borne diseases are also those with less access to improved water sources.

The domestic animal husbandry was associated with human diarrheal disease being faecal-oral pathogen transmission to young children households. Living in proximity to livestock especially in settings lacking basic sanitation facilities can prompt the transmission of disease from animals to humans. Children, who commonly share the task of taking care of household livestock, are at greater risk of exposure, and children under the age of five have the highest risk of severe illness from zoonoses once contracted. Therefore, accessibility to clean water, good hygienic practices and a healthy environment are all positive factors contributing to limit the onset and spread of infectious diseases.

Livestock and Nutrition

Meat and meat products together with dairy and eggs and their products are a valuable source of noble, high biological value proteins, fat and various physiological, functional compounds like micro/trace elements and vitamins. These are of great importance in everyday human diets and in ensuring balanced growth, including cognitive and physical development. Consumption of ASF provides diet nutrients essential for balanced growth and cognitive outcomes in school-aged children. Children‟s consumption of milk and eggs improves their nutrition, linear growth rates and height gains. Consumption of ASFs can improve child nutrition and immune competence. Frequency of consumption of ASF is associated with livestock ownership and healthy household farm animals. Therefore, actions aimed at controlling diseases in animals positively impact not only on livestock productivity but also on ASF consumption patterns. The livestock production systems are now modifying their processes so as to improve both the quality and nutritional traits of meat. Techniques designed to produce pigs with a more balanced ratio of unsaturated to saturated fat acids in their meat have been developed.

Animal foods provide high energy and quality diets, micronutrients and improved nutrition for pregnant and breastfeeding women. Small amounts of ASF in early childhood have been shown to have remarkable impacts on physical and cognitive development, hugely enhancing human capital.

Conclusions

The benefits derived from livestock are well recognized, however, if not managed properly, livestock and their products can be sources of communicable and non-communicable human diseases. Many of the microorganisms harboured by livestock can be transmitted to humans. Overconsumption of ASF leads to an increase in the non-communicable human disease burden. Inappropriate use of antimicrobials in livestock production contributes to rising antimicrobial resistance in animal and human infections across the globe and contamination of soil or surface waters through manure and other waste. Considering the magnitude of the linkages and the complexity of the relationships between human health, animal health, nutrition and the environment, multidisciplinary and interdisciplinary action is required. The One Health concept and approach is considered pivotal in designing and promoting policies, strategies and actions for the livestock sector to ensure healthy lives and production efficiency.

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MICRO IRRIGATION: A BOON FOR DRYLAND AGRICULTURE TOWARDS SUSTAINABLE CROP PRODUCTION

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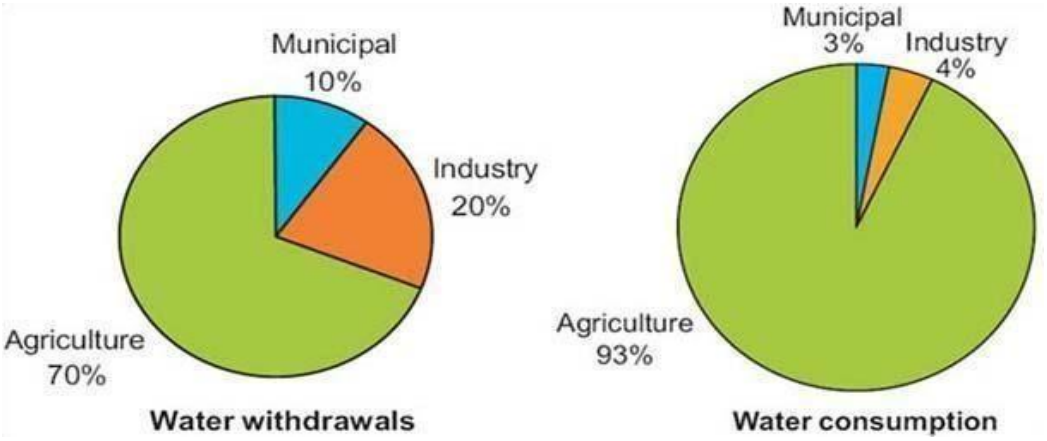
Introduction

Water scarcity in India is mostly caused by regional disparities in water demand and availability. Agriculture is the greatest water-consuming industry, accounting for more than 80% of total withdrawals, and while it only accounts for around 40% of gross cultivated land, India has the most irrigated area in the world. Given the rising scarcity and demand for non-agricultural water, demand management should get special attention. Although numerous demand management measures have been implemented in the irrigation sector in India with the goal of boosting water use efficiency (Vaidyanathan 1998; Dhawan 2002), the overall effect of these strategies on increasing water use efficiency has been ineffective so far. Micro-irrigation (MI) is widely used in Indian agriculture, it is the only one of demand management strategies introduced for manage water consumption. Micro-irrigation supplies water in desired quantity and at the actual location where water is required using a pipe network, emitters and nozzles. According to MI theory, it should result in lower conveyance and distribution losses and improved water usage efficiency. Sprinklers and drip irrigation are two modern micro-irrigation (MI) systems that are gaining popularity. Drip irrigation (DIM) and sprinkler irrigation (SIM) methods differ in parameters such as flow rate, pressure requirement, wetted area, and mobility (Kulkarni 2005), and drip irrigation system on-farm irrigation efficiency can be as high as 90%, compared to 35 to 40% efficiency in surface irrigation method (INCID 1994). However, SIM has a lower water consumption efficiency (up to 70% efficiency) than drip irrigation but much higher than surface or flood irrigation (INCID 1998; Kulkarni 2005).

Micro irrigation systems apply water directly to the root zone of crops using emitters, which are specifically designed equipment that has already been implemented by several nations to change their irrigation system. This method was launched in India in the 8th Plan and has been used commercially for the past decade. Using this technology, India could cover over 1.20 million acres under micro irrigation, primarily for horticultural crops. However, the coverage is now quite limited, with just roughly 69 million hectares covered by this upgraded system. The difficulties of low WUE must be addressed in the face of dwindling water supplies due to solve the issues, the efficacy of development and need-based adoption of micro irrigation systems should be investigated. Micro irrigation, comprising drip, mini sprinklers, and sprinklers, should become a significant component of an integrated water usage system with many agricultural ecological, socioeconomic, and environmental benefits, as witnessed in India and selected emerging nations. Micro irrigation has evolved as a strategy for managing existing water resources, saving water, fertilizers, and energy, and is one of the interventions in high-value agriculture that is contributing to diversification. Unlike conventional irrigation systems, micro irrigation aids in evenly spreading of water. When compared to the traditional idea of irrigation potential, the performance of micro irrigation in terms of water production is seen as a good indication of irrigation. the exceptionally high prevalence of the irrigation industry, particularly surface irrigation. "Water productivity is defined as the ratio of actual yield attained to water utilised." Unlike conventional approaches, the micro-irrigation increases crop output while using relatively little water. As a result, increasing the numerator while decreasing the denominator will result in a significant increase in water production. Through effective irrigation systems, real water savings in agricultural production may be accomplished in arid and semi-arid environments. As a result, micro irrigation has been regarded as a revolutionary tool for long-term agricultural growth.

Why Micro-Irrigation

According to current estimates, thirty-four nations throughout the world will experience a water crisis by 2025, with per capita fresh water resources of less than 100 m^3 per year. On the other hand, as the population grows, so will the need for food and fibre. India will need to enhance its present irrigation capacity of 91Mha to 160Mha, but the anticipated total water resource of 230Mha will also need to fulfil the demand for non-agricultural purposes. A country with renewable water supply in excess of 1700 m^3 per capita will have only occasional or local water shortages. Countries begin to endure occasional or frequent water stress when they go below this level.



Sector wise water use in India Source: FAO, 2013

In the year 2025, India (1400 m^3) and China (1700 m^3) will be first in this category, while the United States will have more than 7000 m^3 $person^{-1}$ $year^{-1}$ and would not experience any scarcity. The world's rising demand for urban and industrial water resources poses a severe danger to irrigated agriculture. Water allotment for agriculture would be reduced from 70% to 50%. Hence, technologies for accurate water application methods must be used, in tandem with technology for water collecting and storage. Conveyance losses are the biggest issue linked with the decreasing availability of fresh water for irrigation, accounting for 46% of the net consumption of irrigation water. However, in order to satisfy the extra need of irrigation with sophisticated water harvesting technologies, more runoff collection, storage, and recycling for precise water application must be implemented by limiting the available quantity of irrigation water. Micro irrigation expands irrigation coverage by utilizing previously available water. Micro-irrigation with fertigation will boost the output per unit of input in these nutrient-deficient, shallow, and loose soils.

Sprinkler Irrigation System

Drip Irrigation System

Role of Micro Irrigation

The micro irrigation approach has been demonstrated to have a considerable influence on water resources, agricultural profitability, and water resource sustainability. Micro irrigation in general, and drip irrigation in particular, has received significant attention from policymakers, researchers, and economists etc due to its perceived ability to significantly contribute to ground water resource development, agricultural productivity, economic growth, and environmental sustainability. The influence of drip irrigation on farming systems has been examined in terms of cropping pattern, resource consumption, and production. Therefore, policy should emphasise the development of drip irrigation in areas where there is a lack of water and manpower, as well as in wide-spaced crops.

a) Increase in water efficiency - 50 to 90%
b) Energy consumption savings - 30.5%
c) Fertilizer consumption savings - 28.5%
d) Productivity increase, Fruit/Crops - 42.4%; Vegetables – 52.7%
e) Irrigation cost savings - 31.9%
f) New crop introduction - 30.4% farmers
g) Increase in Farmers‟ income - 42%

Traditional irrigation technologies are used on more than 80% of the worlds irrigated areas, although their field level application effectiveness is approximately 40-50%. Drip irrigation, on the other hand, provides field level application efficiency of 70-90 percent since surface runoff and subsurface percolation losses are avoided. Drip irrigation may save up to 70% of the water used by particular crops. Drip irrigation also increases agricultural yields by 30 to 200 percent in variety of crops (Kadasiddappa M.M., 2015).

Table -1 Total micro-irrigation area coverage (except rice), and micro irrigation penetration in India (as on 31 March 2015)

State	Micro-irrigationarea (ha)	Penetration (%)
Haryana	573140	16.3
Punjab	42966	1.0
Rajasthan	1684549	9.3
Madhya Pradesh	352117	2.3
Sikkim	8313	10.8
Mizoram	2152	2.2
Nagaland	5205	1.4
Chhattisgarh	256193	5.5
Odisha	100578	2.3
Bihar	102050	1.9
Jharkhand	16222	1.5
West Bengal	51180	1.0
Andhra Pradesh	1163306	10.4
Karnataka	846947	8.5
Gujarat	829373	8.1
Maharashtra	1271126	7.3
Goa	1864	1.4
Kerala	29464	1.4
Tamil Nadu	320445	6.4
All-India total	7775314	5.5

*****_penetration indicates area under micro-irrigation divided by net sown area_

(DES, Agricultural Statistics at a Glance, Directorate of Economics and Statistics, Department of Agriculture Cooperation and Farmers‟ Welfare, Ministry of Agriculture and Farmers‟ Welfare, Government of India (GoI), 2015)

Impact of Micro Irrigation

Applying irrigation at 125 percent pan evaporation (PE) and 100 percent RDF improved soil nutrient and moisture availability and increased yield (5.70 t ha-1) at Tamil Nadu agriculture university Coimbatore, but drip irrigation produced higher grain and straw yield (4.96 t/ha & 5.18 t/ha) when combined with fertigation at 125 percent RDF, but it was on par with irrigation at 125 percent PE (Naiket al., 2015). This shows that drip irrigation saves water, resulting in an increase in WUE (91.01kg/ha/cm) when the crop was fertigated with the full recommended quantity of fertilizer. Another study found that using water soluble fertiliser with drip fertigation resulted in a greater grain productivity (6.5 t/ha) with 100 percent RDF. It was comparable to 100 percent and 75 percent RDF, with 50 percent applied as basal with normal fertilizer and 50 percent top dress as water soluble fertilizer by drip fertigation (6.14 and 5.60 t/ha) and 75 percent RDF via drip fertigation with water soluble fertilizer (5.66 t/ha). Micro irrigation solutions result in net water savings by reducing losses due to deep percolation, evaporation, and inefficient field conveyance and distribution systems. Water application, for example, can be decreased by 50–100% using the drip irrigation approach (Narayan Moorthy, 1997). Although micro-irrigation methods can save water at the plot or field level, they may not result in net water savings at a larger geographical scale, such as the watershed or basin (Molden et al. 2003).

Irrigation Efficiencies under different Methods

When compared to the usual approach, water consumption efficiency in micro irrigation varied from 80 to 90 percent compared to conventional methods (30-35 percent). Several studies show that canal irrigation water use efficiency is less than 30%, where water is delivered over open channels, resulting in water loss through evaporation, percolation, and seepage (Gulati and Banerjee, 2016). Many studies show that MI saves water up to 40 to 80 percent and improves water use efficiency up to 100 percent when compared to conventional practices, as well as savings in energy consumption (30.5 percent), savings in fertilizer consumption (28.5 percent), savings in irrigation cost (31.9 percent), increasing area under new crops (30.4 percent), and an increase in farmers' income (42%). (IAIFICCI Grant Thornton, 2016, Kumar and Palanisami 2010, Suresh Kumar 2008 and Narayanamoorthy, 2009). Hence water saving is high in micro irrigation methods.

Policies to be implemented in India for adoption of micro irrigation

- **Institutional set-up for Synergy among the Nodal institutions Responsible for Implementing PMKSY Scheme**

  A closed loop system is required for the proper execution of the PMKSY technique. The existing silo-based strategy of the Ministries of Water Resources, Agriculture, and State Watershed Departments will be ineffective. To enable successful implementation, a fully empowered special purpose vehicle (SPV) (with money from relevant ministries and departments) that is responsible for effective execution of micro irrigation under the PMKSY plan is required. This SPV should be in charge of all actions, including on-the-ground implementation and monitoring and reaching MI objectives. Given the significance and advantages of SPV, there is a need to establish SPV in other states of India where SPV is not existent, following the lines of GGRC and APMIP, to ensure the effective implementation of PMKSY across the nation.

- **Proposition for Effective Implementation of Existing Schemes**

  Farmers are currently forced to pay for the initial cost of the micro irrigation system in various states, including Punjab, Haryana, Rajasthan, and Maharashtra. Farmers must shoulder the initial cost, which ranges from 50% to 100% of the entire cost must be paid in advance to the MIS vendors, putting additional hardship on the majority of farmers. The lack of clear rules often leads to poor MIS implementation. Where farmers are unable to make full payment ahead for MIS, a provision for NOC might be made, and funds could be transmitted straight to MIS suppliers. The lack of sufficient criteria for subsidy funds allocation in 80 percent of the states may result in

delays in implementation of the scheme. Greater openness is required in the micro irrigation deployment process. All stakeholders should have easy access to information in order to facilitate appropriate monitoring and completion of MIS within deadlines while reducing hassles for farmers. IT should be leveraged to improve monitoring, highlight best practices, and increase openness in the industry.

- **Capacity Building of the Farmers and other Stakeholders**

  The majority of district and block authorities from various states have recommended that capacity building of both stakeholders, that is, beneficiaries and officials, on the operation and maintenance of micro irrigation systems be enhanced. According to an NITI Aayog study, around 61 percent of beneficiaries have requested increased awareness and capacity building through training and demonstrations. Water Users Associations (WUAs) in India should be strengthened with the cooperation of the public and commercial sectors to increase water usage efficiency by giving training on the operation and maintenance of MIS on the field. Precision Farming Development Centres (PFDC) networks that have been formed in India and are accessible in every state to promote precision farming for hi-tech horticulture must be reinforced and equipped to operate as training centres for huge numbers of farmers.

- **Awarding "Infrastructure" Status to Micro Irrigation sector**

  Giving the irrigation sector infrastructure status might result in single-window clearance for irrigation projects in several states, which helps to save time. The irrigation sector's infrastructure status would encourage commercial agencies to participate in restructuring decades-old irrigation infrastructure, resulting in improved management of existing irrigation water supply networks and better planning of future irrigation water projects. For example, in the area of water and sanitation, the Reserve Bank of India (RBI) has granted "Infrastructure" status to Water Supply Pipe Lines and Irrigation (Dams, Channels, and Embankments); this promotes direct and simple access to infrastructure funding for foreign investors. Moreover, it will help to reduce the operating cost for MIS manufacturers, which will in turn reduce the burden of MIS cost on farmers.

- **Pradhan Mantri Krishi Sinchayee Yojna**

  Under PMKSY, the Government of India has established a Centrally Sponsored Scheme on Micro Irrigation. The Scheme was introduced in January 2006 by the Ministry of Agriculture's Department of Agriculture and Cooperation. The Micro Irrigation component of OFWM was incorporated into the Pradhan Mantri Krishi Sinchayee Yojna on April 1, 2015. (PMKSY). It was introduced during the fiscal year 2015-16 in accordance with the same pattern of support and cost rules that existed under OFWM. In FY 2016-17, the funding pattern under PMKSY has been maintained at 60:40 percent between the Central Government and the State Government. The goal of this project is to enhance water usage efficiency by encouraging suitable technological interventions such as sprinkler and drip irrigation systems, as well as to encourage farmers to employ water saving and conservation technologies. Because of its proximity and focused application, micro-irrigation is considered a vital aspect of the Pradhan Mantri Krishi Sinchayee Yojna (PMKSY) which aims at more crop per drop. These are as follows

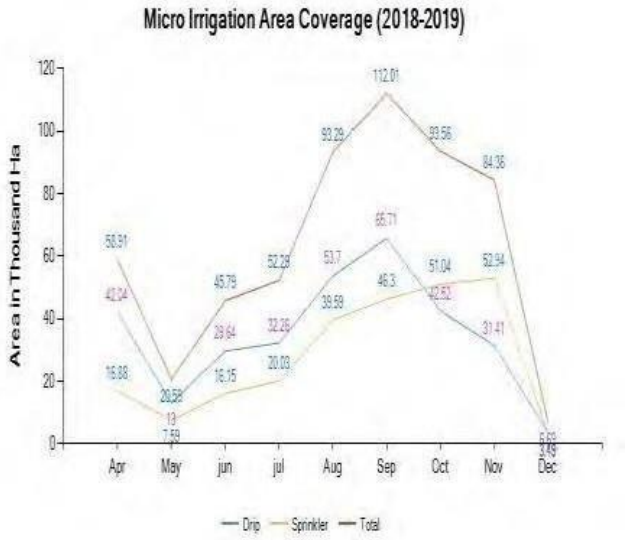
- Micro-irrigation considerably reduces conveyance losses, runoff, evaporation losses, seepage, and deep percolation losses, resulting in water usage efficiency of 50-90 percent. The saved water can be utilized to expand irrigation or for reclamation of troublesome soils or degraded/waste land.
- The saved water can be utilized to expand irrigation or for reclamation of troublesome soils or degraded/waste land. The potential energy savings might be put to use in other areas.
- Applying nutrients to the immediate root zone via micro irrigation or fertigation saves up to 28.5 percent on fertilizer use. It has a long-term influence on obtaining land productivity
- Irrigation using micro irrigation saves water while increasing crop and fruit yield by up to 42.4 percent and vegetable productivity by up to 52.7 percent. As a result, it provides a strong economic return for higher yields.
- Farmers may add more new crops judiciously owing to improved water scenarios, and it is predicted that up to 30.4 percent of farmers have done so.
- More targeted and judicious use of water has resulted in an increase in farmers' revenue.

Holistic Approach for Micro Irrigation System

Poverty Alleviation: basically, vast rainfed areas converting into irrigated areas which are capable with greater productivity and stability and through the creation of additional employment opportunities, especially by involving the private sector.

Horticulture–led Diversification of Agriculture: for capturing new markets particularly under the WTO, raising of high value commodities with the tremendous prospects. This system also permits commercialization of protected horticulture with tremendous economic returns

Enhanced Productivity: through the increasing improved quality of the product and reduced labour and input costs – ensuing in greater competitiveness in the open world market. Then it works on "More crops per drop" subtitle.



Source: Per Drop More Crop - Micro Irrigation (Data collected from PMKSY) (Website https://images.app.goo.gl/wuitKXynudv6fA837

Environmental Protection and Ecological Security: by promoting precision farming where the right quantity, right time, right place and right sources of application of the irrigation water is assured. There is a significant reduction in accumulation of salt in the root zone in the associated problems of water table rise and water logging, in salinization and in the fall of the water table in tube well command areas

Promotion of Equity: by adopting micro irrigation technology varying in nonspecific to location, topography, commodity and the quality of land. Its adoption in waste lands and in hill and mountainous regions will greatly improve the socioeconomic condition of the people in such yet un-reached areas.

Challenges for Adopting Micro-Irrigation Technology

Though the technology has great potential to accrued profits. But, following important issues related to planning and implementation of the technology that could not be addressed by the National Schemes on micro irrigation initiated since 2006:

- Inadequate focus on nationwide spreading of micro-irrigation technology.
- Inefficiency in implementation as the implementation agency was changed from a dedicated mission to a component part of NMSA under PMKSY. In many States, the released funds were not utilized properly due to the lack of implementation strategies.
- Lack of reliable guidelines and delay in Government orders.
- Unavailability of subsidy funds for installation as subsidy reduced from 50% to 35% and allocation of funds under various schemes is declined.

- Difficulty in getting necessary supports from financial services. It was reported that a lower adoption rate due to the reduction in budget during the period (2013-Complicated application process of loan and delay in getting it.
- Inadequate supply of electricity.
- Chocking of laterals and drippers.
- Non availability of quality materials and damage of laterals by rodents.
- Initial high capital investments.
- Inadequate follow up services by the drip agencies.
- Non availability of soluble fertilizers.

The policy and implementation strategies were to be revised for better penetration of this technology.

Conclusion

With the farmer at the centre, one of the ecotechnological ways to achieving sustained and expanded agricultural production and productivity using led agriculture knowledge and technology is micro irrigation. The well-known advantages of micro-irrigation technology include increased yield, improved water usage efficiency, lower costs for water, fertilizers, manures, and weed elimination. All of this adds up to increased total economic advantages from optimal water usage. The technique will very certainly optimize the synergistic interactions of better seeds, water, and fertilizer - the three components of the Green Revolution.

The Green Revolution might be changed into an Evergreen Revolution by micro irrigation to assure sustainability, productivity, profitability, and equity. Because micro irrigation improves water, fertiliser, and energy efficiency and encourages precision agriculture. This technique is extremely significant and praiseworthy since it gives excellent benefits such as irrigation efficiency (50-90 percent), fertilizer (28.5 percent), and energy (30.5 percent). Micro-irrigation is an intervention that addresses a wide range of agricultural growth concerns, and it is thus seen as a leverage technology for sustainable agriculture.

Farmers will use the technology if the economic return is higher. As a result, economic concerns may be integrated with more engineering techniques to make water productivity relevant in economic criteria.

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NANO AGRICULURE: A GREAT WAY FOR MODERN AGRICULTURE

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Abstract

During the climate change phase, global agriculture systems are confronting a variety of unexpected dangers. Advanced nano-engineering is a valuable tool for increasing agricultural yield and ensuring resistance in order to attain food stability. Nanotechnology strives to boost agricultural output by improving input performance and reducing waste. Nanomaterials expand the specific surface area of fertilisers and insecticides. Furthermore, nanoparticles as specialised carriers of agrochemicals offer site-targeted controlled nutrient delivery with increased crop security. Because of their specific and intended uses in the exact control and regulation of inputs (fertilisers, pesticides, herbicides), nanotools, such as nano biosensors, support the construction of high-tech agricultural farms. Nonsensors' ability to detect and understand environmental variables or limitations has been greatly increased by the incorporation of biology and nanotechnology.

Introduction

Nanoparticles (NPs) are nanorange-structured particles having unique optical, magnetic, electrical, and thermal characteristics (Luo et al., 2015). When compared to bulk materials, they have greater strength, enhanced conductivity, and reactivity (Annadhasan et al., 2014). The large number of surface atoms in their nanosize alters the particle's surface-related characteristics. These NPs are highly reactive.

In agriculture, nano intervention boosts yield by improving nutrient absorption efficiency and protects crops from pests using nano formulated pesticide. Crop safety is further aided by the development of new-generation herbicides with superior carrier systems, as well as the use of nanotechnology to decontaminate water and soil. Nanomaterial engineering is a cutting-edge research approach that stimulates the development of high-tech agricultural areas by providing a broader, specialized area critical to the long-term development of agricultural systems. As an alternative to existing technologies, nanotechnology will not only reduce confusion, but will also regulate agricultural production management plans. Agro-nanotech innovations provide short-term technological solutions to many of the problems confronting modern global agriculture. Nano fertilizers with controlled release boost crop growth, yield, and productivity. Crop improvement is achieved by the use of a nano-based target delivery technique (gene transfer). Nano pesticides can be utilised to protect crops effectively. Precision farming benefits substantially from the use of Nano sensors and digital controls. Nanomaterials can potentially be employed to improve soil and plant stress tolerance.

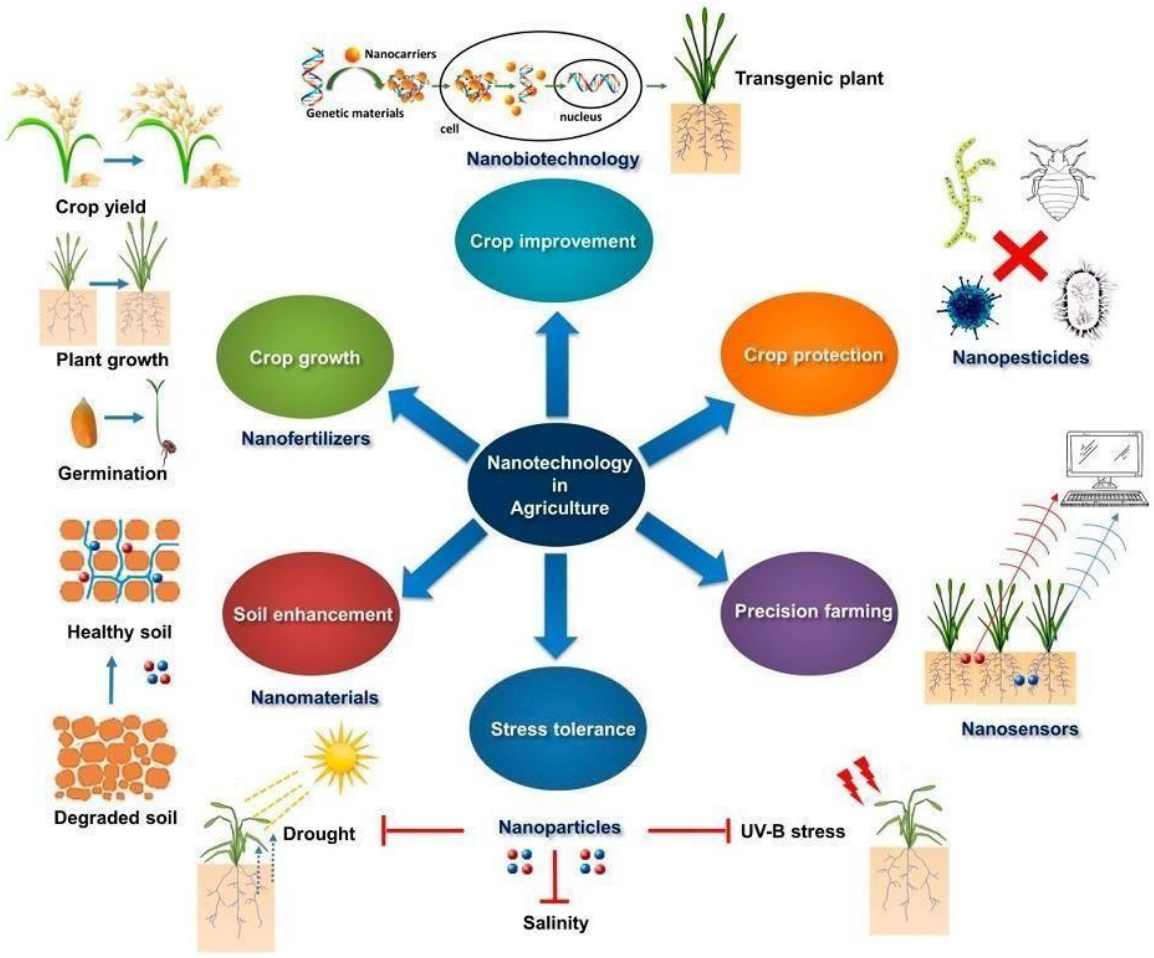

Figure 1. Applications of nanotechnology in agriculture

Nanotechnology in Plant Breeding and Genetic Transformation

In addition to the other strategies, crop protection can also be accomplished by reinforcing the defensive structures of plants, incorporating resistance genes and modifying their current defence mechanisms in order to achieve improved protection. Diverse types of NPs such as CNTs, quantum dots (QDs), liposomes, and lipofectins have been used as gene carriers in the plant biotransformation process (Chen et al., 2011). Compared to traditional processes, a nanotechnology-based gene transformation method seems to be very effective, time-saving, and protects DNA during the transformation process (Rafsanjani et al., 2012).

Production of Green Nanoparticles

Nanoparticles (NPs) are biological, inorganic, or composite materials having at least one dimension ranging from 1 to 100 nm (at the nanoscale). Photochemical processes, volcanic eruptions, forest fires, fundamental deterioration, plants and animals, and even bacteria may all produce NPs in nature. The creation of NPs originating from plants and microorganisms has emerged as a major biological source of green NPs, which have lately aroused the interest of scientists due to their eco-friendliness and ease of production compared to other routes. A variety of plant species and microorganisms, including bacteria, algae and fungi, are currently used for the exploitation of green nanotechnology for NP synthesis. For eg, to formulate gold nanoparticles, Medicago sativa and Sesbania plant species are used. Likewise, within live plants, such as *Brassica juncea, Medica gosativa and Heleanthus annus,* inorganic nanomaterials consisting of silver, nickel, cobalt, zinc and copper can be synthesised. Microorganisms such as Pseudomonas stuzeri, Diatoms, Desulfovibriodes ulfuricans NCIMB 8307 Clostridium thermoaceticum and Klebsiella

aerogens are used to synthesise silicone, while gold and zinc sulphide are used to synthesise nanoparticles of silicon, gold and calcium sulphide.

Nanotechnology in Crop Protection

Crops are attacked by a wide variety of attackers including weeds (monocots, dicots, and parasitic weeds), pests (insets, mites, rodents, birds, and mammals), and phytopathogens (bacteria, fungi, and viruses). These attackers can be classified as stand reducers, photosynthetic rate reducers, leaf senescence accelerators, light stealers, assimilate sappers, and tissue consumers (Kitherian, 2017). For example, *Helicoverpa armigera* feeds on more than 150 crops throughout the world including tomato, chickpea, pigeon pea, etc. (Vinutha et al., 2013). The fruitfly (Bactrocera dorsalis Hendel) is a polyphagus pest that feeds on various vegetable crops and fruits such as guava, apple, mango, orange, and banana. Insects also act as vectors for various plant diseases causing serious crop damage. Plant bacterial pathogens *Pseudomonas syringae, Ralstonia solanacearum, Agrobacterium tumefaciens, Xanthomonas oryzaepv. oryzae, Xanthomonas campestris, Xanthomonas axonopodis pathovars, Erwinia amylovora, Xyllela fastidiosa, Dickeya, and Pectobacterium carotovorum* are important (Mansfield et al.,2012). Fungal pathogens such as *Aspergillus, Blumeria graminis, Botrytis cinerea, Cladosporium, Colletotrichum sp., Fusarium graminearum, Fusarium oxysporum, Magna portheoryzae, Melampsoralini, Mycosphaerella graminicola, Penicillium, Puccinia sp., Phytophthora, Pythium, Rhizopus, sp., Rhizoctonia solani, Sclerotinia sclerotiorum, and Ustilago maydis* cause damage equally (Dean et al., 2012). Crop rotation, selection of the right variety of crop, time of sowing, and mixed cropping are some of the traditional ways of crop protection. Later, chemical pesticides were brought in to eradicate pests and pathogens (Glass and Thurston, 2014). However, most of the pesticides used for crop protection are lost in air or as runoff or spray drift, which results in off-target deposition. Only less than 0.1% of the applied pesticides reach the target; the rest are photo degraded or pollute the environment (Chowdappa and Gowda, 2013). Utility of nano materials is an advanced and alternative method to overcome the foregoing limitations. The advantages of using nano materials in agriculture are:

- Lessening the amount of agrochemicals being used for pest control
- Target-specific delivery of the biocide
- Controlled release of active ingredients
- Nanoformulation of the insoluble chemicals to increase their solubility
- Increased stability of pesticides by protecting them from washaway, leaching, evaporation, photo degradation, hydrolysis, and microbial degradation
- Bioaccumulation of harmful chemicals and environmental health protection as a result of fewer pesticides.

Pesticides are encapsulated into various forms to achieve the foregoing advantages. The encapsulating material that forms the shell around the active ingredient controls the physical, chemical, and release property of the nano pesticides thus formed. For encapsulation, the active ingredients are loaded inside or trapped in the polymeric material forming a nano sized structure. However, there is controversy as to whether 1–1000nm is the nano size of a colloidal system for pesticide delivery or if it should be 1–100nm, which is the actual range of nano. In this chapter, we have considered 1–1000nm as the nanorange (Nuruzzaman et al., 2016).

Nanoparticle-Enabled Smart Delivery Options: A New Window for Sustainable Agriculture

Nanotechnology is regarded as one of the essential technologies of the twenty-first century, having the potential to advance traditional agricultural methods and provide sustainable development through enhancing management and conservation strategies while reducing agricultural input waste. Agrochemical and organic molecule delivery systems, particularly the transfer of DNA molecules or oligonucleotides into plant cells, are critical components of both sustainable agricultural output and precision farming. Agrochemicals are often administered to crops by spraying and/or broadcasting in traditional ways. As a result, relatively few agrochemicals reach crop target areas, much below the minimum effective concentration necessary for healthy plant development.

Chemical leaching, photolysis, hydrolysis, and microbiological degradation all contribute to the losses. For example, while applying fertilizer, greater focus should be placed on nutrient bioavailability owing to soil chelation, microbial degradation, evaporation, over-application, hydrolysis, and run-off issues. In the case of pesticide applications, effectiveness increase through spray drift management so it should be prioritized. To assure environmentally acceptable agricultural operations, the recent breakthrough of nanotechnology-based synthesis of slow or controlled release fertilizers, insecticides, and herbicides has gained special attention in agriculture farming. Nanotechnology has progressed from lab-based experiments to practical applications throughout time. The goal of controlled delivery approaches is to release calibrated amounts of essential and adequate agrochemicals throughout time in order to achieve full biological competence while reducing loss and negative consequences. Because of their enormous surface area, facile adhesion, and rapid mass transfer, nanoparticles provide advantages for efficient pesticide administration. For these reasons, micronic or submicronic particles are absorbed into agrochemicals by a variety of methods, including capsulation, absorption, surface ionic or weak bond attachments, and entrapment in the active ingredient nano-matrix. For example, encapsulating potassium nitrate with graphene oxide sheets significantly delays fertiliser release, and such a formulation appears to be feasible at a cheap cost in large-scale manufacturing. Nanomaterials improve pesticide stability and protect them against degradation and subsequent release into the environment, thereby increasing the efficacy and decreasing the quantity of agrochemicals that are to be used.

Nanotechnology in Soil and Water Management

Unmonitored use of fertilizers, weedicides, etc. to spike growth has also skyrocketed with the freshwater demands. Agricultural wastewater deposits itself on the surface of groundwater, thereby contributing toward water pollution. Again, when the same contaminated water is reused for irrigation, crops suffer. In the field of agriculture, remediation and recycling are of keen interest because of the growing polluted nature of irrigation sources. These problems in soil and water management need urgent solutions to prevent further damage.

Nanotechnology can be used to address all soil and water related issues by using nanoscale materials for soil nutrient/water retention and even dissemination in agriculture, and it has been named by the European Commission as one of the six "Key Enabling Technologies" for long-term competitiveness and growth (https://ec.europa.eu/growth/industry/key-enabling-technologies_). CNTs, nano clays or zeolites, nanoscale membranes, and other materials can be used to purify water. For example, a breakthrough method based on nanoscale Fe particles has been discovered to be promising for the remediation of contaminated water at the source. This zero-valent nanomaterial has a high affinity for fertilizers/pesticides, organic solvents, heavy metals, and other substances (Mueller et al., 2012). Another noteworthy example is the application of TiO2 NP-coated filters in contaminated water for photocatalytic degradation of agro-based pollutants (McMurray et al., 2006). Similarly, soil remediation can be accomplished by embedding nanosized metals in pollutant-adsorbing resins or beads, which increases adsorption specificity and durability. Again, nanoparticles are used to improve soil by retaining applied agrochemicals and allowing them to be released to crops over time. Zeolites are one type of nanomaterial. Research employing natural zeolites found that they are "effective as slow-releasing nitrogen fertilizer" since their application slowed the nitrification process in the soil (Torma et al., 2014). Soil nano clay–polymer composites are also being investigated for the regulated release of nutrients into soil (Sarkar et al., 2014).

Conclusion

The use of nanoparticles in agriculture has shown to be a boon for crop protection. The nano-based distribution of agrochemicals in the form of nano capsules, nanospheres, micelles, nanocomposites, etc. has several advantages over the traditional approach to crop protection. Encapsulated pesticides have a prolonged shelf life due to their regulated release and resistance to photocatalysis, hydrolysis, and/or other degrading activities. Given the benefits of NPs over bactericides and fungicides, their capacity as nano pesticides is outstanding. Real-time monitoring of biophysiochemical parameters linked to crop improvement may now be achieved with great sensitivity using nano-based sensors. Many scientists are also interested in successful plant transformation via gene transfer utilizing nanotechnology. However, at a certain dose, the use of nanomaterials may be phytotoxic, which should be studied

before being used in the field. As a result, it is critical to evaluate the harmful effects of these nanomaterials as well as their bioavailability in animals and the environment. Before releasing nano-based plant protectants to the market, they should be subjected to rigorous regulatory testing to determine their efficacy and toxicity.

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CROP DIVERSIFICATION: AN APPROACH FOR SUSTAINABLE CROP PRODUCTION

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Introduction

India is a country of around one billion people, with more than 70% of the population living in rural areas where agriculture is the primary occupation. The country's food security strategy encourages the implementation of crop diversification that is eco-friendly method for conserving resources and reducing the impact of climate change this transformation aims at boosting agricultural production and productivity in order to keep up with expanding needs of the country's population. Crop diversification is environmentally and economically beneficial, we can make a significant contribution to our response to the majority of problems there by guaranteeing food security and reduced impact of climate change. Diversification of crops is one of the most cost-effective ways to reduce revenue uncertainty for farmers particularly among poor small-scale farmers. It reveals that crop diversification is significant in combating climate change and in acheiving food security. According to Niti Aayog projections, doubling farmers' actual income until 2022-23 from the base year of 2015-16 will necessitate yearly income growth of 10.41 percent. The primary issue in increasing farmers' real income is to maximise the use of available biophysical and human resources. Crop diversification is critical for conserving natural resources, lowering greenhouse gas emissions, and increasing efficiency. The primary need for setting the wheel of economic advancement in motion is the sensible and sustainable use of natural resources. In order to achieve these goals requires both the efficient use of finite natural resources and the conservation of renewable natural resources. Crop diversification in India refers to a transition from traditionally cultivated, lower-paying crops to higher-paying crops as a means of not only regenerating and conserving land but also increasing its production. It is determined by a region's geo-climatic, socio-economic, and technological growth. A great range of agricultural goods are produced in our country due to the country's diversified agro-climatic conditions. Crop diversification is a strategy for moving away from a single crop's regional dominance toward the production of a variety of crops in order to meet rising demand for coarse cereals, pulses, vegetables, fruits, oilseeds, and sugarcane. Its goal is to enhance soil health and keep the agro-ecosystem in a state of dynamic equilibrium. Crop diversification aims to encourage technological advancements in sustainable agriculture by allowing farmers to pick variety of crops for better productivity and income.

Factors Responsible for Crop Diversification

There is a constant rise for diversified agriculture with the introduction of scientific and sophisticated agricultural technologies. Changes in crop pattern, on the other hand, are the result of the interaction of many factors, which would include:

The changes in crop pattern, however, are the outcome of the interactive effect of many factors such as:

a) Resource related factors mainly irrigation, rainfall and soil health
b) Technology related factors mainly seed, fertilizer, water use, marketing, storage and post-harvest processing
c) Household related factors mainly food and fodder self-sufficiency requirement as well as investment capacity of the farmers

d) Price-related factors, which include output and input prices, as well as trade and other economic policies that affect these prices.

e) Institutional and infrastructure related factors covering farm size and tenancy issues, research, extension and regulatory policies of the government.

f) A persistently low level of farmer income can have a major negative impact on the country's future agriculture

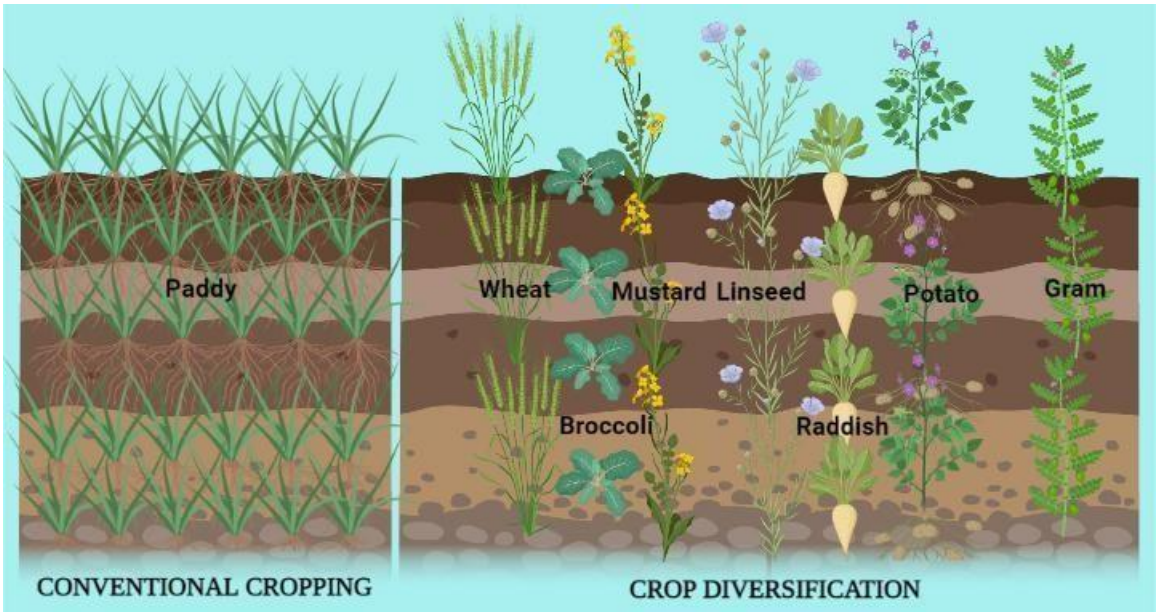
g) To ensure the future of agriculture and enhance the livelihoods of half of India's population, sufficient emphasis must be paid to improving farmers welfare and agricultural income.

h) New varieties, as well as new and emerging production technology, might possibly benefit farmers' cropping systems by raising yields, enhancing drought resistance, increasing pest and disease resistance, and exploiting new market opportunities.

i) Crops that are suitable for a variety of environments and farmer preferences must be identified.

These elements are intricately linked. Economic liberalization measures, as well as the globalization process, are putting significant pressure on farmers' area allocation decisions, primarily through their impact on relative input and output prices. While factors like food and fodder self-sufficiency, farm size, and investment constraints are important in influencing the area allocation pattern among smaller farms, larger farmers with the ability to circumvent resource constraints tend to prioritize economic considerations based on relative crop prices over other non-economic considerations.

Process of Crop Diversification



- **Horizontal Diversification**

  The most widely accepted strategy is the addition of additional crops to current cropping systems (i.e. multiple cropping), which broadens the system's base. This type of diversification is especially important in smallholder production systems, this has proved beneficial to production increases due to increased cropping intensities.

- **Vertical Diversification**

Vertical crop diversification, on the other hand, represents the degree and level of industrialization of agricultural production. This includes agroforestry, dry-land horticulture, medicinal and aromatic plants, as well as other economically valuable shrubs and cattle. Crop diversification, takes into account the economic returns from various crops. It differs from the concept of multiple cropping because of this. To boost crop yields and income generation at the local, regional, and national levels, both types of diversification (i.e. multiple cropping or horizontal diversification and agri-business or vertical diversification) will be required.

Crop Diversification as a Strategy for Food and Nutritional Security and Poverty Alleviation

Crop diversification is a method that can be utilised to address food and nutritional security. Diversification of horticulture crops, particularly fruits and vegetables, has played a critical role in ensuring food security. This has also had a significant impact on poverty alleviation. It has not only increased food grain production but helped to alleviate poverty, and also has increased production of commercial crops such as cotton, oilseeds, sugar cane, fruits and vegetables, as well as cattle and fisheries. Crop diversification can aid farmers in addressing significant poverty determinants such as:

(i) Absence of income and purchasing power (ii) Lacking of income and purchasing power

(iii) Lack of productive employment (iv) The continuous increase in price of food

(v) Inadequacy of social infrastructure

Affecting the quality of life of the people and their employability. The federal and state governments are working to double food output, with a concentration on food grains such as rice, wheat, coarse cereals, and pulses; oilseeds; sugar cane; fruits and vegetables; meat, milk, and fish. The Action Plan envisions a detailed strategy and specific productivity issues for significantly increasing the supply of various food items such that demand for such things for the entire population is comfortably supplied and some exportable excess is available.

Crop Diversification as Strategy for Issues of Natural Resource Management

Apart from diversion of cultivable land for various other purposes, subdivision and fragmentation of land holdings in the country provide very little scope for further expansion of the net sown area (142 m/ha), and land scarcity will become an acute feature of the rural economy. Water is another important natural resource that is facing a number of challenges, and there are a number of concerns about water resources in the country and states. As a result, judicious use of land and water resources will have to be the central theme for sustainable agricultural growth. In recent years, there has been a growing concern about the deterioration of soil health and water resources as a result of ineffective management. Land degradation, water logging, and a drop in the water table have all contributed to the deterioration of land and water resources. There is a greater need for an integrated approach to manage plant nutrients, chemicals, and taking effective measures to address overall pollution issues. There are several potential technologies and alternatives for reducing chemical use in agriculture. These alternatives are not perfect substitutes for chemicals, but their use can significantly reduce the negative impact on the environment. Environmental degradation would be reduced if proper land and water management policies were implemented. Farmers' institutions at the community and village levels must be encouraged to participate in resource consevation stratagies. Land and water resource regeneration programmes must be strengthened. Scientific crop diversification options must be planned in accordance with the land's capabilities.

Crop Diversification as an Important Way-Out for Doubling Farmers Income

According to the central government, the major sources of growth in the agriculture sector could include increased productivity, resource use efficiency or cost savings, increased cropping intensity, diversification toward high-value crops, etc. Many useful strategies were proposed over time, such as

In the due course, many useful strategies were proposed like

(i) Irrigation („Per Drop More Crop“)

(ii) Quality seeds (Improving seed replacement rate)

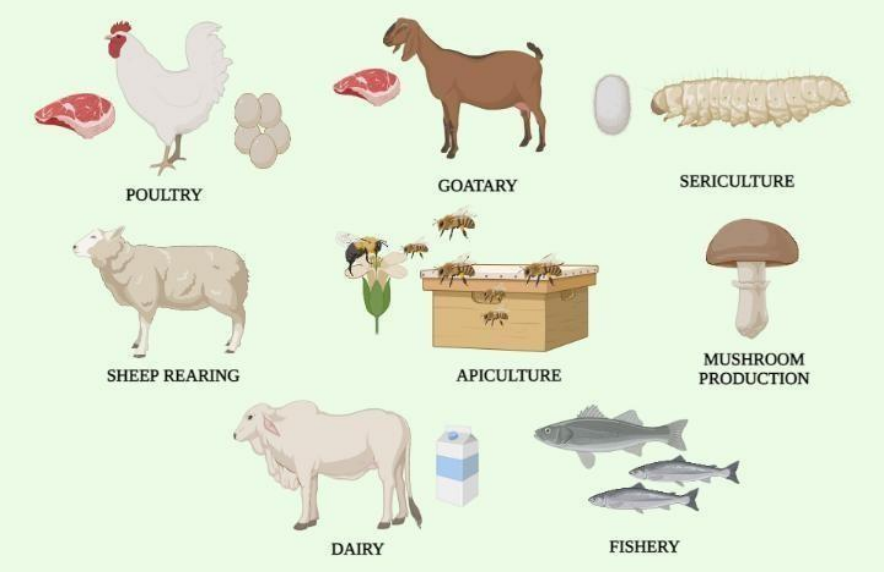
(iii) Soil-test based nutrient management (Distribution of soil-health cards)

(iv) Post-harvest crop losses (Large investments in warehousing and cold chains)

(v) Value addition; Creation of a national agricultural market, removing distortions and e-platform etc.

(vi) New crop insurance scheme (Pradhan Mantri Fasal Bima Yojana)- Minimum Premium and Maximum Security; and

(vii) Promotion of ancillary activities (poultry, sericulture, beekeeping and fisheries) etc



Though doubling farmers' income by 2022 appears daunting, it is both necessary and attainable. Increased area and productivity are two major options for increasing agricultural output. To double farmers' income, three strategies focused on

Three prolonged strategies focused on

i. Development initiatives ii. Technology and

iii. Policy reforms in agriculture are needed to double farmers‟ income.

The high demand for lands for non-agricultural sectors limits the possibility of further agricultural land expansion. Furthermore, the productivity of most crops in the country is low, and there is a huge opportunity to increase productivity in order to double farmers' income. Even within the country, yields of various crops vary greatly between states. Bridging yield gaps between states is critical for increasing national productivity. The variation in productivity with the same level of irrigation, as well as the farmers' low income level, are due to less adaptation of developed technologies and lack of farm modernization. Specific action plans may aid in resolving yield gaps, thereby increasing the productivity of farming systems. Farmers, at least medium and large farmers associated with small and marginal farms, may consider alternatives to agriculture, such as crop diversification and integrated farming systems, which may be more lucrative, more efficient in input use, and involve less risk. The promotion of an integrated farming system approach necessitates the synergistic combination of crops, horticulture, dairy, fisheries, poultry, etc.

Micro irrigation, in conjunction with nutrient application, has the potential to be extremely efficient, and priority should be given in empowering farmers with micro irrigation. The time has come to promote energy-efficient and gender-neutral farm equipment, machinery, and small engine-driven tractors in order to adequately address both the drudgery issue and the time component. Crop diversification and the introduction of new varieties are prioritised strategies and technologies for increasing farm income and profitability.

Constraints in Crop Diversification

The major problems and constraints in crop diversification are primarily due to the following reasons with varied degrees of influence:

Various constraints faced in crop diversification are as follows

(i) More than 60% of the country's cropped area is rain fed and dependent on rainfall.
(ii) Sub-optimal and over-use of resources like land and water resources, causing a negative impact on the environment and sustainability of agriculture.
(iii) A scarcity of improved and high-quality seeds and planting material of improved cultivars.
(iv) Land holding fragmentation and lack of agricultural mechanisation as a result of investment constraints and land holding sizes.
(v) Inadequate basic infrastructure, such as rural roads, power, transportation, and communications.
(vi) Inadequate post-harvest technologies and infrastructure for handling perishable horticultural produce after harvest.
(vii) Underdeveloped agro-based industry
(viii) Inadequate research-extension-farmer collaboration
(ix) Poorly trained human resources and widespread illiteracy among farmers
(x) Emerging diseases and pests having negative impact on most crop plants
(xi) Inadequate agricultural investments and a lack of horticultural crop databases.
(xii) The high demand for lands for non-agricultural sectors limits the possibility of further agricultural arable land expansion.
(xiii) Farmers' low income levels due to less adaptation to developed technologies and a lack of modernization of farms.

Opportunities of Crop Diversification

Changing Consumer Demand

Food consumption patterns in developing countries change noticeably as consumers become wealthier. People are shifting away from a diet based on staples toward animal products (meat, eggs, and dairy) as well as fruits and vegetables. As a result, more dynamic farmers can diversify to meet these demands.

Changing Demographics

Rapid urbanisation has an impact on consumption patterns in developing countries. Furthermore, a smaller number of farmers must supply a larger number of consumers, at least in percentage terms. While this does not imply diversification, it does necessitate adaptation to new farming techniques in order to meet the increasing demand.

Export Potential

Farmers in developing countries have seen significant success by diversifying into crops that can meet export market demand. While concerns about food miles and the cost of complying with supermarket certification requirements such as Global GAP may jeopardize this success in the long run, there is still plenty of room to diversify to meet export markets.

Adding Value

Consumers are devoting less and less time for food preparation, as seen in the West and now spreading to developing countries. They are increasingly requiring ready-to-eat meals and labor-saving packaging, such as pre-made salads. This gives farmers the opportunity to diversify into value addition, especially in countries where supermarkets plays a significant role in retailing.

Changing Marketing Opportunities

Changes in government policies that govern how farmers connect to markets can create new diversification opportunities. For example, policy changes in India that removed the monopoly of state "regulated markets" to handle all transactions enabled farmers to enter into direct contracts with buyers for new products.

Improving Nutrition

Diversifying away from monoculture of traditional staple can provide significant nutritional benefits to farmers in developing countries.

Merits of Crop Diversification

There are many merits of diversification, to specify some of them are as follows

(i) Different crops require different types of soil fertility. A combination or rotation of crops is expected to use all of the soil properties more fully than a single crop year after year. Cereals, for example, use a lot of nitrates, cabbages a lot of sulphates, clovers a lot of lime, and root crops a lot of phosphates. If different crops are grown in successive years, it will be possible to replenish the elements that one crop depletes before planting the same crop again later.

(ii) Crop rotation reduces weeds by allowing cleaning operations to take place at different times. It thus prevents weeds from nourishing and spreading year after year.

(iii) Diversification helps to grow more than one crop in the same field in a year, where it would be impossible to plant and harvest the same crop twice. It also facilitates the breeding of livestock that feeds on crop/grass residue. As a result, it provides the farmer with an additional source of income in the form of meat, milk, wool, or fuel.

(iv) Because different crops are grown, diversification demands for more labour throughout the year.

(v) Diversification allows the farmer and his family to consume a variety of foods that are grown.

(vi) Diversification allows farmers to spread their risks. If one focuses on a single crop or product, a harvest failure or price collapse could ruin him. It is extremely unlikely that all crops/products will fail at the same time in the same year.

(vii) Diversification allows the farmer's income to be more consistent because crops and animal products are sold evenly throughout the year.

(viii) Diversification increasingly involves shifting from low-value crops to high-value crops, which not only helps farmers meet changing demand for farm products but also increases their income.

(ix) Crop diversification improves food security by allowing farmers to grow surplus products for market sale, allowing them to earn more money to meet other needs related to household well-being.

(x) Crop diversification allows farmers to gain access to national and international markets by developing new products, foods, and medicinal plants.

(xi) Moving away from monocultures of traditional staples can provide important nutritional benefits for farmers in developing countries, as well as help a country become more self-sufficient in terms of food production.

(xii) Diversification can also be used to manage price risk, assuming that not all products will experience low market prices at the same time, thereby increasing the farming community's profitability.

Policies and Strategies for Crop Diversification

Realizing the importance of crop diversification, the central and state governments have taken several initiatives. Horticulture sector has been given highest importance considering its importance in nutrition security. Some of the important programs of the government include

(a) launching of National Horticulture Mission

(b) Launching of Technology Mission for the Integrated Development of Horticulture in the North-Eastern Region

(c) Implementing National Agriculture Insurance Scheme

(d) Operationalizing Technology Mission on Cotton

(e) Provision of Capital Subsidy for construction/modernization/expansion of cold storages and storages for horticultural produce

(f) Creation of Watershed Development Fund at the National level for the development of rain-fed areas

(g) Infrastructure Support for Horticultural Development

(h) Strengthening Agricultural Marketing

(i) Seed Bank Scheme

(j) Cooperative Sector Reforms etc. are some examples.

Similarly state of Karnataka has also initiated several programs that directly and indirectly support crop diversification in the state. Some of them include:

(i) Launching of a program for promoting Farm Producers Organizations in horticulture sector

(ii) Weather-based crop insurance for horticulture crops

(iii) Promotion of protected cultivation of high value vegetables

(iv) Establishment of IFAB (International Flower Auction Bangalore) for promotion of production of flower crops

(v) Promotion of greenhouse cultivation of vegetables etc. have leads to diversification of farming. More such programs are required to further diversify the farming in the state and the country for the benefit of farmers.

GIRISDA/LP/006/2022

CARBON MANAGEMENT STRATEGIES UNDER RAINFED CONDITION FOR SUSTAINABLE AGRICULTURE

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Maintenance of soil organic carbon is difficult in dry land as a extent of carbon loss is rapid due to high temperature, the processes of organic matter decomposition is faster and SOM disappears rapidly and the fact that at least four time higher SOM inputs are required in tropical regions then in temperate environment to maintain the SOC Concentration. (Srinivasarao et.al 2012) .Carbon sequestration refers to the storage of carbon in a stable solid form. It occurs through direct and indirect fixation of atmospheric CO2. Direct soil carbon sequestration occurs by inorganic chemical reactions that convert CO2 into soil inorganic carbon (SIC) compounds such as calcium and magnesium carbonates. Direct plant carbon sequestration occurs as plants photosynthesize atmospheric CO2 into plant biomass. Crop and soil management practices like application of plant nutrients, organic amendments like compost, vermicompost, neem cake Gliricidiya green Mannering and tank silt application enhance the soil fertility and sustainability.

Estimate of organic carbon (OC) stock in Indian soil was 24.3 Pg (1 Pg = 1015 g) based on 48 soil series taking into account of a few major soils (Bhattacharrya T. et.al. 2000). The present OC stock has been estimated as 63 Pg in the first 150 cm depth of soils. Soils with their geographical distribution through the country were used for computing soil organic carbon (SOC) stock in different depths in various physiographic regions. To sustain the quality and productivity of soils, the knowledge of OC in terms of its amount and quality in soils is essential.

Soil Carbon Sequestration in India

The prevalent low levels of SOC concentration in India are attributed to soil mining practices of excessive tillage, imbalanced fertilizer use, little or no crop residue returned to the soil, and severe soil degradation. Total organic carbon pool in soils of India is estimated at 21 Pg to 30 cm depth and 63 Pg to 150 cm depth (Table 2), which represents 2.2% of the world pool for 1 m depth. There has been a decrease of 30 to 60% in SOC concentration of cultivated soils even by 1960. Soil inorganic carbon (SIC) pool is generally high in calcareous soils of arid and semi-arid regions. Calcareous soils are widely distributed covering 54% of the geographical area of India. Total SIC pool in soils of India is estimated at 196 Pg to 1 m depth (Pal et al, 2000) as compared to 722 Pg to 1 m depth in world soils (Batjes, 1996). Therefore, the SIC pool in soils of India comprises about 27% of the world total. Pedogenesis of secondary carbonates play a significant role in C sequestration through formation of CaCO3 or MgCO3 and leaching of Ca(HCO3)2 especially in irrigated systems. The rate of formation of secondary carbonates may range from 30 to 130 kg ha-1yr-1 (Pal et. al. 2000). The potential of carbon sequestration in soils of India ranges from 39.3 to 52.0 Tg C yr-1 (Table 2), which comprises of restoration of degraded soil (7.2-9.4 Tg C yr-1), SIC sequestration (21.8-25.6 Tg C yr-1) and reduction in erosion induced emission of C (4.32-7.2 Tg C yr-1) and reduction in erosion induced emission of C (4.32-7.2 Tg C yr-1) (Lal, 2004). Technological options that have been found to be efficient for soil C sequestration in India include green manuring, mulch farming/conservation, tillage, a forestation/agro forestry, grazing management/ ley farming, integrated nutrient management, manuring and choice of cropping system (Lal,2004).

Table 1: The potential of carbon sequestration in soil of India (adapted from Lal, 2004

S.No	Region	Area	C sequestration
1	Arid	52.0	0.67-1.34
2	Semi-arid	116.4	2.33-4.66
3	Sub-humid	86.4	3.46-5.18
4	Sub-humid/humid	33.3	2.06-2.72
5	Per-humid	20.2	2.42-3.03
6	Sub-humid/Semi-arid	8.5	0.34-0.51
7	Humid/ Per-humid	11.9	1.43-1.79
	Total	328.7	12.71-19.23
1	Secondary carbonates	328.7	21.78-25.6
2	Erosion control	---	4.80-7.20
	Total	328.7	39.29-52.03

Sustainable Agriculture

The basic thrust of sustainable agriculture is the improvement of the quality of life in the context of environmentally sound approach so that resources base in maintained or enhanced for future generation. Depending on the institutions and country involved, there are frequently additional focuses on sustainability as portrayed in the definitions given below. FAO (1989)

"Sustainable agriculture should involve successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources" TAC (1988)

"Sustainable agriculture should involve the successful management of resources to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources" Lynam and Herdt (1988)

"A sustainable system is one with a non-negative trend in measured output"

Concept of Sustainable Land Management:

Sustainable land management is an emerging concept which seek to assure the intergenerational equity of the land it is defined as "A system of technologies that aims to integrate ecological and socioeconomic principles in the management of land for agricultural and other uses to achieve inter-generational equity".

From these definitions the following emerge as important institutional values (Eswaran & Virmani1990):

- Discriminatory use of land resources
- Conservation and enhancement of the quality of the environment.
- Increased and stabilized productivity.
- Enhancement of quality of life
- Intergenerational equity.
- Buffer against risks.

The soil component in sustainable land management:

- Available water-holding capacity.
- Nutrient retention capacity – cation exchange capacity.
- Nutrient availability – pH and base saturation.

- Nutrient fixation.
- Chemical constraint – acidity, sodicity.
- Physical constraints – low hydraulic conductivity, permeability, high bulk density, crusting.
- Effective soil volume – depth to root restricting layer, stoniness.
- Surface tilth.
- Erodibility. • Water logging.

Strategies for Soil Carbon Sequestration

Various management strategies are adopted for sequestration of carbon in soil and also lead to mitigation of atmospheric carbon dioxide lode. In India more than 100 million hectares are classified as degraded and greatly depleted in SOM. 35 % of these areas were classified as salt affected. The reclamation of salt affected wasteland in India; up to 2Pg C could be sequestered.

Land Management Practices

Generally, there is a positive interplay between C sequestration in soil and various land management practices related to soil fertility (such as addition of fertilizers, organic manures, sludges and bio solids, tillage, grazing, and forestry). Various technologies that enhance carbon input to soil and decreases output/losses of carbon lead to carbon sequestration in soils. Sources of C input include the amount of above ground and below ground biomass returned to the soil, and any other bio solids applied (eg. manure, compost, sludge etc.). Technologies for enhancing C input to soil include i.e intensification of agriculture, increasing area under forests, and, agro-forestry. Agricultural intensification implies adoption of recommended management practices on prime agricultural soils while restoring degraded and marginal soil to productive land uses. Forestry has been proposed as a means to sequester C and reduce greenhouse gas emission. It has been estimated that application of optimum forest and agro-forestry management practices on 500-800 ha in 12-15 key nations could sequester 1-2 Pg C yr-1 (Winjum et al., 1992). Smith et al. (1997) estimated that a forestation of 30% of present arable land in European Union will increase soil C stocks by about 8% over a century. Switching from annual crops to perennial vegetation increases residue production, plant roots and reduces soil disturbance, thus enhancing soil C sequestration (Paustian et al., 1997b). The optimum level of SOC can be achieved by adoption of appropriate crop rotation (Wright and Hons, 2005).The farm pond with a good crop and soil management improves soil productivity which enhance the SOC sequestration and reduce the risk of soil degradation (CRIDA,2012)

Management options that contribute to reduced decomposition of organic matter or soil respiration include reduced or notillage practices, mulch farming, and reducing bare fallow or increased cropping intensity. Croplands under no-till systems have been shown to increase soil C compared to more intensive tillage operations (Peustian et al., 1997a; Six et al., 1999;) No-till agriculture in which crops are sown directly into untilled soil, greatly reduce the degree of soil disturbance normally associated with annual cropping. Physical disturbance associated with intensive soil tillage increases the turnover of soil aggregates and accelerates the decomposition of aggregate associated SOM (Paustian et al., 2000). No-till increases aggregate stability and promote the formation of recalcitrant SOM fractions within stabilized micro-and macro-aggregate structures, and reduces soil erosion. Greater cropping intensity, i.e. by reducing the frequency in crop rotations and increasing the use of perennial vegetation, can increase water and nutrient use efficiency by plants, thereby increasing C inputs to soil and reducing organic matter decomposition rates (Paustian et al, 2000). It has been widely observed that soil C is lower in systems employing summer fallow than in continuous cropping systems (Campbell et al., 2000, Janzen et al., 1998).No-till, low-till soil management is already resulting in increased levels of soil organic matter (Follett et al., 1987; Liang and Mac Kenzie, 1992).

Biological Nitrogen Fixation

Biological nitrogen fixation in agricultural land can be increased by growing more legume crops in a rotation. It can be increased also by growing high biomass crops that provide large quantities of crop residues with high carbon: nitrogen ratios (Robbins, 1986). Such crops can lead to non symbiotic nitrogen fixation. These crops can also be

grown in rotation for the purpose of soil amending. The proper microorganisms can respond to the residues with biological nitrogen fixation. Use of 10 percent of agriculture land in the USA, on rotation with crops like Sudan grass-sorghum hybrids, can produce 40 MT of organic carbon per ha for a total of 600 million MT per year (Robbins, 1986). Successful sequestration in soil of part of it with biological nitrogen fixation would solve between 5 and 10 percent of the world‟s carbon dioxide problem. Use throughout the world would add more.

Cultivation of High Biomass Crop

High biomass crops have been investigated as potential energy sources. Sudan grass-sorghum hybrids are capable of producing up to 40 MT/ha of carbon in organic matter. Plant breeding may increase that. “The great opportunity for U.S. agriculture, to help mitigate climate change lies in stashing carbon in soil and trees and displacing fossil fuel” (CAST, 1992).

BIOCHAR

Biochar is a C rich. Fine grained porous substance similar in appearance to charcoal. When applied in soil improves C sequestration and soil fertility (Lehmann, 2007). Addition of Biochar to soil has also been associated with enhanced nutrient use efficiency, increased water holding capacity and improved microbial activity (Venkatesh et. al. 2013)

Land Use System

Forest land shifted to agricultural or horticultural land has reduced 64 and 55 percent SOC content in soil after 40 year respectively. The horticulture system has enhanced C concentration of soil up to 23 % compare to agricultural system (Chandran et.al. 2009). Agri-horticultural system has better potential of carbon sequestration than other land-use system (Das and Itnal,1994) Grassland soil have sequestered 44 percent more C in soil as compared to other agriculture system in semiarid climate (Bhattacharryya,et.al.2007)

Tank Silt Application

High intensity rainfall, storm causes soil erosion through runoff leads to soil degradation. In India 65 percent of soildegradation through water erosion only these degraded soils have a high potential of carbon storage. The eroded soil 10% deposited in tank, reducing the storage capacity of tank 1-3 per cent every year. These silt having 20-30 percent more nutrients than the soils of adjoining area of tank and having high carbon the recycle of tank silt is good option for improving the SOC and rehabilitation of marginal land (Vaidya and Dhawan 2014)

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AGRITECH FOR STARTUP ECOSYSTEM IN INDIA – A RAY OF HOPE FOR PROMOTING AGRIPRENEURSHIP DEVELOPMENT AND EXCELLENCE

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Introduction

The agritech ecosystem has attracted a surge of startups in India offering technology-based solutions like offtake marketplaces, storage and transportation services, and agronomy advisory services while large traditional players seek to reduce operational costs and manage scale more efficiently. India‟s Budget 2022-23 also contains provisions to support „digital agriculture‟.

As the global population reaches 7.9 billion in November, and estimated to reach 9.8 billion by 2050, food security has become a top concern across the world. The urgency for action also needs to address the scarcity of resources, distortions in distribution and access, and the need to expand agriculture outputs. Policymakers everywhere are now seeking sustainable methods to leverage technology in agricultural practices to alleviate this crisis.

It has catapulted the attention given to emerging agriculture technology (agritech), with startups in the area raising US$26.1 billion in funds in 2020 worldwide. This was a 35.4 percent growth over 2019. In fact, the global agritech market is projected to grow at a compound annual growth rate (CAGR) of 12.1 percent between 2020-27. India, too, is competing in this segment alongside China and the US.

Developments in agritech are hugely relevant to India‟s economy. Its agriculture sector, which is worth US$370 billion, continues to remain the main source of livelihood for over 40 percent of the population and contributes 19.9 percent (FY 2021) to the national GDP. However, despite the sector‟s contribution, it remains mired in structural weakness that inhibits the growth and productivity. In order to address these challenges and improve farmer‟s incomes, Indian agriculture needs technology-aided modernization, backed by resilient reforms – this is where agritech is expected to play a significant role.

India currently has over 1300 agriculture startups – which are actively employing artificial intelligence (AI), machine learning (ML), internet of things (IoT), etc. – to increase efficiency and productivity in the sector. The COVID pandemic has now put them on an upwards growth trajectory. The states of Karnataka and Maharashtra and the Delhi National Capital Region (NCR) are major hubs for agri-startups in India.

Contribution of the agriculture sector to India's economy

Indian agricultural sector broadly comprises of farming (crops and horticulture) and forestry, livestock (milk, eggs, meat), and fisheries. Ranking second after China, it accounts for 11.9 percent of the global agriculture gross value added (GVA) of US$3,320.4 billion and contributes 12 percent to India‟s exports. Additionally, the sector also impacts consumption and production dynamics in non-agricultural segments, such as consumer products, retail, chemicals, and e-commerce.

The economic inter-linkages make the agricultural sector central to India‟s economic output and growth potential. It‟s also why reforms in the sector are sorely needed.

Impact of agritech on productivity and efficiency in India's agriculture sector

Agritech primarily refers to an ecosystem of companies and startup enterprises that are capitalizing on technological advancements to deliver products or services for increasing yield, efficiency – both in terms of time and cost, and profitability for farmers across the agriculture value chain. The various segments within the agritech sector, which support the overall value chain are:

- **Market linkage – farm inputs:** Digital marketplace and physical infrastructure to link farmers to inputs.
- **Biotech:** Research on plant and animal life sciences and genomics.
- **Farming as a service:** Farm equipment for rent on a pay-per-use basis.
- **Precision agriculture and farm management:** Use of geospatial or weather data, IOT, sensors, robotics etc. to improve productivity; farm management solutions for resource and field management, etc.
- **Farm mechanization and automation**: Industrial automation using machinery, tools and robots in seeding, material handling, harvesting, etc.
- **Farm infrastructure:** Farming technologies, such as greenhouse systems, indoor-outdoor farming, drip irrigation, and environmental control, such as heating and ventilation, etc.
- **Quality management and traceability:** Post-harvest produce handling, quality check and analysis, produce monitoring, and traceability in storage and transportation.
- **Supply chain tech and output market linkage:** Digital platform and physical infrastructure to handle post-harvest supply chain and connect farm output with the customers.
- **Financial services:** Credit facilities for input procurement, equipment, etc. as well as insurance or reinsurance of crop.
- **Advisory/ Content:** Information platforms online platform for agronomic, pricing, market information.

Agritech provides opportunity to plug several pain points that exist in the agriculture sector at present across the value chain, thereby expanding the market potential. Leveraging technology in India‟s agriculture sector can create opportunities for investment through modernizing and introducing systemic efficiencies.

Some ways in which this can be achieved are:

- Facilitating input market linkages supported with robust physical infrastructure network can address the existing issues related to volatility in input prices as well sub-optimal input selection.
- Precision agriculture can enhance yield by up to 30 percent.
- Digitalizing records through farm management can improve operational efficiencies and save costs.
- Introducing quality management and traceability will help farmers attain better outcomes in terms of high quality produce, further incentivizing them to continue with modern methods.
- Facilitating output market linkages through efficient post-harvest supply chain by eliminating inefficiencies, such as high wastage of farm produce, which is a win-win for both farmers as well as consumers.
- Offering better financial services, which could serve 30 percent of farmer households through access to credit, and 65 percent of farmer households through access to crop.

With ever increasing internet penetration in the country, and rural regions being the primary driver of this growth, India stands well equipped to adapt to changing methodologies in agriculture and transition from conventional business models to various innovative business models propelled by agritech.

GIRISDA/AB/001/2022

MANAGEMENT OF MOSAIC OF TOMATO (*Solanum lycopercicum* L.) THROUGH HOST RESISTANCE

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Tomato mosaic is considered to be most destructive disease of the crop which causes considerable losses in yield. The investigation regarding the studies on mosaic of tomato was conducted in the year 2018-2019. Twenty tomato germplasm/ varieties/ cultivar *viz*. Pusa ruby, EC-620406, Arka Vikas, EC-771607, EC-676791, Hisar Anmol , EC-514109, EC-677191, EC-677049, EC- 677123, Avinash 2, Arka Sourabh, Kashi Vishes, Kajal, Hiasr Arun, Money maker, EC-620417, Arka ananya and EC-617048 collected from National Bureau of Plant Genetic Resources and local from local market Jammu were screened for determining resistance against tomato mosaic disease under natural conditions. EC-771607 and Hisar Anmol were found resistant, Kashi Vishes, Hisar Arun and Arka Ananya were found moderately resistant, EC-620406, Arka Vikas, EC-676791, EC-514109, EC-677191, EC-677123, Arka Sourabh, Kajal and Local were found moderately susceptible, EC-677049, Avinash 2, Money Maker, EC-620417 and 617048 were found susceptible Pusa Ruby was found highly susceptible.

GIRISDA/AB/002/2022

OMICS TECHNOLOGY: A BOON TO REMODELING OF CROP PLANTS

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OMICS Technology appertain to acquire a comprehensive outlook of a biological system by analysing genes, RNA, proteins, metabolites, ions and various other important biomolecules that are involved in fundamental processes of life. The purpose of conducting OMICS research in a high throughput way is to proficiently explicit the metabolic activity, functional pathways and bio-molecular interactions taking place inside the living organism. Advances in OMICS research provide insights into expression profiling of system biology and thus pave the way to manipulate the pathways for desired results. The identification of various genetic loci, RNA, proteins along with metabolites and ions can create prodigious opportunities in the field of crop improvement. Further, with the emergence of new technologies and consecutive progress in this field, a huge data is generated which needs to be stored, annotated and scrutinized with the help of bioinformatics tools. The technology can be applied to combat various biotic and abiotic constraints that are responsible to degrade the agronomic potential of the crop plants. The implication of molecular markers, for instance, to identify putative genes encoding essential qualitative and quantitative traits, to enhance variation among the genotypes and introduction of desired characteristics is discernible from the previous reports. Further, detection of specific proteins associated with biotic and abiotic stresses along with other valuable traits is of immense importance. In addition, transcriptome, metabolome and ionome profiling can also offer pragmatic solutions to dwindling biodiversity and reduced abbreviated resources with the continuously increasing population. The coordinated information generated by the OMICS approaches will facilitate the production of elite cultivars adaptable to changing environmental scenarios with high agronomic potential. Therefore, this technology offers immense potential for crop improvement which may have significant benefits in augmenting our existing resources to cope with the challenges posed by environmental and human sources.

GIRISDA/AB/003/2022

STUDY ON ACRYLAMIDE CONTENT IN VARIOUS FRIED AND BAKED FOOD PRODUCTS

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This study evaluates the quantity of acrylamide in some particular starchy foods fried and baked samples by using UV spectroscopy. Commercial and laboratory samples of fried potato chips and biscuits were analysed for acrylamide content and moisture content of potato chips and bakery products. The Acrylamide (AA) content of the samples was estimated by subjecting filtered to 275nm absorbance in the UV-spectroscopy. The change in moisture content of fried potato chips varied from sample 3 high (3.24%), sample 4 low (1.23%) in the case of biscuits sample 12 high (5.68%), sample 11 low (0.39%), and indifferent samples of is 1-4%, and the maximum level is found in biscuits at the range of 4-11% and potato chips at the range of 3-4%. The Acrylamide content of potato chips was in range of samples (3.81%, 3.81%, 3.80%, 3.82%, and 3.80%) and Biscuits (9.96%, 5.57%, 6.24%, 6.24%, 9.96%, and 2.21%). An Acrylamide increasing amount of 2.6 mcg/kg of body weight will cause toxic effects.

GIRISDA/AB/004/2022

CLIMATE RESILIENT AGRICULTURE NEED OF THE CENTURY

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Climate change impacts on agriculture are being witnessed all over the world, but countries like India are more vulnerable in view of the huge population dependent on agriculture, excessive pressure on natural resources and poor coping mechanisms. The warming trend in India over the past 100 years has indicated on increase of 0.60°C. Significant negative impacts have been projected with medium-term (2010-2039) climate change, eg. Yield reduction by 4.5 to 9%, depending on the magnitude and distribution of warming. Since agriculture makes up roughly 15% of India's GDP, a 4.5 to 9.0% negative impact on production implies cost of climate change to be roughly at 1.5% of GDP per year. Planned adaption is essential to increase the resilience of agricultural production to climate change. Management practices that increase agricultural production under adverse climactic conditions also tend to support climate change adaptation because they increase resilience and reduce yield variability under variable climate and extreme events. Some practices that help adapt to climate change in Indian agriculture are soil organic carbon build up, in-situ moisture conservation, residue incorporation instead of burning, water harvesting and recycling for supplemental irrigation, growing drought and flood tolerant varieties, water saving technologies, location specific agronomic and nutrient management, improved livestock feed and feeding methods. Capacity building by extensive participatory demonstrations of location specific agricultural practices helps farmers gain access to knowledge and provides confidence to cope with adverse weather conditions.

GIRISDA/AB/005/2022

THERAPEUTIC EFFICACY OF TOLFENAMIC ACID 8% IN LAMENESS IN BOVINES

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Therapeutic efficacy of Tolfenamic acid 8% was evaluated in ten (10) bovines exhibiting signs of lameness**.** Tolfenamic acid 8% @ 2 mg/ kg body weight at the intervals of 48 hours in repeated or single doses as per recovery as an adjuvant to other drugs used in the treatment namely neuroxin, anhistamine used. Lameness, swelling, pain on palpation, animal movement and general health condition were considered as parameters to study recovery in cases of respiratory diseases. The results indicated that the swelling and pain on palpation was completely reduced to nil on second day and lameness was completely reduced on day 7th of treatment. General health condition was not much more affected due to lameness. It proves the therapeutic efficacy of Tolfenamic acid 8/% in lameness of bovines. There was no adverse effect recorded.

GIRISDA/AB/006/2022

IDENTIFICATION OF REDGRAM (*Cajanus cajan* L.) VARIETIES SUITABLE FOR NORTH COASTAL ZONE OF ANDHRA PRADESH

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Redgram is one of the important pulse crop grown in Andhra Pradesh. Identification of high yielding redgram varieties are beneficial to the farming community. In taking this into consideration, the present investigation was carried out in Redgram (*Cajanus cajan* L.) during Kharif 2018 fourteen redgram newly developed cultures are tested with an objective to identify suitable redgram varieties with highest seed yield at Agricultural Research Station, Yellamanchili, Ankapalle District, Andhra Pradesh. The experiment was carried out with fourteen redgram test entries sown in Randomized block design with three replications and with a plot size of 2.4m × 4m row length and with a spacing of 60 × 20 cm. The test entries are tested against the check Maruthi. Among all the entries the entry LRG 267 recorded highest significant seed yield of 1454 kg/ha with 176 days duration followed by TRG 108 with seed yield of 1242 kg/ha with 161 days duration followed by LRG-208 with 1196 kg/ha when compared with the check Maruthi 735 kg/ha. The coefficient of variation recorded is 18.53%. The mean seed yield is 933 kg/ha. From this study, two varieties LRG-267 and TRG 108 recorded highest seed yields and found suitable to the cultivation in North coastal zone of Andhra Pradesh.

GIRISDA/AB/007/2022

EFFECT OF SUPPLEMENTATION OF RUMEN BYPASS FAT ON LIVE BODY WEIGHT, MILK YIELD, MILK COMPOSITION AND BODY CONDITION SCORE OF GRADED MURRAH BUFFALOES

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The present research was carried out in 10 graded Murrah buffaloes to study the effect of supplementation of rumen bypass fat on live body weight, milk yield, milk composition and body condition score during early lactation. The body weight, milk yield, milk composition and body condition score were recorded at weekly intervals before and after supplementation of rumen bypass fat. Highly significant increase in live body weight, body condition score, and milk production was observed, whereas a non-significant to a significant growth in milk fat and milk protein was recorded. The present study found a significant decrease in milk SNF and a highly significant decrease in milk density percentage. Non-significant effect on milk lactose was recorded. Therefore, it is concluded that supplementation of bypass fat could improve live body weight, body condition score, and proved to be economic in graded Murrah buffaloes.

GIRISDA/AB/008/2022

ROLE OF SILKWORM COCOON PRODUCTION IN ENHANCING THE LIVELIHOOD OF MARGINAL FARMERS: AN ECONOMIC STUDY IN THE KOLAR DISTRICT OF KARNATAKA

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Sericulture plays a vital role in the socio-economic development of the rural community especially marginal farmers and it gives frequent periodicity of economic returns throughout the year. The present study was conducted in the Kolar district of Karnataka through a well-structured survey during 2019-2020 in the view to assess the economics of the production of mulberry silkworm cocoons and its management. The multi-stage random sampling technique was employed to select taluk, villages, and farmers with a sample size of 60 sericulture practicing farmers. The total cost of cocoon production accounted for ` 33076 per 100 Disease Free Layings (DFLs), of which ` 30512 (92.25%) was incurred on variable costs and ` 2564 (7.75%) on fixed costs. Out of the total cost, the expenditure on mulberry leaves (47.16%) formed the major component followed by the cost of human labour (21.60%). The marginal farmers in the study area were able to rear 50 to 150 DFLs of silkworms per one rearing. The yield obtained by farmers was 103 kg per 100 DFLs. The net income obtained by farmers was accounted for 14438/100 DFLs with a gross income of 46339/100 DFLs. The total cost of production was ` 321 per kg of cocoons produced with B: C ratio of 1:1.4. So that, farmers can receives ` 1.4 per rupee invested. Incidence of pests and diseases to the silkworm was a major constraint but it was suggested to manage through various preventive measures such as proper disinfection, use of uzinets all around the entry points to the rearing house and construction of the anteroom. Despite the constraints, the farmers were able to get profit regularly. Hence sericulture was a profitable enterprise that enhances the livelihood of the marginal farmers in the study area.

GIRISDA/AB/009/2022

GENETIC ANALYSIS OF GENES GOVERNING NATURAL VARIATION OF SEED COAT COLOUR IN SOYBEAN [*Glycine max* (L.) Merr.]

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The visual appearance of the soybean seed has been altered as a result of domestication during the transition of the wild *Glycine soja* to the current cultivated *Glycine max*. All modern commercial high yielding soybean (*Glycine max*) germplasms possess yellow seed coats with a range of hilum colours (brown, black, imperfect black, buff, yellow), whereas the wild soybean (*Glycine soja*) accessions possess black seed coats. Colour is one of the phenotypic markers mostly used to study soybean in the study of genetic, molecular and biochemical processes, due to their easy recognizability. Therefore, to investigate the inheritance of seed coat colour in soybean, a cross was made between a vegetable soybean genotype AGS 457 (Brown seed coat) and a grain type soybean SKAF 148 (Yellow seed coat). All the F_1s obtained were brown in colour which indicates that the seed coat is maternal in origin. F_1s were advanced to produce F_2s which were green in colour that possibly shows the interaction of different genes in determining the seed coat colour in soybean. Further, the F_2 population was advanced to produce the F_3 population. Seed coat segregation was observed for Green, yellow and brown seed coat colour in the F_3 population that further confirming the interaction of different genes involved in seed coat colour determination in soybean.

GIRISDA/AB/010/2022

CONSTRUCTION OF LINKAGE MAPPING AND IDENTIFICATION OF QUANTITATIVE TRAIT LOCI (QTL) FOR GRAIN SIZE AND RELATED TRAITS IN BREAD WHEAT (*Triticum aestivum* L.)

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Grain size is an important agronomic trait that influences the grain yield and milling quality of wheat. In this paper, the experimental material comprised of P_1, P_2, F_1, F_2 and $F_{2:3}$ generations of wheat cross GW-11 X GW-322 for grain size and related traits respectively to fulfill the objective of linkage and QTL mapping in bread wheat. Out of 200 SSR markers screened for parental polymorphism for grain size and related traits, about 23% of SSR markers showed good polymorphism between two parental lines. Out of 46 tests for calculated chi-square, 42 test markers do not deviate significantly from expected ratios revealing that observed data are in agreement with expected ratio of 1:2:1. The linkage map was constructed using software Ici Mapping v.4.1 and Recombination frequencies were converted into map distance using Kosambi‟s mapping function. The markers were grouped with minimum logarithm of the odds (LOD) of 3.0 with walking speed was set at 1.0 cM. Seven linkage groups with a total map length of 77.31 cM were constructed using data from 46 SSR marker loci for 74 F_2 plants which ranged from minimum of 2.74 cM (LG2) to maximum of 26.89 cM (LG3). Genotypic data of F_2 and phenotypic data of on 74 $F_{2:3}$ lines were analyzed for identification of the main effect QTLs using the software ICIM-ADD mapping in QTL IciMappingV4.1. A linkage map of grain size and related traits output data file was used for the construction of QTL mapping. A total six QTL had been identified for grain size and related traits, one each for 100-grain weight; number of grain per the main spike (NGPMS); grain yield per plant (GYPP); number of effective tillers per plant (NETPP) and two QTLs for grain weight per the main spike (GWPMS) and could be used for marker assisted selection after validation.

GIRISDA/AB/011/2022

STUDIES ON TOMATO FRUIT ROT, WITH A FOCUS ON *Phytophthora nicotiane* var. *parasitica*, THE CAUSATIVE AGENT OF TOMATO BUCKEYE ROT

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Tomato (*Solanum lycopersicum* L.) is a member of the Solanaceae family that originated in South America and is planted globally. It is grown in the mountainous area of Himachal Pradesh throughout the summer. It is vulnerable to most fungal, bacterial, and viral diseases and poses a severe danger to tomato production. Buckeye rot of tomato is the most destructive tomato crop disease caused by *Phytophthora nicotianae* var. *parasitica*. With disease damage on the rise, the current research focused on isolating diseased fruits on PDA medium and identifying cultural and morphological characteristics. The pathogenicity test was performed on stems, leaves, and fruits of the Heem Sohna tomato variety using two methods, pinprick and surface inoculation, with the first method revealing symptoms on the fruits after 144 hours of incubation and the second method revealing lesions after 192 hours of incubation. Tomato leaves had little brown symptoms, although the stem exhibited none. The efficacy of several management techniques, including six botanicals, was assessed against the related pathogen. Among all botanicals, garlic bulb extract inhibited mycelial growth the most (90.10%), followed by tulsi and turmeric with (26.35%) and (25.33%) inhibition, respectively, and lantana with the least (4.70%) suppression on the mycelial development of the test pathogen under *in vitro* conditions. Cow urine showed the greatest suppression (23.54%) of mycelial development, followed by field formulation with (20.77%) inhibition, while buttermilk was determined to be the least effective against the test pathogen with (17.98%) inhibition. Five fungicides were tested under *in vitro* conditions and revealed that metalaxyl was noticed with 100 per cent inhibition of the mycelial growth of the fungus followed by mancozeb with 81.91 per cent inhibition. The minimum inhibitory effect was noticed in carbendazim with 8.36 per cent inhibition. The combined effect of management practices was also investigated under field conditions. Eight treatments along with control were assessed in which T_1 (metalaxyl + garlic + cow urine) was found most effective with minimum disease severity (17.19 per cent) followed by T_5 (mancozeb + garlic + cow urine) and T_2 (metalaxyl + garlic + field formulation) with (21. 74 per cent) and (22.39 per cent) disease severity, respectively while T_6 (mancozeb (0.2%) + tulsi (10%) + field formulation (10%) was found with the maximum disease severity (34.41 per cent) as compared to the control. Integrated management strategy was suggested to the farmer to minimize the effect of buckeye rot of tomato for the higher yield.

GIRISDA/AB/012/2022

STUDY ON PROCESS OPTIMIZATION FOR KODO AND BARNYARD MILLET-BASED COOKIES, CUPCAKES, AND INSTANT SOUP MIX.

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The current study is framed on optimization of the process for the preparation of Kodo and barnyard millets-based cookies, cupcakes, and instant soup mix. The Value-added products prepared from above said millets have been prepared with 10% and 60% incorporation. In cookies and cupcakes, Kodo and Barnyard millet are mixed in a 5:5:90 ratio to the other ingredients whereas in instant soup mix Kodo and Barnyard millets were added in a 30:30:40 ratio to the other ingredients of products. Five samples with different ratios of (Kodo + Barnyard) millet powder were added to cookies and cupcakes: Control, A (5%), B (10%), C (15%), and D (20%). For process optimization, two drying methods (Microwave oven and baking oven) were applied and differences in the product were analyzed after every 5 minutes. The optimized baking time temperature for cookies and cupcakes was 180°/15-20 min and 180°/25-30 min, respectively. Further, the optimum accepted Kodo and Barnyard millet powder ratio was 5:5 ratio in cookies and

cupcakes. The instant soup mix with a total of 60% (30:30 ratio of millet powders) was accepted by the semi-trained panelist. The nutritional composition of instant soup mix is 5% moisture, 0.3% ash content, 6.2% Protein; Cookies have 6.25% moisture, 1.32% ash, 53.35% carbohydrate, 39.63% total fat, 4.18% protein; and cupcakes have 17% moisture, 3.24% protein, 16% total fat, 0.3% ash, 80.42% carbohydrate.

GIRISDA/AB/013/2022

EFFECT OF DIFFERENT STABILIZERS USED IN PREPARATION OF SEA BUCKTHORN JUICE ON ITS STABILITY AND SHELF LIFE

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In this study, the pH of Sea buckthorn juice was optimized for effects of different stabilizers (CMC, guar gum and xanthan gum) on the physical characteristics of cloudy ready-to-drink mulberry fruit juice (via the addition of sea buckthorn berry pulp at a mass fraction of 5%) during storage (4°C for 24 days) were determined using different mass fractions of the stabilizers. Increasing the stabilizer mass fraction resulted in the increased of viscosity, stability of turbidity and color was analyzed. Using xanthan gum as the stabilizer produced better results for these parameters than CMC and guar gum. The type of stabilizer and its mass fraction had no effect on most sensory characteristics, including appearance, color, taste, texture, and overall acceptability ($P \geq 0.05$), but did affect the odor ($P \geq 0.05$). Xanthan gum stabilizer gave the juice a better odor than guar gum and CMC. Cloudy Sea buckthorn juice containing 0.5% xanthan gum as the stabilizer had the highest acceptance rate among panelists (average acceptance was 6.90 ± 1.37 points) and produced no precipitate during storage.

GIRISDA/AB/014/2022

EFFECT OF HERBICIDES ON SOIL MICROFLORA AND ENZYMATIC ACTIVITY IN HIGH DENSITY PLANTING SYSTEM OF COTTON

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The experiment was conducted for two consecutive years 2017-18 and 2018-19 to study to study the efficiency of new formulation of pre-emergence herbicide clomazone 50 EC on growth and development of HDPS cotton with better weed management in a cost effective manner. Clomazone 50 EC was tried in three different doses, *viz*. 250, 500 and 750 g *a.i.* ha^{-1} concentrations and was compared with pendimethalin 680 g *a.i.* ha^{-1}, post-emergence herbicides such as, pyrithiobac sodium 10 EC and quizalofop ethyl 5 EC @, cultural; method like one HW at 25 DAS and IC at 50 and 75 DAS, weed free check, unweeded control and other integrated methods. The data indicated that pre emergence application of pendimethalin 38.7 CS @ 680 g *a.i.* ha^{-1} and clomazone 50 EC @ 250 g *a.i.* ha^{-1} as PE with one HW at 25 DAS and IC at 50 DAS (30.6 and 29.6) were on par with each other and recorded significantly lower soil dehydrogenase activity over reduced the microbial population (Bacteria, Fungi and Actinomycetes) and dehydrogenase and phosphatase activity significantly over the treatments where no herbicides was applied (one HW at 25 DAS and IC at 50 DAS, weed free check and unweeded control were on par with each other (33.8, 33.7 and 32.2). While the values were on par at 100 DAS and at harvest which indicated that the herbicide effect not persist for longer time as the herbicides degraded in soil by microbes as the herbicides were used as the carbon source for

multiplication. The seed cotton equivalent yield was higher when herbicides were used indicating no adverse effect of the herbicide.

GIRISDA/AB/015/2022

PROFITABILITY OF MARIGOLD CULTIVATION IN HARYANA

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Indian agriculture primarily focuses on cereals production and the focus needs to be shifted from traditional field crops to commercial cropping system for sustainable economic development of the country. Flower cultivation appears to be the promising option due to their increased demand in recent times for decoration, perfumes, essential oils, medicine, textiles and many more. Marigold is one of the most important and popular floriculture crop *i.e.* widely cultivated throughout the country. In India, it is grown over an area of about 74 thousand ha with annual production of 761 thousand tonnes of loose flower and 19 thousand tonnes of cut flower during 2020-21. In Haryana, the crop covers around 1540 ha area and produces 16.6 thousand tonnes of loose flower during the year 2020-21. Since paddy-wheat is the dominant cropping pattern in north Haryana and the state government is focusing on its diversification towards more remunerative and sustainable crop due to emerging concerns regarding the sustainability of existing cropping pattern. Among flower crops, marigold dominates in north Haryana and keeping in view the importance of flower cultivation, the present study was aimed at determining the profitability of marigold cultivation during 2019-20 in Karnal and Kurukshetra districts of Haryana purposively. The study, based on 80 sampled farmers, revealed that total cost of cultivation was 183410 ha^{-1} of which 121236 ha^{-1} was variable cost and the remaining (62174 ha^{-1}) was fixed cost. The loose flower yield was 184.16 q ha^{-1} and the gross returns worked out to be ` 462250 ha^{-1} reflecting net returns of 278838 ha^{-1}. Further, benefit-cost ratio of 2.52 was realized by the farmers which indicated the profitability of marigold cultivation in the study area. So, its cultivation is going to help in doubling the farmers" income goal of the government of India.

GIRISDA/AB/016/2022

AGRICULTURE POLICIES AND ECONOMICS FOR DOUBLING RURAL FARMERS INCOME

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India as the fastest growing economy in the world, it having diversity in geography, economy and ethically. India accounts for 17.7% of world population but having 0.12 ha per capita land, which leads to land scarce for agriculture. Agriculture is the backbone for Indian economy. It plays very important role to boost up the national economy since decades. It is a key sector to contribute in both employment and GDP. In India, since 2011, production has been raising at an average of 3.6% annually. Economic growth around 7% over the last 5 years makes India one of the fastest growing economies. But, somehow the contribution of the agriculture sector to GDP has continued in decreasing trend over two decades from 29% in 1990 to 17% in 2016 a short increase in 2020 is 20.19. Indian Agriculture lag behind due to key challenges like Land fragmentation, long supply chain, risks in long term production, Water crisis, Improper linkage to downstream sectors, less opportunities for global value chains etc. To cope up with these problems, regulation or implementation of agricultural policies is needed. Agricultural policies are the set of laws relating to agriculture and imports of foreign agricultural products, usually government implement

agricultural policies with the goal of achieving a specific outcome in the domestic product markets. It helps to upgrade the income and increase the standard of living of farmers within in time bound. Agricultural policies have remained a highly structural sector in India with government organizations, Government taken agricultural policies during mid 1960's, Initially it focuses on food self-sufficiency in staple food grains like rice and wheat, later on years, it focuses on cultivated area, introduction of land reforms, community development, minimum support price, public storage, procurement and distribution of food grains etc. In India, the policies main aim is to remove the problems regarding agriculture and solve the complications related to improper and inefficient use of natural resources, poor cost-benefit ratio of the sectoral activities, ineffective functions of cooperative farming, etc. These policies are formulated for all round and comprehensive development of the agricultural sector.

GIRISDA/AB/017/2022

TO STUDY THE EFFECT OF PHOSPHORUS, SULPHUR AND PSB ON GROWTH ATTRIBUTING CHARACTERS OF MUSTARD

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A field experiment was carried out at Agronomy Instructional Farm, School of Agricultural Sciences, Career Point University, Kota, Rajasthan during Rabi season of 2019-20 and 2020-21 to Studies on the Effect of Phosphorus, Sulphur and PSB on Mustard [*Brassica juncea* (L.)] growth, Yield and Quality. The experiment was laid out in Split plot design with sixteen treatments whereas four levels of phosphorus (RDF-N constant, 20 kg, 40 kg, 60 kg) and two levels of sulphur (40 kg, 60 kg) and phosphate solubilizing bacteria (control and inoculation) with three replications. The experiment results revealed that the growth parameters such as plant height (154.66, 199.61), fresh weight of shoots (127.28, 189.15), Dry weight of shoots (16.46, 24.56), Number of green leaves per plant (17.79, 20.82), number of branches per plant (23.29, 26.81) maximum was recorded under the treatment T4 (RDF (N constant) + 60 Kg Sulphur ha^{-1} + PSB Inoculation). However, it was at par recorded under treatments T15 (60 kg $P2O5$ ha^{-1} + 40 kg Sulphur ha^{-1} + Inoculation with PSB), at 60 days and 75 days after sowing in 2019-20 and same treatments shows tremendous result in 2020-21. During the year 2019-20 and 2020-21 earliest 50 per cent flowering (52.63, 55.82 days) was observed and Minimum days taken to maturity were recorded (102.72, 106.03) in the treatment T4 (RDF (N constant) + 60 Kg Sulphur ha^{-1} + PSB Inoculation) which was statistically at par with treatment T12 (40 kg $P2O5$ ha^{-1} + 60 kg Sulphur ha^{-1} + Inoculation with PSB). Treatment T4 was statistically significant especially when compared to treatments where no inoculation with PSB was done.

GIRISDA/AB/018/2022

BIOENHANCERS: A NEW CONCEPT FOR LIVESTOCK SECTOR

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Bioenhancers are agents not possessing any inherent therapeutic effects but when co-administered with active pharmaceutical ingredients; potentiate the pharmacological effects, bioavailability and bio-efficacy of those active drugs. They act through several mechanisms which may affect mainly drug pharmacokinetic process including absorption, distribution, metabolism and excretion or pharmacodynamic process. Bioenhancers can be herbal and animal origin. Several herbal bioenhancer compounds including piperine, quercetin, genistein, naringin, sinomenine, curcumin, glycyrrhizin, nitrile glycoside and in animal origin, cow urine distillate have demonstrated capability to improve the pharmacokinetic parameter of several potent active drugs. Bioenhancers have been shown to enhance therapeutic effects of different class of drugs such as anti-tubercular drugs, antibiotics, antiviral, antifungal,

antihypertensive and anticancer drugs. An effective and ideal bioenhancer is nontoxic to both humans and animals, economical, easily procured, non-addictive, lowers the drug resistance problems, easy to concoct, and highly responsive, even when its concentration in a given combination is low. Based on a traditional system of Indian medicine and modern veterinary science, bioenhancers constitute an innovative concept and judicious use of them. The drugs patented for bioenhancing action of human drugs can also be used for increasing efficacy and bioavailability of veterinary drugs. Use of bioenhancers is found essential with the drugs which are toxic, expensive, administered for long period of time ineffective and poorly absorbable. Therefore bioenhancers can be used in combination therapy with drugs and nutrients, reducing drug resistance, poor bioavailability, toxicity, cost and shorten the course of treatment with anti-microbial agents and other therapeutic drugs. Hence for the treatment of infectious diseases combination therapy can be applied in human and veterinary medicine.

GIRISDA/AB/019/2022

STUDIES ON SERO-PREVALENCE OF BRUCELLOSIS IN SHEEP (*Oviesaries*) IN AND AROUND JAIPUR

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Brucellosis is a reproductive disease of livestock that is of immense economic importance. It predominates in most developing countries like India. The disease mainly causes infertility, delayed heat, disrupted lactation, and abortion, decrease of wool, meat and milk production which is of zoonotic value to humans. Brucellosis is transmitted to human through direct or indirect contact with infected animal and material or through the ingestion of animal byproducts. Sheep are natural reservoir of brucella and mainly infected by *Brucellamelitensis.* Sheep mainly reared for wool, meat and occasionally for milk. Sheep skin and manure are also significant earning sources for farmers. The present study was carried out to study the sero-prevalence of brucellosis in sheep in and around Jaipur. A total of 360 serum samples were collected from different locations of Jaipur from sheep and were tested by serological methods *viz*. Rose Bengal Plate Test (RBPT), Standard Tube Agglutination Test (STAT) and Enzyme Linked Immuno-Sorbent Assay (i-ELISA).Test wise sero-prevalence of brucellosis was 1.67%, 6.39% and 7.22% by RBPT, STAT and i-ELISA respectively. Higher prevalence was obtained (3.33%, 6.67% and 10.00% by RBPT, STAT, and i-ELISA respectively) in more than 3 year age group of sheep. Higher prevalence was also found in males (6.25%, 6.25%, and 9.37%) than females (0.67%, 6.41% and 6.75% by RBPT, STAT and i-ELISA). Taking i-ELISA as gold standard test the sensitivity of STAT is higher than RBPT and the high specificity values were reported in both tests. i-ELISA was found most sensitive test in all three serological tests because i-ELISA measured the highest brucella positive serum sample in sheep.

GIRISDA/AB/020/2022

EVALUATION OF MANUALLY OPERATED WEEDER WITH REFERENCE TO FIELD PERFORMANCE

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For increase the productivity per unit area of small land holdings and considering the economic condition of Indian farmers, it is quite necessary to have suitable agricultural implements which farmers can use and also allow them to use for custom hiring. Weeding is an important agricultural unit operation. Present investigation was undertaken with an objective to evaluate different field performance of developed weeder. Present investigation was undertaken in RTMNU, Nagpur, Maharashtra state during the year 2010-2011. For this investigation farmers and farm workers are selected

randomly from Nagpur district. The field performance of the developed weeder was evaluated in the field of cotton, soyabean and groundnut crops. The test conditions such as soil moisture content, soil type, bulk density of soil, root zone depth of weed, density of weed, etc. were taken into consideration. Speed of travel in km/h was calculated by using a stop watch. Present investigation concludes that the mean value of effective field capacity is higher in cotton crop than groundnut and soybean crops. Weeding by developed manually operated weeder increase the weeding index, effective field capacity, theoretical field capacity and field efficiency respectively while decrease the plant damage.

GIRISDA/AB/021/2022

IMPACT OF TILLAGE PRACTICES ON YIELD AND UPTAKE OF POTASSIUM UNDER MAIZE BASED CROPPING SYSTEMS IN ALLUVIAL SOIL OF EASTERN INDIA

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A field experiment was conducted to understand the impact of different tillage practices on yield and uptake of potassium (K) under maize-based cropping systems. For this study, eight-year long ongoing research project "Resource conservation technologies for stabilizing yield under different cropping system" at Bihar Agricultural University, Sabour, Bhagalpur (Bihar) initiated in the year 2011 was targeted. The surface soil sample (0-15 cm) was collected from the permanent conservation agriculture (CA) project which contains three main plots of various tillage practices *viz.* Zero tillage (ZT), Permanent raised bed (PRB) and Conventional tillage (CT) and in sub-plots with three different cropping systems *viz*. maize-maize (M-M), maize-wheat (M-W) and maize-chickpea (M-C) in a split plot design before sowing and after harvest of maize crop. Result shows that the higher yield was observed in case of ZT system and PRB is at par with ZT system in case of yield characteristics of maize. In case of cropping sequence, higher yield was obtained in maize-chickpea followed by maize-maize and maize-wheat system. The potassium uptake was found to be higher in ZT (162.24 kg ha^{-1}) which was 6.33 % and 11.39 % higher than the permanent raised bed (151.96 kg ha^{-1}) and conventional tillage (143.76 kg ha^{-1}) system respectively. In case of cropping sequences, total potassium uptake was 7.13% lower in maize-maize (147.52 kg ha^{-1}) and 4.58% lower in maize-wheat (151.57kg ha^{-1}) than the maize-chickpea system (158.86 kg ha^{-1}). Overall, it can be concluded that ZT and M-C was better over the other tillage practices and cropping systems as far as potassium availability is concerned.

GIRISDA/AB/022/2022

INTEGRATED NUTRIENT MANAGEMENT IN ENHANCING THE GROWTH AND YIELD OF CROPS

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Alleviation of poverty and achievement of zero-hunger target and food security are significant challenges faced by agricultural planners worldwide. Improving many agronomic approaches, which have drastic effects on crop growth and yield, is urgently needed to report this aim. Integrated nutrient management refers to the maintenance of soil fertility and of plant nutrient supply at an optimum level for sustaining the desired productivity through optimization of the benefits from all possible sources of organic, inorganic and biological components in an integrated manner, has a bright solution in this area. Recently, several investigators reported that integrated use of conventional fertilizers

with organic manure is becoming a quite promising practice not only for maintaining higher productivity but also for greater stability to crop production and also reduce environmental impacts. Integrated nutrient management is a tool that can offer good options and economic choices to supply plants with a sufficient amount of nutrients in need and can also reduce total costs, its improve to physical, chemical and biological properties of soil hence improve growth and yield of the crops.

GIRISDA/AB/023/2022

EVALUATION OF SEQUENTIAL HERBICIDE APPLICATION IN TRANSPLANTED RICE UNDER SODIC SOIL

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A field experiment was conducted at Department of Agronomy, Anbil Dharmalingam Agricultural College and Research Institute, TNAU, Tiruchirappalli during late *Samba* (*Rabi*) 2018-19, to study the effect of sequential application of herbicides on weed control and its influence on subsequent weed management in transplanted rice under sodic soil. The experiment was laid out in split plot design with four main plots and five sub plots. Main plot treatments were pre plant application (PPA) of herbicides namely, glyphosate 2.5 kg ha^{-1}, glufosinate ammonium 1.0 kg ha^{-1}, halosulfuron methyl 67.5 g ha^{-1} and control. Sub plot treatments consisted of different weed management practices in transplanted rice namely, preemergence (PE) application of bensulfuron methyl + pretilachlor 660 g ha^{-1} on 3 DAT + hand weeding on 45 DAT, post emergence (POE) application of bispyribac sodium 25 g ha^{-1} on 15 DAT + hand weeding (HW) on 45 DAT, PE bensulfuron methyl + pretilachlor 660 g ha^{-1} on 3 DAT + bispyribac sodium 25 g ha^{-1} on 25 DAT, hand weeding on 25 and 45 DAT and unweeded control. Pre plant herbicides are sprayed at 15 days before puddling. The rice variety TRY 3 was grown during the course of investigation. These results revealed that, pre plant application of glyphosate 2.5 kg ha^{-1} recorded significantly lower total weed density (16.7 m^{-2}), lower total weed dry weight (15.0 g m^{-2}), higher weed control efficiency (88.3%), higher grain yield (4232 kg ha^{-1}), higher net return (` 54391 ha^{-1}) and B:C ratio (2.51) than halosulfuron methyl and control. These results are on par with glufosinate ammonium 1.0 kg ha^{-1}. Among the weed management practices followed in rice, hand weeding twice at 25 and 45 DAT registered significantly lower total weed density (9.4 m^{-2}), lower total weed dry weight (6.9 g m^{-2}) and higher weed control efficiency (96.4%) at 60 DAT. This was on par with post emergence application of bispyribac sodium 25 g ha^{-1} on 15 DAT + one hand weeding on 45 DAT. Post emergence application of bispyribac sodium 25 g ha^{-1} on 15 DAT + one hand weeding on 45 DAT registered significantly higher grain yield (4327 kg ha^{-1}), net return (` 53298 ha^{-1}) and B:C ratio (2.40) than other treatments. From the above study, it could be concluded that, pre plant application of glyphosate 2.5 kg ha^{-1} at 15 days before puddling followed by post emergence application of bispyribac sodium 25 g ha^{-1} on 15 DAT +one hand weeding on 45 DAT recommended for better weed control as well as higher productivity and profitability in transplanted rice under sodic soil ecosystem. Recently, glyphosate has been banned in many states of India includes Kerala, Punjab, Maharashtra and Andhra Pradesh. In this field experiment, glufosinate ammonium was comparable with glyphosate in terms of controlling weeds as well as improving the rice productivity. Hence, it may be an alternative to glyphosate in future.

GIRISDA/AB/024/2022

EFFECT OF ZINC AND SILICON NANOPARTICLES ON GRAIN QUALITY AND ECONOMICS OF RICE (*Oryza sativa* L.)

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An investigation to know the effect of nano zinc and silicon on quality and yield of rice was conducted at AHRS, Bavikere, UAHS, Shivamogga. The experiment consisted 12 treatments replicated thrice and was laid in completely randomized block design. The treatment details are seed treatment of nano zinc and silicon, foliar spray of zinc and silicon nanoparticles, combination of both seed treatment and foliar application, at 40 DAT foliar spray of EDTA ZnSO4 (0.5%), potassium silicate (0.5%), ZnSO4 soil application @ 25 kg ha^{-1} and rice hull ash @ 2 t ha^{-1} along with RDF were compared with the control. Application of both zinc and silicon (T6) in nano form as foliar @ 40 ppm each at 40 DAT registered significantly higher no. of productive tillers (18.72), protein content (11.41%), starch content (75.70%) and closer results were obtained from treatment receiving foliar spray of zinc nano particles alone @ 40 ppm at 40 DAT. The same trend was also seen in grain yield (6034 kg ha^{-1}), straw yield (6693 kg ha^{-1}) with higher economic net returns (98631 ` ha^{-1}). The presence of nano particles in the leaf sample of this treatment confirmed the effect of nanoparticles on increasing yield of rice.

GIRISDA/AB/025/2022

ASSESSMENT OF AVOIDABLE YIELD LOSSES CAUSED BY *Lipaphiserysimi* (KALTENBACH) IN *Brassica juncea* GENOTYPES (RH 725 AND RB 50)

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Rapeseed-mustard is one of the most economically essential oilseed crop worldwide is attacked by many insect pests, prominent among them being the *Lipaphiserysimi* that inflicted significant losses in the crops yield. Therefore, a field experiment was conducted in a paired plot design, in two sets i.e., protected (Sprayed with Dimethoate 30 EC @ 625 ml ha^{-1}) and unprotected (unsprayed), with thirteen replications to assess the yield losses due to *L. erysimi* in *B. juncea* genotypes (RH 725 and RB 50) at farmer‟s field, Kolana village, Aravalli Hills Region, Rewari, Haryana, India during the *Rabi* season of years 2019-20 and 2020-21.The pooled data showed that the per cent reduction in *L. erysimi* population was computed to be 86.84 and 88.37% in RH 725 and RB 50 genotype, respectively. Attributable to the infestation of *L. erysimi*, all the yield parameters of *B. juncea* showed significant differences (P<0.01) among protected and unprotected conditions except for seed germination percentage (P>0.01). The avoidable seed yield losses were more in RH 725 (26.25%) as compared to RB 50 (25.92%) genotype. Investigation on another parameter like 1000 seeds weight inferred the highest losses in RH 725 (14.41%) against RB 50 (13.99%), however losses in terms of weight of 100 siliquae (36.10 and 29.26%), 100siliquae husk (45.63 and 33.32%) and 10 main apical shoots of ten centimeter length (33.33 and 29.66%) were maximum in RB 50 than RH 725, respectively. The losses concerning seed germination percentage were registered higher in RH 725 (3.03%) as compared to RB 50 (2.88%). The outcomes of the current research emphasized the significance of crop protection approaches that can assist in reducing yield losses suffered by farmers due to this pest infestation.

GIRISDA/AB/026/2022

IMPACT OF NUTRITION EDUCATION INTERVENTION ON NUTRITIONAL STATUS AND NUTRITIONAL KNOWLEDGE OF RURAL ADOLESCENT GIRLS

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Adolescence can be said as a modern – and even postmodern – concept which recognizes the unique space between childhood and full adulthood. Malnutrition is posting a great threat to adolescents, especially in developing countries like India. Anemia reduces physical and cognitive capacity and the subsequent impact on reduced learning skill and academic performance among early adolescent school-going girls. Dietary patterns and physical activity, in addition to schooling and countervailing social norms for early marriage, influence health and nutritional well-being of adolescents. Nutrient requirements including those for energy, protein, iron, calcium, and others increase in adolescence to support adequate growth and development. In settings where dietary intakes are suboptimal, anemia and micronutrient deficiencies are high. Given the persistence of iron-deficiency anemia, vitamin A deficiency, and iodine deficiency, food fortification (iron and iodine in salt), diet modification, and public health and disease control measures may be needed. Factors that need attention are, promoting and educating mothers and family members regarding child‟s health, promoting low-cost area specific nutritional recipes, promotion of food security, nutrition and importance of regular check-ups and follow ups and raising awareness about hygiene and sanitation. Few researchers found that higher intake of nutrients during early childhood and adolescent stage has a long-term impact on adult educational outcomes. Information about absolute levels and trends with respect to adolescent girls‟ under nutrition are of relevance for designing, initiating or modifying intervention programs. Adolescents, however, have been considered a low-risk group for poor health and nutrition and frequently get inadequate consideration. Proper nutrition education is therefore a pre-requisite to maintain the basic health level in India.

GIRISDA/AB/027/2022

YIELD MAXIMIZATION OF WHEAT UNDER RESTRICTED IRRIGATION CONDITION

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Wheat (*Triticum aestivum* L.), being an important prehistoric crop, is backbone of our national food security system. India, being blessed and enriched with a diverse agro- ecological condition, ensuring food and nutritional security to a majority of the Indian population through production and steady supply particularly in the recent past, is the second largest producer of wheat worldwide. According to FAO (2013), the global demand of wheat will increase to about 900 million tons of wheat by the year 2050. It has been estimated that India will need at least 140 million tonnes of wheat by 2050 as against present estimated production of 109.24 million tonnes. High yields come from achieving the correct leaf and shoot numbers, maintaining a green leaf canopy, increasing grain numbers/ear and grain size. A balanced crop nutrition programme including all macro and micro nutrients is essential to help manage all of these components. Wheat cultivation stretches under wide range of agro-climatic conditions and thus, it has to encounter multifarious biotic and abiotic stresses. Weed control is achieved through direct methods and also by adopting indirect methods such as altered land preparation, soil moisture regulation, planting methods, seeding rate and fertilizer management. Furrow-irrigated raised bed technology has resulted improvements in irrigation and nutrient management, saving in water, better crop stand, lower seed rate, and reduction in lodging. Raised bed planting provides an opportunity for mechanical weed control, permits band application of fertilizers, improves nitrogen use efficiency, and reduces crop lodging. Adopting raised bed planting method is recommended to increase the efficacy and to control the weed in wheat crop.

GIRISDA/AB/028/2022

INTEGRATED ORGANIC FARMING SYSTEM FOR SMALL AND MARGINAL FARMERS OF HYDERABAD KARNATAKA REGION UNDER DRYLAND CONDITION

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A field experiment was conducted on performance of integrated organic farming system over conventional farmers practice system for one hectare area at Organic Farming Research Institute farm, UAS, Raichur, Karnataka for six successive years of 2014-15 to 2019-20 under rainfed conditions in deep black soils to explore the productivity and profitability under rainfed condition. Among the system evaluated integrated farming system has recorded higher average net returns (` 64380) and benefit cost ratio (10.35) over the conventional method. The productivity and profitability under the practice of integrated organic farming system records higher net, gross return with lesser cost of cultivation when compared to conventional farmers practice.

GIRISDA/AB/029/2022

PRECISION FARMING FOR A SUSTAINABLE AGRICULTURAL SYSTEM

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Precision Farming or Precision Agriculture is generally defined as information and technology-based farm management system to identify, analyse and manage spatial and temporal variability within fields for optimum productivity, profitability, sustainability and protection of the land resource by minimizing the production costs. Precision Agriculture can help in managing crop production inputs in an environmentally friendly way by using site-specific knowledge, Precision Agriculture can target rates of fertilizer, seed and chemicals for soil and other conditions. Precision Agriculture substitutes information and knowledge for physical inputs. Precision agriculture benefits to the environment come from more targeted use of inputs that reduce losses from excess applications and from reduction of losses due to nutrient imbalances, weed escapes, insect damage, etc. Increasing environmental consciousness of the general public is necessitating us to modify agricultural management practices for sustainable conservation of natural resources such as water, air and soil quality, while staying economically profitable. The use of inputs (i.e., chemical fertilizers and pesticides) based on the right quantity, at the right time, and in the right place. This type of management is commonly known as “Site-Specific Management”. The productivity gain in global food supply have increasingly relied on expansion of irrigation schemes over recent decades, with more than a third of the world's food now requiring irrigation for production. Most of them estimated indirectly the environmental benefits by measuring the reduced chemical loading. Results of the sensitivity analysis show that Precision Agriculture is a modestly more profitable alternative than whole field management. All-together, market-based global competition in agricultural products is challenging economic viability of the traditional agricultural systems, and requires the development of new and dynamic production systems.

GIRISDA/AB/030/2022

AN OVERVIEW ON BIOFORMULATIONS FOR SUSTAINABLE AGRICULTURE

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Sustainable agriculture is a type of agriculture that focuses on producing long-term crops and livestock while having minimal effects on the environment. This type of agriculture tries to find a good balance between the need for food production and the preservation of the ecological system within the environment. Economic growth, social equity and environmental protection are the three pillars of sustainable agriculture. The current agricultural practices include the wide production and extensive use of agrochemicals cause negative health effects in human and wildlife and to degrade the natural environment. However, when considering the environmental issues, it is clear the current methods of agriculture cannot be sustained. Therefore, bioformulation or beneficial organism based formulation used as an alternative to chemicals on plants. Although, bio-pesticides and other beneficial organism-based formulations are very effective in laboratory conditions but fail in field occasionally due to un-stability of antagonist and storage problems. In this context, formulation type plays an important role in helping to solve stability and storage problems and making a formulation very effective even in the fields (Bhattacharyya and Jha, 2012). Currently, bioformulations containing certain microorganisms including prokaryotes and eukaryotes, are safer for humans and animals. Species of *Trichoderma* are most often considered as fungal bioformulation. Hence, various bio-formulation prepared by using substrates of various agricultural and domestic wastes because of low cost and high availability to suppress plant diseases and also sustain environment (Paramasivan *et al.,* 2019).

GIRISDA/AB/031/2022

PROFITABILITY, PRODUCTIVITY AND QUALITY OF DOUBLE ZERO INDIAN MUSTARD (*Brassica juncea* L.*)* AS INFLUENCED BY DIFFERENT NUTRIENTS

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A field experiment entitled "Profitability, productivity and nutrient use efficiency of Double Zero Indian mustard (*Brassica juncea* L.*)* as influenced by different nutrients" was conducted at Crop Research Centre, SVPUAT, Modipuram, Meerut. The experiment comprised of 12 treatments of various nutrient combinations and was tested in Randomised Block Design (RBD). The treatments comprised of Control (T_1), 100 % N (T_2), 100 % NP (T_3), 100 % NPK (T_4), 125 % NPK (T_5), 100 % NPK+ S@40 kg ha^{-1} (T_6), 100% NPK+ Zn@5kg ha^{-1} (T_7), 100% NPK + B@1kg ha^{-1} (T_8), 75% NPK+ VC@ 2t ha^{-1} (T_9), 75% NPK+FYM@ 6t ha^{-1} (T_{10}), 75% NPK + VC@ 2t ha^{-1}+ Azotobacter (T_{11}) and 75% NPK + FYM@6t ha^{-1} + Azotobacter (T_{12}). Indian mustard cultivar Pusa Mustard 31(PDZM -31) was grown during winter (*rabi*) season of 2020-21 with a view to compare the production potential under different nutrient management practices and also to find out the economic viability of this cultivar for soil quality. Results revealed that treatment T_{11} (75% NPK + VC@2t ha^{-1} + Azotobacter) and T_{12} (75% NPK + FYM@6t ha^{-1} + Azotobacter) exhibited significant influence on the growth, yield attributes and yields of mustard as compared to the application of 100% NPK alone. Significant improvement in growth parameters *viz.* plant height, leaf area index, dry matter accumulation as well as crop growth rate, relative growth rate, yield attributes and yields was recorded with the application of T_{11} and T_{12}.The maximum gross return was obtained in T_{12} followed by T_{11} The highest net return was obtained in T_5 followed by T_{12}, T_6 and T_{11}, while minimum gross return and net return was obtained in T_1. Application of 75% NPK + FYM@6t ha^{-1} + Azotobacter (T_{12}) and 75%NPK + VC@ 2t ha^{-1}+ Azotobacter (T_{11}) recorded higher gross return and

net return but the B:C ratio was lower due to higher cost of vermicompost. Highest B: C ratio (4.23) was obtained in T_6 and T_5.

It can be concluded that to obtain higher seed yield of Indian mustard *cv.* Pusa Mustard 31 and sustain soil health, the application of 75% NPK + FYM@ 6t ha^{-1} + Azotobacter will be most beneficial followed by 75%NPK + VC@ 2t ha^{-1}+ Azotobacter and 100% NPK+ S@40kg ha^{-1}.

GIRISDA/AB/032/2022

EFFECT OF FOLIAR APPLICATION OF ZINC BASED NANOFERTILIZER AND VARYING FERTILITY LEVELS ON GROWTH ATTRIBUTES, YIELD ATTRIBUTES, YIELD AND ECONOMICS OF MAIZE

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A field experiment was conducted during two consecutive *Kharif*, seasons of 2020 and 2021 at Instructional Farm, Rajasthan College of Agriculture, Udaipur to evaluate the effect of foliar application of zinc based nanofertilizer and different fertility levels on growth attributes, yield attributes, yield and economics of maize. The experiment was laid out in a factorial randomized design with three replications comprising four foliar application of nanofertilizer (Control, at knee high stage, at 50% tasseling stage and both at knee high stage and at 50% tasseling stage) and four fertility levels (100% RDF, 90% RDF, 80% RDF and control). Significantly highest grain, stover and biological yield (51.90, 82.32 and 134.21q ha-1) were recorded with the dual foliar application of nanofertilizer at knee high stage and at 50 per cent tasseling stage over single stage foliar application. Among different levels of fertility, application of 90 per cent RDF significantly increased grain, stover and biological yield. Yield attributing characters viz., cob length (cm), girth of cob (cm), grains cob-1, cob height (cm), grain weight cob-1 (g), 1000 grain weight (g) and Shelling (%) were significantly higher with the dual foliar application of nanofertilizer at knee high stage and at 50 per cent tasseling stage and application of 90 per cent RDF in maize. Similarly, the significantly highest protein content of maize (11.13 % and 10.97 %) was found in with dual foliar application of nanofertilizer and 90 per cent RDF, respectively. The significantly highest net return and B:C ratio were found under dual foliar application of nanofertilizer 82956 and 3.04) and soil application of 90 per cent RDF (`86112 and 3.15) in maize.

GIRISDA/AB/033/2022

EVALUATION OF DIFFERENT SUBSTRATE WITH SUPPLEMENTS FOR CULTIVATION OF *Lentinula edodes* (BERK.) PEGLER

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Lentinula edodes (Berk.) Peglar, the shiitake mushroom, is worldwide one of the most widely cultivated mushrooms. The cultivation of edible mushrooms is a biotechnological process that uses various residues to produce food of high nutritional value. Two strains of Lentinula edodes (DMR-356 and DMR-35) were cultivated on basal substrate wheat straw and poplar sawdust alone and in combination with supplements (Wheat bran, Rice bran and Maize Meal). Complete spawn run, bump formation, basideocarp formation days, total yield and biological efficiency were recorded. Minimum time taken for complete spawn run, bump formation and basideocarp formation was observed on wheat straw + wheat bran (20%) + CaCo3 (2%). Wheat straw + wheat bran (20%) + CaCo3 (2%) produced maximum total yield and biological efficiency in DMR-356 (567.0g/900g of dry substrate) with biological efficiency (63.0%) and DMR-35 (497.6g /900g of dry substrate) with biological efficiency (55.2%). Poplar sawdust substrates alone proved to be least effective for the cultivation of Lentinula edodes strains, with maximum days taken for complete spawn run, Bump formation and basideocarp formation day, while minimum total yield with DMR-356 (114.0g/ 900g of dry substrate) and corresponding lowest biological efficiency (12.6%) and with DMR-35 strain minimum total yield (57.0g/ 900g of dry substrate) and biological efficiency (6.0%) was recorded.

GIRISDA/AB/034/2022

EFFECT OF DIFFERENT TRANSPLANTING DATES AND SHOCK PREVENTING METHODS ON THE PERFORMANCE PEARL MILLET (*Pennisetum typhoides* L.) VARIETIES

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A field experiment was conducted on loamy sand soil at the Rajasthan Agricultural Research Institute, Durgapura, Jaipur, during two consecutive *kharif* seasons in 2019 and 2020. The experiment comprises two pearl millet varieties (RHB-173 and RHB-177), four transplanting shock preventing methods (No treatment, Triacontanol @ 0.25 ml/litre, Triacontanol @ 0.50 ml/litre and Leaf clipping) and three dates of transplanting (15^{th} – 30^{th} June, 1^{st} – 15^{th} July and 16^{th} – 31^{st} July) replicated thrice in factorial randomized block design. Result revealed that pear millet growth parameters, yield attributes and yields, net returns and B: C ratio were significantly higher with hybrid RHB-173 as compared to RHB-177. Among transplanting shock preventing methods, triacontanol @ 0.50 ml/litre showed significantly higher plant population, crop growth parameters, yield characteristics and yields, net returns and B: C ratio were significantly as compared to no treatment and leaf clipping, but it remained at par with its lower dose treatment triacontanol @ 0.25 ml/litre. Result further revealed that transplanting of pear millet during 1^{st} –15^{th} July gave higher plant population, growth and yield attributes, grain yield, net returns and B: C ratio as compared to 15^{th} – 30^{th} June, but it remained at par with transplanting during 16^{th} – 31^{st} July.

GIRISDA/AB/035/2022

BACTERIAL AETIOLOGY OF INFERTILITY IN DOGS WITH SPECIAL REFERENCE TO BRUCELLOSIS

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Canine breeding has increased tremendously in the last few years especially in the wake of covid-19 pandemic, which in turn has led to the rise in infertility cases presented to veterinary hospitals. Bacterial causes of infertility in dogs include *Brucella* spp., *Escherichia coli*, *Staphylococcus* spp., *Streptococcus* spp., *Salmonella* spp. etc. A total of 60 dogs consisted of 50 animals with various reproductive problems and 10 animals of normal breeding history were selected for the study. Main clinical signs observed in the ailing animals include persistent greenish grey vaginal discharge, mid to late term abortion, orchitis/epididymitis, scrotal oedema and azoospermia. Out of 60 sera samples collected and screened for brucellosis using rose bengal plate test (RBPT), 26 (43.33 per cent) animals were detected as reactors. Culture and identification of bacterial isolates obtained from clinical materials of infertile dogs were identified based on biochemical characters as *E. coli* (36.84 per cent), *Staphylococcus aureus*, *Klebsiella* spp., *Proteus* spp., *Shigella* spp., *Pseudomonas* spp., *Enterobacter* spp., *Citrobacter* spp., *Micrococci* spp., *Streptococci* spp. and *Salmonella* spp. The results of antibiotic resistance test of bacterial isolates from infertile dogs had shown maximum sensitivity to ceftriaxone (92.98 per cent), followed by cefpodoxime and cefaperazone. The results of the antibiogram profiling of all isolates of *E. coli* obtained from clinical cases revealed multidrug resistant isolates indicated by multiple antibiotic resistance index (MARI) ranging from 0.3 to 0.9. Deoxyribonucleic acid (DNA) extracted from clinical materials were subjected to Brucella genus and species specific polymerase chain reaction (PCR). Out of twelve *Brucella* spp. positive samples, eleven samples yielded amplicons with a 100 per cent homology to *B. abortus* on sequencing. The sensitivity and specificity of RBPT as a screening test was assessed and found 91.67 per cent and 60.52 per cent respectively when compared with PCR as the gold standard test. To conclude, all urogenital infections in animals should be treated with antibiotics only if warranted and should be in accordance with the culture and sensitivity pattern of antibiotics. Dogs of reproductive age should be regularly screened for brucellosis and those animals tested positive should not be used for further breeding purpose.

GIRISDA/AB/036/2022

STUDIES ON GRAIN MOULD RESISTANCE IN SORGHUM (*Sorghum bicolor* (L.) Moench)

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The present investigation on "Studies on Grain mould resistance in sorghum (*Sorghum bicolor* (L.) Moench)" was carried out to estimate the amount of heterosis and heterobeltiosis, the general and specific combining by using 10 divergent parents and their 45 F_1 and 45 F_2 progenies in half-diallel fashion. The highest estimates of heterobeltiosis 49.08 per cent for panicle length, 25.50 per cent for panicle width, 94.13 per cent for number of grains per primary branch, 64.80 per cent for 100 seed weight, 158.12 per cent per cent for grain yield, -80.00 per cent for field grade score, -67.74 per cent for threshed grade score, 41.84 per cent for grain hardness, 11.88 per cent for grain density, 36.10 per cent for germination, -77.95 per cent for glume coverage, -44.94 per cent for water absorption capacity, -81.01 for fungal load of *Fusarium spp*., -85.39 for *Curvularia spp*. and -85.31 for fungal load of other spp. The hybrids having high heterobeltiosis for grain yield were AKGMR 110 x IS 14332, PMS 42B x IS 14332, AKGMR 110 x B58586, AKGMR 110 x I 26, I 26 x PMS 42B, AKGMR 110x PVK 801, AKGMR 110 x MS296B, PMS 71B x

IS 14332, PMS 42B x PVK 801, MS 296B x I 26, AKGMR 110 x PMS 42B, B 58586 x PMS 42B, MS 296B x PMS 42B, MS 296B x PVK 801 and hybrids having desirable significant heterobeltiosis for germination percentage were AKGMR 110 x PVK 801, MS 296B x PVK 801, MS 296B x I 26, GNM 14-7 x PMS 74B, AKGMR 110 x PMS 74B and I 26 x PVK 801.

GIRISDA/AB/037/2022

PREDATORS ARE ATTRACTED TO THE OLFACTORY SIGNALS OF VARIOUS BORDER CROPS IN CABBAGE ECOSYSTEM

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Cabbage, Brassica oleracea var capitata L (Cruciferae) is an important temperate vegetable crop that grows well throughout the world. It is also a common vegetable grown in India throughout the year. Cabbage (cv. Ganesh) was sown in an area of 630 m^2 in well prepared soil. The distance between row to row was 45 cm, and plant to plant was 30 cm. Cauliflower, Mustard, Radish, Turnip, Broccoli and Knol Khol, cowpea, Onion, lab lab, Tomato, coriander and French bean, marigold, cosmos, zinnia, sunflower, fenugreek, gingelly were raised as a border crop (1m^2) around cabbage on different dates to coincide flowering of cabbage plants. The plot size for each treatment was 30 m^2. There were seven treatments including a control in a Randomized Block Design (RBD) with three replications. Six arm olfactometer was used for this study. About 10g of leaves of Cabbage plants from each treatment were kept in the arm and firmly closed with a lid. Out of the six arms one arm was treated as control and compared with other treatments. There was significant difference in the attraction of coccinellids in olfactometer arms due to leaf and flower samples of border crops. The mean data revealed that coccinellids were high in mustard arm (2.83) followed by broccoli (1.50), cauliflower (1.08), and control (0.66) arms. This revealed that the mustard and broccoli flowers had more attraction cue for coccinellids. Mean data revealed that more population was in cowpea (2.83) arms followed by tomato (2.67) coriander (2.50), onion (2.16), French bean (1.83), lab lab (1.66) and control (0.50) arms. This revealed that the tomato and cowpea flowers showed excellent orientation response to the predatory coccinellids. Mean data revealed that more population was in marigold (2.67) arm followed by sunflower (1.83), zinnia (1.75), cosmos and fenugreek (1.50) gingelly (1.33) and control (0.58) arms. This revealed that the marigold and sunflower flowers showed excellent orientation response to the predatory coccinellids.

GIRISDA/AB/038/2022

SEASONAL INCIDENCE OF MAJOR DISEASE AND INSECT PEST OF BUTTON MUSHROOM CROP GROWN IN JAMMU AND THEIR MANAGEMENT

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Survey conducted at different mushroom farms of Jammu division revealed maximum incidence of wet bubble disease whereas incidence of brown plaster mould was recorded second highest in Jammu and Samba districts while in case of Udhampur district, white plaster mould was observed second highest to the green mould. In case of mixed infections dry bubble along with green mould was observed higher in Samba and Udhampur. Assessment of insect population revealed that the incidence of phorids fly was maximum and minimum of beetles. Among nematodes, *Ditylenchus myceliophagus* was found to be most predominant followed by *Aphelenchoides* spp. The effect of weather parameters

on wet bubble and dry bubble incidence and insect pest population showed positive and significant correlation of the disease development with temperature while the mean relative humidity was negatively correlated non-significantly. For both the sciarids and phorids fly population, temperature had positive but non-significant correlation and relative humidity showed a negatively non- significant correlation. Morphological characters of different *Mycogone perniciosa* isolates revealed average maximum radial growth in MP4 isolate however in *Verticillium fungicola,* average maximum radial growth was observed in VF6 isolate. The colour of the culture varied from white to light brown in *Mycogone perniciosa* isolates while creamy to white in *Verticillium fungicola*. *In vitro* evaluation of different botanicals revealed *Azadirachta indica* as the best treatment against *Verticillium fungicola* and *Mycogone perniciosa*. *In vivo* evaluation of different botanicals against dry bubble and wet bubble disease revealed *Azadirachta indica* as the best treatment. Different bio pesticides and botanical treatment were also evaluated against infestation. The lowest per cent infestation of mushroom flies was recorded in neem oil. The effect of different botanicals and insecticides on yield revealed that maximum yield (2.28 kg and 2.23 kg/10 kg substrate) through application of neem oil.

GIRISDA/AB/039/2022

EFFECTS OF LOOSE HOUSING DESIGNS ON EXPRESSIONS OF MILKING PARLOUR BEHAVIOURS AND MILK YIELD OF CROSSBRED JERSEY COWS UNDER TROPICAL CONDITIONS

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Housing comfort is a good indicator to improved welfare of animals and highly essential for optimization of livestock production performance. Improved welfare is directly related with optimum expression of animals‟ production potential. The aim of the study was to investigate the influence of housing comfort on expressivity of milking behaviours of cows in parlour, milk yield and compositions. Forty Jersey crossbred cows were selected and kept at two different types of loose house; each containing 20 animals. Two types of housing patterns were - (*i*) Existing shed (T_0) – having asbestos roof and concrete floor and (*ii*) Thermo-comfortable shed (T_1) – having thatched roof , more central height, ridge ventilation and half of the open area is soil floored and rest half is concrete. Milking temperament were significantly lower (1.91±0.10) in cows kept in thermo-comfortable shed (T_1) as compared to (2.45±0.10) cows in existing asbestos shed (T_0). Stepping frequency was significantly less in T1 cows as compared to T_0. Daily milk yield was significantly higher (6.83±0.04) in T_1 group of cows compared to T_0 (6.64±0.05). Similarly milk compositions were better and significantly higher in T_1 group of cows than T_0. Current results suggested that under tropical conditions cows maintained under thatched roofed thermo-comfortable dairy barns with 50% soil floored loose house provided better environment for expression of parlour behaviours of dairy cows, favourable milking temperament scores / behaviour, showed higher milk yield/day/cow and better milk compositions compared to traditional concrete floor and asbestos shed cow shelters.

GIRISDA/AB/040/2022

IN VIVO INTEGRATED MANAGEMENT OF ANTHRACNOSE DISEASE IN SPINACH CAUSED BY *Colletotrichum dematium* (Pers.) Grove F. Sp. *spinaciae* (ELLIS AND HALST.)

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Spinach (*Spinacia oleracea* L.) belonging to the Amaranthaceae family is one of the most important vegetables.Anthracnose disease of spinach incited by C*olletotrichum dematium* f. sp. *spinaciae* fungus leads to severe symptoms and losses in spinach, thereby reducing both yield and quality of the crop.The results of the integrated management of anthracnose disease in spinach revealed that highest reduction in disease incidence was obtained from the plots sprayed with *Z. officinale* rhizome extract followed by the plots sprayed with Biomix, *T. asperellum* and *T. harzianum*, which reported a per cent disease reduction of 86.94, 78.82 and 75.88 per cent, respectively over the untreated control. The per cent reduction in anthracnose disease incidence of all the three combination treatment plots *viz.*, $T_1 + T_2$ (*T. asperellum + T. harzianum*), $T_4 + T_5$ (*Z. officinale + A. indica*) and $T_3 + T_6$(*T. asperellum + T. harzianum+ Z. officinale + A. indica*) over the control plot was 27.84, 43.72 and 50.00 per cent, respectively. However, lowest reduction in disease incidence over the control was observed in plots sprayed with A. *indica* leaves extract (19.92%) at 20 per cent concentration. The average per cent increase in spinach yield over the untreated control from both the first and second cuttings was highest in the plots sprayed with Biomix consortium (64.00%), while it was lowest in the plots sprayed with *A. indica* leaves extract (17.79%) at 20 per cent concentration.

GIRISDA/AB/041/2022

EFFECT OF TEMPERAMENT SCORE ON MILK YIELD AND ASSOCIATED BEHAVIOURS IN PRIMIPAROUS JERSEY CROSSBRED COWS

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Temperament, influences productivity, milkability, sociability and have implications that commercial dairy farms cull dairy cows because of poor temperaments. The objective of the present study was to evaluate milking behaviour traits and the effects that temperament has on milk production in Jersey crossbred dairy cows. The study was conducted on 24 Jersey crossbred dairy cows in their first lactation and observations were recorded in morning. Temperament score (TS) significantly ($P<0.01$) influenced the milk yield, milk flow rate, milking duration and flight speed from the milking parlour. Among different milking behaviours, stepping behaviour during milking was observed in 46.4%, 45.0%, 1.6% cases with 1, 2 and > 2 stepping, respectively and rest 7% showed no stepping. Cows of calmer temperament (TS=1) had no stepping, whereas very nervous cows (TS=3) showed 37.3 % cases of ≥2 stepping per milking. Defecation frequencies in milking parlour in nervous cows were more (25.60%) compared to calmer cows (0.80%). Similar trends were observed in urination frequencies but in different magnitudes. Vocalization during milking was observed in 7 % observations only, with higher (6.2%) in cows having more TS. In early lactation stage (up to 150 days), calmer cows (TS=1) had significantly more milk yield in morning (6.87±0.29 kg/d) compared to nervous cows (TS=3, 4.26±0.46 kg/d). Trends were also similar in late lactation stage (>150 days). Milking duration and milk flow rate were also more in calmer cows as compared to nervous cows in both the lactation stages. Leaving of milking parlous on release (flight speed) was less in calmer cows (0.32±0.02 m/s) than that of nervous cows (0.54±0.04 m/s). Results indicated that Jersey crossbred cows having higher temperament score are less milk yielder, their milk flow rates were less and they exhibited higher flight speed, more stepping, higher urination, defecation and vocalization frequencies than the calmer counterpart.

GIRISDA/AB/042/2022

EFFECTS OF MILKING TEMPERAMENT ON MILK YIELD, UDDER HEALTH AND MILK COMPOSITION IN CROSSBRED JERSEY COWS

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The aim of study was to investigate the effects of milking temperament on milk yield; milk ability and udder health in Jersey crossbred cows. The experiment was conducted on Jersey crossbred cows (N=94) maintained at ICAR-National Dairy Research Institute, Eastern Regional Station, Kalyani, West Bengal. Temperament score (TS) of cows was assessed in 5 points scale (1-docile, 5-aggressive). Calmer cows (TS-1&2) comprised of relatively higher (75.24%) proportions and none for TS-5. Milk yield (kg)/day of TS-1cows was significantly (P<0.01) higher (11.19±0.14) compared to TS-2, 3 & 4(7.50±0.11, 5.30±0.14 and 4.13±0.77, respectively). Milking durations, exit score, flight speed and milk flow rate gradually declined as TS increased from 1 to 4. Cows with TS-1 had higher (P<0.01) milk fat, solids not fat and protein% compared to TS-4. Somatic cell counts did not differ significantly with TS. The temperament score was positively correlated (P<0.01) with stepping/milking (0.72), exit score (0.33) and flight speed (0.43), while negatively (P<0.01) correlated with milk yield (-0.64), milk flow rate (-0.65) and milking duration (-0.61). It was concluded from the above study that milking temperament significantly influenced milk yield, composition, milk flow rate and ease of milking in Jersey crossbred cows. Thus, docile cows should be selected for getting benefits of milk yield, milk composition, milking ease and milk flow rate.

GIRISDA/AB/043/2022

STUDY ABOUT GAIN WEIGHT AND FEED EFFICIENCY OF BROILER

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The experiment was conducted at the Livestock production and management unit, MGCGV Chitrakoot- Satna (M.P.) To complete the research work following steps where followed Day old 75 broiler chicks (DOC) of same hatch where produced and reared in deep litter system the chicks were weighed, leg banded and distributed randomly into 5 groups of 15 chicks each as treatment. Chicks of each treatment where further divided into three sub groups of 5 chicks in each in randomized block design (RBD). Chicks of each its sub groups where accommodated comfortable in cage system providing 1 sq. ft./ chick. Chicks wear fed standard starter ration up to 1-2 weeks (1-14 days) and then broiler finisher ration up to 3-4 weeks (15-28 days). At T_0 T_1, T2, T3 and T_4 which were supplemented with neem leaves @ 2.0 $_g$ 4.0$_g$ 6.0$_g$ and 8.0$_g$ /kg of broiler ration respectively. Weekly observation were recorded for live body weight, weekly gain in weight, weekly feed consumption and feed conversion of chicks for four weeks. Based on the results of the experiment, it may be concluded that feed supplementation with Neem leaf powder significantly influenced the body weight, gain in body weight, feed intake and feed efficiency of broiler chicks. Based on feed intake and feed efficiency, the best performance of broilers was obtained with feed supplementation of 6 g Neem leaf powder per kg of standard ration, followed by 8 g Neem leaf powder. Almost all the treatments were economically superior over the control.

GIRISDA/AB/044/2022

A REVIEW OF CHALLENGES AND SOLUTIONS IN THE PRODUCTION OF BIOCHAR AND NANO-BIOCHAR BASED SLOW-RELEASE FERTILIZERS, AS WELL AS THEIR APPLICATIONS IN AGRICULTURE

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Agriculture is under enormous strain due to the rising global population and shrinking arable land. Chemical fertilizer use in agriculture has increased food production substantially in recent decades, contributing to a 50% rise in crop yield. The negative environmental effects of chemical fertilizers are garnering increased attention around the world due to their widespread use. Overuse or incorrect application of chemical fertilizers results in decreased fertilizer efficiency and serious environmental hazards. The unique features of biochar and nano- biochar based slow-release fertilizers (SRFs) have recently received more interest. In-situ pyrolysis, co-pyrolysis, green synthesis, ball milling, impregnation, encapsulation, and granulation are some of the methods for the production of biochar and nano-biochar based SRFs fertilizers to improve the fertilizer efficiency. Biochar is great because it turns waste into a more valuable product and can be used as a soil amendment, boosting plant growth, water treatment, and carbon sequestration material. Bulk biochar (B–BCs, 0.04–20 mm) is commonly used in agriculture and for environmental sustainability. Biochar particle sizes range from micrometers to centimeters, depending on the pyrolysis technology used. Decreasing particle size in the micron range (10–600 μm) enhanced the number of accessible adsorption sites, Further reduction in the size of biochar particles to the nanosized range, up to 100 nm or below it, enhanced its properties thus higher surface to volume ratio increased surface energy, more negative zeta potentials, smaller hydrodynamic radius, high adsorption potential, high mechanical and thermal stability, a higher number of functional groups containing oxygen and carbon, reactive organic species (ROS), and thus helps in biological effectiveness. Although numerous related studies have been published, the development of biochar and nano- biochar based SRFs for practical use is still in its infancy. The synthesis of effective biochar-based SRFs, the evaluation of nutrient release and bioavailability, and the long-term assessment of a genuine application are all current problems. In terms of the foregoing aspects, the research perspectives are also discussed. As a result, biochar and nano-biochar-based SRFs have a better chance of reducing nutrient leaching, increasing water retention, and so improving plant nutrients, and are seen to be an environmentally friendly material and viable for sustainable agriculture.

GIRISDA/AB/045/2022

EFFECT OF ADDITION OF GLUTATHIONE ON TYROSINE PHOSPHORYLATION AND APOPTOSIS-LIKE CHANGES IN CRYOPRESERVED HARIYANA BULL SEMEN

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Our study aimed to evaluate the beneficial effects of incorporation of Glutathione as an additive in Tris egg yolk-based extender in Hariana bull semen opted for ultralow freezing. The study evaluated physical seminal attributes (motility, livability and membrane integrity), process of cryocapacitation, immunoblotting for identification of tyrosine-phosphorylated proteins, immunolocalization of tyrosine phosphoproteins in spermatozoa and apoptosis-like changes in terms of mitochondrial transmembrane potential and DNA integrity during after equilibration and thawing. Ten ejaculates from four Hariana bulls were divided into three aliquots: One aliquot was diluted with egg yolk tris citrate (EYTC) extender (Control), the second aliquot was diluted with EYTC but supplemented with 0.5mM Glutathione (T1) and the third aliquot was diluted with EYTC and supplemented with 1.0mM Glutathione (T2) and were cryopreserved. Semen evaluation at equilibration and post-thaw showed supplementation of Glutathione (0.5mM) to EYTC extender significantly ($P < 0.05$) increased motility, viability and membrane integrity of spermatozoa. The degree of cryocapacitation was significantly ($P < 0.05$) decreased in Glutathione supplemented group. Immunoblot revealed six proteins that were tyrosine phosphorylated and protein of 30kDa (p30) showed differential variation in intensity in the three samples. There was a significant reduction in band intensity of 30kDa in T1 as compared to control and T2. It was also found that tyrosine-phosphorylated proteins were differently located during different stages of semen preservation. The addition of GSH significantly decreased the percentage of spermatozoa showing fragmented DNA after thawing as compared to control. Along with this, GSH supplementation significantly increased the percentage of spermatozoa with high transmembrane mitochondrial potential. The result of the present study demonstrated beneficial effects of Glutathione supplementation on post-thaw cryocapacitation and apoptosis-like changes in spermatozoa and it can be suitably incorporated for long-term preservation of spermatozoa.

GIRISDA/AB/046/2022

CHANGE IN TOTAL SOLUBLE SOLIDS OF GUAVA FRUIT TREATED WITH NANO-FORMULATIONS DURING ROOM TEMPERATURE STORAGE

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Total soluble solids (TSS) of a fruit comprises acids, minerals, and total sugars. TSS are important parameter in fruit quality determination. As fruits matures increase TSS increases. Four treatments were performed *viz.* control (uncoated guava), T1 (alginate+$CaCl_2$), T2 (alginate+$CaCl_2$+ajwain extract) and T3 (alginate+$CaCl_2$+giloy extract) nano-formulations (NFs) coated fruits. In guava, TSS increased initially and then decreased during later days of storage. In control fruits, it ranges 9.10 % to 12.98 % at room temperature storage (32±2 ^oC). In control fruits, it increases from 9.10 % to 12.98 % and then decreases to 12.27 %. In coated fruits, it increased from 9.10 % (0DAT) to 11.92 %, 11.01 % and to 11.15 % (8DAT) and then decreases to and 11.38 %, 9.91 % and 9.96 % (10DAT). Minimum content was maintained in T2 coated fruits followed by T3 and T1. Nano-formulations reduces the oxidative process in fruit and aid in maintaining fruit quality and ajwain extract based herbal NFs proved most efficient in preserving fruit quality.

GIRISDA/AB/047/2022

ROLE OF MANUALLY OPERATED WEEDER FOR EMPOWERMENT IN AGRICULTURE

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For increase the productivity per unit area of small land holdings and considering the economic condition of Indian farmers, it is quite necessary to have suitable agricultural implements which farmers can use and also allow them to use for custom hiring. Weeding is an important agricultural unit operation. Delay and negligence in weeding operation affect the crop yield up to 30 to 60 per cent. Hence present investigation was undertaken with an objective to evaluate performance of manually operated weeder from ergonomics point of view. Present investigation was undertaken in RTMNU, Nagpur, Maharashtra state. For this investigation farm workers are selected randomly from selected villages. Majority of the workers perform weeding activity for 5 hrs and above time. That‟s why they were found suffering from postural discomfort due to traditional method of weeding. But keeping in view of their participation in weeding operations, sample size increased to almost equal. Various body dimensions measured during the study and the mean, standard deviation, 5th percentile and 95th percentile values of important anthropometric parameters of agricultural workers. For the designing of manually operated weeder anthropometric measurements are very important. The dimensions vary from individual to individual age wise, statures, occupations, sex and from place to place. Considering anthropometric dimensions would reduce the factors of bad posture and thus pain and injuries to the human body. It was observed that with decrease in soil moisture content, the ΔHR of all the treatments increased. At 9.52 percent moisture content, ΔHR was found to be maximum followed by 11.63 and 13.52 percent moisture content for all the treatments. The lowest ΔHR at 13.52 percent moisture content due to the soft condition of soil that required less effort during weeding operation. It was observed that oxygen consumption rate (Vo2) of all the treatments increased with decrease in moisture content and were highest at 9.52 percent moisture content. Field evaluation of the weeding activity showed significant reduction in the plant damage while, significant increase was observed in the effective field capacity (-2.42**), theoretical field capacity (-2.51**), field efficiency (-5.82**) and weeding index (-5.97**). Heart rate readings of farm workers showed that developed manually operated weeder is comfortable for farm workers in weeding operation. That‟s why increase the efficiency of farm workers and increase the productivity of work. This shows that developed manually operated weeder is the instrument of drudgery reducing technology for farm workers and increase the productivity.

GIRISDA/AB/048/2022

THE INFLUENCE OF FAMILY ENVIRONMENT AND SOCIAL FACTORS ON JUVENILE DELINQUENTS

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The meaning of juvenile delinquents is a child or young person who commits some form of crime or antisocial behavior before 18 years of age or whose behavior is beyond parental control and may be brought before juvenile court. The family environment and social factors of juvenile delinquency to investigate the demographic and the socio-economic statuses of children offender and to investigate the different type of offenses committed by juveniles. The literature found that 96.25% of juveniles are between the ages of 13 to 17 years. Around 86.25% of children were male and 68.75% of the delinquents children come from rural areas and poor family backgrounds. The literature reveals that the consequences of the study are congruent with what exists in literatures indicating monetary troubles or

poverty is the principal cause for lots juvenile‟s involvements in crimes. The literature also determined that 26.25% of the juveniles had been institutionalized out of peer influences. Furthermore, other social causes including dysfunctional families, rural-urban migration, large family size, sort of family relationships, lack of parental control, and the accessibility of alcohol and, drugs within the neighborhood motivated these juveniles into crime and delinquency. About the different kinds of crime committed by the children, the literature determined that theft and associated crimes have been ordinarily dedicated by a juvenile than any other offense. The factors of family environment that influence delinquency in juveniles. As a result, environmental factors as such family size, economic deprivation, parental deprivation, family discipline, between parents‟ relationship, child- parent relationship, and acceptance/ rejection of parents were found to play important and effective roles in the personality development and growth as well as juvenile delinquent‟s social behavior. Family environmental factors that influence delinquency in adolescents. The findings indicate that environmental variables like size of the family, economic deprivation, parental deprivation, family discipline, inter parental relationship, child – parent relationship and parental acceptance – rejection play an important and effective role in the developmental growth of personality as well as social behavior of the delinquents. Finally, the family environment characterized by poverty also greatly increased the risk of transition to the juvenile justice system.

GIRISDA/AB/049/2022

POPULATION GENETIC STRUCTURE OF COTTON PINK BOLLWORM, *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) FROM INDIA

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Pink boll worm, *Pectinophora gossypiella* became serious pest on BG II cotton hybrids globally causing huge economic losses in cotton even during later stages of crop growth. In the present investigation, the population genetic structure, distribution, and genetic diversity of *P.gossypiella* in cotton growing zones of India using partial mitochondrial DNA cytochrome oxidase-I (*COI*) gene was addressed. Results revealed a total of 9 haplotypes (17.64 %) identified from 51 individual sequences distributed in 16 populations belonging to different cotton growing zones of India. Diversity analysis of COI sequences revealed low genetic diversity (0.000 to 0.01066), high haplotype diversity (0.800), low nucleotide diversity (0.002), negative Tajima D (-0.670) values and high gene flow. This data on population genetics indicate populations of pink bollworm are genetically similar and Hap5, as ancestral haplotype from which other haplotypes have evolved suggests that the migration and dispersal over long distance and invasiveness are major factors.

GIRISDA/AB/050/2022

PERFORMANCE OF NEW WHEAT GENOTYPE AT DIFFERENT NITROGEN LEVELS UNDER TIMELY SOWN RAINFED CONDITIONS

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A field experiment was undertaken at the Experimental farm of Rice and Wheat research, Malan CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur (H.P.) during *Rabi* 2014-2015 to evaluate the performance of the new wheat varieties under timely sown rainfed conditions. The treatments consisted of two new genotypes (HS 562 and HPW 380) and four check varieties (HS 507, VL 907, HPW 349 and VL 804) which were tested at three different nitrogen doses (40, 60 and 80 kg N / ha). The trial was laid out in split plot design. The soil of the experimental site was silty clay loam in texture. Among different nitrogen levels, significantly higher number of earheads per meter square was recorded with the application of 80 kg N/ha though it was at par with 60 kg N/ha while significantly lowest number of earheads per meter square was recorded with the application of 40 kg N/ha. Among the genotype tested significantly lowest number of grains per earhead of wheat was recorded in variety HPW 349. Number of grains per earhead and 1000-grain weight was not significantly affected by different nitrogen levels. Among the genotype tested significantly higher number of grains per earhead was recorded in variety VL 804 and lowest was recorded in variety VL 907 while significantly higher 1000 grain weight was recorded in variety VL 907 and lowest was recorded in VL 804. Significantly highest grain yield was recorded with the application of 80 kg N / ha though it was at par with 60 kg N / ha with significantly lowest yield recorded with the application of 40 kg N / ha. Among the genotypes HPW 380 gave significantly highest yield though it was at par with VL 804 and HS 562 with other varieties producing lower yields.

GIRISDA/AB/051/2022

STUDIES ON EXPLOITATION OF HETEROSIS IN RICE AND FUTURE PROSPECTS

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Heterosis is the superiority of F1 offspring from their parents in terms of yield, quality and other characters. It is done in crop plant for the betterment of livelihood. Crops are produced with higher resistance to disease and pest. Many crops are planted as hybrids to increase yield over open pollinated varieties as it leads to an evolution. Heterosis mainly refers to the phenomenon that progeny of diverse varieties of a species or crosses between species exhibit speed of development, fertility and greater biomass than both parents. It assigns germplasm into heterotic groups and identifies their heterotic pattern in different crops. In this article role of heterosis and its exploitation is defined in rice for the production of hybrid seeds and also to fulfill the need rapidly growing population. As Rice is the richest source of carbohydrates and gives us energy, it also contains fibre, vitamins, Manganese which is key components for the growth and development of humans.

GIRISDA/AB/052/2022

STUDIES ON EFFECT OF DIFFERENT EDIBLE OIL COATINGS ON SHELF LIFE OF GUAVA (*Psidium guajava* L.) DURING STORAGE

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The present investigation entitled "Studies on effect of different edible oil coatings on shelf life of Guava *(Psidium guajava* L.) during storage" was conducted in the laboratory Of Department of Horticulture, College of Agriculture, Gwalior during the year 2021-22 to find out the best edible oil coating to extend the shelf life of Guava. The guava variety which was chosen for the experiment was Gwalior-27. The fruits were collected at the maturity at colour break change from green to scant yellow. The fruits were stored for 12 days at ambient temperature and the different physical, biochemical and sensory parameters were observed at 0, 3, 6, 9, 12 days. The Present experiment was laid out in Completely Randomized Design (CRD) with 8 treatments viz. T0 (Control), T1 (coconut oil), T2 (Olive oil), T3 (Linseed oil), T4 (Sesame oil), T5 (Almond oil), T6 (mustard oil), T7 (castor oil). Each treatment was replicated three times and three fruits were taken in each replication. The results of the research revealed that the (T1) Coconut oil coating at ambient temperature greatly extend the shelf life of guava while, maintaining sufficient Total Soluble Solids (TSS), Total Sugar content, phenol and ascorbic acid content than control. Guava fruits coated with coconut oil showed minimum physiological loss in weight (10.22%) and maximum marketable fruits retained (86.38%) as compared to other treatments. Among the different edible oil coating treatments (T1) Coconut oil also showed better fruit colour, Flavour, texture and taste as compared to control and other treatments. Coconut oil is also cost effective and farmers can easily use coconut oil for extending the shelf life of Guava.

GIRISDA/AB/053/2022

TRAINING FARM WOMEN ON VALUE ADDED MILK PRODUCTS

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In India dairying is a female dominated enterprise. Women in India play an important role in agricultural development and allied activities including livestock, horticulture, post-harvest operations, fisheries etc.Women in villages of district Ambala also contribute in dairy farming work in addition to their household activities. Two to three animals kept at their home to fulfil their daily requirement and as a source of income. The production of these animals contributes to family economy. They used to sell milk directly to consumer for their income. Value addition can be a great tool for increasing their income and making more profit out of milk using certain techniques.Training has been recognized as potent tool to equip a person enabling one to deliver the goods in better way.Keeping in view the above points thirty (30) women from different villages of Ambala were imparted training on "Milk and Milk products" during year 2021 at Krishi Vigyan Kendra, Ambala. They were provided training on making ghee, butter, flavoured milk, ice cream, cheese etc. from milk. These products can be easily made at their home without extra investment. In addition value added milk products have longer shelf life than raw milk, provide various health benefits and boost the income of the farmer/farm women.

GIRISDA/AB/054/2022

INFLUENCE OF NUTRIENT SPRAYS ON VEGETATIVE CHARACTERS OF APPLE UNDER HIGH DENSITY PLANTATION .VAR. GALA REDLUM

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The present investigations were carried on seven years old plants of Apple cv. Gala Redlum grafted on M9-T337 rootstock at experimental orchards, Division of fruit science, SKUAST-K, Shalimar during 2018-2019. The sustainability of any system requires optimum resource utilization be it water, fertilizer, or soil. There is, therefore, a need for technological interventions that will help minimize the use of these valuable resources and increase fruit production, without any negative environmental impact. The foliar spray is regarded as a credible method to acquire a rapid response to fertilization of fruit trees, especially when soil conditions limit the uptake of elements by the root or during periods of rapid growth or reproductive growth stages. The 3 liquid ready-made nutrient formulations named Macarena, Plentigrow, Cytored were used @ 1.5 ml/l, 4ml/l, 4 ml/l respectively, the solely application of each were used and the combination of three were also used. These 3 nutrients consists of all macro and micro nutrients which are required for proper growth and development of plant. The nutrients were sprayed at 50% bloom and one month after first spray. The combined application of these three nutrients gives the best results in response to vegetative growth parameters of apple trees like annual increase in trunk girth, annual increase in TCSA, annual incremental tree height, annual incremental tree spread, annual extension growth and leaf area. Foliar application of nutrients carried out during the study program may, therefore be helpful for successful high density apple plantation. Some of the salient features of technology are as: Combined foliar application of both macro and micro nutrients can be useful tool for orchardists to overcome the problems associated with other methods of application. The foliar application method has overcome the antigonastic effects of nutrients occurring due to soil application. The nutrients get readily available to plant within short period of time due to direct application at the target site. By foliar application of nutrients, the vegetative characters improved due to which the maximum amount of assimilated are formed and the yield and quality parameters of apple trees improved due to maximum translocation of assimilated from source to sink.

GIRISDA/AB/055/2022

PERFORMANCE OF MACRO PROPAGATED PLANTS OVER SUCKERS OF BANANA

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India is the largest producer of banana in the world. For the cultivation of banana, there are enormous requirement banana plants. Presently, tissue culture plants and suckers two most important methods of propagation of banana plants in India. After that, macro-propagation remains as the next best alternative with tremendous potential for production of quality planting material. This is the simplest method of plant propagation because of ease to multiplicate choice of varieties and it also save the cost of planting material. The macro-propagation techniques involved decortications, decapitation and hardening which is likely to produce 20-22 shoots/suckers. An experiment was laid down at FRS, NAU, Gandevi under ICAR-AICRP on Fruits comprising two methods of propagation in two varieties of banana. The trial was laid down in Randomized Block Design (RBD) with 5 replications and 12 plants treatment/replication and 1.8 X 1.8 m spacing. Treatments were macro-propagated plants and suckers of banana with varieties Grand Naine and Robusta during 2017-18.

The significantly higher pseudostem girth (72.01 cm), number of leaves/plant (19.72) and leaf area (1.26 m2), bunch weight (27.60 kg), yield (85.16 t/ha), bunch length (93.71cm), number of hands per bunch (11.43), number of fingers per bunch (212.1) were recorded in macro-propagated plants of cv. Robusta. Same trend was observed in macro-propagated plants of cv. Grand Naine as compared to suckers. However, maximum finger length (21.72 cm) as well as finger girth (12.56 and 12.20 cm) cv. Robusta suckers. The minimum days taken to shooting (271.6 days) as well as minimum days to harvesting (380.3 days) were recorded in macro-propagated plants of cv. Grand Naine. In relevant to quality parameters, maximum shelf life (8.09 days) and minimum weight loss due to ripening (13.46 %) in suckers of cv. Grand Naine. While, highest TSS (20.60^0 B) was recorded with macro propagated plants cv. Grand Naine. The BC ratio was found higher in macro-propagated plants cv. Robusta (3.27), followed by Grand Naine (2.75) over sucker‟s plant of both the varieties.

GIRISDA/AB/056/2022

BIOMASS PRODUCTION OF THREE LEGUME WEEDS AND ITS GREEN MANURING EFFECT ON THE YIELD OF TOMATO (*Lycopersicon esculentum* MILL.)

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Green manuring is the process of turning the green plants into the soil when in green stage before flowering and are incorporated into the soil. A green manure crop is primarily used for soil amendment and as a source of nutrient for the subsequent crops. The objective of the study was to estimate the biomass production of three legume weeds (*Crotolaria micans* (Link) Hassk, *Aeschynomene indica* L. and *Calopogonium mucunoides* Desv.) and its green manuring effect on the yield of tomato (*Lycopersicon esculentum* Mill.). The study was conducted under field conditions in Horticulture Research farm of Mizoram University, Aizawl following Complete Randomized Block design (RCBD) with four treatments viz., *Crotolaria micans* (T1)*; Aeschynomene indica* (T2)*; Calopogonium mucunoides* (T3); control: without green manure (T4) and each treatment was replicated five times. Initially, the legume plants were grown and harvested before its flowering stage to (90 DAS) estimate their biomass and were used as green manure by incorporating into the soil where its effect on tomato growth were determined. The study reveals that *Crotolaria micans* has higher aboveground biomass production (85229.23 kg/ha) followed by *C. mucunoides* (38624.34 kg/ha) and *A. indica* (24267.97 kg/ha). Also, it shows that the yield of tomato was significantly higher when compared to control. Green manuring with *Crotolaria micans* resulted in maximum yield.

GIRISDA/AB/057/2022

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH, YIELD AND QUALITY OF GARDEN PEA (*Pisumsativum var. hortense*) UNDER GIRD AGRO-CLIMATIC ZONE OF MADHYA PRADESH

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The field experiment was conducted at Research Farm, College of Agriculture, Gwalior (M.P.) during rabi 2021-22, “Effect of Integrated nutrient management on growth, yield and quality of garden pea (*Pisumsativum* var. *hortense*) under gird agro-climatic zone of Madhya Pradesh.”The experiment was laid out in randomized block design with ten treatments of inorganic fertilizers (NPK20:60:40 kg/ha) and integration with organic sources combinations (FYM 2.5

t/ha) were tested against the control. Application of 75% recommended fertilizer dose + FYM through chemical fertilizers produced significantly highest green pod yield ,Number of seeds/pod, number of pods/ plant and other yield attributing characters significantly more with 75% recommended fertilizer dose + FYM. Maximum grain yield with 75% RDF along with FYM (26.74 q/ha) and remained at par with 75% recommended fertilizer dose + Rhizobium + PSB (25.08 q/ha). 75% recommended fertilizer dose + FYM through chemical fertilizers proved to be the best treatments for enhancing productivity and profitability of garden pea under gird agro-climatic zone of Madhya Pradesh. Therefore, FYM combined with a 75 percent recommended fertilizer dose of chemical fertilizers may serve as an alternative to NPK inorganic fertilizers without the risk of pollution, and it may also be recommended to take advantage of the garden pea's superior eco-friendly economic pod yield.

GIRISDA/AB/058/2022

CONTACT TOXICITY OF INSECTICIDES AGAINST INDIAN POPULATION OF SAW TOOTHED GRAIN BEETLE, *Oryzaephilus surinamensis*

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Saw-toothed grain beetle, *Oryzaephilus surinamensis* is a secondary pest in storage known to reduce nutritional content and germination percentage of stored grains. It is also known to cause allergies to humans and therefore effective management is required if infestation is detected in the stored commodity. In India organophosphorus (OP) insecticides Malathion and synthetic pyrethroid deltamethrin is being used as contact insecticides since decades. The alternative insecticides need to be identified so that overuse of these insecticides can be avoided. In present study the contact toxicity of insecticides like spinosad, spinetoram, lambda-cyhalothrin, and chlorfenapyr were evaluated against adult and larval stage of *O. surinamensis* using glass as exposure surface. Based on lethal concentrations obtained, it was revealed that Chlorfenapyr 10SC was most toxic to the adult stage (LC_{50}= 3.67, 0.42 and 0.13 ppm respectively for 24, 48, and 72 h exposure) whereas lambda-cyhalothrin 5EC was proved to be effective against larval stages (LC_{50} = 7.23, 4.07 and 1.24ppm respectively for 24, 48 and 72 h exposure). The comparative susceptibility of different stages have also been recorded. The insecticides like chlorfenapyr and lambda-cyhalothrin are found to be promising alternative insecticides and further studies need to be done using different surfaces to ascertain their efficacy.

GIRISDA/AB/059/2022

IMPLICATIONS OF CLIMATE CHANGE ON INDIA'S FOREST ECOSYSTEM

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India is a mega-diversity country, with forests covering nearly a quarter of the country's total land area. With its geography, culture and history, as well as its natural ecosystem's immense biological diversity, India has a distinct identity. Climate is one of the key regulators of worldwide vegetation patterns, influencing the distribution, structure, and ecology of forests. A scientific study conducted by the Indian Network for Climate Change Assessment (INCCA, 2010) indicated warming inclusively over the Indian sub-continent, which is linked to rising greenhouse gas (GHG) concentrations. According to the IPCC, when temperatures rise by 2-3°C over pre-industrial levels, around 20-30% of the world's vascular plants are expected to face an increasingly high danger of extinction. The upper Himalayas, the northern and central Western Ghats, and parts of central India are particularly vulnerable to the expected impacts of climate change. The northeastern forests, southern Western Ghats, and forested areas of eastern India, on the other side, are predicted to be the least vulnerable. Changes in plants' physiological responses, particularly early flowering, are widely recognized among key biological indicators of climate change. The actual impacts may be more as different species respond differently to the changing climate. Several indigenous species may undergo rapid demographic changes

and perhaps extinction. These repercussions are projected to have adverse socioeconomicimplications for forest-dependent people and the country's economy. In particular, forests provide livelihood and are especially important for a large number of forest-dependent communities for numerous goods and services. Hence, there is an urgent needto review our current understanding of the effects of climate change on the forest ecosystem and our capacity to project future impacts.

GIRISDA/AB/060/2022

ETHNOMEDICINAL UTILIZATION OF *Rauwolfia serpentina* (L.) BENTH. EX KURZ.

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Plants have evolved to produce a diverse range of secondary metabolites which have been utilized as a source of remedial agents. The various parts of *Rauwolfia serpentina*, i.e., barks, leaves, roots, and rhizomes are used in Ayurvedic medicines for centuries, for curing several diseases such as mental agitation, epilepsy, high pressure, anxiety, excitement, traumas, eight schizophrenic disorder, insomnia, and psychopathy. This plant is been used as an effective drug in the modern medical world. Due to the presence of alkaloids, carbohydrates, flavonoids, glycosides, phlobatannins, phenols, resins, saponins sterols, tannins, and terpenes it accustomed cure variety of diseases. The present review is focus on the use of *Rauwolfia serpentina* in the treatment of different ailments by the tribe communities or the aboriginals as an ethnomedicine.

GIRISDA/AB/061/2022

FECUNDITY PARAMETERS OF *Helicoverpa armiger* (HUBNER) (*LEPIDOPTERA: NOCTUIDAE*) ON CHICKPEA CROP UNDER ALTERNATING TEMPERATURE

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A Laboratory trial was conducted to evaluate the fecundity of *Helicoverpa armigera* in chickpea at laboratory of entomology, Shree Guru Gobind Singh Tricentenary University, Gurugram during 2020-21. The fecundity of females varied from 624.10±65.42 to 318.60±42.51 eggs per female at different alternating temperatures. The highest intrinsic rate of increase (rm) of *H. armigera* was reported at 30:10 ºC (0.0385) closely followed by 25:16 ºC (0.0455) and 25:13 ºC (0.0323). Low net reproductive rates (R_0) of 7.12 to 21.31 in different treatments indicated the unsuitability of chickpea genotype PBG 7 as host for *H. armigera*. Low larval survival of *H. armigera* from 9.00± 1.52 to 18.00±3.42 per cent suggested that chickpea genotype PBG 5 was an unsuitable host.

GIRISDA/AB/062/2022

INSECT PHEROMONES, THEIR ROLE IN COMMUNICATION AND PEST MANAGEMENT

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The world of insects is filled with a variety of odours. These odours are used by insects to guide them through a range of complicated social actions such as courtship, mating, and egg laying. Insect olfaction mechanism is an important part of chemical communication between various insect species. The olfactory system ability to distinguish between different odours is solely dependent on the molecules evolutionary pressures, which encourage the development of unique binding proteins (BPs) and specific receptor sites on individual chemosensory neurons (Yew and Chung, 2015). Specialized chemosensory neurons situated in hair-like sensilla on the surface of body appendages detect pertinent intraspecific signals. Pheromones are species-specific chemical signals that allow life-forms of the same species to communicate with one another. It has an impact on survival, reproduction, and social structure. Characterizing their shapes, roles and biosynthesis leads to the creation of agricultural pest management techniques (Fleischer and Krieger, 2018). In integrated pest management (IPM) tactics, pheromones are being used as an alternative to insecticides. The most effective approach is sex pheromone and its production in females is regulated by the peptide hormone (Jurenka and Rafaeli, 2011). Pheromones are promising and can be used alone or in combination with other management tactics in agricultural systems to monitor and control insect pests. Lower costs, specificity, ease of use, and high sensitivity are all advantages of utilising pheromones to monitor insect infestations (Roge, 2021). As a result, they can be used as monitoring or management tools in IPM programmes while remaining sustainable and environmentally safe.

GIRISDA/AB/063/2022

IN VITRO MANAGEMENT OF DOMINANT SEED MYCOFLORA OF CHILLI USING BIOAGENTS AND FUNGICIDES AS SEED TREATMENT

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Chilli is an important spice crop grown in India having commercial and therapeutic value. Seed-borne pathogens of chilli reduce quality, quantity and longevity of seeds and transmit various diseases. *In vitro* study was carried out on efficacy of seed treatment on chilli (var. GVC 101, GVC 111) by bioagents and fungicides. Their effect on seed germination and seedling vigour was studied by paper towel method. Seeds pretreated with respective dominant fungi (*A. niger*, *Colletotrichum* sp. and *Fusarium* sp.) followed by treatment with bioagents revealed that treatment with P. fluorescens + B. subtilis @6g+6g/kg seeds and T. harzianum + P. fluorescens @5g+6g/kg seeds proved very effective with higher seed germination and vigour index in seeds pretreated with *A. niger* in varieties GVC 101 and GVC 111. Similar results were obtained in seeds pretreated with *Colletotrichum* sp. and *Fusarium* sp. in both varieties. Seeds pretreated with respective dominant fungi followed by treatment with fungicides revealed that treatment with captan @3.5g/kg seeds and carbendazim + mancozeb @2.5g/kg seeds proved very effective with better seed germination and vigour index in seeds pretreated with *A. niger* in both chilli varieties. Whereas, mancozeb@3g/kg seeds and metalaxyl + mancozeb @3.5g/kg seeds proved very effective with better seed germination and vigour index in seeds pretreated with *Colletotrichum sp*. in both the varieties of chilli. Metalaxyl + mancozeb @3.5g/kg seeds and carbendazim@2g/kg seeds proved very effective with better seed germination and vigour index in seeds pretreated with *Fusarium sp.* in both the varieties of chilli.

GIRISDA/AB/064/2022

IMPACT OF INTEGRATED PEST MANAGEMENT PRACTICES ON FRUIT FLY AND FRUIT BORERS IN GUAVA CV. TAIWAN WHITE

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Among guava cultivars, Taiwan guava is the world's premier cultivar which can produce all year round. The nutritional content and yield of the guava is affected by more number of insect pests like mostly fruit fly and fruit borers. Due to the usage of vast chemicals, the insects are developing resistance against it and these chemicals sprayed are having an adverse effect on natural enemies and environment. So, here we implemented Integrated Pest Management practices which is free of toxic chemical spray against fruit fly and fruit borers and studied the impact of these practices against fruit fly and fruit borers. The experiment was conducted in established guava orchard of Dr. Y.S.R. Horticultural University, Andhra Pradesh during 2019-2020. The observations on fruit fly and fruit borers in Integrated Pest Management plot and control plot are taken on weekly intervals. The results shown the mean population of fruit fly (*Bactrocera dorsalis*) maggots was 5.79 ± 1.17 per fruit in Integrated Pest Management plot, whereas in the control plot it was 11.31 ± 4.14 per fruit. The maximum mean fruit infestation per cent was recorded in control plot with 35.5 ± 13.95 per cent which was 42.7 per cent higher than in Integrated Pest Management plot with 14.01 ± 2.09 per cent. Lowest number larvae of *Conogethes punctiferalis* (1.04 ± 0.30 larvae per tree) and *Deudorix isocrates* (1.07 + 0.38 larvae per tree) were recorded in IPM plot with whereas, significantly high number of fruit borer larvae was recorded in control plot.

GIRISDA/AB/065/2022

INFLUENCE OF PREVAILING WEATHER PARAMETERS ON POPULATION DYNAMICS OF *Clavigralla gibbosa*, POD BUG IN PIGEONPEA

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The present study was conducted at the Research Farm of Pulses Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar during *Kharif* 2019 to check the incidence of *Clavigralla gibbosa* on four genotypes of Pigeonpea *viz.*, UPAS 120, AL 1747, PAU 881 and Paras sown on (21st June, 2019: 25th SMW) and influence of prevailing weather parameters on insect-pest. The population of *Clavigralla gibbosa* was recorded on five randomly selected and tagged plants in each genotype. For recording the nymphal and adult population of *C. gibbosa*, the plants were shaken on the cloth sheet of 1x1 m, then number of pod bugs were counted quickly. The results showed the commencement of nymphal and adult population of pod bug, *C. gibbosa* from 36th SMW (2nd week of September) and remained active upto 48th SMW (1st week of December). On mean basis, nymph population of *C. gibbosa* ranged from 0.08 to 0.26 nymphs per plant during different SMW‟s. Overall, among all the four genotypes, PAU 881 showed more nymphal population (0.16 nymphs/plant) followed by AL 1747 (0.15 nymphs/plant), UPAS 120 (0.13 nymphs/plant) and Paras (0.08 nymphs/plant). Average data of *C. gibbosa* adults showed that population ranged from 0.20 (48th SMW) to 3.69 adults/plant (40th SMW) during different SMW‟s. The results of correlation of insects-pests with weather parameters revealed that nymphal population of *C. gibbosa* showed significant and negative correlation with maximum temperature (r= -0.63**), minimum temperature (r= -0.63**) and wind speed (r= - 0.52*). Relative humidity (Mor., Eve. & Avg.), sunshine hours exhibited negative and non- significant correlation with nymphal population. Similarly, adult population of *C. gibbosa* showed significant and negative correlation with RH (E) (r= -0.52*) and RH (Avg.) (r= -0.50*). However, correlation between sunshine hours and adult population of *C. gibbosa* was found positive and non-significant, whereas remaining abiotic factors *viz.*, temperature relative humidity (M), wind speed and rainfall showed non-significant and negative correlation.

GIRISDA/AB/066/2022

IMPACT OF ALUMINIUM TOLERANCE ON PROTEIN SYNTHESIS, CHLOROPHYLL CONTENT AND ALUMINIUM UPTAKE IN *Dolichos* BEAN SEEDLING

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Soil acidity coupled with aluminium (Al) toxicity is a limiting factor for crop production. Nutrient deficiency is major problem under acidic condition which effects growth and yield, drastically. The present investigation was carried out in pot containing soil to study the mechanism of aluminium tolerance in *Dolichos lablab*. Genotypes tolerant to Al (VRSEM-207) and the susceptible to Al (VRSEM-941) were taken. The seedlings were given varying level of aluminium treatments (0, 15, 30 and 45 mg/kg soil) and were uprooted at 28 days. From the present investigation it was revealed that increasing Al treatment significantly reduced biomass, chlorophyll content and protein content in sensitive genotype whereas there was little or no significant effect on the tolerant genotype. The tolerance in the genotype was due to up-regulation of protein synthesis, stable chlorophyll content and reduced aluminium uptake. Therefore chlorophyll stability index, protein content and Al uptake can be used for screening for aluminium tolerance in *dolichos* bean and other legumes.

GIRISDA/AB/067/2022

SSR BASED FINGERPRINTS AND DNA BARCODES FOR VARIETAL IDENTIFICATION IN MANGO HYBRIDS

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The importance of varietal identification has grown dramatically on a global scale, particularly in the context of plant variety protection. In present study, 100 hyper-variable simple sequence repeats (HMSSRs) markers were screened for polymorphism; 89 polymorphic markers utilized for fingerprinting of 24 promising mango hybrids bred at ICAR-IARI, New Delhi. A total of 1861 alleles were detected in these 89 polymorphic markers with an amplicon size ranging from 130 to 450bp. The average number of alleles observed was 2.60 per locus. The PIC value ranged from 0.04 (HMSSR1382) to 0.72 (HMSSR1289) with an average of 0.39. Gene diversity ranged from 0.30 to 0.62. The generated allelic variations of these polymorphic markers were translated into DNA barcode profiles by separating the allele size from each HMSSR locus. DNA fingerprinting of mango hybrids revealed that hyper-variable mango SSRs, *viz*., HMSSR965, HMSSR2048, HMSSR1382, HMSSR1218, HMSSR888, HMSSR1430 and HMSSR2040 amplified unique cultivar-specific alleles for mango genotypes namely, Mallika, Mallika, NH-17-1, Pusa Deepshikha, Pusa Peetamber, Pusa Peetamber and Pusa Peetamber respectively. Additionally, the validation of these distinct alleles was tried on a set of five tree replicates of the same genotypes that all yielded the identical amplicons. The DNA barcode can be deposited and used for clear identification of these hybrids and to address intellectual property rights related issues. This study identifies mango hybrids and is an important reference to test the authenticity and varietal purity of these hybrids in the future.

GIRISDA/AB/068/2022

ORGANIC FARMING FOR SAFE ENVIRONMENT

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Food quality and safety are the two important factors that have gained ever-increasing attention in general consumers. Conventionally grown foods have immense adverse health effects due to the presence of higher pesticide residue, more nitrate, heavy metals, hormones, antibiotic residue, and also genetically modified organisms. Moreover, conventionally grown foods are less nutritious and contain lesser amounts of protective antioxidants. In the quest for safer food, the demand for organically grown foods has increased during the last decades due to their probable health benefits and food safety concerns. Organic food production is defined as cultivation without the application of chemical fertilizers and synthetic pesticides or genetically modified organisms, growth hormones, and antibiotics. The popularity of organically grown foods is increasing day by day owing to their nutritional and health benefits. Organic farming also protects the environment and has a greater socio-economic impact on a nation. India is a country that is bestowed with indigenous skills and potentiality for growth in organic agriculture. Although India was far behind in the adoption of organic farming due to several reasons, presently it has achieved rapid growth in organic agriculture and now becomes one of the largest organic producers in the world. Therefore, organic farming has a great impact on the health of a nation like India by ensuring sustainable development.

GIRISDA/AB/069/2022

BLOCK WISE ESTIMATION OF MILK PRODUCTION AND SOCIO-ECONOMIC STATUS OF JAMMU DISTRICT THROUGH SMALL AREA ESTIMATION TECHNIQUE.

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The demand for small area statistics is growing day-by-day not only in public but also in private sectors, and small area estimation technique (SAE) is becoming very important in survey sampling due to the thrust of planning process has shifted from macro to micro level. Small Area Estimation technique has been applied for obtaining estimates of per day total milk production at block levels in the Jammu district of J&K state. For this purpose, stratified three stage random sampling plan was adopted with blocks constituting the strata, villages as the primary stage units, households possessing livestock as the secondary stage units and cows/buffaloes in milk in the selected households as the third stage units. A cross classified structure with blocks as „small areas and groups as cows and buffaloes was constituted. The block wise estimates of total milk production of cows and buffaloes per day were estimated through conventional estimators of this study. It has been observed that the average agricultural income of all 20 blocks of Jammu district and showed that the agricultural income of block Bishnah was maximum (Rs.26,95,000), whereas the block Khara Balli had the least (Rs.13,000), among all the twenty (20) blocks of district Jammu of Jammu and Kashmir State. Also, it was clear that the blocks Arnia and Khour were at par.

In case of milk production, it has been observed that the estimate of milk production estimated through composite estimator seems best based on mean square error and absolute relative bias criterion

In this paper we have empirically investigated the estimate of per day average milk production at block levels of district Jammu of J&K UT through direct and indirect methods of small area estimation using real milk data set for different small domains and the results so obtained are compared in terms of mean square error.

GIRISDA/AB/070/2022

EFFECT OF DIFFERENT DRYING METHODS ON PHYSICO-CHEMICAL ATTRIBUTES OF GUAVA FRUIT PULP POWDER

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Guava (*Psidium guajava L.)* is one of the most popular fruit in tropical and subtropical regions of India. It is popularly known as" Apple of tropics", belongs to the family Myrtaceae and often considered as "super fruit". It is rich in vitamin A and C, omega-3 and 6 polyunsaturated fatty acids and contains high levels of dietary fibre and other nutritional properties. Guava is a highly perishable fruit crop and has a very limited shelf life, so there is a need to preserve the fruits in dried form, whose powder can be used for processing purposes, value addition in off season demands. Therefore, we conducted an experiment to study the Effect of different drying methods on Physico-Chemical attributes of guava fruit Pulp Powder. Fruits of guava pulp were used to prepare powder by different drying methods like Freeze drying, Sun drying, Air drying and Oven drying. Results showed that bulk density and moisture percent was highest in sun drying followed by Air drying, however lowest was reported with Freeze drying. Maximum nutritional value like total sugar, reducing and non-reducing sugar, protein, ascorbic acid, titratable acidity, and total phenol and DPPH radical scavenging activity was found with freeze drying followed by Air drying. Taste, flavour, aroma and overall acceptability were better in freeze drying followed by Air drying.

GIRISDA/AB/071/2022

AN OVERVIEW ON MANAGEMENT OF ROOT KNOT NEMATODE BY ENVIRONMENTALLY BENIGN TREATMENTS

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Root-knot nematodes (RKNs), *Meloidogyne* sp., are sedentary endoparasites that negatively affect almost every crop in the world. Current management practices are not enough to completely control RKN. Application of certain chemicals is also being further limited in recent years. It is therefore crucial to develop additional control strategies through the application of environmentally benign methods (Zukerman and Esnard, 1994). Application of nematode antagonistic microorganisms could provide another option for nematode damage management. Antagonistic bacteria, nematophagous fungi, and yeasts have all been tested as biocontrol agents against nematodes (Kiewnick and Sikora, 2005; Muwaffah, 2013). There has been much research performed around the world on the topic, leading to useful outcomes and interesting findings capable of improving farmers‟ income. It is important to have dependable resources gathering the data produced to facilitate future research. Therefore, environmentally benign treatments included beneficial microorganisms, soil amendments and other emerging strategies were used to control RKN.

GIRISDA/AB/072/2022

EFFECT OF DIFFERENT DRYING METHODS ON PHYSICO-BIOCHEMICAL ASPECTS OF AONLA FRUIT PULP POWDER

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Aonla (*Emblica officinalis* Geartn.) possess significant nutraceutical properties and to utilize Aonla for various value additions, its fruit powder is one of the best option for several preparations. As there are different drying methods for preparation of fruit pulp powder, it is needed to find out the most suitable method for drying which can efficiently retain nutritional and organoleptic properties of Aonla Fruit pulp powder. Thus, we conducted an experiment to study the effect of drying methods *viz.*, Sun Drying, Oven Drying, Air Drying and Freeze Drying on Physico-Biochemical properties of Aonla fruit pulp powder. The findings shows that moisture percent and bulk density was maximum in Sun drying method followed by Air drying while minimum was with Freeze drying followed by Oven Drying. Protein percent, Total Sugar, Reducing & Non-Reducing Sugar, Titratable Acidity, Ascorbic acid, Total Phenols and DPPH Radical Scavenging Activity was found maximum with Freeze Drying followed by Air drying. Taste, flavour, Aroma and Overall Acceptability was reported best with freeze drying followed by air drying.

GIRISDA/AB/073/2022

THE EFFECT OF INTERCROPS IN SKIP ROW PLANTING ON GROWTH AND SOIL NUTRIENT PARAMETERS OF DESHI COTTON GUGULOTHU

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A field experiment was conducted at Agronomy Farm, College of Agriculture, Dhule (Maharashtra) during kharif season of 2018-19 to assess the effect of intercrops in skip row planting on development of the deshi cotton. The experiment was laid out in randomized block design with seven treatments viz., T1: Sole cotton, T2: Sole skip row planting of cotton, T3: Skip row planting of cotton + intercropping of green gram (2:1), T4: Skip row planting of cotton + intercropping of black gram (2:1), T5: Skip row planting of cotton + intercropping of soybean (2:1), T6: Skip row planting of cotton + intercropping of sesamum (2:1) and T7: Skip row planting of cotton + intercropping of pearl millet (2:1). The results revealed that maximum plant height, leaf area plant-1, dry matter accumulation was recorded in skip row planting of cotton + intercropping of pearl millet (2:1) and significantly superior to skip row planting of cotton + soybean (2:1) and skip row planting of cotton + pearl millet (2:1) and it was on par with the rest of the treatments. Skip row planting of cotton + black gram (2:1) recorded significantly the highest number of sympodial branches statistically at par with T6: Skip row planting of cotton + intercropping of sesamum (2:1) than skip row planting of cotton + pearl millet (2:1). It is might be due to availability of optimum space to utilize the soil and environmental resources to the maximum extent due to less competition among crop plants. However, adverse effect of pearl millet may be due to its dominance and hybrid nature. Among soil nutrient studies, available soil nitrogen, phosphorus and potassium content were significantly higher in skip row planting of cotton + black gram (2:1) (170.18 kg ha-1) and skip row planting of cotton + soybean (2:1) (169.03 kg ha-1) were at par with each other. Minimum observed in the skip row planting of cotton + pearl millet (2:1).

GIRISDA/AB/074/2022

LIMIT OF DETECTION (LOD) AND LIMIT OF QUANTIFICATION (LOQ) OF DIFFERENT INSECTICIDES RESIDUE IN KINNOW JUICE AND PEEL

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A Laboratory trial was conducted to evaluate the LOD and LOQ of organophosphate and neonicotinoid insecticides in Kinnow at Agrochemicals Residues Testing Laboratory, Department of Agronomy, CCS Haryana Agricultural University, Hisar during August-October 2016-17 and 2017-18. The residues of malathion, imidacloprid and thiamethoxam were determined by comparing peak area of the reference standard with those of unknown or spike sample run under identical working conditions of the Gas chromatograph-mass spectrometry (GC-MS/MS) and high performnce liquid chromatography (HPLC-PDA). The limit of detection (LOD) and limit of quantification (LOQ) for Malathion in juice and peel was observed to be 0.001 and 0.005 ppm. In case of imidacloprid and thiamethoxam the LOD and LOQ in Kinnow juice and peel were 0.01 and 0.05 ppm. The fruits were picked up at zero, one, three, five, seven, ten, fifteen and thirty days after spray.

GIRISDA/AB/075/2022

PRODUCTION OF CLEAN-GREEN HYDROGEN FUEL FROM BIOTIC COMPONENTS

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With increasing the world‟s energy demand and climatic changes, the world is now looking for new energy sources. Production of biological hydrogen (H2) from biotic components such as microorganisms will fulfill the demand for the world's energy source without harming our environment. Biological hydrogen is highly combustible, renewable, sustainable, and will avoid environmental pollution and this will help in the development of decarbonization. There are different methods of producing biological hydrogen such as a) fermentation: dark and photofermentation, b) bio-photolysis: direct and indirect photolysis and c) bio-electrochemical system using a microbial electrolytic cell. Dark fermentation is a process in which microorganisms (Clostridium) enable H2 production in a dark anaerobic and photo-fermentation occurs in presence of sunlight using purple non-sulfur bacteria. Bio-photolysis is the process in which H2 production is done in presence of sunlight, water, and oxygen. With direct photolysis, microalgae evolve H2 gas through hydrogenase activity. However, in indirect photolysis which is a two-step process: the first step, using light energy O2 and carbohydrate (Cyanobacteria) are produced and the second step involves the conversion of carbohydrate to CO2 and H2 with light energy under an anaerobic condition with less O2 with higher hydrogen rate than other processes. In a bioelectrochemical system, by using microbial electrolytic cells H2 production is done. Thus, these above processes will help to produce sustainable biohydrogen in large quantities. Hydrogen plays important role in power plants, steel industries, the biotechnology sector, the space industry, the aerospace sector, aviation fuel, the automotive industry, the semiconductor production, the medical, the pharmaceutical sector, and the agricultural sector. Overall, in the future, green hydrogen will be a game-changer energy source for the entire world.

GIRISDA/AB/076/2022

SOCIAL DEMOGRAPHY OF MAIZE GROWERS IN RAJOURI DISTRICT OF JK-UT

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A study was conducted in Rajouri district of JK- UT where two blocks were selected by the random sampling technique and subsequently, two villages were selected from each block using random sampling technique. Thus, the total number of eighty respondents were studied. Maize is widely cultivated in Jammu region of the state with an area of 190.160 thousand ha. and having a production of 436.523 thousand MT. (Directorate of Agriculture, 2018). The Rajouri district of Jammu & Kashmir state is situated between 320^0 98‟ and 350^0 52‟ North latitude and 740^0 01‟ to 740^0 23‟ East longitude. Maize is the predominant crop in Rajouri district with an area of 46.8 thousand hectare and production of 137.275 thousand MT and productivity of 31.36 kg/ha respectively (Directorate of Agriculture, 2018). The study revealed that 36.76 per cent of maize growers were between the age group of 25-35 years followed by 24.40 per cent between the age group of 35-45 and a very least percent of growers were of the age group above 50 years. Education is an important determinant of the socio-economic condition of the farm family, particularly the education of the head of the family. The highest proportion that is 25.52 per cent of the sample farmers had passed middle education qualification followed by 24.52 percent of matric education qualification, 21.56 per cent of primary qualification, 17.02 per cent were having senior secondary qualification whereas 06.11 per cent were illiterate.

GIRISDA/AB/077/2022

BIO-EFFICACY OF CERTAIN NEWER INSECTICIDES AGAINST WHITEFLY (*Bemesia tabaci*) OF MUNG BEAN [*Vigna radiata* (L.) Wilczek.]

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A field study was conducted at Agricultural Research Farm, Banaras Hindu University, Varanasi (U.P.), during *Kharif*, 2018 for the evaluation of bio efficacy of certain newer insecticides against whitefly (*Bemesia tabaci*) of mung bean, *Vigna radiata* (L.) Wilczek. The results indicated that Diafenthiuron @ 312.50 g a.i./ha was found to be most effective treatment for the control of whitefly population in the field followed by Flonicamid @ 75.0 g a.i./ha. The highest yield was recorded from plots sprayed with Diafenthiuron @ 312.0 g a.i./ha (10.11 q/ha) followed by Flonicamid @ 75.0 g a.i./ha (9.10 q/ha). All other treatments were found to be effective over the control plot by reducing the population of whitefly in field.

GIRISDA/AB/078/2022

STUDIES ON FERTIGATION LEVEL ON QUALITY OF STRAWBERRY UNDER MID-HILL CONDITIONS OF HIMACHAL PRADESH

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An experiment was conducted at the Experimental Research Farm Chhapang, DKSGACA, Eternal University Barusahib to monitor the effect of fertigation levels on quality character of strawberry (cv. Camarosa, Chandler and Winter dawn) under naturally ventilated Polyhouse conditions during the year 2021-22. The experiment was layout in randomized block design with three replications. The healthy runners of strawberry cultivars Camarosa, Chandler and Winter Dawn about one year old plants were planted.The variability among different cultivars was evaluated for bio-chemical characters and it was concluded that cv. Winter dawn resulted in maximum TSS (˚B), Juice content (%), Total sugar (%), Reducing and non-reducing sugars (%),Ascorbic acid(mg/100g), antioxidants, anthocyanin (mg/100g) and phenolic content whereas maximum titratable acidity was recorded in cv. Chandler among different fertigation levels maximum total antioxidant, TSS (˚B), Juice content (%) Total sugar (%), Reducing and non-reducing sugar, anthocyanin content, ascorbic acid percent phenolic content of strawberry was obtained with 100% NPK and maximum titratable acidity percent of strawberry obtained in case of control. Among different interaction winter dawn + 100% NPK shows maximum TSS (˚B), Juice content (%), Total sugar (%), Reducing and non-reducing sugars (%), Ascorbic acid (mg/100g), antioxidants, anthocyanin (mg/100g) and phenolic content and maximum titrable acidity in chandler + control.

GIRISDA/AB/079/2022

D^2 ANALYSIS IN FORAGE SORGHUM (*Sorghum bicolor* L. Moench)

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Sorghum (*Sorghum bicolor* L. Moench) is "camel" among crops and it is the fifth most important cereal crop in the world after maize, wheat, rice, and barley having use as food, feed, fodder and fuel. It belongs to family *Poaceae*, often-cross pollinated crop, diploid (2n=2x= 20) and C_4 plant having high photosynthetic efficiency. Genetic diversity is a necessary part of a successful hybrid breeding programme. One of the reasons why the hybrids programme hasn't had much success is that there hasn't been a systematic assessment of genetic variation in parents before incorporating into a hybrid combination. In the present experiment, 37 genotypes of Sorghum [*Sorghum bicolor* (L.) Moench] were evaluated in a Randomized Block Design with three replications at SVBPUA&T, Meerut, Uttar Pradesh. The objective of present study was to measure the genetic divergence for yield and yield related components by using Mahalanobis D^2 method. The observations were recorded for 10 different traits and results revealed that six different clusters were obtained. The cluster I was largest and contained the maximum number of genotypes *i.e.*, 14 followed by cluster V (8), cluster III (6), cluster VI (5) and cluster II (3) while the cluster IV have only one genotype. The maximum intra cluster distance was obtained for cluster I (2.38) and highest inter cluster distance was recorded between cluster II and IV (5.81). The higher inter cluster distance as compared to intra cluster distance suggested the presence of sufficient amount of genetic divergence among genotypes under studied. Maximum inter-cluster distance was obtained between cluster II and IV, which indicated that the genotypes belonging to these clusters could be used as parental material under a hybridization programme for getting desirable/transgressive segregants. The trait green fodder yield per plant showed highest contribution to divergence followed by leaf length, leaves per plant, plant height, leaf breadth, stem girth, TSS, leaf stem ratio and leaf area. Lower contribution was made by days to 50% flowering towards the genetic divergence.

GIRISDA/AB/080/2022

MANAGEMENT OF ZINC DEFICIENT SOILS OF UTTARAKHAND FOR IMPROVED CROP PRODUCTION

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Zinc is an essential micronutrient for the normal healthy growth and reproduction of plants. Plants absorb Zn as zinc ions (Zn^{+2}). Zinc sufficient plant contains 27 to 150 ppm Zn in mature tissues. Zinc plays a key role as a structural constituent or regulatory co-factor of a wide range of different enzymes and proteins in many important biochemical pathways. When the supply of zinc to the plant is inadequate many important physiological functions of zinc are unable to operate normally and plant growth is adversely affected. The changes in plant physiological mechanisms brought about by a deficiency of zinc can result in the plant developing visible symptoms of stress which might include one or more of the following: stunting, interveinal chlorosis, bronzing of chlorotic leaves, small and abnormally shaped leaves and/or stunting and rosetting of leaves.

Due to low in soil reaction, optimum soil organic carbon status and favorable climatic condition, Zn deficiency in soils of Uttarakhand is much less than the national average. However, introduction of intensive cultivation, high yielding crop varieties and high dose of primary fertilizers application made it potential to become Zn deficient in wide scale. Among various inorganic sources, zinc sulphate heptahydrate is the most efficient, commonly available and cheapest zinc source for correcting Zn deficiency either through soil or foliar application in most of the crops and diverse soils as compared to sparingly soluble Zn sources, chelates and mixtures (Singh, 2004). Modern concept of micronutrient management in soil is to grow such varieties of crop which have the ability to extract the required micronutrients from insoluble sources (Deb *et al*., 2009). As regards the management for improving crop production certain practices need to be undertaken viz. choice of varieties, soil types and properties, optimization of rates, sources and methods of application, nutrient interactions, behavior in cropping systems and proper distribution of Zn fertilizers in the targeted area.

GIRISDA/AB/081/2022

DIVERSIFICATION OF RICE (*Oryza sativa* L.)-BASED CROPPING SYSTEMS FOR WATER USE EFFICIENCY IN KYMORE PLATEAU AND SATPURA HILLS ZONE OF MADHYA PRADESH

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The continuous growing of rice has led to a deterioration in soil quality, resulting in a serious threat to agricultural sustainability in the high rainfall zone of Kymore plateau and Satpura hills of Madhya Pradesh. Therefore, crop diversification with a wider choice in the production of crop varieties is being promoted to restore the soil quality. A field experiment was conducted in AICRP on IFS JNKVV, Jabalpur during 2011 to 2013 on a Vertisol to evaluate the productivity, sustainability, resource-use efficiency and economics of 12 rice-based cropping systems. The results showed that the water use efficiency ranged from 37.9 to 49.2 kg cm ha^{-1} with an average of 46.4 kg cm ha^{-1}. The highest water use efficiency was recorded for rice-chickpea (T2; 49.2 kg cm ha^{-1}) followed by rice-wheat (T1; 49.0 kg cm ha^{-1}) in kharif season. The water use efficiency of different cropping systems based upon rice cropin rabi season ranged from 34.3 to 205.1 kg cm ha^{-1}. The average water use efficiency of different cropping systems based upon rice

crop108.2 kg cm ha^{-1} was observed. The highest water use efficiency was recorded for rice-gobhi sarson-sorghum (T9; 205.1 kg cm ha^{-1}) followed by rice- gobhi sarson- okra (T10; 156.5 kg cm ha^{-1}) in rabi season. The water use efficiency in summer season ranged from 16.4 to 165.1 kg cm ha^{-1} with an average of 69.9 kg cm ha^{-1}. The highest water use efficiency in summer season was recorded for rice-gobhi sarson-black gram (T6) followed by rice- gobhi sarson-okra (T10; 164.7 kg cmha^{-1}). The total water use efficiency in all seasons ranged from 74.4 to 369.6 kg cm ha^{-1} with an average of 207.4 kg cm ha^{-1}. The highest water use efficiency was recorded for rice- gobhi sarson-okra (T10) sequence.

GIRISDA/AB/082/2022

TOOLS AND PRACTICES FOLLOWED UNDER ORGANIC CULTIVATION

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International Federation of Organic Agriculture Movements (IFOAM) defined Organic farming defined "Organic farming as a production system that sustain the health of soils, ecosystems and people. A good organic farm is a mimic the diversity of nature through: Intercropping and companion crops, Establishment of beneficial habitat, Crop rotation, Better chance for supporting beneficial macro and micro-organisms, Encourage the diversity among the enterprises and Various enterprises like crop husbandry, dairy, poultry, fishery, piggery, sericulture, culture of mushroom etc. these enterprises will helps in achieving sustainability in productivity while minimizing the risk involved in conventional cropping system where crop failure due to natural calamities. The crop rotation should be remunerative and sustainable. The networking project on organic farming of ICAR have identified the suitable cropping systems. Soybean- Berseem / Mustard / Chickpea, Rice-Wheat / Potato / Mustard / Lentil and Soybean-Durum Wheat / Mustard / Chickpea. The inclusion of legumes has been found beneficial in almost all cropping systems. In the rice wheat cropping system rice and wheat cropping system rice and wheat straw particularly in the rice straw has become surplus and is mostly burned into the field. The burning of residues disturbed the biological activities in the soil, thus in the long run crop residues has to be incorporated in the soil, it will help to improve the soil fertility and gave sustain production. Soil and water conservation practices reduce the losses of plant nutrients caused by runoff and leaching. Water harvesting techniques and development of irrigation leads to the efficiency of nutrients and water use. Protection of soil against erosion through the soil and water conservation means to enhance and restore soil fertility and productivity of organic system. Conservation tillage is beneficial for conserving or adding organic matter reduces the soil erosion and compactness. Weeds are alternate hosts plants for different insect‟s pests and diseases. Hence it is very essential to manage the weeds under such production systems. Cultural methods like tillage combined with appropriate application of irrigation water, seeding dates, use of weed free seeds, selection of cultivars, cropping systems, mulching, hoeing, weeding, flooding, may be adopted to manage the weeds, manipulation of planting geometry.

GIRISDA/AB/083/2022

ASSESSING AGRICULTURE STUDENTS' ENTREPRENEURIAL BEHAVIOR FOR A SUSTAINABLE AND SELF-RELIANT INDIA

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The first of FAO's five key food and agriculture sustainability principles is to boost productivity, employment, and value addition in food systems. In recent years, India is working hard to develop sustainable agriculture that meets the country's needs holistically while also considering future generations. Because of its demographic advantage, India has a great opportunity to shape the world's perspective on building a sustainable future. India is home to one-fifth of the world's youth (366 million). Because it has a large pool of ambitious and highly educated young people, India has an advantage in a disproportionately high number of start-ups and independent firms encouraging homegrown talent. Nonetheless, Indian youth appear to be taking a different path. According to a 2015 survey by counterview.org, 62 per cent of young people would prefer to leave farming for a good job in the city. To assess this scenario more closely, a study was undertaken to examine entrepreneurial behaviour among students and explore the challenges they face. Students from Anand Agricultural University make up the statistical population of this study. The main data collection tool was a questionnaire that was validated by an expert's opinion. According to research, the most desired job is that of a government agricultural officer (3.237), followed by that of a large agriculture firm (2.829). The third option for students is to start their own agribusiness (2.733). Further, the students were asked to discuss the challenges they face when starting a business. Among the students, 59.00 per cent believe they lack sufficient entrepreneurship knowledge, 56.70 per cent lack market information, and 53.00 per cent see risk and uncertainty as significant barriers. The findings will aid practitioners, researchers, planners, policymakers, and academicians in making the necessary changes to encourage youth to pursue entrepreneurship.

GIRISDA/AB/084/2022

GRAIN YIELD OF FINGERMILLET AS INFLUENCED BY STAGGERED SOWINGS AND VARIETIES

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Millets are known for their climate-resilient features including adaptation to a wide range of ecological conditions, less irrigational requirements, better growth and productivity in low nutrient input conditions, less reliance on synthetic fertilizers, and minimum vulnerability to environmental stresses. Among different millet crops, finger millet has a high amount of calcium (0.38%), fibre (18%), phenolic compounds (0.3–3.0 %), and sulphur containing amino acids. The combined potential of millets as both resilient crops for resource constrained farmers and as a nutritious food stuff for growing populations, is now considered as a nutritious cereal in the world of escalating malnourished population and it can play a major role in nutritional security. In fingermillet crop, during *rabi* season observed the duration of vegetative stage was reduced and early panicle initiation and flowering from past three to four years due to temperature variations. Hence the experiment was conducted during the year 2021-2022 rabi season at Agricultural Research Station, Perumallapalle to study the time of sowing in relation to climatic change and its influence on the grain yield of fingermillet varieties. The experiment was laid out in s split plot design with treatments of main plots were dates of sowing i.e., October 15th, November 15th, and December 15th sub plots were viz., fingermillet varieties of Vakula, Tirumala and Srichiatanya,in three replications. Agronomic practices like weeding, fertilizer application and irrigation were taken up as per recommendation. The experiment results revealed the grain yield of fingermillet was singnificantly influenced by the dates of sowing and varieties with significant

interaction. Among three dates of sowing, October 15th date of sowing recorded higher grain yield with irrespective of varieties and sowing of fingermillet during November 15th resulted in highest grain yield, straw yield with Tirumala variety. This may be due to favourable weather conditions like light intensity, growing degree days, relative humidity and moisture availability for proper crop growth and yield.

GIRISDA/AB/085/2022

INNOVATIVE TECHNOLOGY FOR CROP IMPROVEMENT, BIOTECHNOLOGY AND GENETIC ENGINEERING

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Agricultural crops have been subjected to a dramatic alteration since the introduction of their initial original wild counterparts to the human race. The inception of this transformation seeds back to the exercising of domestication of plants by humans. Through the course of domestication, people started selectively picking and growing the improved varieties, without an appreciation for the underlying genetic basis. The discovery of gene and inheritance mechanisms, by George Mendel, brought a phenomenal advancement to the selective breeding and instigated the notion of selective cross breeding. The classical breeders, which worked with induced mutagenesis, had also played significant part in generating, and subsequently selecting & propagating improved crop varieties. However, the selection of desirable traits in crops through the traditional breeding programmes were quite labour-intensive and time-consuming, and proved to be incompetent in conserving many beneficial traits along the course of development of new varieties. These shortcomings, however, were exceptionally abolished with the intersection of genetic engineering, and biotechnology, which, in turn, have remarkably revolutionizing the crop improvement programmes. The advent of genetic engineering and biotechnology has equipped crop breeders to not only transfer desirable genes (traits) with an amazing precision but also to efficiently track transgene (s) in an extremely economical manner in terms of the involved labour and time. Nonetheless, the astonishing values/advantages linked to the applications of biotechnology and genetic engineering in the crop improvement programmes substantially dwarfs the associated risks and in future, the aforementioned risks might even get further ameliorated to a promising extent with advent of new developments in these technologies. Concisely, this article attempts to present a comprehensive review on the key milestones in the development of crop improvement programmes with a sense of appreciation to the underlying role of biotechnology and genetic engineering through this progression.

GIRISDA/AB/086/2022

BIOCHEMICAL ANALYSIS OF INDIAN MUSTARD (*Brassica juncea* L.) GENOTYPE (s) AGAINST FUNGAL DISEASES

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Indian mustard (*Brassica juncea* L. Czern. & Coss) is the most pre-dominating crop of oilseed Brassica group, which is a natural amphidiploid (2n = 36, AABB genome), self- pollinated with some extent of cross-pollination and with a physical genome size of 920 Mb. Fungal Diseases in Indian mustard is emerging as major problem in India. Mustard cultivation in India is number third in the production of mustard farming. The world's top importer of edible oil is India owing to the low productivity of Indian *Brassica* genotypes, so development of improved high yielding cultivars is urgently needed. Being one of the chief oil seed, mustard are indeed very high in calories; 100gm of seeds provide

508 Kcalories. Seeds are made of quality protein (26.08%), essential oils (30%), vitamins, minerals & dietary fiber (12.2%). During present research, a field experiment was carried out at Research Farm and laboratory work at Plant Molecular Biology Laboratory, Biotechnology Center, RVSKVV, and Gwalior (M.P.). Experimental material consists of 75 genotypes with diverse reactions against different fungal diseases. Plants were evaluated for the incidence and severity of fungal diseases and yield loss due to fungal diseases. Biochemical parameters were estimated from infected and healthy mustard plants. The analysis of Chlorophyll, Total sugar, Amino acid, Phenol, Proline, Malondialdehyde (MDA) test (Lipid peroxidation Assay), Reducing & Non reducing Sugar and Protein. The genotypes have shown various significant reactions due to infestation of fungal diseases. In addition to this, molecular characterization of Indian mustard genotypes against different fungal diseases was also done employing gene-specific molecular markers. Fungal diseases resistant/tolerant genotype (s) can be employed for further crop improvement programme that can stand with fungal infestation and harsh climatic conditions.

GIRISDA/AB/087/2022

EVALUATION OF ORGANIC EXTRACTS AGAINST CABBAGE BORER, *Hellula undalis Fab*. ON CAULIFLOWER

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An experiment was conducted during *Rabi* 2020-21 at Parinche, Pune to study the efficacy of organic extracts viz; Triparni extract 10 %, PDKV organic formulation 10 % and PDKV botanical extract 10 % alongwith control at different incubation periods of 7, 15 and 30 days in FRBD design with twelve treatments replicated thrice to manage head borer, *Hellula undalis* Fab. on cauliflower. The bio-efficacy studies against the *H. undalis* indicated that among all organic extracts, 30 days incubated PDKV organic formulation was significantly more effective in recording minimum head borer damage i.e. 2.80, 2.80, 3.14 and 3.84 per cent at 3,7, 10 & 14 days after spraying. However this treatment was found at par with 30 days incubated PDKV botanical extract, 30 days incubated Triparni extract, 15 days incubated PDKV organic formulation and 15 days incubated PDKV botanical extract. Maximum head borer damage was noticed in the untreated control plots (i.e. 8.80%). The treatment of 30 days incubated PDKV organic formulation recorded highest cauliflower yield (22.06 t/ha) as against untreated control with 11.50 t/ha. The present findings indicates that the treatments of organic extracts with 30 and 15 days incubation period protected the cauliflower crop from pest damage with recording increased yields. Therefore, these could be incorporated in integrated pest management program of organically grown crops.

Keywords: Cauliflower, Incubation period, *Hellula undalis* , organic extracts

GIRISDA/AB/088/2022

AGRICULTURAL APPROACHES FOR REALIZING CLIMATE RESILIENT AGRICULTURE

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Climate change is expected to increase the frequency and intensity of extreme weather conditions. The global climate change and extreme weather events are causing greater monsoon variability, leading to disasters in form of sea level rise and new vulnerabilities with differential spatial and socio-economic impacts on communities. Agriculture in India will be under severe constraints as the productivity of crops is expected to decline in the days to come. This will put strain not only on national economy but also poses a formidable challenge to achieve food security at the national

level. With rising temperature, biotic and abiotic stresses are predicted to become more severe in terms of their scope and spectrum. This will adversely impact productivity and sustainability of production of agricultural crops. It also presents challenge to the food security and economy of the country as majority of Indian population is dependent upon agriculture for food and livelihood. To meet these emerging challenges of climate change, there is an urgent need to modify and improve various agricultural approaches for mitigation and adaptation in order to combat adverse impacts of climate change and climate variability on Indian agriculture. Contingent crop production management technology includes diversification, recycling and judicious use of integrated disease and pest management. Combining these with improved agricultural practices can be used to develop integrated packages for agriculture to ensure sustainable production under adverse impacts of climate change.

GIRISDA/AB/089/2022

CLIMATE CHANGE RESILIENT AGRICULTURE

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Today climate change has become a global issue affecting the agricultural produce so drastically that agricultural income estimated to be reduced by 15-25% worldwide. It is evident that India is witnessing an increase of 0.60°C increase in warming trend over 100 years. If the issue of climate change is not bring to notice it would become difficult to fulfill the demand of food to huge population along with other major issue of socio-economic imbalances. This is the high time to adopt climate resilient agriculture that includes sustainably management of natural resources from local to global level to conserve it for forth coming generation and to achieve long term productivity with maintaining economic status of the farmers. Climate resilient agriculture adopt strategies and technologies that enhances the food security to meet the demand of population and to reduce hunger and poverty across the globe. To promote climate resilient agriculture certain practices are necessary to cope with climate change such as improve soil health by building soil carbon increase water retention capacity, biotic and abiotic resistant crops, emphasis on technologies like rain water harvesting etc., if deployed prudently can improve agriculture productivity even under diverse climatic conditions.

GIRISDA/AB/090/2022

DOUBLING THE FARMERS INCOME THROUGH AGRICULTURAL PRODUCE

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In past, strategy for the upliftment of agriculture sector of India the main focus was on increasing agricultural output to meet the food shortage. Green revolution came in existence that acts as catalyst which multiplied the production by 3.7times. That not only made India self-sufficient in food, but the exporting country in food. Strategy passes to meet the food requirements but fails to raise the farmer‟s income. Farmer‟s income increased as output increased but not as per the rate at which output increased. Consequently, the farmer remains economically weaker even after the tremendous wave of green revolution. On 28th Feb 2016, Kisan Rally in Bareilly (UP) Prime Minister Narender Modi mentioned in his statement about his dream of doubling the farmer‟s income by 2022. In order to meet this objective, the annual growth rate of 10.41%is required. For doubling farmer‟s income, the input prices, labor and wages use should result in per unit cost saving then the income raise would be as higher as to the rate of output. Making a scope of increase in income within or outside the agriculture sector is need of ours. An innovative approach for doubling the farmer‟s income is use of better-quality seeds or planting material, growing high value crops, adopting organic farming, efficient use of resources (water, soil and nutrients), value addition or food processing, going for warehouse

and cold store facilities to minimize the post-harvest losses, resolving the stress of agricultural marketing by e-NAM. Adopting the mentioned measures can help to meet the objective of doubling the farmer‟s income through innovative approach.

GIRISDA/AB/091/2022

NEW BREEDING APPROACHES FOR SUSTAINABLE AGRICULTURE

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In an outline of a new agriculture and new agricultural practices, many new techniques are playing a dominant role for making the world of agriculture more feasible and also more efficient. Now in this technologically sound era, we have many challenges to overcome the issues pertaining to different fields. In the field of agriculture, plant breeders are not only looking forward to get higher returns of agricultural produces for economical purpose but also trying to find new innovative techniques to overcome the limitations of classical breeding techniques.

Application of new breeding techniques (NBTs) based on the through expertise on genome of species and varieties will help to get the plant resistance against new biotic and abiotic stresses, production of medicines and vaccines as well as detoxification of water and soils. Use of site directed nuclease, cisgenesis oligonucleotide directed mutagenesis are some of the new breeding techniques used by the plant breeders for carrying out new results in the field of sustainable agriculture. Breeders are trying to develop new biotechnological tools based breeding methods and modifying techniques like traditional cross breeding, mutagenesis, transgenesis, genome editing and many more also CRISPR (new step in genetic manipulation) which can improve plant research and traits in an efficient way to achieve sustainable agricultural production.

GIRISDA/AB/092/2022

FIELD EVALUATION OF IPM MODULES AGAINST TOMATO FRUIT BORER, *Helicoverpa armigera* (HUBNER)

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Seven different treatment modules were laid out in randomized block design (RBD) consisting of botanicals *viz*., Neem seed Extract (NSE) 5%, Azadirachtin 10,000 ppm, Azadirachtin 300 ppm and bio-pesticides like HaNPV 250 LE/ha, *Beauveria bassiana* 1 x 10^8 CFU, *Metarhizium anisopliae* 1 x 10^8 CFU, *Bacillus thuringiensis* 1000 g/ha and *Trichogramma chilonis* @ 1.5 lakh/ha along with untreated control at days after planting (DAP) in each module for the management of *Helicoverpa armigera*. The first application of each treatment module for tomato fruit borer was undertaken at 35 DAP and 55 DAP and was repeated at an interval of 10 days after application. The observations on tomato fruit borer infestation and it‟s natural enemies were recorded after the initiation of fruit formation on the plant and application of each treatment module at 3, 5 and 10 days. The yield and ICBR due to different treatment modules were also worked out for their cost effectiveness. The treatment module M5 (Application of Azadirachtin 10,000 ppm @ 3 ml/lit at 35 and 45 DAP, Application of HaNPV 250 LE at 55 DAP and Release of *T. chilonis* @ 1.5 lakh/ha at 65, 75 and 85 DAP) had shown the positive impact against tomato fruit borer. The treatment module M4 and M3 were found promising in minimizing the per cent fruit infestation of tomato fruit borer. Similarly the treatment modules M5 and M4 were found safer to natural enemies like spider. Likewise, the treatment module M3 proved to be promising in retaining the spider population.

GIRISDA/AB/093/2022

CLIMATE SMART HORTICULTURE: THE WAY FORWARD

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Horticulture is going to be significantly impacted by climate change by the end of this century due to changes in temperature and rainfall, increasing sea levels, and the projected rise in the frequency of extreme weather events. Horticulturists face a significant worldwide challenge in providing food security for all, particularly the poorest, in the face of these shifts. Being perennial in nature these crops have less adaptability to climate than annual crops and that is why they are considered more vulnerable to climate change. This implies that farmers from all over the world will have to adjust to new conditions, which will necessitate significant adjustments. It is the assumption of climate-savvy horticulture that it is feasible to satisfy the demands of farmers while adapting to and minimizing the effects of climate change. It is a strategy for assisting those in charge of horticulture systems in adapting to the effects of global warming. A plan that involves site- and crop-specific analyses in order to find appropriate production technologies and methods. To achieve a triple win, CSH is the only way forward that can simultaneously raise production, cut emissions, and improve climate change resistance. Therefore, adoption of climate smart horticulture is need to the hour so as to counteract the effect of climate change on horticulture.

GIRISDA/AB/094/2022

HYDROPONICS AND AEROPONICS IN ADVANCED FLORICULTURE

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Recent advances in floriculture, hydroponics and aeroponics are ingenious and escalating sectors of horticulture which can cope-up the limitations of soil in sustainable growing of crops in protected cultivation due to soil-borne diseases, nematodes, drainage as well as limited availability of cultivable and arable lands, rapid industrialization and urbanization and threats from climate change to horticulture. In hydroponics roots of plants are suspended in nutrient solutions with or without the use of artificial medium (sand, peatmoss, vermiculite, gravel, rockwool and sawdust) and in aeroponics plants are grown in an environment saturated with fine drops of nutrient solutions. It is bringing up urban and semi-urban households along with progressive growers. This accompanies controlled environment and has advanced a great deal in ornamental crop production during the last two decades. Gaining rapid momentum in floriculture for maximum utilization of space and practiced in growing commercial flower crops like chrysanthemum, carnations, roses (Rosa berberifolia), marigold, gerbera, anthuriums and also in ornamental crops like epiphytic orchids, bromalids, philodendron, crotons, dracaena, geranium, lilium etc. These are capable of doubling income of farmers with the advantages of higher and better yields, free from soil-borne disease and pests, efficient nutrient regulation, higher planting density, multi-cropping, throughout year production, cuttings free from soil particles, less labor and time. It is relevant to farmers having small land holding. It also guarantees adaptability and strengthening of crop production system in areas with adverse growing conditions. Hydroponic irrigation methods include drip irrigation, deep water culture, nutrient film technique and flood and drain. Hydroponics and aeroponics could dominate crop production in future by improving space and water conserving methods. Keywords: Hydroponics, Aeroponics, Floriculture.

GIRISDA/AB/095/2022

IRRIGATION MANAGEMENT PLANNING AND PRACTICES TO INCREASE WATER PRODUCTIVITY

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Having an overview on the importance of irrigation, management and the water user‟s participation in elevating the productivity of water and the development of existing irrigation hold area, the demonstration was made to evaluate the present irrigation system and water management resources for possible improvement in the area of Ghatera Babaji tank canal located in Betwa River basin. The command area which was considered has 101 land holdings ranging from 0.23 ha to 6.32 ha related to 87 farmers. *Cropping potency and irrigation potency was recorded to be 83.4% and 81% respectively.* Productivity of wheat crop ranged from 4.5 to 35.1 q ha-1 which when transfigured to water productivity ranged between 0.33 to 1.55 kg m^{-3}. Water productivity for chickpea ranged from 0.97 kg m^{-3} to 1.86 kg m^{-3}. More than 50 per cent farmers accepted the use of sprinkler irrigation, improving crops and field bund. Among the total 5 groups of farmers studied to know about adaptive behavior it was found that the suggestions were accepted four groups based on their age, education, income and land holding at Ghatera Babaji WUA's. On the basis of soil, crop, water resources, water users and climatic conditions improvements it was asked to change their irrigation method, substitution of crop varieties, superior working of water user association, irrigation intervals, proper drainage, conservation and functioning of canal, and usage of full package of practices for crops.

GIRISDA/AB/096/2022

EFFECT OF DIFFERENT DRYING MODE ON QUALITY OF WALNUT KERNELS

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Walnut (*Juglans regia L.*) called as „akhroot‟ in hindi and „dun‟ in kashmiri, is a nutrient-rich food. Being a rich source of PUFA having high moisture content, walnut kernels are susceptible to chemical and enzymatic oxidation reactions that result in the inferior quality walnut with shorter storage life. Drying of walnut kernels immediate after harvesting is the utmost step for enhancing the storage life of walnuts. The objective of this study is to develop suitable and effective method of drying to produce high quality kernel. After deshelling, walnut kernels were exposed to three different drying methods (sun drying, solar drying and cabinet drying) and consequent changes in its physicochemical characteristics were studied. The water activity of 0.98 and moisture content of 40.50% was recorded for fresh walnut kernel. The cabinet dried kernel was proved to be the best method as it took less time (3 days) to produce kernel with stable moisture content (4.20 %) and lowest water activity (0.231). The lowest peroxide value (1.28 meq O_2 /kg) and higher sensory attributes were shown by walnut kernel subjected to cabinet drying. Sun and solar drying resulted in walnut kernel with highest peroxide value and lower sensory scores. On the basis of higher physico-chemical and sensory characteristics, it is advisable to use cabinet drying method to produce high quality walnut kernels with better taste and texture.

GIRISDA/AB/097/2022

EFFECT OF BIOORGANIC AND CHEMICAL NUTRIENT SOURCES ON GROWTH AND QUALITY PARAMETERS AND YIELD OF FRENCH BEAN GROWN IN SUB-TROPICS OF HIMACHAL PRADESH

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An experiment was conducted at experimental farm of the Department of Soil Science and Water Management, College of Horticulture and Forestry, Hamirpur (Neri) during 2018 and 2019. Different combinations of jivamrit, ghanjivamrit, FYM, vermicompost and chemical fertilizers were compared. The experiment comprised of nine treatments, replicated thrice in randomized complete block design. Minimum days to 50% germination and days to 50% flowering were recorded in treatment comprising of combined use of vermicompost @ 5t/ha +Jivamrit @ 5% at weekly interval (T_6). Maximum plant height, yield per plant and yield per hectare were also recorded in treatment comprising combined use of vermicompost and jivamrit (T_6). The highest value of TSS was recorded in T_3 (FYM @ 20t/ha + Jivamrit @ 5% at weekly interval) followed by T_6 whereas, lowest value of TSS was recorded in treatment comprising use of only chemical fertilizers.

GIRISDA/AB/098/2022

INTEGRATED WEED MANAGEMENT

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Integrated weed management is a combination of variety of control methods for reducing reliance on herbicides alone, and increasing the chances of successful control or eradication of weeds from filed cropped area. It is a weed management program based on a combination of preventive, cultural, mechanical, and chemical practices. In preventive methods avoid use of crop that are infested with weed seeds for sowing, feeding screenings and other material containing weed seeds to the farm animals, clean the farm machinery thoroughly before moving it from one field to another and keep irrigation channels, fence-lines, and un-cropped areas clean. Cultural method involves good seed bed preparation, Summer deep tillage one in two or three years, Maintenance of optimum plant population of field crop, Crop rotation with fast growing crops, growing of intercrops, Mulching with crop residue, plastic covering material on soil surface, Solarization during summer time. These practices are best to manage weed population in field area. We also can go for minimum use of herbicides – The principles of chemical weed control involve those chemicals capable of killing plants, especially certain types without injury to crops such as Fluchloralin, Atrazine. Use of living organism‟s viz., insects, disease organisms, herbivorous fish, snails or even competitive plants for the control of weeds is called biological control. In biological control method, it is not possible to eradicate weeds but weed population can be reduced. A biological weed control regiment can consist of biological control agents, bioherbicides, use of grazing animals, and protection of natural predators. Hence, integrated weed management practices is the best to reduce the pressure of weeds on crops in the field area.

GIRISDA/AB/099/2022

ORGANIC FARMING WITH RESIDUE-FREE PRODUCTION

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After the independence, a challenging phase of food shortage and famines came that enforced the nation to develop the food aid practices with the determination to become self-reliant in food production by modernizing agriculture. That was when the birth of Green revolution became the savior for an ailing famine prone country like ours. With the advent of Green revolution, India witnessed tremendous increase in crop productivity as result of introduction of high yielding varieties that require large amounts of chemical fertilizers and pesticides and fulfilled the dream of transforming India from food importing to food exporting nation. But this achievement came with the cost of compromising environment friendly farming and well-being of human as it is affecting eco system and human health drastically due to residual effect of these harmful chemical fertilizers and pesticides. Organic farming is the best known approach to meet the objective of sustainable agriculture based on traditional farming and is one of the alternative for conventional farming. Organic farming emphasizes on residue free farming with the use of organically driven biocides and bio-fertilizers to manage the crops, which in broad term known as Integrated nutrient management and integrated pest management. Integrated pest management prevent and reduces the infestation of economically damaging pest in eco-friendly way without the accumulation of any harmful chemical residues in the crop through the practices which includes cultural, physical, mechanical, biological and chemical methods. Major setbacks in adopting residue-free organic farming are lack of awareness, High input cost, inadequate supporting infrastructure and marketing of organic produce.

GIRISDA/AB/100/2022

BIOCHAR'S POTENTIAL AND OPPORTUNITIES IN INDIA FOR IMPROVING AGRICULTURE AND THE ENVIRONMENT

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In India's agriculture sector, crop residue management is still a major issue. Farmers in India face numerous challenges each year, including the monsoon, crop quality, declining yields, and soil fertility. Seasonal crop residue burning is a major contributor to air pollution in the North India because there is no viable way to dispose of crop residue each season. In-situ crop residue burning degrades soil, increases erosion risk, and raises soil temperature, all of which kill soil microorganisms. This has an impact on the financial cost of restoring soil fertility as well as the risk of increased pollution from increased fertiliser use. Farmers in India burn crop residues due to the high cost of incorporating, collecting, transporting, and processing them. Crop residue burning decisions are also influenced by crop residue marketability, labour shortages, and the short time between harvest and the next cropping season. The conversion of waste to biochar could be one of the techniques for safely disposing of it and has gained significant scientific attention as a potential solution to these issues. In India, 517.82 MT of crop residue is produced per year and converting it into biochar can yield 212.04 ± 44.27 MT. Utilization of biochar in agriculture has attracted the attention of most researchers because of its effectiveness in improving soil quality, crop yield, assisting sustainable production, carbon sequestration, and potential benefits in agriculture fields. In addition, crop residue-derived biochar has a market value of about $500 billion in India. Market and employment opportunities exist for biochar applications in the cosmetics, pharmaceutical, and chemical industries. This paper presents a state-of-the-art review of biochar applications for agricultural and environmental improvement. Furthermore, beliefs and perceptions about crop residue burning must be changed through education and awareness.

GIRISDA/AB/101/2022

TRANS-GRAFTING A NEW BIOTECHNOLOGICAL TOOL FOR SUSTAINABLE FRUIT PRODUCTION

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While much recent science has focused on understanding and exploiting root traits as new opportunities for crop improvement, the use of rootstocks has enhanced the productivity of woody perennial crops for centuries. Only during the last two decades horticulturists realized the potential of this old activity and studied the physiological and molecular mechanisms involved in rootstock and scion interactions, thereby not only explaining old phenomena but also developing new tools for crop improvement. Rootstocks can contribute to food security by increasing the yield potential of elite varieties, closing the yield gap under suboptimal growing conditions and decreasing the amount of chemical (pesticides and fertilizers) contaminants in the soil. A protein, hormones, mRNA and small RNA transport across the junction is currently emerging as an important mechanism that controls the stock/scion communication and simultaneously may play a crucial role in understanding the physiology of grafting more precisely. The latest technology of silencing transmissible RNA and its potential to regulate growth and stress responses has provided new opportunities to understand stock-scion relationships. Undeniably, there is great scope for the development of transgenic rootstocks, in fruit trees that carry transportable mRNAs which regulate key horticultural traits, such as disease and stress resistance properties or dwarfing growth habits. This kind of approach would not only improve the characteristics of scion using transmissible mRNA from a transgenic rootstock but also might shun some of the disagreements regarding transgenicfruit production. In recent years, studies on rootstock-scion interactions have proposed the existence of an epigenetic component in grafting reactions. Epigenetic changes such as DNA methylation, histone modification, and the action of small RNA molecules are known to modulate chromatin architecture, leading to gene expression changes and impacting cellular functions. If these modifications are heritable, they can result in permanently changed phenotypes and influence essential agricultural properties, making grafting a viable alternative to breeding for producing superior plants with enhanced attributes.

GIRISDA/AB/102/2022

REGENERATIVE AGRICULTURE: MEETING OUT RISING FOOD DEMAND IN TIMES OF CLIMATE CHANGE

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Food demand is expected to rise by 70% by 2050 which in conjunction with rising global populations and per capita demand has put up a huge pressure on arable and degraded land resources to produce more food per unit land. Conventional agriculture practices that seem to enhance agricultural productivity in short run also have a negative environment impact and enhance carbon output from soils. To meet out the criteria of enhancing food production in a sustainable way, regenerative agriculture has come to limelight recently which combines organic agriculture practices, conservation agriculture practices with agro-forestry to restore the soil health and producing more food keeping in view the rising food demand. Regenerative agriculture is estimated to sequester 14.5 to 22 gigatons of carbon dioxide by 2050 and can reverse climate change. Agricultural practices such as conservation tillage, crop rotation, soil cover with cover crops and crop residues and agroforestry practices such as alley cropping, enhances soil biological activity, windbreaks and silvi-pasture have the potential to restore soil organic carbon content, nutrient recycling and sustainable nutrient and pest management which will ultimately soils more productive, restore degraded lands, reduces

their dependence on external chemical inputs and reduce rising concerns of climate change. Therefore, regenerative agriculture combines the practices which have the potential to restore degraded lands, boost soil productivity in arable lands, mitigate climate change and produce more food in coming times.

GIRISDA/AB/103/2022

INDEXING SOIL QUALITY UNDER DIFFERENT TILLAGE AND WEED MANAGEMENT PRACTICES IN MAIZE (*Zea mays* L.) - WHEAT (*Triticum aestivum*) CROPPING SYSTEM

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Intensive tillage methods, burning of crop biomass and the misuse of herbicides contribute to soil degradation, loss of nutrients, and poor soil health, emission of air pollutant and reduction in crop productivity in the North Western Himalaya. Conservation agriculture (CA) is a sustainable way of intensifying crops and mitigating climate change under various ecosystems that sustain and improve crop productivity and at the same time conserve scarce natural resources including soil, water, energy, and the environment. Rain-fed acid alfisol soils in the North Western Himalayan regions of India have poor soil quality. Therefore, we evaluated the effects of different tillage manipulation in combination with various weed management strategies on system productivity, soil physic-chemical properties and soil quality. For the purpose, research experiment was laid in strip plots design where fifteen tillage treatments, *viz*. conventional-till maize and wheat (CT-CT), conventional-till maize and zero-till wheat (CT-ZT), conventional-till maize and zero-till wheat (ZT-ZT), conventional-till maize and zero-till wheat (ZT-ZT), and conventional-till maize and zero-till wheat (ZTR-ZTR), along with three weed management practices, recommended herbicides (H-H), integrated weed management (IWM-IWM) and hand weeding (HW-HW) was evaluated in maize-wheat cropping systems. From results it is clear that enhancement of soil physical, nutrient availability and biological properties were associated with CA based production system. Similarly, enzymatic activities *viz*. microbial biomass carbon, dehydrogenase activity, urease activity, acid phosphatase activity and alikaline phosphatase activity were higher under CA based scenarios in the tune of 117%, 111%, 112%, 123% and 108%, respectively compared to conventional tilled plots. However, IWM-IWM had higher soil physical parameters and organic carbon content, whereas, available phosphorus and potassium were higher in herbicide application (H-H) treatment. Enhancement of soil microbial population and enzymatic activities were higher IWM-IWM compared to H-H in maize-wheat cropping system. Thus our study suggests that CA based maize-wheat cropping system should be recommended for better soil quality and yield sustainability in North West India.

GIRISDA/AB/104/2022

OCCURRENCE OF SAL HEARTWOOD BORER *Hoplocerambyx spinicornis* (Newman) INFESTATION IN CHHATTISGARH

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Shorea robusta Gaertn.f. (Family: Dipterocarpaceae), commonly known as Sal in India, is a large deciduous, resiniferous tree having majestic shining foliage. This potential species is one of the most important timbers of India both ecologically and economically. Madhya Pradesh including Chhattisgarh is the second largest state with extensive Sal forests (27, 800 sq.km.), distributed mainly in eastern part of the state forming 25% of the total Sal forests of the country. It is widely distributed in central and north India and constitutes an important ecosystem, which provides cool

and calm environment rich in biodiversity. Chhattisgarh are important states with extensive damage to Sal trees both in standing as well as freshly felled timbers. The Sal heartwood borer, *Hoplocerambyx spinicornis* Newman (Coleoptera: Cerambycidae), commonly known as Sal borer, is the most devastating insect pest responsible for catastrophic damage of Sal forests of the country. Till date, over 21 epidemics of this borer have been recorded in Sal forests of the country. To combat this major pest of Sal, "Trap Tree Operation" is used for trapping the beetles. This is an environmentally sound and very effective non-toxic method of control, currently available. The present paper reports the emergence of Sal heart wood borer, *H. spinicornis* and its infestation in Sal trees at different forest divisions of Chhattisgarh, during the year 2020- 21. Out of the eight Sal forests ranges, Viz., Rengaghar, Taregaon, Amabeda, Bade Rajpur, Kanker, Mainpur, Navagarh and Narayanpur. The Sal borer incidence was recorded in eight ranges and there was borer affected trees recorded in amabeda range, were belong to type T1 (1 tree), T2 (2 trees), T4 (2 trees), T5 (3 trees) and T7 (1 tree). The girth class of borer affected trees were recorded 180 cm GBH. Trap tree operation was conducted during the adult emergence period (June-July) in different affected compartments of forest ranges, for its collection. A total number of borer beetles trapped were 27 during the year 2020-21, collected from eight forest ranges. The collection of borer beetles reduced its incidence which reflects the efficiency of tree trap operation in management of *H. spinicornis* in Sal trees.

GIRISDA/AB/105/2022

SMART FARMING: ENVIRONMENTALLY MANAGEMENT OF CROP PRODUCTION

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The most pressing problems to global sustainable development are food scarcity and population increase. Smart agriculture is an agricultural production model that enables land and crop management, more economical use of resources and minimizes environmental damage in order to increase agricultural productivity by using the opportunities of technology. Artificial intelligence (AI), the Internet of Things (IoT), and mobile internet are examples of advanced technology that can help solve some of the world's problems. The Internet of Things (IoT) connects sensor devices to execute a variety of fundamental activities, making it one of the most important pillars in smart systems. Sensors for monitoring water level, irrigation efficiency, climate, and other variables were integrated in the smart irrigation system. Smart irrigation relies on intelligent controls and sensors, as well as mathematical relationships. In addition, using IoT, artificial intelligence (AI), deep learning (DL), machine learning (ML), and wireless communications, this work demonstrated the use of unmanned aerial vehicles (UAVs) and robots to perform tasks such as harvesting, seeding, weed detection, irrigation, spraying of agricultural pests, and livestock applications in real time. Despite the fact that smart farming applications in underdeveloped nations face a number of problems, this study revealed various smart farming methodologies. Furthermore, the use of Smart Decision Support Systems (SDSS) in developing nations facilitates real-time analysis, mapping of soil properties, and effective decision-making. Finally, governments and the corporate sector in underdeveloped nations must provide more assistance for smart agriculture.

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TARGETED PROTEOMICS APPROACH FOR PRECISION PLANT BREEDING

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The changes in the crop improvement have been altered due to technological advancements in traditional plant-breeding methods. Due to abiotic and biotic stresses, plant growth and development halts which ultimately leads to reduction in the crop yield. Proteins encoded by genomes have a considerable role in the endurance and adaptation of plants to different environmental conditions. Biotechnological applications in plant breeding depend upon the information generated from proteomic studies. Proteomics has a specific advantage to contemplate the post-translational modifications, which indicate the functional effects of protein modifications on crop production. Proteomics helps in exploring the precise cellular responses and investigating the networking among subcellular compartments during plant development and biotic/abiotic stress responses. Large-scale mass spectrometry-based plant proteomic studies with a more comprehensive overview are now possible due to dramatic improvements in sample preparation procedures, analytical software, and strengthened availability of genomes for numerous plant species. Development of stress-tolerant or resilient crops is essential to improve crop productivity and growth. Use of high throughput techniques with advanced instrumentation gives efficient results. Proteomic studies accelerate markerassisted genetic augmentation studies in various crops for developing high yielding stress-tolerant varieties.
Key words: abiotic stress, mass spectrometry, marker-assisted, proteomics, subcellular.

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UREA BRIQUETTES APPLICATION: AN INTEGRATED NUTRIENT MANAGEMENT

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In India, effective nutrient management has contributed a major role in attaining the massive increase in food grain production. Integrated nutrient management comprises of maintaining soil fertility to an optimal level for crop yield in order to get the more benefit from all feasible sources of plant nutrients such as organic, inorganic and biological components in an integrated way. Due to leaching, volatilization and denitrification of applied nitro gen, the efficiency of nitrogen fertilizer is low in lowland rice. Urea is one of the most utilized nitrogen fertilizers in rice. In broadcasted rice field under the aerobic zone, urea is rapidly hydrolyzed producing NH which is quickly transformed to NO by the process of nitrification. The application of urea briquettes is good method for controlling the loss of nitrogen from urea, which are large in size (1-2 g). Because of diffusive transport and cation exchange, the urea briquette serves as a slowly available N fertilizer controlling the rate and duration of urea briquettes- N availability to rice plants. The efficiency of urea briquettes is enhanced by manually or with the help of an applicator with inserting these briquettes 5-7 cm soil depth which enhanced yield and N use efficiency and significantly reduced N loss. Deep placement of briquettes at reduced zone prevents volatilization and subsequent losses, which results in significant increases in nitrogen uptake by plants and in grain yield. Application of urea briquette in soil, inhibits the nitrification for seven weeks and reduced NH3 and NO emissions by nearly 94%. This method is environmentally safe and agronomically efficient technology.

GIRISDA/AB/108/2022

BIOLOGICAL CONTROL OF DRY ROOT-ROT OF CHICKPEA WITH SEED AND SOIL APPLICATION OF UNDER FIELD CONDITIONS AS SUSTAINABLE APPROACH FOR DISEASE MANAGEMENT

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Effectiveness of four bio-fungicides viz., Biowilt X (*Trichoderma harzianum*), Bioderma (*T. viride*), Abtec Pseudo (*Pseudomonas fluorescens*) and Abtec Bacillus (*Bacillus subtilis*) were evaluated against dry root-rot of chickpea in microplot (3x2 m) trials. The disease incidence was found to be 64% and the severity index was 4.1 on 0-5 scale under field conditions in untreated plots (P≤0.05). However, the disease severity was decreased with seed and soil application of bio-fungicides. Seed or soil application of Biowilt X was found superior to other treatments in managing the root-rot disease. The disease incidence was reduced to 30% and 33% and the severity to 2.2 and 2.3 over control with seed and soil application of *T. harzianum* (Biowilt X), respectively. The root-rot infected plant had lesser number of functional nodules (42%) and plant growth was reduced by 29-32%, and experienced 30% and 41% reduction in seed weight and pod formation over uninoculated control (P≤0.05). However, an increase in root nodulation, plant growth and yield were recorded in root-rot infested plants with the bio-fungicide application under field conditions in microplot experiment. The bio-fungicides application suppressed the pathogenic effects of the fungus and increased the pod formation and seed weight increased by 15-46% and 27-34.5% over inoculated control (P≤0.05). Seed and soil application of Biowilt X improved the growth and yield parameters of infected chickpea plants by 35-42% and 31-46%. due to soil and seed treatment, respectively. The increase in shoot and root length ranged from 32-36% and 30-42% depending on mode of application and the bio-fungicide used. Bioderma was next in effectiveness and improved the plant growth by 35-40%, podding by 38-42% and seed weight by 30-32%, respectively over control (P≤0.05). Abtec Bacillus was comparatively less effective against the root-rot pathogen. The greater suppression of root-rot pathogen was recorded with seed application then with soil application of any of the bio-fungicides used. Seed treatment was also found superior enhancing the root nodulation in infected plants (P≤0.05). The overall order of performance of bio-fungicides was Biowilt X>Bioderma>Abtec Pseudo>Abtec Bacillus.

GIRISDA/AB/109/2022

GLOBAL WARMING AND ITS IMPACT ON NEMATODE COMMUNITY STRUCTURE IN SOIL, DISTRIBUTION POPULATION DYNAMICS AND PLANT-NEMATODE INTERACTIONS

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Global warming may impact global food production by influencing phyllosphere and rhizosphere microbial community structure thus suppressing or aggravating plant diseases. The CO_2 concentration has risen from 316 ppm to 400 ppm and is expected to reach 530 ppm by 2050 leading to 2°C rise in earth temperature. Nematodes survival and development is expected to be influenced by changing CO_2 levels. Their interaction with plants may experience a positive, negative or no change and will depend on the host physiology, the dominance of nematode species and changing environment. To understand nematode response to global warming in a better way it is essential to understand the carbon and nitrogen cycle, as their increase may lead to increased plant biomass and alter C/N ratio in plants. Being soil inhabitant‟s nematodes play an active role in decomposition of residue and any change in composition of plant residue will influence them. Under elevated CO_2 greater plant residue would be available in to nematodes in low nitrogen soils, hence their abundance will increase while maturity index might exhibit decline over

time. The population of bacterial-feeders, free living and predatory nematodes will be greater under elevated CO_2 in low nitrogen soils due to toxic effect of low nitrogen on saprophytic fungi in soil. However, the population of root parasitic nematodes might decrease or remain unchanged over long term exposure to elevated CO_2. The distribution pattern of plant parasitic nematodes viz., *Meloidogyne* spp, *Heterodera glycines, Radopholus similis, Globodera rostochiensis*, *Aphelenchoides* and *Ditylenchus* is changing fast and they are emerging as threat to agricultural crops in areas where they were earlier of minor importance causing severe losses. Xiphinema and Longidorus spp are also spreading rapidly increasing the threat of nematode transmitted viral diseases in plants. Under elevated CO_2 the nematode abundance, diversity and maturity index increases in certain ecosystem while in others it might tend to decline suggesting the effect of host cues under changing climate on species composition. Population of *Xiphinema* remains unchanged under elevated CO_2 but its size gets reduced while the abundance of *Aphelenchoides* spp got reduced at elevated CO_2 concentrations in experimental trials.

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HOST PLANT RESISTANCE AND ITS IMPORTANCE IN PEST MANAGEMENT

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On earth, phytophagous insects and plants are known by having a prior co-evolutionary history of evolution in the term of various traits of specialization. Most of the plants always produce a number of extra leaves, shoots and various parts as food source for stability of ecosystem and food chain while phytophagous insects use to act in their own niche to reduce survival competition. Apart from serving as a host for stability of ecosystem, plants may develop some specific characters which may alter the behavior of insects in the term of feeding, seeking shelter, biology and many other things, these traits later named as resistance factors and properly studied by Reginal Henry Painter, 1951 in his historical book “Insect Resistance in Crop Plants”. Resistance traits in crops plants can be explained in two major categories such as morphological plant traits and biochemical plant traits. In morphological, stem structure and height, thickness, number of leaves, leaf structures, cell wall thickness, trichome density, trichome length and toughness of trichomes etc can be included as resistance/tolerance factors while in bio-chemicals, NPK, S, Zn, Chlorophyll, various plant alkaloids, silica content of leaves, antibiotics like DIMBOA and various phenols have important role. The book, Techniques for Evaluating Insect Resistance in Crop Plant is a good source for estimation of various resistance traits in crops. Incorporation of Host Plant Resistance traits in insect pest management programme is a very easy and convenient method of pest management. The major benefit can be stated as the farmer does not require any specific knowledge in growing the resistance cultivars. These cultivars require very less or minor application of pesticides if needed. Resistance genotype can easily be incorporated with other management tactics like biological control, cultural control, chemical control and other control approaches. There are no any adverse of harmful impact on pollinators, biological control agents and other non-targeted fauna.

GIRISDA/AB/111/2022

VARIABILITY AMONG THE *Fusarium oxysporum* f.sp. *Lycopersici* ISOLATES CAUSING *Fusarium* WILT OF TOMATO

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Fusarium wilt of tomato, caused by *Fusarium oxysporum* f.sp. *lycopersici* (Sacc.) W.C. Snyder and H.N. Hans is one of the major constraints in tomato production. Ten isolates of *Fusarium oxysporum* f.sp. *lycopersici* were recovered from five districts *viz.*, Udaipur, Chittorgarh, Jaipur, Pratapgarh and Banswara of different Agro-climatic Zones of Rajasthan (IVA, IIIA and IVB) in the year 2019-20 and 2020-21 and designated as UDPA Fo-1, UDPB Fo-2, PRTB Fo-1, PRTD Fo-2, JPRD Fo-1, JPRB Fo-2, CHTT Fo-1, CHTG Fo-2, BNSH Fo-1 and BNSB Fo-2. These isolates were compared for morphological and cultural characters on the potato dextrose agar medium. Among the isolates maximum colony diameter was observed in UDPA Fo-1 and JPRD Fo-5 (90mm), while minimum colony diameter was observed in CHTG Fo-8 (68mm) after seven days of incubation 28±1°C. Highest sporulation $4.6x10^6$ conidia/mm^2 was recorded in UDPA Fo-1 and lowest 2.3 $x10^6$ conidia/mm^2 in CHTG Fo-8 isolate. Isolates showed white, creamy white, pinkish and purple mycelial colony with white, pinkish, purple and yellow pigmentation. The size of macro conidia varied between 7.80±0.40 to 22.60±0.50 µm in length and 2.17±0.25 to 5.72±0.31 µm in width. Largest macro conidia were found in CHTG Fo-8 that was 22.60±0.50 µm in length and 5.72±0.31 µm in width. Smallest macro conidia was found in UDPA Fo-1, 7.80±0.40 µm in length, 2.17±0.25µm in width while, in micro conidia average size was ranged from 4.05±0.15 to 5.89±0.21 µm in length and 1.19±0.11 to 3.04±0.06 µm in width. Largest micro conidia were found in CHTG Fo-8 that was 5.89±0.21 µm in length and 3.04±0.06 µm in width. Smallest micro conidia were found in UDPA Fo-1, 4.05±0.15 µm in length, 1.19±0.11µm in width. All the isolates showed variations in cultural and morphological characters.

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RESPONSE OF FERTIGATION LEVELS AND DIFFERENT HYBRIDS ON QUANTITATIVE ATTRIBUTES AND BENEFIT COST RATIO OF CUCUMBER (*Cucumis sativus* L.) GROWN UNDER POLYHOUSE CONDITIONS

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Research trial was carried out at Experimental Research Farm Chhapang, Dr. Khem Singh Gill Akal College of Agriculture, Eternal University, Baru Sahib, District Sirmour, Himachal Pradesh in the year 2021.The experiment was laid out in Randomized Block Design with three replications and sixteen treatment combinations. In the research trail four fertigation levels were used along with four commercial hybrids of cucumber are used which are mostly grown by farmers in Sirmour valley. Among the different hybrids Aviva recorded maximum number of fruits/ plant, fruit weight, fruit diameter, Fruit yield/m^2 and fruit yield/ha. Among the different fertigation levels (F_3=150kg NPK/ha) fertigation levels recorded maximum number of fruits/ plant, fruit weight, fruit diameter, Fruit yield/m^2 and fruit yield/ha. Among the different treatment combinations, hybrid Aviva fertigated at 150kg NPK/ha, recorded maximum number of fruits/ plant, fruit weight, fruit diameter, Fruit yield/m^2 and fruit yield/ha. The treatment combination Aviva fertigated at 150kg NPK/ha recorded maximum profit along with the benefit cost ratio.

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EFFECT OF DIFFERENT CONCENTRATIONS OF VERMIWASH ON VEGETATIVE GROWTH OF BLACK PEPPER CUTTINGS (*Piper nigrum* L.)

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The present investigation entitled "Effect of different concentrations of vermiwash on vegetative growth of black pepper cuttings (*Piper nigrum* L.)" conducted at the Department of Horticulture, College of Agriculture Dapoli, and Dist. Ratnagiri during the 2018-2019 with Randomized block Design with six treatments and four replications. The treatments were T_1-Vermiwash 10 % drenching, T_2-Vermiwash 20 % drenching, T_3-Vermiwash 30 % drenching, T_4-Vermiwash 40 % drenching, T_5-Vermiwash 50 % drenching and T_6-Control. With objective, to study the effect of different concentrations of vermiwash on vegetative growth of black pepper cuttings. Drenching of vermiwash (50 ml) was given to per cutting at monthly basis and vegetative parameters like number of leaves, leaf area(cm^2), sprout height (cm), thickness of sprout (mm) were calculated per month up-to six months and survival percentage (%) at end of research were recorded.

Highest (88.50 %) survival was in T_4 which was significantly superior over rest of the treatments and maximum sprout height (93.00 cm) was in treatment T_4 which was significantly superior over all treatments, maximum number of leaves per cutting was in T_4 (13.05) which was followed by T_5 (12.00), T_3 (11.15), T_2 (10.10) and T_1 (9.35) and the lowest number of leaves (9.00) were observed in T_6, highest thickness (4.92 mm) among all the treatments wa observed in treatment T_4 which was at par with treatments T_5 (4.84 mm), T_3 (4.67 mm) and the lowest thickness (3.06 mm) of the sprout was observed in treatment T_6. Vermiwash is plant growth regulator which contains considerable amount of enzymes, vitamins and hormones (*i.e.* auxins, gibberellins *etc.*) along with macro nutrients and micronutrients. Hence, it has significant effect on vegetative growth which ultimately provides larger area for photosynthesis and helps in improving vegetative growth.

GIRISDA/AB/114/2022

WOMEN IN RURAL INDIA: PROSPECTS AND CHALLENGES

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The women in Indian villages achieve multiple roles that include looking after the several needs of the family members, contributing in home secure income making activities and holding jobs outer the home. Women position in patriarchal India is condensed to good offspring, good partners and mothers. Wifehood and motherhood are usually accepted as key roles for women in an Indian society and by those suggestions they should not follow any different profession. Especially this once required by higher education or specialized trainings, which make them, lose focus on main household duties. Status of rural women replicates an even darker description. Out of 135 crore population of India, 65.13 percent lives in the rural systems and women found 48 percent of total rural population. 74.8 percent women are agricultural workers, but only 9.8 percent own a piece of land.

Patriarchal system in an Indian society also means that the family unit is based on the joint household structure, where only one male is a head of house. Usually this role does belong to a father. He does make choice in terms of marriage alliance, both daughters and sons, decision about buying and selling properties, and maintaining family property day-to-day life. In terms of domestic arrangement, the elder woman in a family is in charge.

GIRISDA/AB/115/2022

PREPARATION OF SYNBIOTIC LASSI FROM BUFFALO MILK

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Lassi is close to sweet stirred yoghurt (yoghurt drink) which is a popular summer drink in India, especially in North India. Prebiotics are non- digestible food ingredients that beneficially affect the host. Probiotic helps to modulate immunity, improve digestive process, prevent cancer, improve lactose intolerance etc. Maltodextrin is produced from vegetables starch by partial hydrolysis and easily found as a white hygroscopic spray-dried powder. Maltodextrin is easily digestible, being absorb as rapidly as glucose and may be either moderately sweet or almost flavourless. Maltodextrin is used to improve the mouthfeel of food and beverages product. In present study, lassi was manufactured from buffalo milk. Maltodextrin was added @ 1, 1.5, 2% and *Lactobacillus acidophilus* was added 1.5% in all treatments. From the outcomes results of present investigation, it may be concluded that maltodextrin could be successfully utilized for manufacture of synbiotic lassi. The most acceptable quality of synbiotic lassi can be manufactured by using 1.5 per cent maltodextrin which contained on an average 22.33, 5.04, 3.16, 13.63, 0.62 and 0.75 per cent total solids, fat, protein, total sugar, ash and titratable acidity, respectively. The production cost of most acceptable synbiotic lassi (T_2) was Rs.55.98/- per lit. On the basis of sensory evaluation for most acceptable level, it is found that product was acceptable up to 8th day under refrigerated condition at 5 to 7 ^{0}C temperature.

GIRISDA/AB/116/2022

REMOTE SENSING TECHNOLOGY FOR SOIL

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Remote Sensing is art and science of making measurements of earth, through sensor based aero planes and satellites. These sensors collect data in the form of images provides specialized collect data in form of the images provides specialized capabilities of manipulating, analyzing and visualizing those images. Use of optical, microwave, Lidar and hyper spectral remote sensing data for soil mapping with emphasis on applications at local and regional level. Remote sensing is expected to offer possibilities for improving incomplete spatial and thematic coverage of current regional and global soil databases. Soil properties that have been measured using remote sensing approaches include mineralogy, texture, soil iron, soil moisture, soil organic carbon, soil salinity and carbonate content. In sparsely vegetated areas, successful use of space borne, airborne and in situ measurements using optical, passive and active microwave instruments has been reported.

GIRISDA/AB/117/2022

A COMPARATIVE STUDY ON FATTY ACID AND PROXIMATE COMPOSITIONS OF CULTURED *Penaeus vannamei* (BOONE, 1931) WITH DIFFERENT STOCKING DENSITY DURING SUMMER AND MONSOON CROP IN THE PROVINCE OF GUJARAT STATE IN INDIA

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Culture of shrimp was conducted for 120 days of culture at commercial pond at Datardi village, Rajula (Gujarat). Every aquatic animals has their conducive environment, in which they normally grow without any health problem. Any deficiency within body directly affect the normal cellular and organelle function. Shrimp culture activity is usually taken up during summer and monsoon season, this seasonal effect over fatty acid and proximate composition directly affect the total biomass at harvest (kg). Macro and micro nutrients within aquatic medium, helps shrimp to flourish enzymetics action and good growth and survival. This study was conducted and sample of shrimp was collected at harvest period (120 days of culture) from total 18 numbers of culture ponds of size 0.5 ha and depth was 1.8 m. The experiment was conducted in as completely randomized design (CRD) with 6 treatments with 3 replications. Summer crop, treatment and stocking density was represented as S, T1 and 30 nos of shrimp/m^2 respectively denoted has ST1 30 nos/m^2 as on for 2nd treatment ST2 40 nos/m^2, ST3 50 nos/m^2, ST4 60 nos/m^2, ST5 70 nos/m^2, and ST6 80 nos/m^2 similarly for monsoon crop, represented as MT1 30 nos/m^2 upto MT6 80 nos/m^2. The present study was conducted to evaluate the effect of stocking density on *L. vannamei* with the emphasis on biochemical proximate and fatty acid composition. The proximate composition of *L.vannamei* during summer and monsoon crop showed higher protein(%) in low stocking density (30 nos/m^2)treatment followed by crude fat (%), carbohydrate (%) and Ash (%) in ST1 and MT1 (30 pc/m^2). During summer crop, the total 18 fatty acid were detected whereas during monsoon crop 16 fatty acid were detected in all treatment. The results indicated that during summer crop, the *L.vannamei* shrimp has higher values of SFA,PUFA, MUFA. The total unsaturated fatty acids (USFAs) was higher in treatment ST2 with (66.15 µg/g of FAME) followed by ST3 (66.00µg/g of FAME), ST6 (65.58 µg/g of FAME), ST4(63.04 µg/g of FAME), ST1 (62.75 µg/g of FAME) and ST5 (62.08 µg/g of FAME),whereas during monsoon crop, the data revealed that the total unsaturated fatty acids (USFAs) was higher than SFAs in treatment MT3 with (59.3 µg/g of FAME) followed by MT1 (58.67µg/g of FAME), MT4 (57.5 µg/g of FAME), MT2 (56.08µg/g of FAME), MT5 (43.8µg/g of FAME) and low in MT6 (34.18µg/g of FAME). Comparing both the season, summer crop is better than monsoon, as summer crop showed higher level concentration of proximate composition to SFAs/MUFAs and PUFA may be due good quality and quantity of natural feed, water quality and conducive water parameter additionally higher stocking density (no/m^2) also affect the level and concentration on proximate composition and fatty acid in both the season. So comparing both season and effect of stocking density of shrimp, there is clear evident that both the factor directly affect the proximate and fatty acid level in *L.vannamei* cultured shrimp.

GIRISDA/AB/118/2022

ASSOCIATION BETWEEN CHARACTERISTICS OF POTATO GROWERS AND KNOWLEDGE OF POTATO PRODUCTION TECHNOLOGY

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Potato is one of the important tuber crops in India. Importance of potato as vegetable in human diet has been well recognized. It was viewed in general a common man‟s food. Potato produces more food per unit area than wheat, paddyand many other cereals and that much in shorter time. The present study was conducted through Ex-post Facto research design and multistage sampling method. Total 150 potato growers were selected from fifteen villages belongs to Modasa, Bayad and Dhansura talukas of Aravalli district of Gujarat state. The data were collected by personal contact method with help of structured interview schedule and data were coded, classified, tabulated and analysed in the light of objectives. Ten independent and one dependent variables were selected for study. The independent variables viz., education, land holding, annual income, source of information, market orientation, decision making ability and cropping pattern were positively and significantly associated with knowledge of potato production technology. While, extension contact had positive and highly significant correlation with knowledge of potato production technology. Whereas, age and method of irrigation had non-significant correlation with knowledge of potato production technology.

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INTEGRATED WEED MANAGEMENT

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Use of harmful chemical for weed control increased very rapidly after Green Revolution. It not only pollute the environment but also effect the soil health, human health etc. Integrated Weed Management (IWM) technique is basically based on the combination of all the methods of weed control viz. Cultural, physical, chemical and biological methods in a compatible manner. Continuous use of single method of weed control results to build up tolerant weeds. Therefore, for effective and economical control of weeds, it is very important to change or combine 2 or more methods. INM works on some principles:-Restrict the introduction and spread of weed by using suitable agronomic practices, by using different practices keep the weeds balanced, cultivate the crop in such a way that it can compete with weeds.

GIRISDA/AB/120/2022

STUDY OF F_2 SEGREGATION RATIOS'S OF VARIOUS QUALITATIVE TRAITS IN SAFFLOWER (*Carthamus tinctorius* L.)

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The cultivated oilseed crop safflower (*Carthamus tictorius* L.) is a densely branching herbaceous plant with spiny leaves. Its oil consists of unsaturated fatty acids such as oleic acid, Linoleic acid, and Linolenic acid which is considered as good for cardiac patients. This experiment was undertaken during *rabi* season to explore the gene interaction pattern of various qualitative features in safflower (*Carthamus tinctorious* L.). Parents with differing

qualities were chosen, and five distinct crosses were created. F_1 generation of the crosses were investigated for traits such as petal colour, bract type, capitulum form, stigma colour, and faded petal colour in order to determine their inheritance pattern. After that, plants were raised in bulk in the F_2 generation to determine their distinct segregation ratios. The segregation ratio was calculated using the Chi-square test. Petals colour were segregated in 9Red:7Yellow, 15Yellow:1White, 15Red:1Yellow whereas bract shape were segregated as 15 Lanceolate: 1Ovate, 9Narrow lanceolate: 7Broad lanceolate, 9Long lanceolate: 7Short lanceolate, 3Lanceolate:1Extra narrow ovate were recorded. For capitulum shape segregation ratio were recorded as 15Beak shape: 1Big flat and for stigma colour it was 15Yellow:1Red. Faded petal colour were segregated in 15Dark red: 7Off yellow. This research was quite valuable in understanding mendelian inheritance of specific qualitative features of safflower (*Carthamus tinctorious* L.) which can play an important role in crop improvement program.

GIRISDA/AB/121/2022

MANAGEMENT AND UTILIZATION OF POULTRY LITTER/MANURE CONSIDERING ENVIRONMENTAL CONCERN

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The poultry industry is one of the largest and fast growing agro-based industry in the world. India ranked 3rd largest egg producer and 4th largest meat production industry in the world. Poultry industry is currently facing number of environmental issues because of accumulation of large amount of waste in the form poultry manure, hatchery and slaughter house waste. Accumulation of these wastes poses disposal problems and environmental pollution concern unless sustainable and appropriate management techniques are implemented. The litter production in India is about 14.58 million Kg/day. Improper management practices and indiscriminate land application causes contamination of land, ground water, structure of soil. Uncontrolled decomposition of manure product causes NH_3 vitalization. Furthermore greenhouse gases such as CO_2, methane, nitrous oxide released in environment which are hazards for human health and environment. Presently various method used for disposal of litter and manure are land application, animal feed, composting, combustion, production of biogas. There is need to reduce adverse effect on environment, utilizing alternate cost effective improved technology of proper disposal method and also to earn some more profit. The conventional and various alternate management practices for effective use of poultry litter/manure to mitigate environmental consequences associated with air and water quality.

GIRISDA/AB/122/2022

PREDICTION OF HEAT STRESS BY NEUTROPHIL TO LYMPHOCYTE RATIO IN LACTATING SAHIWAL CATTLE

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Prediction of heat stress is an enigma for animal scientists working in the field of environmental physiology. Researchers have used variety of THI models which may be species specific or environmental variable specific. Animal response to stress can be measured in terms of behavioural, physiological, biochemical, hormonal and

molecular responses. However, information on test which can predict heat stress in lactating cattle is scarce in literature. Therefore, forty-eight lactating *Sahiwal* cattle aged above 2 years, weighing 200 to 250 kg of similar parity, lactational yield, and stage of lactation raised at Livestock Farm Complex were included in the study which lasted from February to August with blood sampling of six animals at every fortnightly interval for hematological analysis by auto-analyzer and cortisol estimation by commercial ELISA kit. The meteorological parameters were recorded daily from one-week prior to beginning of experiment till one week after end of experiment and THI was calculated for every fortnight. Neutrophil to lymphocyte ratio was calculated and it was found that N: L ratio had positive correlation with cortisol concentration (R=+0.683). With an increase in THI from 70.42 to 82.44, cortisol concentration has reduced while N: L concentration has not changed while with increase of THI from 83.16 to 88.94, cortisol concentration increased and N: L ratio also increased. Contrarily, with increase of THI above 88.94, both Cortisol concentration and N: L ratio reduced. Thereby, indicating that N: L ratio seems to follow cortisol concentration above THI threshold level of 83.00 and can be used easily for predicting stress.

GIRISDA/AB/123/2022

DECONTAMINATION PROCESSING OF TEBUCONAZOLE AND COMBINATION OF FIPRONIL AND IMIDACLOPRID RESIDUES IN CHILLI FRUITS

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Field and laboratory experiments were carried out to investigate the effect of different decontamination processes on reduction of tebuconazole, fipronil (including its metabolites viz., fipronil desulfinyl, fipronil sulfide and fipronil sulfone) and imidacloprid (including its metabolite, 6- chloronicotinic acid) residues in chilli fruits like tap water washing, lukewarm water washing, saline water washing, vinegar water washing, open pan cooking and microwave cooking after application of tebuconazole and a pre-mix formulation Lesenta 80 WG (fipronil 40% + imidacloprid 40%) on the crop. Tebuconazole and combination of fipronil + imidacloprid in chilli fruits were applied following the application @ 215 and 50 + 50 g a.i. ha^{-1} after spray, respectively. Chilli fruits were collected at 1,3 and 5 days interval after the last spray and subjected to decontamination processes. Washing of contaminated chilli samples provided 22.63-24.87, 20.33-24.33 and 22.22-25.76 % relief from tebuconazole, ∑fipronil and imidacloprid residues, respectively from 1 to 5 day chilli fruits. Lukewarm water washing provided 32.66-34.50, 31.01-33.72 and 35.18-37.62 % relief from tebuconazole, ∑fipronil and imidacloprid residues, respectively. Saline water washing removed tebuconazole, ∑fipronil and imidacloprid residues up to 43.50-48.95, 42.94- 44.91 and 45.37- 47.45 %, respectively. Dipping of chilli fruits in 5 per cent acetic acid for 5 minutes provided relief from tebuconazole, ∑fipronil and imidacloprid residues in the range of 62.50-64.88, 55.60- 57.21 and 63.72-100.00 %, respectively. Open pan cooking reduced tebuconazole, ∑fipronil and imidacloprid residues up to 81.37-100.00, 83.95-100.00 and 82.03-100.00 %, respectively. Microwave cooking when cooked at 800W output in microwave for 5 minutes leads to reduction of tebuconazole, ∑fipronil and imidacloprid residues in the range of 93.62-100.00, 98.12-100.00 and 100.00 % from 1-5 days contaminated chilli fruits, respectively. Decontamination of sprayed chilli fruits revealed that microwave cooking was most effective followed by open pan cooking and vinegar water washing.

GIRISDA/AB/124/2022

REGENERATIVE FARMING PRACTICES FOR ENHANCING CROP PRODUCTIVITY AND REDUCING ENVIRONMENTAL FOOTPRINT

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The present tropical agriculture system escalating towards degenerative commodity mainly because of the high cost of cultivation, low/no carbon input, rapid carbon mineralization and deterioration of soil health due to climate change and non-judicious intensive use of chemical fertilizers and pesticides. Regenerative agriculture offers a low-cost climate-resilient farming practice that catalyzes carbon sequestration by tipping the balance of more carbon input than output and a balanced fertilizer approach leading to a reduced environmental footprint. Enriching carbon in soil play a pivotal role in restoring degraded soils, enhancing crop production and holding onto other nutrients including nitrogen and phosphorus, keeping them from seeping into surface water and triggering harmful algal blooms in lakes and streams. Keeping in view the above-mentioned challenges in present agriculture and prospects of regenerative agriculture, an experimental trial was laid at IRRI South Asia Regional Centre (ISARC), Varanasi.The objective of the trial is to evaluate the regenerative farming practices in terms of productivity, profitability, soil health and GHGs mitigations. The experiment was initiated in Rabi 2020-21 in main plots (Conventional Farming (CF-rice-wheat; no residues) and Regenerative farming (RF-rice-wheat-mungbean; 50% rice crop residue)) and sub-plot (State Fertilizer Recommendation (SRF) and Site-Specific Nutrient Management (SSNM)). The SSNM recommendation was generated by Rice-Wheat Crop Manager (RWCM) developed for EasterN UP in collaboration with BHU and several other partners. The sub-plot was further divided into with Samvardhak and without Samvardhak. The trial was replicated four times in a split-plot design. PBW 343 wheat variety was used for the experiment. In the Samvardhak plot, we reduced NPK by 25% to assess the impact of its application on yield and other attributes. In conventional farming, 15% and 21% yield increment was observed by the application of Samvardhak in SFR and SSNM, respectively. Whereas 18% and 26% increment in yield was recorded by the application of Samvardhak in SFR and SSNM, respectively in regenerative farming. Such increment might be due to the provisioning of conducive rhizosphere micro-climate for nutrient uptake and mobility. Growth parameters showed a similar trend with the yield. In nutsheel, regenerative farming practices might be the game changer in developing sustainable production systems in Eastern UP with provisioning of improved livelihood and scalable technologies for reducing GHGs emission.

GIRISDA/AB/125/2022

STUDIES ON GENETIC VARIABILITY IN GERMPLASM OF MAIZE (*Zea mays* L.)

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The present investigation was carried out to estimate genetic variability for twelve characters in 18 inbreds of maize using Randomized Block Design with three replications at Rajasthan College of Agriculture, MPUAT, Udaipur (Rajasthan) during *spring* 2021. Significant genotypic differences were observed for all the traits taken under study, revealing that ample of variability exists among the inbreds for all the characters. Phenotypic coefficient of variation (PCV) was little higher than the respective genotypic coefficient of variation (GCV) for all the characters indicating the existence of interaction of environment with the inbreds. The PCV and GCV for plant height, cob height and grain yield per plant were observed high and the traits had least differences between GCV and PCV, hence selection based on phenotype for these traits may be beneficial. Days to 50 per cent tasseling, days to 50 per cent silking and grain oil content possessed high heritability together with moderate genetic advance as per cent of mean (Genetic Gain), implying that these characters can also be taken into consideration for advancement. High heritability coupled with

high genetic gain was observed for plant height, cob height, grain yield per plant and grain protein content. Therefore, the investigation suggests that selection for these traits would be rewarding for enhancing the productivity of the inbred germplasm or utilizing them in hybridization programmes for yield improvement in maize.

GIRISDA/AB/126/2022

ANALYSIS OF TRENDS IN THE STREAMFLOW OF WEST BANAS RIVER, RAJASTHAN

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This study presents a statistical quantification of the changes experienced in observed streamflows in the West Banas River, which flows through a stretch of 50 km in the Sirohi district of Rajasthan, during the past three decades. The daily streamflow data for a period of 30 years (1989 – 2018) at the sole gauge station located in the town of Abu Road was obtained from the Water Year Books published by the Central Water Commission, India. The daily streamflow data was converted into datasets representing mean streamflows of various time steps, i.e., monthly, seasonal and annual. The analysis entailed the application of widely-used Mann-Kendall (MK) test in order to ascertain the direction of trend in every time series. The autocorrelation in the time series were also evaluated in order to identify any inherent serial correlation which may hinder the performance of MK test. The *acf* function and *modifiedmk* package in R software were used to conduct the autocorrelation test and MK test, respectively, and a modified version of the MK test consisting of a variance correction approach was implemented in case of a serially correlated series. The results of the autocorrelation test revealed that the monthly mean flow series of January and seasonal time series of Winter were serially correlated. The MK test indicated that streamflow possessed a decreasing tendency across all the mean flow series except in the case of monthly series of August, September and October along with the series of post- monsoon season. The mean monthly series of July was found to be the only statistically significant time series (at 10% confidence level) and it witnessed a marked decrease in streamflow.

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CLIMATE RESILIENT TECHNOLOGIES TO MEET THE CHALLENGES IN VEGETABLE PRODUCTION

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Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate resilient is the development and identification of climate resilient crop varieties, with enhanced tolerance to heat, drought, flooding, chilling and salinity stresses are essential in order to sustain and improve crop yields to cope with the challenges of climate change. Climate Resilient Agriculture can be defined as 'agriculture that reduces poverty and hunger in the face of climate change, improving the resources it depends on for future.The changing patterns of climatic parameters like rise in atmospheric temperature, changes in precipitation patterns, excess UV radiation and higher incidence of extreme weather events like droughts and floods are emerging major threats for vegetable production in the tropical zone. Vegetable crops are very sensitive to climatic vagaries and sudden rise in temperature as well as irregular precipitation at any phase of crop growth can affect the normal growth, flowering, pollination, fruit development and subsequently decrease the crop yield. To mitigate the adverse impact of climatic change on productivity and quality of vegetable crops there is need to develop sound adaptation strategies. The emphasis should be on development of production systems for improved water use efficiency adoptable to the hot and dry condition. The crop management practices like mulching with crop residues and plastic mulches help in

conserving soil moisture. Excessive soil moisture due to heavy rain becomes major problem which can be overcome by growing crops on raised beds. Development of genotypes tolerant to high temperature, moisture stress, salinity and climate proofing through conventional, nonconventional, breeding techniques, genomics and biotechnology etc. are essentially required to meet these challenges.

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ADVANCES IN DAIRY SCIENCE AND TECHNOLOGY FOR ENHANCING THE FARMER'S INCOME

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Farmers in India as well as other parts of world are very much dependent on dairy and allied industries for their income. Due to inadequate and bad farm management, the dairy industry is dealing with low animal output. Advances in dairy equipment, technologies and products can surely help in increasing farmer‟s income as well as taking dairy field to new heights. Various new technologies and farm innovations like better breeding, robotic milking, feed innovations, health tracking, digital farm management and many others are the need of the hour. Also, there is a requirement for local and regional technology generation. Apart from this, innovations and technologies must reach the farmers at the right time in order to have better results. Furthermore, the impacts of these technologies on the farmers‟ livings are needed to be addressed properly for future recommendations. Already, a large number of dairy innovations are present in the society, all we need to do is to have a better extension system and much better follow up system.

GIRISDA/AB/129/2022

RENEWABLE ENERGY: CURRENT STATUS AND FUTURE POTENTIAL

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Non-renewable resources cannot be replaced or are replaced slowly and gradually by only natural processes. It is very essential to choose which source of energy must be used and why. Fossil fuels will deplete one day and the industries must turn to renewable sources as soon as possible. India‟s power demand has been rising at a fast pace. Renewable energy resources can be replaced easily within a short time period. In India, renewable energy resources like solar energy, wind energy, hydropower, tidal energy, geothermal energy and bioenergy can be used to overcome energy shortages. Renewables comprise~36.2% of total installed capacity, with solar accounting for ~9.8% and among renewables, solar accounts for 27.2% of the installed capacity. India is the only country, among the G20 countries, which is on track to achieve its targets under the Paris Agreement. As of July 2021, India had 96.96 GW of renewable energy capacity, and represents 25.2% of the overall installed power capacity. As of August 2021, India‟s installed renewable energy capacity stood at 100.68 GW. The country plans to reach 450 GW of installed renewable energy capacity by 2030, with 280 GW (over 60 %) expected from solar power. India has been ranked fourth in wind power, fifth in solar power and fourth in renewable power installed capacity, as of 2020. In the EY Renewable Energy Country Attractive Index, India ranked third due to an exceptional performance on the solar photovoltaic (PV). Advancement in technology, proper regulatory policies, tax deduction, and attempts in efficiency enhancement due to research and development (R&D), are some of the pathways to conservation of energy and environment that should guarantee that renewable resource bases are used in a cost-effective and quick manner. Given the enormous potential

of renewables in the country, coherent policy measures and an investor-friendly administration might be the key drivers for India to become a global leader in clean and green energy.

GIRISDA/AB/130/2022

ABIOTIC STRESS MANAGEMENT IN VEGETABLE CROPS

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During the last 50 years, it has been shown that abiotic stresses influence plant growth and crop production greatly. The yield and quality of vegetable crops mainly depend on genotype, environmental conditions, and cultivation management. Abiotic stresses, such as adverse environmental conditions can strongly reduce crop performance, yield losses ranging from 50% to 70%. The most common abiotic stresses are represented by cold, heat, drought, flooding and salinity. These abiotic stresses affect multiple physiological and biochemical processes in plants. The ability of plants to face these stresses depends on their adaptation aptitude, and tolerant plants may express different strategies to adapt to or avoid the negative effects of abiotic stresses. At the biochemical level, several antioxidant systems can be activated and many enzymes may produce such compounds as proline, glycine, betaine, amino acids, etc. These stresses reduced the yield of crops, depending on the type of crop and stress period. In many semi-arid and arid regions of the world, crop yield is limited due to increased rate of soil salinity. Salinity and drought are the two most complex stresses, which have severely affected plant growth and biomass production since long. Abiotic stresses have proved to reduce crop performance and yield. According to reports, agriculture is considered the most endangered activity adversely affected by climate changes. Food security and ecosystem resilience are the most concerning subjects worldwide. Climate-smart agriculture is the only way to lower the negative impact of climate variations on crop adaptation, before it might affect global crop production drastically. Water excess or hypoxic conditions during winter and spring can be treated with nitrate fertilizers, which increase survival rate. Salinity stress of sensitive crops may be alleviated by maintaining water content close to the field capacity by frequent and low-volume irrigation. Lodging can be prevented by installing shelterbelts against dominant winds, adopting equilibrated nitrogen fertilization, choosing a suitable plant density, and optimizing the management of pests and biotic diseases harmful to the stability and mechanic resistance of stems and roots.

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AVIFAUNAL COMMUNITY DIVERSITY IN AGRICULTURAL LANDSCAPES ALONG THE ARPA RIVER CATCHMENT IN CENTRAL INDIA

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Avian communities are very good indicators of integrity and stability of ecosystem structure and functions. Therefore the assessment of bird assemblages in different landscapes is emphasized from an environmental monitoring perspective. Arpa River which originates from the high hills of the Maikal range of Central India, is lifeline of Bilaspur district in Chhattisgarh. It flows in the stretch of 147 km through the diversity of habitats like forest, scrubland, agricultural fields, urban and village settlements. In the present work bird surveys were carried out during 2019-2022 to document the avian species assemblage of agricultural landscapes along the catchment of Arpa river. A total of 101 bird species under 44 families and 18 orders were recorded from the study area. The bird species richness was highest for the order Passeriformes, followed by other orders. Among the recorded avifauna, 77 species were residents, 18 species were winter migrants and six species were summer migrants. Species richness was recorded to

be highest in the winter season compared to the remaining year. Species richness, abundance, diversity and evenness differed significantly ($P < 0.05$) between seasons as well as among the different habitats. One endangered species *Neophron percnopterus* and two Near Threatened species *Threskiornis melanocephalus* and *Psittacula eupatria* were recorded in this region. Most bird species were insectivorous followed by carnivorous, omnivorous, granivorous, frugivorous and nectarivorous. The present study provides significant records in the study site and provides a baseline data for future study with reference to conservation in Central India region.

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EVALUATION OF INBREDS AND THEIR F1S FOR FLOWERING AND POST-HARVEST ATTRIBUTES IN SNAPDRAGON (*Antirrhinum majus* L.)

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The present investigation was carried out in half diallel crossing pattern using ten parental lines (AG-1, AG-2, AG-3, AG-4, AG-5, AG-6, Vilmorin, SA-1, Sant-11 and Sant-22)to evaluate the diversity created. The evaluation of F1s was done in two years 2004-2005 and 2005-2006 for flowering and post-harvest characters. The experimental material (10 parents and 45 F1s) was planted in Randomized Block Design. Twelve stems of each genotype were cut to 8 cm from the ground and placed in distilled water. Stems were discarded when last floretwas about to wilt. Significant differences were noted among the genotypes for all the charactersin both years. Among different genotypes of snapdragon, diameter of spike ranged from 4.29 to 12.61 mm. Maximum spike weight was observed in SA-1 × AG-4. This also gave highest number of open florets/spike and maximum weight of spike at senescence. Spike length was found to be maximum with SA-1, which was at par with SA-1 × AG-4. The maximum diameterof florets was recorded with AG-1 × Vilmorin, whereas maximum number of spikes per plant for cut-flower was recorded with AG-3 × AG-5. The cross AG-1 × Sant-11 was resulted in maximum number of florets per spike during both the years. However no definite pattern followed in per cent opening of florets. Vase life ranged from 11.00 days to 14.45 days duringfirst year. Whereas in second year, it varied from 10.22 days to 21.50 days. This variation in range may be due to insect infestation occurred more during first year.

GIRISDA/AB/133/2022

GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN GROUNDNUT

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The Present investigation of experimental yield trial on genetic variability involving 36 genotypes of groundnut were carried out in kharif season 2018-19 at Research farm, Department of genetics and plant breeding, college of agriculture, RVSKVV, Gwalior (M.P.). The 14 traits were recorded and genetic parameters *viz.*, PCV, GCV, heritability and genetic advance as per cent of mean were studied. The analysis of variance revealed genotypes were significantly differed for all the characters, thereby, indicating variability for all the characters. The estimation of high heritability value coupled with high genetic advance was recorded for pod yield per hectare, followed by number of primary branches per plant, pod yield per plant, kernel yield per hectare, kernel yield per plant, number of secondary branches per plant, 100 pod weight, number of pod per plant, 100 kernel weight and plant height indicating that the inheritance of these characters were most likely due to additive gene effects and direct selection for these traits would be more effective for desired genetic improvement. The genotypes viz., ICGV-8705, ICGV-13564, ICGV-13565, PBS-12201, ICGV-13574 and ICGV-13555 demonstrated high mean performance for pod yield and its related traits.

GIRISDA/AB/134/2022

SUSTAINABLE TRANSFORMATION OF AGRICULTURE AND FOOD PRODUCTION SYSTEM IN ALLEVIATING POVERTY

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Poverty and hunger are addressed in the global agenda for sustainable development through building sustainable agriculture and food systems. Intensive farming methods and their variants, such as sustainable intensification or ecological intensification, are currently being marketed as technology that can boost agricultural productivity while lowering environmental impact. These, on the other hand, are solely concerned with per-hectare productivity, with growing negative consequences for local culture and the environment. As an illustration of important difficulties in global agriculture, this study examines the harmful effects of crop- and livestock-based farming systems on the Indo-Gangetic plains, as well as in the United States, China, and South America. These effects are divided into four categories: environmental, social, economic, and health. These have been analysed for four farming systems: low-input, high-input, organic, and desirable farming systems. They are separated into technical, geographic, and social indicators. In order to create pathways for the adoption of the new paradigm, seven global geographic regions were examined in terms of their socioeconomic indicators and agricultural situation. The suggested path for change in this article includes an emphasis on research and training, legislative and institutional changes, a cost-benefit analysis, and modifications in production models that take scale and sustainability indicators into account and include innovations in consultation with all stakeholders. This new paradigm has the ability to channel global efforts toward more community-driven, 'bottom-up' solutions.

GIRISDA/AB/135/2022

EXPLOITATION OF TWO LINE BREEDING BY USING THERMO SENSITIVE MALE STERILE LINES IN RICE (*Oryza sativa*. L)

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Rice (*Oryza sativa* L.) is the most important staple food for about 50 per cent of the world‟s population that lives in Asia, where 90 per cent of the world‟s rice is grown and consumed. One of the most effective ways to make use of crop heterosis is to produce hybrids by taking advantage of male sterility with the utilization of the three-line system is a classical method. This system is expensive and cumbersome. Maintaining the CGMS (Cytoplasmic Genic Male Sterility lines) and choosing an appropriate restorer line for developing the fertile hybrids are major limitations. The application of genetic male sterility in hybrid rice production has great potential to revolutionize hybrid seed production technology in rice. The two line system of hybrid breeding utilizing Environmental Sensitive Genic Male Sterility (EGMS) is considered as an alternative to overcome the problems associated with three-line breeding and to surpass the yield plateau (Maruyama *et al.*, 1991). In rice both photoperiod sensitive genic male sterility (PGMS) and temperature sensitive male sterility (TGMS) has been discovered and successfully developed. In tropical condition like India, where day length differences are marginal, TGMS system is considered to be more useful than the PGMS system (Virmani, 1996). After the identification of the TGMS mutant, Anong 1S (Tan *et al.*, 1990), several TGMS lines have been developed in China, IRRI and other countries. For successful exploitation of this novel male sterility system in heterosis breeding, more TGMS lines need to be developed and characterized for their sterile and fertile alteration. Studying the inheritance of TGMS would help in breeding new TGMS lines with diverse genetic back

grounds.The TGMS lines become completely sterile under high temperature (> 32˚C) and fertile under low temperature (< 24˚C) (Maruyama *et al.,* 1990) at panicle initiation stage have been taken advantages for hybrid seed production and seed increase of PGMS and TGMS lines. The major advantages of TGMS system are simplicity, overcoming the negative effects of male sterile cytoplasm and the ease of multiplication and restoration (Yuan, 1997). These two line hybrids have 5-10 per cent yield advantage over the three line hybrids.

GIRISDA/AB/136/2022

GENETIC ENGINEERING AND BIOTECHNOLOGY IN FLORICULTURE

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A key goal in floriculture is to develop new ornamental cultivars with superior floral qualities. Because of increased demand, the ornamental plant business requires new plant varieties with superior morphological features, flower colour, pigments, stress tolerance, and disease resistance. Classical breeding methods, in combination with biotechnological approaches such as tissue culture and micropropagation techniques, polyploidy induction, mutation breeding and genetic engineering have been used to develope many varieties of ornamental plants and have been widely adopted as more feasible methods to overcome the inherent limitations of traditional techniques. Biotechnology can be used to create plants with novel traits such as flower architecture, colour, aroma, abiotic stress resistance and post-harvest life. Genetic engineering is a useful tool for increasing the floriculture gene pool and fostering the development of new commercial types. Currently, the commercialization of genetically altered flowers is limited to unique coloured carnations. In model flowers like petunia, the biosynthesis of floral colours, particularly anthocyanins has been explored in considerable detail. The first success story in floriculture genetic engineering was the creation of new flower colours. Floral smell, floral and plant shape, flower senescence on the plant, post-harvest and disease resistance have all been studied. New cultivars for dwarf plant types, early flowering, fragrant cultivars, photo-insensitivity, uniformity, shape, size, dwarfness and colour are desperately needed. Floricultural crops may include nutritive and physiologically active components such as alkaloids, phenolic acids and flavonoids whichshould be investigated in order to increase the value of the plant species of interest. The idea of floral trait modification has supported genetic engineering and as a result, transgenic plant types with great aesthetic and commercial value have emerged. Flowerson ornamental plants are typically very attractive.

GIRISDA/AB/137/2022

EFFICACY OF SOME AUTOCHTHONIC PLANT EXTRACTS AGAINST TORMENTOR OF HOLD ON FOOD COMMODITIES- GENUS *Tribolium castaneum*: COLEOPTERA (TENEBRIONIDAE)

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India produces more than 163 staple foods including grains, legumes, spices, oilseeds, tubers, etc. and herbs, in addition to 900 processed foods. Efficient post-harvest storage can contribute significantly to socio-economic empowerment in developing countries. Most of the harvested grain is more or less stored on the sidewalks, as storage of edible grain is essential in both times of scarcity and times of overproduction. The Food and Agriculture Organization explained that a third of all food production is lost annually, about 1.3 billion tons (20% in oilseeds, meat and dairy products, 30% in grains, 35% in fish and 40-50% in fruits and vegetables). The animal feed and its ingredients consist of grain flour and are stored according to the recipe for later rearing. This feed or grain used is normally attacked by storage insects, mainly of the genus *Tribolium*. The present studies were carried out to evaluate the effectiveness of the botanicals to assess the effect of the extract of four plants *Catharanthus roseus, Nerium Indicum, Eucalyptus globulus* and *Azadirachta indica* against two pests *Rhizoperta dominica* and *Tribolium castaneum* to assess the percentage of mortality determination of larvae and examination of adult animals. The results showed that the extract from all plants had a lethal effect on adults and larvae of both pests during storage compared to the control treatment. *Azadirachta indica* extract was more effective in adults of both stored grain pests, resulting in 58.67% mortality for *Rhizoperta dominica* and 80.00% mortality for *Tribolium castaneum*. Similarly, *Azadirachta indica* also showed the highest mortality against *Tribolium castaneum* larvae (58.67%) and *Rhizoperta dominica* larvae (65%). From the previous results, it is concluded that *Azadirachta indica* showed the highest mortality rate against larvae and adults of both pest kernels. The insecticidal effects of plant extracts have been considered more effective and accessible to control various insect pests.

GIRISDA/AB/138/2022

INDIAN POLICIES FOR AGRICULTURE: AN OVERVIEW

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Agriculture endures to be an important sector of Indian economy, though its share in the gross domestic product (GDP) has dropped from about 50 per cent in early-1950s to 14 per cent in 2011-12. Occupation in agriculture has also shown a drop, although slowly and presently it accounts for 52 per cent of the country‟s total labour force. The decreasing share of agriculture in GDP and employment is reliable with the theory of economic development. However, a faster and sustainable development in the sector ruins dynamic for making of jobs, improving incomes, and confirming food security. India has 140 million hectares of net cropped area, next only to that of the USA. Similarly, India‟s irrigated area (63.26 Mha net and 86.42 Mha gross) is also the second largest in the world, next only to China. The country is wealthy with natural resources and various climatic conditions, and much of the land in India can be double cropped. Here we will evaluate all agricultural policies from 1947 to 1999 under 5year plans. The performance of agricultural sector has been quite inspiring, making the country self-sufficient in food. During the Eleventh Five-Year Plan, the agriculture and allied sector has recorded a regular annual growth rate of 3.6 per cent, slightly lower than the target of 4.0 per cent, but higher than the average annual growth rate of 2.4 per cent achieved during the Tenth Plan. This improved presentation in recent years is also credited to the impressive growth in capital formation in the sector. The gross capital formation in agriculture and allied sector has more than doubled in the past

10 years with an average annual growth of 8.1 per cent. As per the latest Agricultural Statistics at a Glance (2012), India is the world‟s largest producer of pulses, milk, many fresh fruits and vegetables, major spices, select fresh meats, select fibrous crops such as jute, several clips such as millets and castor oil seed.

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INDIAN FLORICULTURE MARKET GROWTH

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The cultivation of flowering and attractive plants is known as floriculture or flower farming. Although flowers have long been a part of Indian culture and have been planted for a variety of purposes ranging from aesthetic to social and religious, the commercial floriculture sector is relatively new. Floriculture has become one of India's most important economic trades due to strong growth in demand for cut and loose flowers. By 2026, the Indian floriculture market is estimated to reach INR 661 billion, with a CAGR of 19.2% from 2021 to 2026. Because of the increasing urbanization and impact of western cultures, "Saying it with flowers" has become increasingly popular fora variety of occasions, including Valentine‟s Day, birthdays, festivals, anniversaries, marriages, farewell parties and religious rituals and so on. We expect flower consumption to rise in the coming years as urbanization and the influence of western culture grow. The majority of flower producers have been able to build a product that uses next generationtechnology and encourages better irrigation control in response to flower farmers' expectations. This product produces robust and uniform plants that can build a robust and healthy root system in low-light or high-light circumstances. Producers may expect optimal performance, quantity and quality regardless of the season. To stay competitive, flower producers have developed instruments like the groWatch, which is a box (hub) with a distinct design that collects data from nearby sensors. In short, the facility can control up to 10 sensors that measure temperature, humidity and brightness, as well as a webcam. The case then restores the data that is available in real-time on a computer viaa specialized web page, as well as on a tablet or smartphone via a specific application.

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INTEGRATED NUTRIENT MANAGEMENT IN MARIGOLD

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Marigold has become one of the most popular commercial flower crops in Maharashtra's Vidharbha region. Day by day its market demand increases during the GaneshChaturthi, Diwali, Dusherra, and Navratri festivals. It has gained popularity among gardeners and flower dealers due to its easy culture and adaptability. It has a wide range of flowering habits, produces marketable flowers in a short period of time and attracts flower growers with its attractive colour, shape, size and keeping quality. Nutrients play a critical role in influencing the growth and yield of the crop. Therefore standardising the appropriate dose of nutrients particularly Integrated Nutrient Management is essential for optimising soil structure, physico-chemical qualities and flower output. Organic manures and biofertilizers, along with a balanced application of chemical fertilizers, have been shown to increase soil physico-chemical and biological qualities as well as fertilizer efficiency. With the introduction of vermiculture, the potential of vermicompost to provide nutrients and sustain beneficial bacteria is being recognised. Almost all crops, including flowers, benefit from manures because of their low carbon-nitrogen (C: N) ratio and high nutrient value. Micronutrient spray mixed with inorganic fertilizers may aid to enhance flower productivityand quality with an extended shelf life of flowers through Integrated Nutrient Management.Furthermore, overuse of these synthetic fertilisers and chemicals can cause environmental pollution, posing risks to flora and fauna as well as humans. In this case, 100% organic farming may be a desirable proportion for boosting agricultural produce quality without compromising soil health or environmental quality. Therefore more focus should be given on the use of organic manure such as farm yard manures, biofertilizers like VAM, Azotobacter, PSB and plant growth promoting microbes and micro nutrient foliar spray, in addition to the chemical fertilizers.

GIRISDA/AB/141/2022

AN OVERVIEW ON CYST NEMATODE MANAGEMENT THROUGH BIO-AGENTS

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Cyst nematode, *Heterodera* spp. are sedentary endoparasites that negatively effect on many crops in all over the world. Current management practices are not enough to completely control cyst nematodes. Application of certain chemicals is also being further limited in recent years. It is therefore crucial to develop additional control strategies through the application of environmentally benign methods (Zukerman and Esnard, 1994). Application of nematode antagonistic microorganisms could provide another option for nematode damage management. Antagonistic bacteria, nematophagous fungi, and yeasts have all been tested as biocontrol agents against nematodes (Sharma and Guta, 2010). There has been much research performed around the world on the topic, leading to useful outcomes and interesting findings capable of improving farmers‟ income. It is important to have dependable resources gathering the data produced to facilitate future research. Therefore, environmentally benign treatments included beneficial microorganisms, soil amendments and other emerging strategies were used to control cyst nematodes.

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IN VITRO RESPONSE OF PROMISING SUGARCANE VARIETIES FOR SALINITY TOLERANCE THROUGH SHOOT TIP CULTURE

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Sugarcane is one of the most important industrial crop in both tropical as well as subtropical regions of the world and a major export product of many developing countries. Reduction in sugarcane productivity and sugar recovery is mainly due to abiotic stresses. In India most of the sugarcane growing areas are under the influence of salinity. The present investigation was carried out on experimental shoot apex portion of two sugarcane varieties CoN-13073 and CoN-13072, were exposed to different NaCl levels to assess salinity tolerance under *in vitro* condition. Among the shoot apex portion, undergone to different NaCl concentrations maximum survival per cent was found in untreated shoot apex (37.20%) in genotype CoN-13073. Maximum regeneration per cent (78.40%) was observed without NaCl concentration in genotype CoN-13073. In case of number of days for shoot formation genotype CoN-13072 regenerated within 15.40 days without NaCl concentration. The highest number of multiple shoots were obtained (28.40) and (24.20) from the treatment where 0.0% NaCl application was done in CoN-13073 and CoN-13072 respectively.

GIRISDA/AB/143/2022

INTEGRATED NUTRIENT, WEED, DISEASES AND PEST MANAGEMENT

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Soil is a fundamental requirement for crop production as it provides plants with anchorage, water and nutrients. A certain supply of mineral and organic nutrient sources is present in soils, but these often have to be supplemented with external applications, or fertilisers, for better plant growth. Fertilisers enhance soil fertility and are applied to promote plant growth, improve crop yields and support agricultural intensification. The aim of Integrated Nutrient Management (INM) is to integrate the use of natural and man-made soil nutrients to increase crop productivity and preserve soil productivity for future generations. The under-lying principle in any pest control programme is that the crop must be protected, while interfering as little as possible with factors which affect the long-term maintenance of the production system. The cheapest and most reliable way to deal with pest and weed problems is to anticipate and avoid them, if possible. When pesticides are needed, choose materials and application methods that are effective without adversely affecting other organisms or the natural environment. The cost aspect is also important; where two registered chemicals are equally effective for specific control, it is logical to use the less expensive one. Many normal cultural practices can be manipulated to minimise pest damage. Making such adjustments is often the most economic and reliable long-term defence against pests. A strong, well-grown crop is often less prone to attack by various pests and diseases, as well as being better able to withstand such attacks, than physiologically weak plants. Cultivar selection, field selection, land preparation, planting methods, time of planting, fertilizer application, irrigation and cropping sequence (rotations), are all points which have an impact on pest problems. This encourages farmers to focus on long-term planning and make greater consideration for environmental impacts.Plant diseases are a major threat to farmers, consumers, environment and the global economy. Advance prediction of these diseases through plant diseases forecasting systems can be very helpful solution in minimizing these losses. Indiscriminate use of pesticides is also a serious health concern as many are toxic and biomagnified. Integrated plant diseases management advocates the use of multiple control measures, including, if possible, a rational system for predicting the risk of diseases outbreak. Presently, web based technologies have led to great strides in the development and employment of decision support system.INM relies on a number of factors, including appropriate nutrient application and conservation and the transfer of knowledge about INM practices to farmers and researchers. Boosting plant nutrients can be achieved by a range of practices covered in this guide such as terracing, alley cropping, conservation tillage, intercropping, and crop rotation. It is absolutely vital for the grower to maintain a “hands-on” management approach in production. He must be aware of problems as soon as, or even before, they occur. Weeds may be shaded out by the developing crop, and pests and diseases may be present, but reduced to such a low level that the manager could decide to tolerate the problem without taking active measures for control. However, awareness is needed before the action decision is taken, and routine visits to the field must be made frequently.

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CROP IMPROVEMENT BY MUTATION IN GLADIOLUS

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The floriculture industry is changing quickly all around the world. Because of the globalization andits effect on revenue generation in many regions of the world, most countries per capita consumption offlowers is increasing. The climate of Maharashtra state is ideal for growing a wide variety of floricultural crops. It also provides numerous hidden possibilities for gladiolus cultivation success. Its cultivation, however is limited to areas near major cities such as Mumbai, Pune, Nasik and Satara where exotic and indigenous varieties are primarily produced. Despite a favourable climate, gladiolus agriculture has not yet reached its full potential. The slow rate of area expansion is due to a glut in the floral markets. Gladiolus, an ornamental bulbous plant, is well-

known for its spikes with rows of lovely flowers that endure for a long time. Gladiolus is referred to as the "Queen of the Bulbous Flowers" and it has been extensively hybridized, and many variants have a wide range of beautiful bloom colours. Gladioli are vegetatively propagated by corms and cormels that are best suited for commercial exploitation through mutation breeding with no homozygosity and loss of any favourable characteristics. Previously, many mutants for various attractive colours were isolated. In recent years, induced mutations have played increasing important role in annual self pollinated crops. The history of mutation is as old as the science of modern genetics. Genetic variability, the raw product for evolution of plant species is replenished by spontaneous mutations. It is ideally suited for the improvement and induction of new types in vegetatively propagated crops like gladiolus, which is highly heterozygous and frequently polyploid in nature. Gladiolus has long period of sexual reproduction and in some varieties seeds are rarely formed and take two to three years to produce flowers. However by mutation breeding, it is possible to produce new cultivars within a short span of time. The process could easily be speeded through invitro culture technique cum mutation breeding.

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IMPACT OF ORGANIC MANURES ON SOIL HEALTH AND SOIL PROPERTIES

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As a key component of agricultural sustainability, organic manures contribute greatly to improving soil fertility. The applications of organic manures play a vital role in improving soil physico-chemical properties and distribution of micro-macro nutrients and their transformations under different cropping system. The applications of organic manures control the soil pH and electrical conductivity and aided in improving soil physical conditions *viz.* bulk density, particle density, porosity, and water holding capacity etc. The newly sourced artificial fertilizer had a short-term benefit, but it had severe long-term side effect such as soil toxicity and decline soil fertility. Subsequently, the idea of organic farming has been highly acceptable for developing organic agriculture system. The use of organic manures has many advantages of being cheap, improving soil structure, texture and aeration increasing the soils water retention abilities and stimulating healthy root development. There are several sources of organic fertilizer such as minerals, animal sewage sludge and plant. Therefore, it is highly recommended that, usage of organic manure or organic fertilizer (i.e., animal manure, plants residue and sewage sludge) on longer term basis has shown continuous improvement in soil productivity.

GIRISDA/AB/146/2022

PROTECTED CULTIVATION: A TECHNOLOGICAL INNOVATION IN HORTICULTURE

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In the present scenario, yield and quality of horticultural crops are dictated by the changing climatic conditions which includes extremes of temperature, humidity, light, rainfall, wind velocity and carbon dioxide concentration, among others and also biotic stress which includes problems of weeds and pests. These factors have led to regular crop loss and caused huge economic losses to the farmers. Therefore, new production technologies are required which can enhance the productivity of crops and profitability of farmers. One such technological innovation in the field of horticulture is protected cultivation. Protected cultivation is a process of growing crops in a controlled environment as per region and requirement of the crop. Some of the commonly used practices under protected cultivation includes greenhouse technology, low height tunnels, naturally ventilated polyhouses, net houses, walk-in tunnels, anti-insect net polyhouses, drip irrigation systems, fertigation and mulching. Vertical farming techniques by growing vegetables

in vertically stacked layers which maximizes crop productivity in a limited space, is also included under the protected modes of cultivation. It often incorporates controlled environment agriculture, which aims to optimize plant growth, and soilless farming techniques or hydroponics by using mineral nutrient solutions which provides access to nutrition, water and oxygen. Among all the protected cultivation structures or techniques, greenhouse cultivation provides maximum benefit to the farmers. The major crops which can be grown under protected structures includes high-quality vegetables like cherry tomatoes, yellow and red bell peppers, cucumber, chilli, green capsicums, parthenocarpic brinjal, leafy and exotic vegetables and floriculture crops like orchids, carnation, rose or gerbera. Protected cultivation technology is being widely practiced in the developed countries, but in India its use is limited because of high initial capital cost and lack of skilled human power and technical knowledge. Therefore, need of the hour is to focus more on this high technology-based agriculture so that the economic returns from the horticultural produce can be increased substantially.

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EFFECT OF DRIP FERTIGATION SCHEDULE AND DIFFERENT MULCHES ON VEGETATIVEGROWTH OF GLADIOLUS CV. *Psittacinus* HYBRID

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The field experiment was conducted at Department of Horticulture, Junagadh Agricultural University (Junagadh) during the year October 2016 to April 2018. The experimentwas laid out in Randomized Block Design with Factorial concept (FRBD) consisting three factors with three replications. The treatment comprised with three levels of drip fertigation viz., water soluble NPK @ 200:200:200 kg/ha (F1), water soluble NPK @ 300:225:225 kg/ha(F2) and water soluble NPK @ 400:250:250 kg/ha (F3); three levels of split application of fertilizer viz. 2 split i.e. 30 and 60 DAP (S1), 3 split i.e. 20, 40 and 60 DAP (S2) and 4 split i.e.15, 30, 45 and 60 DAP (S3) and three different mulches viz. red mulch (M1), black mulch (M2)and silver mulch (M3). The effects of these treatments were noted on vegetative growth of gladiolus. Significantly maximum sprouting percentage, plant height (at 30, 60 and 90 DAP), number of leaves (at 30, 60 & 90 DAP), number of effective tillers/plant and number of total tillers/plant, while number of non-effective tillers/plant was minimum with the application of drip fertigation of NPK @ 200:200:200 kg/ha (F1), 3 split application of fertilizer (S2) and use of red mulch (M1). For interaction effect, the result was found non-significant for all parameters except number of effective tillers/plant was recorded in treatment combinations F1S2, S2M1, F1M1 and F1S2M1.

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COMPARATIVE STUDY OF SEED-CUM FERTILIZER DRILL FOR SOWING OF WHEAT CROP IN VERTISOL

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In India rice- wheat copping system is very common. India is one of the main wheat producing and consuming country in the world. Delay in wheat sowing due to presence of crop residue reduced crop yield of 30-40 kg per ha per day if crop is sown after mid of November. This loss can be saved through early and fast seeding of wheat using seed cum fertilizer drill compared to broadcasting method. Also the yield by conventional method is very much less than the potential. Considering the above points, feasibility testing of seed cum fertilizer drill was done at farmer's fields for three consecutive years. The comparison was made between seed cum fertilizer drill and conventional method of sowing (broadcasting). Studies were conducted to evaluate the comparative performance of zero till seed drill and roto-till seed drill for wheat crop and its comparison with conventional method, to study the effect of speed of operation (km/h) and depth of sowing (cm) with respect to fuel consumption (l/h), wheel slippage (%). Field capacity (ha/h), field efficiency (%), yield (tones\/ha). Speed of operation and ground drive wheel skid were found positively

correlated with fuel consumption. It was also noted that there was a high positive correlation of depth of operation, speed of operation with slippage. The result of field test conducted showed that the working performance were proper at the forward speed of 3.0 km/h with an average depth of sowing of 4.5 cm for zero till seed drill and forward speed of 3.5 km/hr and depth of 4.5 cm for conventional seed drill and roto till seed drill. In case of zero till drill the capacity at this forward speed was .4431 ha/h with a field efficiency of 81% and in case of roto till seed drill field capacity was found to be .3796 ha/h with a field efficiency of 77%. The average seed rate obtained in the field was observed as 124kg/ha, 154kg/ha, and 117kg/ha for conventional seed drill, zero till seed drill and roto till seed drill.

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INFLUENCE OF DIFFERENT CROPPING SYSTEMS ON RUNOFF, SOIL LOSS AND NUTRIENT LOSS IN EASTERN DRY ZONE OF KARNATAKA

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The field experiment was conducted during *Kharif* 2019-20 at AICRP for Dryland Agriculture, UAS, GKVK, Bengaluru entitled "Influence of different cropping systems on runoff, soil loos and nutrient loss in Eastern dry zone of Karnataka". The study consists of five Cropping system grown in respective micro watershed (T_1: French bean sole; T_2: Finger millet sole; T_3: Pigeonpea + Field bean (1:1); T_4: Finger millet + Pigeonpea (8:2); T_5: Perennial mixed fruit (Pomelo + Guava) orchard). The farm ponds were constructed at end of each micro watershed to collect runoff water. After rainfall, whenever runoff occurred from the plots, the runoff quantity, soil loos and nutrient loss were estimated. The results revealed that runoff and runoff per cent during the year 2019 were lower with finger millet+ pigeonpea (8:2) cropping system (219963 l ha^{-1} and 2.94 %, respectively) and pigeonpea + field bean (1:1) cropping system (384203 l ha^{-1} and 5.37 %, respectively). The runoff and runoff per cent were higher in catchment area with pomelo (1056632 l ha^{-1} and 13.64 %, respectively) and french bean sole (783370 l ha^{-1} and 10.61 %, respectively). The higher runoff was recorded in month of June (276631 l ha^{-1}) in pomelo and September (289413 l ha^{-1}) in french bean sole. Similarly the lower soil loss, nitrogen loss, phosphorus loss and potassium loss were recorded in catchment area with pigeonpea + field bean (1:1) (820.3 kg ha^{-1}, 9.03 kg N ha^{-1}, 0.69 kg P ha^{-1} and 3.92 kg K ha^{-1}, respectively) and finger millet+ pigeonpea (8:2) cropping system (880.6 kg ha^{-1}, 9.63 kg N ha^{-1}, 0.70 kg P ha^{-1} and 4.40 kg K ha^{-1}, respectively). The higher soil loss, nitrogen loss, phosphorus loss and potassium loss were recorded in french bean sole (2047.0 kg ha^{-1}, 16.06 kg N ha^{-1}, 1.18 kg P ha^{-1} and 11.12 kg K ha^{-1}, respectively). Hence, finger millet+ pigeonpea (8:2) and pigeonpea + field bean (1:1) intercropping systems plays a vital role in Soil and Water Conservation for a sustainable agricultural system in Eastern dry zone of Karnataka when compared to sole cropping system.

GIRISDA/AB/150/2022

MATURATION AND SPAWNING OF *Amblyceps mangois* (HAMILTON BUCHANAN) A RARE CATE FISH FROM RIVER MANDAL IN GARHWAAL HIMALAYAS

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Amblyceps mangois is a small size cat fish, commonly known as "seeple" in the Mandal valley. It is one of the less known species whose conservation is essential to maintain its race and also for its culture as an ornamental species. The knowledge on the reproductive biology of any fish is very important for productive aquaculture and scientific based fishery management of any water body. It includes the maturation biology based on the study of developing eggs in ovary, season and frequency of spawning, reproductive capacity and ecology of the spawning grounds. This study contributes to the knowledge of the sexual maturity of this species, by investigating the biological aspects of maturation including the Gonado-somatic index (GSI), Dobriyal index, spawning season and determination of spawning grounds. Samples of *A. mangois* were obtained from the water body and then total length (TL) and weight of each specimen was measured in fresh condition. The Gonado-somatic index (GSI) and Dobriyal index were used to estimate maturity month and spawning frequency in this particular case study. The maximum GSI values for both the sexes of *A. mangois* were observed when the fish attained full maturity in the month of August. The minimum GSI value of *A.mangois,* for male and female was observed in the month October. Spawning activity of Indian cat fish in the Mandal River lasted at least 3 months from early July to September. In the present work it is indicated that *A. mangois* is a single spawner, which spawns from August and September. D.I. (Dobriyal index) has been found a better index to indicate exact time of spawning as it was recorded maximum in August and first fall in the value during September shows that spawning has already started in September itself. In the present investigation, seven maturity stages were determined in *A. mangois*.

GIRISDA/AB/151/2022

REARING ATTRIBUTES OF ERI SILKWORM FED WITH VARIOUS CASTOR GENOTYPES

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Eri silkworm (*Philosamia ricini)* is one of the most exploited, multivoltine, domesticated and commercialized non mulberry silkworms. Eri silk production and productivity depends highly on feeds consumed by eri silkworms. A study was undertaken to evaluate different castor genotypes on the rearing attributes of commercial breed (C2) of eri silkworm. Seeds of different castor genotypes *viz*., GCH 4, GCH 7, DCH 519 and TMV 5 along with local variety were obtained from Tapioca and Castor Research station, Yethapur, Salem. The treatments were laid out in a Completely Randomized Design (CRD) with four replications. The performance of eri silkworm *viz*., growth attributes, economic parameters and grainage parameters were studied by feeding them with the leaves of different castor genotypes and locally available castor variety were separately reared in cellular rearing method. The genotypes showed significant differences among growth attributes and economic parameters, *viz*., Larval weight (g), Larval duration (days), Silk gland weight (g), SGTSI (%), Cocoon weight (g), Shell weight (g), Cocoon yield (kgs), Shell Ratio (%), ERR (%), Silk Productivity (%), Sericin and fibroin content (%) and grainage parameters, *viz*., Egg hatchability (%), Fecundity (nos.) of C2 breed of eri silkworm. Among the five genotypes, GCH 4 and DCH 519 genotypes showed superior among all the other genotypes on commercial parameters and grainage performance except fecundity. This study reveals that of the five castors genotypes, GCH 4 cultivation would be more beneficial to the castor farmer for ERI culture as it yields more after local castor variety.

GIRISDA/AB/152/2022

VERTICAL GARDENING- A NOVEL CONCEPT OF URBAN ORNAMENTAL HORTICULTURE

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A vertical garden grows vertically, rather than horizontally, using a trellis or other support system. This is a different approach to gardening that allows you to grow plants in a vertical environment. The reduction of the heat island effect in cities, passivecooling of buildings through walls, and increased thermal insulation of the building envelop are the primary benefits of vertically greening buildings, all of which contribute to a cleaner indoor environment, and more beautiful space, and increased biodiversity. Bengaluru, Mumbai, Delhi, Nagpur, and Ludhiana are prominent Indian cities that play an important role in vertical gardening. These are the cities that provides a variety of vertical gardening options. Ferns, Bromeliads, Pothos, and other small- growing plants are ideal for vertical gardens. Vertical gardens come in a variety of styles and designs, including green Façade and Green Walls. The temperature difference between the outside air temperature and the temperature of the inner vegetative wall is.4.8,2.4, and A five-level building with a vertical garden uses 378 (kWh) and a five- level building without a vertical garden uses 395 (kWh). The study of vertical gardens is a new subject to examine in terms durability, maintenance, plant selection that is appropriate for the current climatic conditions, materials used, and so on. The impact of physical structure, panel material, substrate type, composition, and depth on the performance of vertical greenery systems must be investigated.

GIRISDA/AB/153/2022

BIOEFFICACY OF COMBINATION PRODUCT OF FLUBENDIAMIDE AND DELTAMETHRIN TO MANAGE OKRA JASSIDS AND FRUIT BORER

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Bioefficacy of a combination product of flubendiamide and deltamethrin (Fame Quick) against okra jasssids and fruit borer was studied in the experimental farm of Department of Entomology, Dr YS Parmar University of Horticulture and Forestry, Solan. The study comprised of treatments *viz.*, flubendiamide + deltamethrin 480 SC @ 22.5 + 15, 36 + 24 and 72 + 48 g a.i./ha, flubendiamide 480 SC @ 36 g a.i./ha, deltamethrin 100 EC @ 24 g a.i./ha and imidacloprid 17.8 SL @ 20 g a.i./ha. All the treatments were applied thrice on the crop at the time of insect pest appearance. Imidacloprid @ 20 g a.i./ha was found most effective against okra jassids, *Amrasca biguttula biguttula* showing 74.00 percent reduction followed by flubendiamide + deltamethrin @ 72 + 48 (48.54 percent reduction) and 36 + 24 g a.i./ha (42.82 percent reduction). In case of fruit borer (*Helicoverpa armigera*), flubendiamide + deltamethrin @ 72 + 48 g a.i./ha was the most effective treatment with 91.35 percent reduction followed by flubendiamide + deltamethrin @ 36 + 24 (84.46 percent reduction) and 22.5 + 15 g a.i./ha (75.80 percent reduction). However, minimum fruit damage was observed with flubendiamide + deltamethrin @ 72 + 48 g a.i./ha (4.90 percent) followed by flubendiamide + deltamethrin @ 36 + 24 g a.i./ha (6.63 percent). Foliar applications of test insecticide (Fame Quick) at standard and double dose did not showed any phytotoxic symptoms and no significant effect of the treatments was noticed on coccinellid beetles.

GIRISDA/AB/154/2022

ROLE OF PGPR IN ENHANCING SECONDARY METABOLITES IN MEDICINAL HERBS

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Plants are important source of biologically active compounds with therapeutic properties. These active compounds are commonly called as phytoconstituents or secondary metabolites and are of significant importance in the efficacy of medicinal plants. With increase in population, demand of medicinal plant products has been also increased and to fulfil this need new innovative techniques for cultivation of medicinal herbs are developed. Inoculation of medicinal plants with PGPB for cultivation has lead positive impact on cultivation of medicinal plants. PGPB plays important role in growth, development, protection and enhancement of secondary metabolites in medicinal herbs.

PGPB are extracted from rhizospheric, endospheric and phyllospheric zone of various plants and their effect on plant is studied and isolation of particular bacteria with specific role in medicinal plants is done. PGPB affect plant growth both directly and indirectly; directly by production of phytohormones, nitrogen fixation, solubilisation and production of siderophores and indirectly by production of antibodies, HCN production, induce systemic resistance and compete with phytopathogens.

GIRISDA/AB/155/2022

IMPACT OF NATURAL FARMING ON YIELD AND QUALITY OF SOYBEAN (*Glycine max*. L) UNDER MOUNTAINOUS CONDITIONS OF HIMACHAL PRADESH

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An experiment was conducted in field during kharif season of 2019 at Model Organic farm of COA, CSKHPKV, Palampur -176062 (H.P) to study the effect of environmental changes on growth, yield and quality parameters of Soybean (*Glycine max* L.) under organic and zero budget natural farming conditions. The variety of Soybean (Palam soya) was sown with eight different forms of treatment and three replications during the study period. Application of FYM, vermicompost, and natural farming with rhizobium all had a significant impact on growth metrics, yield, and yield contributing qualities. The significantly number of pods per plant and physiological parameters viz, RGR, CGR and NAR were recorded in T_6-(Vermicompost -10t/ha + vermiwash- 3 Spray). The significantly highest seed yield (825.0 kg ha^{-1}), biological yield (2409.09kg ha^{-1}) and test weight (173.22 g) were recorded in treatment T_6. Meteorological parameter showed a positive effect on growth and yield of soybean. The treatment T_6 (Vermicompost - 10t/ha + vermiwash- 3 Spray) proved to be the best treatment for increasing the yield and yield attributes of soybean under mid-hill conditions of Himachal Pradesh.

GIRISDA/AB/156/2022

STUDIES ON HETEROSIS, GENE ACTION AND COMBINING ABILITY FOR YIELD AND ITSCOMPONENTS IN WHEAT (*Triticum aestivum* l.)

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The experimental materials of the present study comprised of 113 treatments of wheat [(48 F_1's, their F_2's and 16 parental lines (12 lines viz., (12 lines viz., HD-2733, NW-5054, HPW-355, PBW-443, NW-1012, K- 307, K-9107, K-9006, DBW-17, K-8027, HD-2824, and NW-4108 and 4 testers *viz.*, K-911, NW-1067, NW- 1014, and KRL-210, Check- NW 2036) were grown at Main Experiment Station of Department of Genetics & Plant Breeding, Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad during *Rabi* 2014-15 in Randomized Block Design (RBD) with three replications to study the heterosis, gene action and combining ability for yield and its components. The observations were recorded on ten characters, namely, days to 50% flowering, days to maturity, plant height (cm), number of effective tillers per plant, number of spikelets per spike, number of grain per spike, 1000-grain weight (g), grain yield per plant (g), biological yield per plant (g) and harvest index (%). The analyses of variance revealed that mean sum of squares due to treatments were significant for all the characters. The highest mean performance for seed yield per plant along with some of the component traits was exhibited by NW 5054 (9.78 g), K 9006 (9.60 g), NW 4108 (8.97 g), K 911 (8.97 g) and HD 2824 (8.87 g). The high estimates (>20%) of PCV followed by GCV was recorded for grain yield per plant, biological yield per plant and number of effective tillers per plant in both generations, and moderate estimates (>10 % to <20%) for grain yield per plant and biological yield per plant and number of spikelets per spike in F_1 generations only, whereas number of effective tillers per plant and plant height in both F_1 and F_2 generations. Remaining, traits showed low estimate (<10%) of PCV and GCV for all the characters under study. High estimate of heritability in broad sense (>75%) was recorded for plant height, 1000 grain weight, days to maturity, grain yield per plant, inboth F_1 and F_2. The high estimate of genetic advance in per cent of mean (>20%) was observed for grain yield per plant, biological yield per plant, plant height in both F_1 and F_2. Moderate estimate of genetic advance in per cent of mean (>10% - <20%) was observed for number of spikelts per spike, 1000-grain weight in both $F_1$and F_2, while number of grains per spike in F_1 only. High heritability coupled with high estimate of genetic advance in per cent of mean was observed for plant height, and grain yield per plant in both F_1 and F_2, while biological yield per plant in F_1 only. High heritability coupled with moderate estimate of genetic advance in per cent of mean was recorded for all the characters except days to 50 per cent flowering, days to maturity, and harvest index in both F_1 and F_2. Analysis of variances for combining ability revealed that variances due to lines x testers were highly significant for all the ten characters in F_1 and F_2 except days to maturity, number of effective tillers per plant and harvest index in F_1. The value of sca variance was found significant and positivefor all the characters indicating preponderance of non-additive gene action for all the characters. The value of degree of dominance was less than unity (<1) for all the traits except for harvest index in F_1 indicating existence of incomplete dominance for all the traits except above mentioned, whereas, in F_2 the value of degree of dominance was more than unity (>1) found for number of grains per spike, number of spikelets per spike, biological yield per plant and number of effective tillers per plant exhibited existence of over dominance for these traits. High estimates of heritability in narrow-sense were recorded for all the characters both F_1 and F_2 generations, except harvest index. Lines HD 2733, NW 5054, K 9006 and HD 2824 in both F_1 and F_2, among lines and NW 1014 among the testers, in F_1 generation showed desirable and significant gca effects for seed yield per plant and several other important traits. Parent HPW 355, Parent NW 5054 and NW 1014 were found good combiner for most of the characters studied. Out of 48 crosses studied, the most promising crosses were *viz.*, NW 5054 X K 911 (1.84), NW 1012 X KRL 210 (1.45), K 9006 X NW 1014 (1.43), PBW 443 X NW 1067 (1.30), K 9107 X NW 1067 (1.17) in F_1 and HPW 355 X NW 1014 (1.31), NW 4108 X KRL 210 (0.84), K 9107 X NW 1067 (0.76), NW 1012 X KRL 210 (0.65) and K 307 X K 911 (0.63) in F_2 showed significant & positive sca effects for seed yield per plant as well as some other yield components. The cross PBW 443 X KRL 210, K 9107 X KRL 210, NW 5054 X K 911, HPW 355 X KRL 210, NW 1012 X KRL 210, K 9107 X KRL 210, HPW 355 X KRL 210, NW 4108 X KRL 210 and HPW 355 X NW 1014 were found the most promising as it had high significant sca effects for major yield contributing characters both F_1 and F_2 generations. The crosses exhibiting high order significant and desirable sca effects for different characters involved parents having all types of combinations of gca effects such as high × high(H × H), high × average (H × A), high × low (H × L), average × average (A × A), average × low (A × L) and low × low (L × L) general combiner parents indicating thereby lack of any relationship between positive and significant sca effects of crosses with gca effects of their parents for the characters under study. The maximum contribution of the lines x testers was recorded for harvest index followed by number of grains per spike, number of effective tillers per plant, biological yield per plant and grain yield per plant. Similarly, the contribution of the lines was also higher than its corresponding contribution of testers for all the characters in both F_1 and F_2 generation. In case of grain yield per plant, heterobeltiosis ranged from 29.95 to 18.62 % and for standard heterosis from 28.68 to 95.88 % in F_1 and from -29.95 to 18.62 %

for better parent and standard heterosis from -28.55 to 22.21 % in F_2.. Out of 48 crosses, all the F_1's and F_2's showed significant andpositive heterosis over better parent for grain yield per plant. The best five crosses for positive heterobeltiosis in F_1 were NW 5054 X K 911, K 9006 X NW 1014, HD 2824 X NW 1067, NW 4108 X NW 1014 and PBW 443 X NW 1067 and in F_2 were HPW 355 X NW 1014, NW 4108 X KRL 210, DBW 17 X KRL 210, HD 2824 X K 911 and HD 2824 X NW 1067; over standard variety all the crosses in F_1 and only 13 crosses in F_2 showed significant and positive heterosis. The best five crosses in F_1 generation were NW 5054 X K 911, K 9006 X NW 1014, HD 2824 X NW 1067, NW 4108 X NW 1014 and PBW 443 X NW 1067 and in F_2 were HPW 355 X NW 1014, NW 5054 X NW 1014, NW 5054 X KRL 210, HD 2824 X NW 1067 and NW 4108 X KRL 210. Inbreeding depression for this trait ranged from 25.80 to 46.49 % for the crosses NW 1012 X NW 1014 and K 307 X NW 1014, respectively. All the 48 crosses showed significant inbreeding depressionin positive direction. The best five F_2 crosses exhibited significant inbreeding depression in positive direction were K 307 X NW 1014 (46.89%) followed by NW 4108 X NW 1014 (46.69%), DBW 17 X K 911(46.13%), DBW 17 X NW 1067 (45.36%) and HPW 355 X KRL 210 (44.98%). Grain yield per plant at phenotypic level exhibited positive and highly significant association with biological yield per plant and days to maturity in both F_1 and F_2 respectively. Path analysis revealed, the highest positive direct effect on grain yield per plant was exerted by biological yield per plant in both F_1 and F_2 and harvest index in F_2 while number of grains per spike, days to 50% flowering in F_1 and number of spikelets per spike and days to maturity in F_2 showed higher order negative direct effect towards expression of grain yield per plant at both genotypic and phenotypic level.

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PRIMING INDUCED ACTIVATION OF THE ANTIOXIDATIVE DEFENCE SYSTEM IN TOMATO PLANTS DISEASED WITH FUSARIUM WILT AND DAMPING OFF

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Being sessile organisms, plants are often exposed to various kinds of biotic as well as abiotic stresses. Pathogen induced damage to plants leads to the synthesis and accumulation of reactive oxygen species (ROS) to various extent. Once produced, these ROS led to the destruction of plant metabolism due to the oxidation of lipids, proteins, nucleic acids carbohydrates etc. To face these ROS and to defend themselves, plants have developed an intricate immune system encompassing enzymatic and non-enzymatic defensive molecules. In the present investigation, we have monitored the effects of fusarium wilt and damping-off induced production of MDA and H_2O_2 contents, and their effective disposal by the development of an antioxidative defence system in terms of ascorbic acid, α-tocopherol, glutathione, phenolic contents and free radical scavenging activity in tomato leaves. This research work has also focused on the seed priming remedial effects of *Trichoderma virens* (*T. virens*) and Jasmonic acid (JA) against pathogen stimulated generation of ROS. A significant increase in MDA, H_2O_2 and phenolic contents has been monitored because of pathogenic infection. A similar trend has also been exhibited in the case of free radical scavenging activity. On the other hand, reduction in ascorbic acid, glutathione and α-tocopherol contents has also been depicted in our observation. From our studies, we can conclude that in comparison to individual treatments, combined applications of *T. virens* and JA introduce more ameliorative influences on tomato plants infected with fusarium wilt and damping off.

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SHELF- LIFE OF LOOSE SELLING INDIAN SWEETS

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India had a long tradition of sweets with boundless significance in its culture. No festival or occasion is complete without Indian sweets. “Have something sweet before beginning” is a common saying. However, the major limitation

with sweets is their limited shelf-life. The milk based sweets have even lesser shelf-life and are more prone to microbial growth. Keeping in view, this survey was undertaken in an attempt to analyze the average shelf- life of Indian sweets in standard market and in response to develop the methods or packaging materials to extend the shelf-life of sweets. In survey, the five selected sweets (Peda, Gulab Jamun, Barfi, Rasgulla and Laddu) were evaluated for their shelf-life in different environmental conditions at local Indian sweet shops. Through survey the reported shelf-life (in days) of Peda, Gulab Jamun, Barfi, Rasgulla, and Laddu found was 3.4±0.9, 3.5±1.0, 3.4±0.9, 3.5±1.0 and 4.7±0.7 respectively in summers at ambient conditions (without refrigeration). In refrigeration conditions (3-6°C) during summer, an increase in shelf-life (days) of Peda (7.7±1.6), Gulab Jamun (8.7±3.3), Barfi (7.7±1.6), Rasgulla (9.0±2.6), and Laddu (9.7±2.4) was noticed. Similarly, in winter/ rainy season at ambient condition (without refrigeration) the Peda, Gulab Jamun, Barfi, Rasgulla, and Laddu showed a shelf-life (days) of 6.0±1.4, 6.6±2.3, 6.0±1.4, 6.2±1.6, and 8.3±1.4 respectively. A subsequent increase in shelf-life (days) of Peda (10.5±1.6), Gulab Jamun (12.2±4.0), Barfi (10.5±1.6), Rasgulla (12.1±4.0), and Laddu (13.2±3.6) was reported when stored at refrigeration conditions (12-15°C) during winter/rainy season. Through survey we concluded that the Indian sweets possess different shelf-lives at different storage conditions. The efforts were made to improve the shelf-life of sweets through proper packaging and addition of natural preservatives.

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SNP GENOTYPING OF MAIZE (*Zea mays*) HYBRIDS AND PARENTAL INBRED LINES FOR GENETIC PURITY TESTING USING DOUBLE DIGEST RESTRICTION SITE-ASSOCIATED DNA SEQUENCING

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Maize (*Zea mays*) is the third major cereal crop in the Indian subcontinent, but the crop yields per hectare of Indian maize cultivars are less than half of the global average due to the impurity of seed lots supplied to farmers. In this study, we discovered high-quality Single Nucleotide Polymorphic markers (SNPs) in two widely cultivated maize hybrids and their parental inbreds. Paired-end double digest restriction site-associated DNA sequencing was used to discover SNPs and a total of 30,764,454 reads with a read length of 151 bp per sample were generated. Genotyping of SNPs for maize hybrids „MAH 14-5" and „Hema" revealed a total of 47,812 and 15,815 Genetic Purity Analysis markers, respectively, of which 44,388 and 12,391 were unique with 3,424 being common to both hybrids. Identified SNPs were used to develop primers for Kompetitive Allele- Specific PCR genotyping assays to determine the genetic purity of 10 seed lots and the results were found to correlate with Grow-out-Tests. Thus, the SNPs discovered in this study proved reliable to test the genetic purity of commercial seed lots. Advances in plant molecular breeding tools especially ddRADseq for SNP discovery offer new opportunities to genotype existing cultivars and accelerate the production of genetically pure seeds.

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MOLECULAR PROFILING IN WHEAT GENOTYPES WITH SSR MARKERS

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A research study was undertaken to examine the genetic diversity of 10 bread wheat [*Triticum aestivum* (L.) em. Thell] genotypes, using 10 SSR primers to produce scorable and reproducible bands on agarose gel. These 10 SSR primers generated a total of 64 bands. The polymorphism information content (PIC) was recorded for all polymorphic

primers and varied from 0.39 with primer GWM160 to 0.92 with primer XGWM132. The higher PIC value indicated the informativeness of the primers pairs in detecting genetic diversity. Hence the primer WMS30, GWM2, GWM5, GWM44, GWM46,GWM265, XGMW 484 and XGWM 132seems to more informative as they shown the expected gene diversity value higher than 0.50 and can be used in future for genetic diversity and molecular characterization of different genotypes. The SSR profile was used for estimating pair wise genetic similarities among various entries using Jaccard‟s coefficient method. All the polymorphic bands were scored as 0-1 and the genetic similarity matrix was generated using UPGMA clustering algorithm program by software programme SPSS version 2.0. Based on the distance matrix, a Dendrogram was generated by the UPGMA method. Similarity coefficient value for all the 10 genotypes ranged from 0.08 to 0.80. The minimum similarity exhibited by genotype RAJ 4037 and HD 3086 whereas the maximum similarity was shown by genotype MP 3288 with genotype HI 1544.

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EFFECT OF DIFFERENT TRANSPLANTING DATES AND SHOCK PREVENTING METHODS ON THE PERFORMANCE PEARL MILLET (*Pennisetum typhoides* l.) VARIETIES

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A field experiment was conducted on loamy sand soil at the Rajasthan Agricultural Research Institute, Durgapura, Jaipur, during two consecutive *kharif* seasons in 2019 and 2020. The experiment comprises two pearl millet varieties (RHB-173 and RHB-177), four transplanting shock preventing methods (No treatment, Triacontanol @ 0.25 ml/liter, Triacontanol @ 0.50 ml/liter and Leaf clipping) and three dates of transplanting (15^{th} – 30^{th} June, 1^{st} – 15^{th} July and 16^{th} – 31^{st} July) replicated thrice in factorial randomized block design. Result revealed that pear millet growth parameters, yield attributes and yields, net returns and B: C ratio were significantly higher with hybrid RHB-173 as compared to RHB-177. Among transplanting shock preventing methods, triacontanol @ 0.50 ml/liter showed significantly higher plant population, crop growth parameters, yield characteristics and yields, net returns and B: C ratio were significantly as compared to no treatment and leaf clipping, but it remained at par with its lower dose treatment triacontanol @ 0.25 ml/liter. Result further revealed that transplanting of pear millet during 1^{st} –15^{th} July gave higher plant population, growth and yield attributes, grain yield, net returns and B: C ratio as compared to 15^{th} – 30^{th} June, but it remained at par with transplanting during 16^{th} – 31^{st} July.

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NUTRITIONAL AND ANTINUTRITIONAL PROPERTIES OF POPPED AND MALTED FINGER MILLET AND SORGHUM GENOTYPES

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Popped and malted finger millet (*Eleusine coracana*) and sorghum (*Sorghum bicolor*) genotypes were investigated for their nutritional (crude protein, crude fat, crude fiber, ash, and total carbohydrates) and antinutritional properties (tannins, saponins and oxalate). The results showed that crude protein slightly increased (6.57%-6.9%; 6.08%-6.26%) when popped and decrease (6.57%-5.57%; 6.08%-5.46%) after germination whereas crude fiber content decreased (4.99%-3.44%; 4.5%-3.6%) when popped and increased (4.99%-5.9%; 4.5%-5.2%) after malting in finger millet and sorghum, respectively. The millets showed reduction in fat content (3.6%-2.1%; 2.8%-1%) and (3.6%-1%; 2.8%-0.9%) with hike in total soluble carbohydrates (82.14%-86%; 85.4%-87.1%) and (82.14%-89.11%; 85.4%-89.9%), respectively, after popping and malting. Increase in ash content after popping (2.4%-3.08%; 4.2%-5.8%) and decrease after germination (2.4%-1.74%; 4.2%-2.1%) was noted. The results of antinutritional factors revealed that after popping and malting the tannin content were found to increase (1.0073-1.0125 µg/g) and (0.0073-0.0158 µg/g), respectively. On the other hand, reduction in the saponin (1.0514-1.0367 µg/g) and (1.0514-1.0305 µg/g) along with oxalate content (2.1-1.88 mg) and (2.1-1.77 mg) was seen after popping and malting, respectively. This investigation may provide information on the potential utilization of popped and malted millet flour as functional food constituent in the food industry.

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MOLECULAR VARIABILITY AMONG THE ISOLATES OF *Rhizoctonia bataticola*, CAUSING DRY ROOT ROT OF SOYBEAN

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Dry root rot caused by *Rhizoctonia bataticola* (Taub) Butler, is one of the most widely distributed and destructive disease of Soybean [*Glycine max* (L.) Merril], causing accountable quantitative and qualitative losses. The genomic DNA of 16 isolates of *R. bataticola* isolated from dry root rot diseased specimens of soybean was subjected for PCR amplification by using RAPD primers. Initially 26 random primer viz., OPA, OPB and OPC series were screened. Among these, 08 primers produced large number of reproducible amplicons, which were employed for molecular characterization of the 16 test isolates. Dendrogram generated based on UPGMA analysis of RAPD data grouped all of the 16 test isolates (*R. bataticola*) into two major clusters. The Cluster I included 14 isolates *viz.*, Rb-1, Rb-2, Rb-10, Rb-3, Rb-12, Rb-8, Rb-13, Rb-9, Rb-16, Rb-14, Rb-15, Rb-11, Rb-5 and Rb-6, collected from three zone of Marathwada region and their similarity coefficient ranged from 0.79 percent. Cluster II comprised of only two isolates Rb-4 and Rb-7, with similarity coefficient of 0.56 per cent.

GIRISDA/AB/164/2022

EVALUATION OF DIFFERENT SOILLESS GROWING MEDIA FOR TOMATO CULTIVATION UNDER POLYHOUSE

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Protected farming has a lot of potential in India's north, where the climate is harsh and having extreme winters. The availability of tomato crops in Punjab has been hampered by severe low temperatures and frequent rainfall in the region's different agro-climate zones. It's quite difficult to grow tomatoes all year in Punjab because of the problematic soils in the south-west and the high rainfall in the northern part. Tomato crops grown under cover are more profitable since they allow for product availability during periods when open-field production is not possible. Although soil is the most cost-effective growth medium for all cultivars, but in some cases (such as saline soils or soil-borne insect-pest problems), a soilless substrate may be a preferable option for commercial tomato farming. The objective of the study was to standardize the most cost-effective tomato cultivars and growth material for protected production in Punjab. The experiment was carried out in a poly-house structure with 6 different media substrate treatments: M1-soil as control, M2-Cocopeat only, M3-Cocopeat+ Vermicompost in ratios (2:1, v/v) and M4-Cocopeat+ Vermicompost in ratio (3:1, v/v), M5-Cocopeat + Vermiculite + Perlite in ratio (3:1:1, v/v) and M6-Cocopeat + Vermiculite + Perlite in ratio (6:1:1, v/v). The study conclude that among the different growing media treatments, the B:C ratio of media M1(Soil only) was found higher (0.93), followed by (0.74) in the media treatment (M-3) cocopeat + vermicompost (2:1, v/v), which was statistically higher among organic media as comparison to other treatments. The soilless growing media combination of organic and inorganic substrates, Cocopeat + Vermiculite + Perlite in the ratio (6:1:1, v/v) can be used as best growing media for commercial cultivation of tomato as widely used sterilized growing media.

GIRISDA/AB/165/2022

EFFECT OF SKIPPING BREAKFAST ON THE NUTRITIONAL STATUS AMONG HOSTEL BOARDERS OF JORHAT DISTRICT, ASSAM

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Breakfast is one of the central components of daily nutrient requirement and it greatly affects the nutritional status of a person. The present investigation was carried out to study the breakfast consumption pattern and its association with the nutritional status of hostel boarders of Jorhat, Assam. A total of 400 hostel boarders were selected randomly from 10 different hostel of Jorhat city. A validated questionnaire was used to collect information on the sociodemographic profile, food habit, breakfast consumption and frequency of skipping. Anthropometric indices such as height and weight were measured. The data obtained were analysed statistically. The study comprised of 48.50 % male and 51.50 % female with mean age of 21.41 years. Majority (92.75%) of the population were non-vegetarian and consumed three meals a day (66.25%). Most (46.50%) of the hostel boarder consumed cereal based products in their breakfast on a daily basis while consumption of fruits, vegetables, egg and milk based products daily was less. The study also revealed that 48.25 % of the population skips breakfast of which 12.95 % skips breakfast daily, 46.11 % skips 1-2 times/week, 21.24 % skips 3 times/week and 19.69 % of the population skips breakfast more than 3 times/ week. 55.44 % of the population skips breakfast due to lack of time while 26.42 % avoids breakfast because they dislike food served due to monotonous food pattern followed in hostels. The data on nutritional status revealed that 69.50 % population had normal weight while 20.00 and 10.50 % were underweight and overweight respectively. A strong association ($p<0.05$) between breakfast consumption and nutritional status of the population was obtained in the study. Hence the study calls for the need to aware the hostel boarders regarding the significance of breakfast consumption in order to improve their nutritional status.

GIRISDA/AB/166/2022

DECONTAMINATION OF IMIDACLOPRID, LAMBDA CYHALOTHRIN AND SPIROMESIFEN ON CABBAGE THROUGH DIFFERENT HOUSEHOLD PROCESSING METHODS

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Supervised field trials were carried out at the experimental farm of the Department of Entomology, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan (H.P) to investigate the effects of household processing to eliminate the imidacloprid, lambda cyhalothrin and spiromesifen residues in cabbage heads. Individual spray applications of imidacloprid, lambda cyhalothrin and spiromesifen were made at 25, 15 and 96 g a.i/ha (single dose), respectively. After spray, cabbage heads were collected at 1, 3 and 5 day interval and were subjected to various decontamination processes like tap water washing, saline water washing (2% NaCl), lukewarm water washing, open pan cooking, microwave cooking and outer leaf removal. Further, after processing the head samples were examined using QuEChERS technique and residues were estimated by GC-MS, ECD and HPLC. Among various decontamination processes, microwave cooking was found most effective which provided 92.95 - 100 per cent relief from insecticide residues in cabbage heads followed by outer leaf removal (80.31 - 100 per cent), open pan cooking (74.01 – 100 per cent), saline water washing (42.45 – 100 per cent), lukewarm water washing (29.24 – 100 per cent) and tap water washing (23.27 – 100 per cent).

GIRISDA/AB/167/2022

ROLE OF BIOFILMS IN FOOD INDUSTRY

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Biofilm is an association of microbial cells or microorganisms that are attached irreversibly to a surface (living or non-living) and enclosed within a self-produced matrix or gelatinous layer namely, Extracellular Polymeric Substance (EPS). In the year 1684 a Dutch researcher, Antoni van Leeuwenhoek observed the biofilms on the tooth surface with help of a simple microscope and called it „Animalcule" which in today"s world known as dental plaque. The term „Biofilm" was coined by J.W. Costerton in 1978. Biofilm development is a multi-stage process that begins with adhesion of microbes to a surface followed by establishment of a micro-colony, and finally to the formation of a three-dimensional structure that matures and then detaches, allowing microbial cells to spread. The biofilm formation can be both beneficial and detrimental in industries based upon agriculture and food. Due to their advantageous structure, biofilms produced by the beneficial microbial strains are utilized in a variety of industrial applications e.g., in bioremediation and waste-water treatment plants, beneficial biofilms of probiotic and bacteriocin producers, biofilms specific to certain fermentation food processes and as biocontrol agent. Biofilm microorganisms are well recognized to have favorable impact on food quality parameters including texture, biochemical composition, as well as sensory aspects. The biofilm of probiotic strains protects not only its own viability but also of other beneficial strains by covering them with EPS. For e.g., the matrix of *B. subtilis* has been shown to protect other probiotic strains against harmful substances. In the food processing plants, microbial biofilms can cause equipment breakdown, product contamination, damage, and energy losses due to which their elimination is important. Inhibitors of cell-signaling (citric acids and lactic and), chemical treatments (sanitizers such as NaOCl), modifications in the steel surface (such as nanoparticles), bacteriocins (nisin), disruption by use of enzymes (DNAses, proteases), biosurfactants (such as surfactin or lichenysin), and plant essential oils (such as carvacrol or citral) are among some important methods to prevent biofilm prevention and disruption method.

GIRISDA/AB/168/2022

ANALYSIS OF DIFFERENT PRESERVATION METHODS OF KER AND SANGRI FROM RAJASTHAN WITH RESPECT TO THEIR CHEMICAL CONTENT

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To bridge the gap and ensure food security at household, regional and national levels, popularization of traditional food plants plays a very important role. Among the fruit tree species of Rajasthan, *Prosopis cineraria* and *Capparis decidua* rank high in local people's preferences. Both *Prosopis cineraria* and *Capparis decidua* have the potential to serve as models for diversifying income and improving livelihoods of local people. These tree species are currently not utilized systematically either because of sub-optimal management or due to lack of scientific studies. They provide varied food and medicinal uses and other income generating opportunities. Though traditionally they are extensively used but not much research work on post harvest processing is reported. Research and support activities are needed to maximize their utilization to help contribute to rural livelihood and enhance the desert lands.

Being of so much economic value these fruits suffer from a drawback of having a very short shelf life. The dry fruits get infested and are treated traditionally in a number of ways by the local people. But these methods have not been scientifically optimized. In the present paper the storage of these fruits has been studied under different conditions vis a vis their sugar and protein content. This work will help in preserving these fruits for a longer duration thus contributing to the livelihood generation.

GIRISDA/AB/169/2022

IMPACT OF PRUNING AND PLANT GROWTH REGULATORS ON FRUIT YIELD OF GUAVA (*Psidium guajava* L.) cv. ALLAHABAD SAFEDA

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A field experiment was conducted at the Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand during the years 2015-16 & 2016-17 with a view to study the "Effect of Pruning and Plant Growth Regulators on Fruit Yield of Guava (*Psidium guajava* L.) cv. Allahabad Safeda". For this experiment 10 years old plants of guava var. Allahabad Safeda planted at 6x6 meters were uniformly selected considering their age and canopy. The experiment comprised of eighteen treatment combinations involving three levels of pruning at 0 i.e. Control (unpruned plants), 25, 50% and their combinations with plant growth regulators viz.; GA_3 (100 and 150 mg l^{-1}), NAA (150 and 200 mg l^{-1}) and control (water spray and absolute control) were embedded in Complete Randomized Design (Factorial) with three repetitions. Treatments were repeated for three times on the 54 selected plants. The results pertaining to fruit yield parameters with respect to pruning, significantly the maximum fruit set percent per secondary branch (75.05, 79.85 and 77.45 %), fruit retention percent per secondary branch (81.70, 81.72 and 81.71 %), minimum fruit drop percent per secondary branch (19.36, 18.28 and 18.82 %), maximum number of fruits per shoot (4.38, 4.29 and 4.33), number of fruits per plant (140.56, 143.30 and 141.93), fruit yield per plant (42.21, 43.22 and 42.72 kg), fruit yield per hectare (11.73, 12.01 and 11.87 t) recorded with treatment 25 % shoot pruning during the years 2015-16, 2016-17 and in pooled analysis, respectively. Whereas, in different plant growth regulator treatments, application of GA_3 150 mg/l recorded maximum fruit set percent per secondary branch (71.72, 80.34 and 76.13 %), fruit retention percent (80.34, 82.33 and 81.33 %), fruit yield per plant (39.37, 40.95 and 40.16 kg), fruit yield per hectare (10.94, 11.38 and 11.16 t) and minimum fruit drop percent (19.66, 17.67 and 18.67 %) in the years 2015-16, 2016-17 and in pooled analysis, respectively.

GIRISDA/AB/170/2022

PHENOTYPIC COMPOUND AND ALLELOCHEMICAL COMPOUNDS OF THE FRUITS OF *Momordica charantia L.* GENOTYPES AS SOURCES OF RESISTANCE AGAINST FRUIT FLY (*Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae) OF BITTER GOURD

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Host plant resistance is a key factor for integrated management of the melon fruit fly, *Bactrocera cucurbitae* (Coquillett), due to difficulties associated with its chemical and biological control. Various morphological traits including fruit length, fruit diameter, toughness, longitudinal rides, colour and in biochemical traits including total soluble sugars, protein content, ash content, Phenols, and moisture content of fruit were studied on 37 varieties/genotypes of bitter gourd (*Momordica charantia* L.), in relation to resistance against *B. cucurbitae* under field conditions. Thirty-seven genotypes of bitter gourd were screened against fruit fly infestation. The correlation coefficients revealed that the larval density and bitter gourd fruit damage (%) had significant positive relationship (r = 0.99). The Fruit length, fruit diameter and fruit rides had significant positive effect on the fruit damage (r = 0.95, 0.91, 0.88) and number of larvae per fruit (0.93, 0.935, 0.91). The toughness showed significant negative correlation (r= -0.88) with fruit fly infestation and number of larvae per fruit (r =- 0.95). The correlation coefficients of chemical compound revealed that the larval density and bitter gourd fruit damage (%) moisture content had significant positive effect on the fruit damage (r = 0.78) and number of larvae per fruit (0.93). Significant differences were found in tested varieties/genotypes for fruit infestation and larval density per fruit. The ash %, total soluble sugar, phenol and crude proteincontent (r = -0.84, -0.86, -0.91, -0.88) showed significant negative correlation with fruit fly infestation and number of larvae per fruit (r = -0.933, -0.936, -0.937, -0.86).

GIRISDA/AB/171/2022

CLIMATE CHANGE RESILIENT AGRICULTURE

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Climate change resilient agriculture is an approach that includes sustainably using existing natural resources through crop and livestock production systems to achieve long-term higher productivity and farm incomes under climate variabilities. Climate resilient agriculture (CRA) is a sustainable approach for converting and reorienting agricultural systems to support food security under the new realities of climate change through different adaptation and mitigation mechanisms. Agricultural systems are extremely vulnerable to climate change; given their sensitivity to variations in different threats like temperature, precipitation and incidence of natural events and disasters such as drought and floods with this on an average the extreme weather patterns can impact farm incomes in the range of 15-18%. Threats can be reduced by increasing the adaptive capacity of farmers as well as increasing resilience and resource use efficiency in agricultural production systems. CAR promotes synchronized actions by farmers, government, scientist, private sector, and policy makers through three main action area: Building the capacity to identify the threats, curing the threats and sustain their adaptive mechanism over a long time. The vulnerability of existing conditions of poverty, malnutrition and increasing populations puts intense pressure on finite natural resources. In this context, it becomes imperative to adopt CRA measures at co-operative scale to address the impending impact of climate change on agriculture.

GIRISDA/AB/172/2022

SCREENING OF DIFFERENT CHICKPEA VARIETIES AGAINST GRAM POD BORER, *Helicoverpa armigera* (HUBNER)

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Chickpea, *Cicer arietinum* (L.) is nutritionally very rich source of protein (18-22%), carbohydrate (61-63%) and fat (4-5%) and also contains calcium, phosphorus, iron, niacin, vitamin B and C. It provides the valuable protein supplement to the diet of predominantly vegetarian human population; besides it contributes to the national income. However, the production and productivity of chickpea is adversely affected by several biotic and abiotic stresses out of which gram pod borer, *Helicoverpa armigera* (Hubner) is the major one. The damage caused by *Helicoverpa armigera* starts from vegetative growth and continues till maturity of the crop (Dhingra *et al.,* 2003).

A field experiment was conducted to screened the thirteen varieties (GNG-1488, GNG-1499, GNG-1581, GNG-1958, GNG-1969, RSG-945, RSG-895, RSG-888, CSJ-140, CSJD-884, CSJK-6, RSG-957 and RSG-896) of chickpea against gram pod borer, *H. armigera* for two consecutive years, *Rabi*, 2014-15 and 2015-16 at Research Farm, College of Agriculture, Bikaner (Rajasthan). The observations on the incidence of pod borer infesting chickpea were recorded on five randomly selected tagged plants in each plot by counting the larval population. The varieties GNG-1581, GNG-1488 and CSJD-884 were found least preferred, whereas varieties GNG-1499, GNG-1969 and CSJK-6 were found highly preferred. The varieties *viz.,* GNG-1958, RSG-888, RSG-945, RSG-895, RSG-957, CSJ-140 and RSG-896 were found moderately preferred. The maximum per cent pod damage (31.93 %) was recorded on variety CSJK-6 followed by GNG-1969 (30.64 %) and GNG-1499 (30.35 %) while it was minimum in GNG-1581 (20.82 %). The maximum seed yield was obtained in GNG-1581 (11.08 q ha^{-1}) followed by GNG-1488 (10.79 q ha^{-1}) and CSJD-884 (10.50 q ha^{-1}) while lowest seed yield was recorded from CSJK-6 (7.01 q ha^{-1}).

GIRISDA/AB/173/2022

INTERSPECIFIC HYBRIDIZATION IN THE GENUS *Capsicum* AND MOLECULAR CHARACTERIZATION OF F_1 HYBRIDS

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The present study was carried out to assess the success of interspecific crosses and the reciprocals using three different species of chilli-two genotypes of *C. annuum*, five genotypes of *C. chinense* and one genotype of *C. frutescens,* and identifying the incompatibility barriers along with morphological and molecular characterization of the F_1 hybrids.

The crosses involving *C. chinense* and *C. frutescens* were found to be compatible; whereas crosses involving *C. annuum* and *C. chinense* were found to be partially incompatible. Both the *C. annuum* (Krishna, Capsicum) genotypes were found to be cross compatible with King chilli accession A18; while the genotype of *C. frutescens* (Mem) was cross compatible with only accession A5 indicating genotype specificity in success of interspecific cross. Presence of pre-fertilization barriers such as drying of pollinated fruits while still on the mother plant, unilateral incompatibility and post-fertilization barriers with the formation of abnormal/empty seeds, lack of vigor and hybrid sterility etc. were observed.

The pollen viability of the parents ranged from 72.64 per cent (%) to 94.92 per cent (%) whereas pollen viability of the hybrids ranged from 23.55 to 81.02 per cent (%). Thus, hybrids exhibited lower pollen viability compared to the parents. Significant difference was observed in between parents and their hybrids for the traits under present study except for some of the traits under study. On comparison of morphological characters between parents and F_1 progeny it was observed that some of the characters were similar to the male or female parent and other characters were either intermediate or novel.

Estimation of Usual Euclidean distance among parents and their F_1 plants revealed that Capsicum (*C. annuum* L.) had the maximum dissimilarity with rest of the genotypes including parents and their F_1s.

A total of thirty SSR primers were screened for detection of parental polymorphism and then the polymorphic markers obtained were used for the confirmation of hybridity of F_1s.

GIRISDA/AB/174/2022

INTERACTION OF PRESSURIZED IRRIGATION AND FERTIGATION FOR IMPROVING WATER PRODUCTIVITY, FARM PROFITABILITY AND SOIL HEALTH

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Indian agriculture is facing difficult times due to erratic weather conditions, especially drought and excessive moisture, thereby, resulting into widespread distress among farmers. The rural areas in several parts of the country are facing food and livelihood crisis, more specifically the shortage even for drinking water. During green revolution indiscriminate and unbalanced application of fertilizer and poor water management for ensuring food security caused continuous deterioration of soil resources, which is being reflected as significant decline in fertilizer and water use efficiency, farm profitability and soil health. This could be managed by adopting modern farm technologies like pressurized irrigation and fertigation over conventional methods because water and nutrients are so intrinsically related that these should be managed together. Crops are sensitive both to excess and deficit moisture conditions. Either of the moisture stresses adversely affect the crops growth and productivity. Therefore, optimum soil moisture regime during course of crop growth is of paramount importance for higher crop and water productivity. The main objective of irrigation is to supplement water to the crop‟s requirements for growth and development with maintaining proper timing and amount of water application for achieving higher water use efficiency. Also, government needs to proactively address the situation and make more long-term farmers centric policies related to irrigation and farm profitability so as to empower the farmers socially and economically.

GIRISDA/AB/175/2022

INNOVATIVE APPROACHES IN SOIL HEATH MANAGEMENT

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Increasing demand of food, environmental factors and various man made factors that are leading to the degradation of soil health is a major aspect to think about. Directly or indirectly soil is an important natural source for growth of plants on which humans and animals are dependent. Components on which good soil is dependent are water balance, mineral content, organic matter, living microorganism, air etc. These factors can fluctuate depending on numerous factors such as water supply, cultivation practices and soil type. When there are adverse effects on these factors it can lead to change in basic nature of soil which then becomes unsuitable for plant growth. Issues related to soil health including physical degradation, chemical degradation, biological degradation and their effects on plant growth is

discussed in this presentation. It is important to maintain the health of soil and this can be done by applying different agronomic approaches. Such as green and brown manures, crop residue, agro industrial waste, minerals and minerals waste and implementing different modern tillage techniques. Enhancing the soil microbial diversity can also help in improving soil health. Integrated farming system will increase the efficient resource cycling, leading to improvement in capacity of soil. This Presentation focuses on latest methods and their contribution to soil health improvement. In coming days special emphasis should be given on developing more innovative methods other than mere application of manures and fertilizers to improve soil health and crop nutrition so that it becomes suitable to meet the needs of future generations.

GIRISDA/AB/176/2022

MOLECULAR AND INSILICO CHARACTERIZATION OF *MADS25* TRANSCRIPTION FACTOR IN INDIAN RICE CULTIVARS

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Rice is a staple food crop and plays a pivotal role in the diet of mankind. Drought is one of the major abiotic stresses that is affecting the productivity of rice every year. Drought avoidance and tolerance mechanisms are adopted by plant system. Certain genes express under such stress conditions and help the plant to cope with the circumstances. MADS-Box transcription factor, ***OsMADS25,*** was reported for its key function in the development of roots in rice. Though this gene is being studied since years, still there are certain functions left unexplored. In the present study, we have analysed the expression pattern of *OsMADS25* gene, under drought stress. Three-week-old seedlings of Indian rice cultivars Nagina22 & BPT5204, which are drought resistant and drought succeptable respectively, were taken and a pot experiment was conducted under polyhouse conditions. Water was withholded after 21days of germination and left them until the symptoms of drought expresses. Sampling was done with three replicates during the drought stress for three consecutive days. RNA was isolated and RT-PCR was performed to check the expression profile of *OsMADS25* gene. Later, this gene was charecterized insilico by retrieving the sequences from NCBI and RAPDB databases. EXPASY analysis has given approximately 26KDa molecular weight, a theoretical pI of 8.86, and aliphatic index of 82.86 and GRAVY index of -0.780. Further, STRING analysis, showed the interaction of *OsMADS25* with its predicted functional partners OS03T0685750-00, GLU3, GCN5, OsJ_18692, OsJ_18693, OsJ_23197, OS05T0440632-00, OsJ_25020, OsJ_35446, OsJ_36238. Using SWISS-MODEL and Phyre-2, a predicted 3D structure of protein was created, which showed a local quality estimate up to 0.8. Homology Modelling was done by taking the "Developmental protein SEPALLATA3 Structure of the DNA-binding domain of SEPALLATA 3" as a template, as it shows 65.45% similarity. Ramachandran plot has shown 98.10% favoured regions with a clash score of 1.16 and mol probity score 0.83. We conclude that the gene OsMADS25 is induced under drought and the predicted protein structure of OsMADS25 gene could become a basis for the crystallographic analysis. The OsMADS25 gene could act as a potential candidate gene for drought stress responses.

GIRISDA/AB/177/2022

EFFECT OF DRIP IRRIGATION AND IRRIGATION SCHEDULING IN BITTER GOURD (*Momordica charantia*) CROP

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The study was conducted in an area of 7 ha at GHRU farm in the village- saikheda, Sausar, Dist- Chhindwara (M.P.) during 2018. Drip irrigation provides the ultimate water use efficiency for open field agriculture, often resulting water saving of 30-50 per cent compared to flood irrigation. The average ET_o calculated was 3.77 mm/day for 2018. The irrigation efficiency and field efficiency 80 per cent and 70 per cent were considered. The irrigation scheduling was done for calculating the water requirement of crop at different stage of the crop. It was calculated by calculating the Crop factor, canopy factor at different stage of crop and weekly evaporation data collected from Metrological station of GHRU, Saikheda. The water requirement of bitter gourd varied from 42.833-127.48 cu.m./ha/day during the period of establishment of plant to flowering and harvesting. The calculated time varied from 0.636-1.893 hrs. Drip irrigation resulted in higher yield obtained 200q/ha over flood irrigation practices. The fertigation scheduling gives idea about proper supply of fertilizer at calculated quantity to plants. fertigation enables the farmers to apply optimum quantity and right combination of fertilizer nutrient mixed in water uniformly throughout the irrigated area according to crop development phase. Proper designed drip irrigation minimizes conventional losses such as deep percolation, runoff and soil water evaporation.

GIRISDA/AB/178/2022

INNOVATIVE GREEN EXTRACTION TECHNIQUES FOR ECO-FRIENDLY NATURAL PIGMENTS

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Natural pigments derived from plants have created a centre of attraction for their usefulness in various industries. One of the major value-added products of recent years are natural pigments which are present in fruits, vegetables, flowers, roots, stem and other parts of plants. Food colour is an important attribute of food quality and affects consumer acceptance. Natural pigments are classified as chlorophylls, carotenoids, anthocyanins and betalains. Due to adverse effect of synthetic dyes on human health and environment there is increasing demand for natural pigment in food industry, pharmaceutical industry, nutraceutical industry and dyeing industry. There are number of conventional and modern methods for extracting colour. With current economic and environmental concerns, extraction industry developed efficient processes called green extraction techniques in terms of cleanliness to environment, safety of operators and use of space. The revolutionary development of green technology has markedly influenced the recovery of natural compounds. Various green extraction methods include supercritical fluid extraction, ultrasound assisted extraction, microwave assisted extraction, microwave assisted hydro-diffusion, pressurized liquid extraction, pulsedelectric field extraction and enzyme-assisted extraction. These techniques are beneficial due to higher extraction efficiency, higher quality extract, reduces extraction time, number of unit operations, reduces global energy consumption, use of less solvent in the process, no or less environmental impact, reduced economical costs, less quantity of waste generated, prevention of pigment degradation and control of extraction temperature. Improving methodologies of extraction and generating cost-effective processes are currently challenging because of the large diversity of natural dye sources.

GIRISDA/AB/179/2022

SIGNIFICANCE OF CHANGE IN UPTAKE OF NITRATE TO AMMONICAL FORM OF NITROGEN IN RICE (*Oryza sativa*)

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Nitrate and ammonium are the two major forms of nitrogen available in soil which plant could absorb and utilize. Nitrate is predominantly available in aerobic soil condition whereas ammonical form is available in anaerobic condition. When plant absorb ammonical form and metabolize it then plant releases excess hydrogen ion into the soil and creating acidic environment and while plant uptake nitrate then they release OH^- ion into the soil and higher pH can be seen in medium. In this experiment single plant was grown in hydroponics solution with three different nitrogen treatments viz., ammonium nitrate (both forms together), ammonium and nitrate. The pH of the solution was recorded up to 30 days from the date of sowing. The results indicated that in ammonical form of nitrogen pH has a decreasing trend and in nitrate treatment pH tend to increase, and in mixed form of nitrogen initially pH increases up to 22-24 days of sowing then after it start decreasing. This suggests that rice plant prefer nitrate form of nitrogen in the initial period of growth and development and then it switches to the ammonical form of nitrogen for uptake. This is the stage when rice is usually exposed to anaerobic conditions with agronomic, soil and water management where ammonical form of nitrogen is predominant, indicating the evolutionary significance of stage specific switch.

GIRISDA/AB/180/2022

PRETREATMENT OF PADDY STRAW WITH BIO-DIGESTED SLURRY GROWN MICROBIAL CONSORTIUM FOR ENHANCING BIOGAS PRODUCTION

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Paddy straw, ligno-cellulose rich biomass from agricultural fields is underutilized by open field burning in northern India. Burning of paddy straw causes various detrimental health and environmental problems to animals, humans and soil. Utilization of this unutilized paddy straw for commercial applications such as production of biogas requires the removal of recalcitrant lignin-silica complex structure in the paddy straw. Biological pretreatment using microbial culture proved to be more economical and sustainable technique over physical and chemical pretreatment methods. Biodigested slurry, waste from biogas plant was used as substrate for cultivating the microbial consortium consisting of 6 bacterial and 2 fungal cultures in the current research and was used for pretreatment of the paddy straw. Pretreatment was carried out with 10% and 20% inoculum concentration for 7 days and was analyzed for proximate and chemical contents followed by the estimation of biogas production potentiality. Pretreated paddy straw with 20% microbial consortium showed 4.18%, 3.84% and 2.13% reduction of total solids, volatile solids and total organic carbon content compared to 3.54%, 3.18% and 1.77% in 10% microbial consortium treated and 2.24%, 1.78% and 0.99% in untreated paddy straw respectively. Paddy straw pretreated with 20% microbial consortium showed 8.8% and 8.2% reduction in cellulose and hemicellulose respectively as compared to 6.6% and 5.7 reduction in untreated paddy straw. Silica and lignin content was found to be more as compared to untreated paddy straw. Biogas production was enhanced by 82.69% in 20% microbial consortium as compared to untreated paddy straw. The enhancement of biogas in this experiment is directly related with reduction of structural complexity by microbial consortium pretreatment. Microbial consortium used in this study proved to be potential organisms for enhancing biogas production through the degradation of paddy straw lignocellulosic structure.

GIRISDA/AB/181/2022

IMPACT OF CLIMATE CHANGE ON BIODIVERSITY

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Climate is a major driver of global patterns of nutritional structure, production and formation of plants and animals. Changes in estimates, extremes, and climate change determine the impact of climate change on biodiversity. Climate change is associated with other aspects of global change, such as land use patterns and declining ecosystems, primarily due to land degradation, declining water quality and quality, loss of habitat, adaptation and divergence, special use of species and the introduction of non-native species types etc. Global pressure is mounting in many parts of the world, with increasing demand for crops, meat and dairy products, bio-energy and timber, and further degradation and climate change. The release of greenhouse gases and aerosols from human activities alters the formation of the atmosphere. Of the 4,161 land and water species currently recognized by the IUCN as vulnerable to climate change, 33% are at risk of habitat change due to climate change, and 29% are at high temperatures, 28% at risk of drought. Climate change abiotic conditions affect systems and biological processes. Changes in bio-phenology or seasonal phenomena have been observed due to changes in temperature, rainfall, and light cycles in terrestrial and aquatic environments, as well as patterns due to current sea temperatures in the marine environment. Bio-phenological events include leaf appearance, flowering, plant flowering changes, and animal life and migration changes. Rainfall and temperature also affect food availability and can indirectly lead to changes in body size. Fire-related fires and droughts are more likely to destroy the forest than the gradual stress of climate change. So, changes in the earth's climate system can eliminate species and thus reduce biodiversity.

GIRISDA/AB/182/2022

ROLE OF ORGANIC PRODUCTS IN SUSTAINABLE MANAGEMENT OF SOIL BORNE PATHOGENS

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Agriculture is faced with many challenges including loss of biodiversity, chemical contamination of soils, and plant pests and diseases, all of which can directly compromise plant productivity and health. In addition, inadequate agricultural practices which characterize conventional farming play a contributory role in the disruption of the plant-microbe and soil-plant interactions. This review discusses the role of organic amendments in the restoration of soil health and plant disease management. While the use of organic amendments in agriculture is not new, there is a lack of knowledge regarding its safe and proper deployment.The utilization of organic amendments for control of soil-borne plant pathogens has often been considered at best variable, but more often as a snake-oil remedy. Understanding the mode of action of these products, however, provides insight as to where and how to exploit these underutilized energy sources for the benefit of plant and soil health. Organic amendments containing high nitrogen, such as poultry manure, meat and bone meal, and soymeal, significantly reduced populations of a wide spectrum of soil-borne plant pathogens. Pathogen control was shown to arise from the ammonia and (or) nitrous acid generated, the concentrations of which are controlled by pH, organic matter content, soil buffering capacity, and nitrification rate. Swine manure can reduce pathogen populations by both these mechanisms as well as by an additional process involving volatile fatty acids.

GIRISDA/AB/183/2022

ACTIVITY OF ESSENTIAL OIL ENCAPSULATED ZINC OXIDE NANOPARTICLES ON DISEASE INCIDENCE OF ALTERNARIA LEAF SPOT

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Alternaria leaf spot is a destructive disease of strawberry which causes damage both in leaves and fruits. The symptoms were observed on leaves as minute dark brown to black spots and on fruits also, which forms enlarged concentric rings from small to large with collapsing of spots. The isolation of pathogens was done from infected leaves and pathogenicity was established on healthy plants of strawberry. On the basis of morphological and microscopic examinations the pathogen was identified as *Alternaria alternata*. Essential oil encapsulated ZnO nanoparticles were synthesized in biotechnology laboratory, University of Agriculture. The various treatments were evaluated under *in vitro* conditions to evaluate the fungus growth on petri plate. Both essential oil and ZnO nanoparticles were evaluated. The maximum disease incidence 39.43% was recorded in (T0= Control) treatment followed by (T2= 150 ppm ZnO) treatment 36.25% and the minimum disease incidence was recorded in (T1= 1% Essential oil) treatment 15.49%. The lowest fungal growth was observed in T6 with highest fungus mycelial growth inhibition (56%) followed by T1 (39%) as well as the highest fungal growth was recorded and also no inhibition of fungal growth was observed in T0 and T2.

GIRISDA/AB/184/2022

HYDROPONIC GREEN FODDER PRODUCTION TECHNOLOGY FOR SUSTAINED DAIRY CATTLE PRODUCTION DURING FODDER SCARCITY

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Hydroponic green fodder production is a soilless alternate fodder production technology which facilitates production of nutritious green fodder in short period of time with limited water requirement and is useful especially during natural calamities like drought. The high cost of commercial hydroponic machine is a big limitation for adoption of hydroponic technology by the farmers. Hence, University Innovation and Instrumentation Centre of TANUVAS fabricated a low-cost hydroponic fodder production device with a fodder production capacity of 20 kg/day which is suitable for rural farmers with 2 to 4 dairy cattle. To popularize the hydroponic green fodder production technology among rural dairy farmers and to study the impact of hydroponic fodder feeding on the performance of dairy cattle at field level a project was implemented with Government of Tamil Nadu funding. Under this project, 320 rural small dairy farmers with 2 to 5 dairy cattle (i.e. 80 farmers per district) from four drought prone districts of Tamil Nadu were identified. The selected farmers were provided with a low cost hydroponic fodder production device and hands on training on hydroponic green fodder production. Later, the adoption level and impact of the technology was studied. The adoption level of hydroponic green fodder technology was found to be 100% among the selected farmers as all the farmers have utilized the device for hydroponic maize fodder production during summer. The performance of dairy cattle reared by the farmers before hydroponic fodder feeding was considered as control. About 70% of the farmers reported increase in milk yield by 500 – 1000 ml/cattle/day by feeding 5 kg of hydroponic maize fodder by replacing 1 kg of concentrate feed. The net income/animal/day ranged from Rs.125.00 to Rs.142.50 after adoption of hydroponic fodder feeding which is Rs.17.50 to 35.00 higher to control feeding. About 30% of the farmers reported resumption of cyclicity in anestrous cows within two week of hydroponic maize fodder feeding at 5 kg/animal /day in addition to routine grazing/feeding. Thus, hydroponic fodder feeding can increase milk yield in dairy cattle by 11-22% and lower the incidences of anestrus with added economic gain during fodder scarcity period. To conclude, hydroponic fodder production technology may be employed for sustained dairy cattle production during fodder scarcity period.

GIRISDA/AB/185/2022

GENE ACTION FOR SEED YIELD AND FIBRE TRAITS IN LINSEED (*Linum usitatissimum* L.)

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The present investigation was undertaken to detect the presence of non-allelic interactions by understanding nature and magnitude of various genic effects including interactions for seed yield, oil content, fibre yield and associated traits in linseed. Eight generations namely, two parents (P_1 and P_2), F_1, F_2, BC_1, BC_2, BC_1F_2/B_{1S}, BC_2F_2/B_{2S} were evaluated in compact family block design with three replications for 16 characters in five cross combinations namely, Surbhi × Nagarkot, Baner × Belinka, KL-270 × JRF-1, T-397 × Surbhi and K1-Raja × Nagarkot. The research was carried out in Experimental Farm, Department of Crop Improvement, CSK HPKV, Palampur and research station SAREC Kangra and HAREC Kukumseri. Generation mean analysis suggested that both additive and dominance effects were important for most of the traits but dominance was predominant as compared to additive effects. Duplicate type of gene action was observed in Surbhi × Nagarkot for four characters namely, primary branches per plant, secondary branches per plant, capsules per plant and 1000-seed weight; Baner × Belinka for four characters namely, plant height, technical height, primary branches per plant and capsules per plant; KL-270 × JRF-1 for four characters namely, plant height, primary branches per plant, secondary branches per plant and capsules per plant. In T-397 × Surbhi, one character i.e. harvest index and K1-Raja × Nagarkot for six characters namely, primary branches per plant, aerial biomass per plant, seed yield per plant, 1000-seed weight, fibre yield per plant and oil content which suggested the exploitation of these crosses by growing large segregating populations and adopting biparental mating to get transgressive segregants. Complementary type of gene action was observed in Surbhi × Nagarkot for plant height; K1-Raja × Nagarkot for secondary branches per plant and Baner × Belinka for both seed yield per plant and fibre yield per plant which implies the use of biparental approach and early generation selection to be followed.

GIRISDA/AB/186/2022

LENTIL VARIETY RKL 58F-3715 (KOTA MASOOR 4): A CASE STUDY DEPICTING EMERGENCE OF DESIRABLE TRANSGRESSIVE SEGREGANTS AND RECOMBINANTS OVER GENERATIONS

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The lentil (*Lens culinaris* Medikus ssp. *culinaris*) is highly self pollinated crop thus has little possibility of generation of natural recombinant variants. In nature mutation process generates random genetic variations with low frequency of desirable alleles. The new lentil variety RKL 58F-3715 (Kota Masoor 4) was first of its kind which developed by identification of the spontaneously generated variable single mutant from the popular base variety DPL 62. The breeding strategy used for the development of new variety was a combination of modified single seed descent (SSD) method and pedigree method. A series of large number of hyper variable segregants were observed during the generation advancement of single mutant plant especially for seed characteristics. After seven years of rigorous selection, high yielding stable mutant line was tested under All India Coordinated Research Project on MULLaRP for three years during rabi 2017-18 to 2019-20 for yield and other parameters. Results showed that average weighted

mean yield of bold seeded spontaneous mutant RKL 58F-3715 across the locations, was 1865 kg/h with the maturity duration of 108-115 days. It showed 22.80 percent higher yield to the base variety or check DPL 62, 12.09 percent yield superiority over the national check L 4076 and 15.61 percent and 17.21 percent over the check varieties JL 3 and IPL 316, respectively. Among the twenty one test locations, the highest seed yield of 2885 kg/ha was obtained at location Chittrakoot, followed by 2777 kg/ha at Sagar. The RKL 58F-3715 displayed enhanced levels of resistance against wilt (23 %) and rust (2.88) diseases. By considering these facts, the new variety RKL 58F-3715 (Kota Masoor 4) was released and notified in the year 2021 for cultivation in rainfed area of Central Zone of India.

GIRISDA/AB/187/2022

BIOCHEMICAL ALTERATIONS IN MUSKMELON IN RELATION TO FUSARIUM WILT INCIDENCE

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Muskmelon (*Cucumis melo* L.) is a cucurbitaceous crop cultivated worldwide. Melon is a healthy food option as it is a rich source of bioactive compounds and had low calories, zero cholesterol, nutritious, sweet and juicy fruits; but biotic stress is the major limiting factor in melon crop production worldwide, due to its susceptibility to fusarium wilt, which is instigated by a soil borne pathogen, *Fusarium oxysporum* f. sp. *melonis* (FOM), causing yield loss as high as 100%. During the process of pathogenesis, several changes in biochemicals associated with defense pathways have been revealed. In the present study, we have monitored the underlying changes in activities of chitinase and glucanase enzyme and in contents of total phenols, total soluble proteins, crude protein; after artificially inoculation of FOM in roots at 7, 14, 21 Days of Inoculations (DOI), in five melon varieties (Snap Melon & Wild Melon- resistant; Hara Madhu- moderately resistant and Punjab Sarda & Punjab Sunehri- susceptible). The disease severity index was recorded following 0-5 scale (0 for no wilt symptoms; 1, 2 or 3 for very little wilt development; whereas 4 or 5 for large wilt symptoms. FOM inoculation led to increase in enzymatic activity upto 21st DOI of both enzymes i.e. Chitinase and glucanase. Wild melon has maximum activity of glucanase (163.9 µg glucose released/mg Fresh weight tissue (FW)) and Snap melon has maximum activity of chitinase(40.6 µmol of NAG released/gm FW). Total phenolic content, total soluble proteins, crude protein content found to be more in FOM inoculated state, with maximum at 14th day in Snap melon i.e. 2.61 µg/g FW, 3.9 mg/g FW, 25.65% respectively. Resistant varieties had higher expression as compared to susceptible varieties for all the studied biochemicals. This data could act as a framework to further explore the gene expression changes pertaining to influenced biochemicals at the genomic level.

GIRISDA/AB/188/2022

SUSTAINABILITY OF LIVELIHOODS DURING COVID-19 PANDEMIC IN DAIRY SECTOR OF PUNJAB

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The agricultural production system in India is largely characterized by mixed crop-livestock farming, with the livestock segment complementing farm incomes by providing employment, draught power for agricultural operations, fuel for cooking food, manure for maintaining the soil fertility etc. The agriculture sector in India has witnessed a downfall during the last decade and so. It has failed to achieve 4 per cent growth rate as envisaged in the 11th and 12th five year plan periods. The agrarian crisis has manifested itself in the form of decline in income, increase in cost of production, indebtedness and farmer suicides across different regions etc. The nature and extent of the crises varies

from region to region and the different states/regions of the country has responded differently to agrarian crises. Some regions such as Punjab and Haryana are still endowed with resources for subsidiary occupations such as dairy, poultry and other subsidiary occupations, while other regions still being excessively dependent upon rain-fed farming lag behind in the development of dairy sector. As a result, the contribution of different regions towards dairying is also likely to be different. While the government of India has made ambitious plans to double the income of the farmers by 2022. It is, therefore, stressed that in order to revive agrarian economy, steps are needed to be taken to diversify agrarian economy to other subsidiary occupations and non-farm sectors. In this context, dairying is looked as an alternative to boost the livelihood conditions of the farming, besides ensuring food security of the nation. The demand for milk and milk products has also grown rapidly due to various demand driven factors such as rise in per capita income, health consciousness, education level, rapid urbanisation etc. Thus, the dairying sector in India is undergoing rapid structural changes largely due to shift in emphasis in agricultural production towards other subsidiary occupations along with rise in demand for various dairy products. In this context, the study seeks to explore various structural transformations that have taken place in dairy sector of India in terms of its contribution towards agricultural sector, milk production and contribution of milk by different states as well as animal species since 1991. The livestock sector continues to drive rural livelihoods and contribute significantly to the agricultural economy of Punjab. Within livestock sector, milk accounts for about 80% of the total value of output of livestock. In the recent times, dairy sector has undergone rapid growth and structural shifts in terms of establishment of dairy cooperatives, producer companies and private dairy companies, which are seen as one of the several pathways to diversify and boost the rural income and livelihoods in crisis ridden agrarian state of Punjab. It is argued that the imposing of lockdown and curfew disrupted all the economic activities and disruptions in agriculture and allied sectors pose a major challenge, which may have serious implications for food production and in ensuring food security. In this context, it becomes imperative to explore how does the dairy sector in Punjab, particularly the milk producers, get affected due to the outbreak of Covid-19? How do the milk producers and the state government respond to Covid-19 pandemic to ensure a sustainable dairy production system in the post-Covid-19 period? The study reveals decline in milk sales and procurement, increase in cost of dairy production, rise in animal health and productivity issues etc. due to the outbreak of covid-19. The study brings out useful policy recommendations to meet challenges from such pandemic outbreaks to make the dairy enterprise a win-win situation for all the stakeholders.

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HOW LONG CAN BEE SPECIMEN BE LEFT IN PAN TRAP UNDER SUB-TROPICAL CONDITIONS WITHOUT COMPROMISING ITS EXTRACTABLE GENOMIC DNA QUALITY AND QUANTITY?

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Worldwide there are 20,507 bee species, majority of which comprise a valuable natural resource as these offer pivotal ecosystem service i.e. cross pollination in various ecosystems. Thus, help in preserving the diversity in an ecosystem and sustaining the yield of important crops. Bee diversity is a hot topic of research due to escalating reports on pollinators‟ decline due to various anthropogenic activities. Sampling is the pre requisite to understand the pollinators‟ diversity of a region. In this task, coloured pan traps filled with detergent as a collecting medium is the commonly employed method. Second step is to identify the bee species through molecular taxonomy. This requires excellent quality genomic DNA (gDNA). When large area is to be studied and samples can‟t be collected daily, decaying of samples due to high temperature and humidity conditions under subtropical conditions becomes a major constraint. This ultimately affects the quality of gDNA for molecular studies. In this context, the present study was conducted to estimate how much time bee specimens can be left without comprising its DNA quality and quantity. Experiment was conducted at Apicultural Laboratories, Department of Entomology, Punjab Agricultural University, Ludhiana to know the suitability of pan trap (3% detergent in water; pH=6.5-7.5) caught bee specimen sampled at various time intervals

for extraction of gDNA. It was found that significantly highest average concentration of gDNA (1440.55 ng/µl) can be extracted from fresh samples during the summer and rainy seasons. The reduction in average concentration was 79.67 per cent on 11th day and 59.18 per cent on 3rd day respectively, during summer and rainy season, which reduced further in the succeeding days. In both the cases, the purity of gDNA was within the specified range (1.8 to 2.00). On subsequent days, amplification of mitochondrial DNA through PCR using universal primer *i.e.*, LCO/HCO declined as it was evident from the amplicon brightness which was directly proportional to the corresponding concentration of genomic DNA. It is recommended that the bee samples can be left in pan traps for 11 and 3 days during summer and rainy seasons, respectively. At this time, the concentration of extracted gDNA was 467.97 and 588.43 ng/µl, respectively. Hence, the sampling frequency for hymenopteran insects through pan trap can be adjusted accordingly.

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STUDY THE CORRELATION OF LSWI AND NDVI WITH DIFFERENT ABIOTIC DROUGHT AFFECTING ON CROP GROWTH

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This investigation was under taken to study the use of LSWI and NDVI to monitor cotton crop. As cotton is long duration crop which was very sensitive to midterm or late-season and nutrient deficiency (abiotic stress) therefore used for the study LSWI and NDVI help to assess agricultural drought in cotton growing Surendranagar districts of Gujrat, India, during *Kharif* cropping season 2015. Persistent stress (i.e. Moisture deficits and nutrient deficiency) during flowering and yield formation stage are referred to as late-season agricultural drought. Satellite-based indices like the Normalized Difference Vegetation Index, land surface water index from landsat-8 satellite data were analyzed. The analysis was carried out by comparing the satellite-derived indices with the previous normal years, and the assessments were made. The satellite-based indices clearly brought out the stress that the crop endured during September, while LSWI indicated soil and crop water stress in early September. The results show that when satellite indices correlated with cotton crop biophysical parameter collected from different area of irrigated and rainfed surendranagar Dist, its shows that if cotton crop did not have enough soil moisture during the critical stage of flowering and boll formation and suffered severe yield loss due to the late-season agricultural drought.

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ORGANIC FARMING WITH RESIDUE FREE PRODUCTION

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Agriculture, the backbone of the Indian economy and is one of the widest sectors in the country. Highest percent of the country‟s population is dependent on the Agriculture. Many factors influence the agricultural production technology in either positive or negative ways. In this regard, the usage of pesticides and strong chemical fertilizers has been a predominant factor in the agriculture sector since quite a long time. It had a very negative impact on the environment as well as on the masses who consume it. Keeping this in the view there were many other farming approaches that came into existence but on whole they also hold some pros and cons as well. The hot topics in today‟s agriculture and food safety are organic and residue free foods. The terms „organic‟ and „residue free‟ are used interchangeably to make matter confusing. Organic farming, on one hand is defined as an agricultural system that includes the usage of pest controls and biological fertilizers, obtained from animal and plant wastes. Residue free farming, on the other hand can be phrased as the use of organically derived biocides and biofertilizers to protect the

crops and augment their growth. Apart from the advantages of the organic farming like Crop rotation and curbing the risk of groundwater contamination, it also holds some disadvantages like low yielding capacity and absence of clear indicators which show that the products offer higher nutritional content. Whereas Residual free farming aims to address the drawbacks of organic farming along with its positive effects like good yielding capacity and high nutritional value. Thus on upholding the organic farming along with residual free production of foods not only increases capability of serving the need of growing population but also stands as a preferred option for the health conscious consumers of today. They also benefit the buyers as well as the farmers in avoiding the risk of handling unhealthy practices to supplement their fields and crops. In this era of ever expanding demand for quality food, this disruptive farming practice stands as a harbinger of a greener, cleaner and healthier agricultural sector.

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EFFECTIVE COMMODITY VALUE CHAINS APPROACHES THROUGH AGROFORESTRY

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Agroforestry is a unique land management approach that blends Agriculture, Forestry and or Livestock/Pasture on same land to enhance productivity, profitability and environmental stability (Palsania *et al*., 2009). It provides direct and indirect benefits and produces variety of products like timber, fuelwood, fruits, fodder etc. to meet household needs and to generate some income through sale in local markets (Millard, E. 2011). Market system approach focuses on connecting farmer to local and regional markets supporting farmer organizations can strengthen their positions in negotiating prices and enables them to access finance, training, input services. The provision of a market support system for a wide range of pulp wood, plywood, timber exerted a significant influence among tree-growing farmers. Commodity Value Chains are the full range of activities which are required to bring a product or service from conception, through the different phases of production, transformation and delivery to final consumers, and eventual disposal after use. Marketing at the farmer level has received little attention in the past and poorly understood (Kaplinsky and Morris 2002). In order to sustain these value chain innovations and interventions the institutional development mechanisms and activities need to be accelerated which shall help to resolve the issues of raw material security. By understanding market linkages and interactions, it should be possible to improve smallholder farmers‟ livelihoodsby focusing their agroforestry production towards market opportunities (Parthiban *et al*., 2021). The review of commodity value chains has found that agroforestry can become an increasing part of a production and marketing system for different products that is sustained by the value chain participants.

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CLIMATE SMART AGRICULTURE – BUILDING RESILIENCE TO CLIMATE CHANGE

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Climate resilience is a fundamental concept of climate risk management. In this context, resilience refers to the ability of an agricultural system to anticipate and prepare for, as well as adapt to, absorb and recover from the impacts of changes in climate and extreme weather. Climate variability and change have intensely affected agricultural systems, which are the major sources of livelihood for rural families in developing countries. Climate change holds the potential to radically alter agroecosystems in the coming decades, and devastating crop failures are already evident in several countries of the world. We may expect changes in land vegetation, ocean circulation, sea surface temperature

and global atmosphere composition, which will in turn impact rainfall patterns. These changes will bring new challenges to farmers. The 5th Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) suggests that tropical rice productivity is likely to decline at a 1.3% to 3.5% rate for each 1 ºC average global 32 Sustainable Development Goal 13 warming. Increased average global temperature may lead to increased thermal and water stresses and, consequently, decreased productivity. It is estimated that climate change is already reducing global crop production by 1% to 5% per decade over the past 30 years, and will continue to pose challenges for agriculture in the coming decades. Therefore, in the face of global climate change, farmers must adapt their practices to deal with changing temperatures and more frequent extreme weather events. These adaptations must first and foremost build resilience within the agroecosystem, increasing its ability to continue functioning when faced with unexpected events. To ensure greater resilience and adaptability to climate risks, it will be important to quantify the risk to which agroecosystems will be exposed in the different ecological regions. Resilience can be enhanced by implementing short and long-term climate mitigation and adaptation strategies, as well as ensuring transparent and inclusive participation of multiple actors and stakeholders in decision-making and management processes. Climate vulnerability resulting from global changes implies the need to diversify production and to better explore opportunities and aptitudes of each ecosystem. In this context, climate change impacts can also be minimized by adopting diversified ecological systems or SAF. Creating such a system based on the available local natural resources meets a growing demand of part of the population for agroecological or strictly organic food production and meets a number of requirements linked to farmer‟s comfort and animal welfare. Some management practices must need to follow in order to enhance resilience in agriculture for climate change. The most important are Climatic Risk Climate Action Agricultural Zoning – which contributes to reduce risks by recommending more favourable times for sowing agricultural crops; genetic and animal breeding programs – which seek to adapt plants and animals to adverse climatic conditions; and intensive and integrated production systems such as ICLF, functional agroecosystems and aquaponics – which integrate aquaculture with plant production. Climate change poses a very high risk for food security if adequate mitigation and adaptation measures are not taken; it is, therefore, fundamental to continuously develop and improve technologies, products and processes that ensure agroecosystem resilience and adaptation.

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DEVELOPMENT AND SENSORY EVALUATION OF GRAPES RTS (READY-TO-SERVE)

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The commercially important fruit grape is grown and consumed globally. The grapes being potential source of polyphenols, antioxidants, anti-hypertensives and other bioactive compounds possess many health benefits. But owing to high moisture the grapes have a limited shelf-life. Therefore, processing them into ready to serve (RTS), a non-alcohol beverage made using fruit juice, sugar and water helps to preserve them. RTS beverages are highly regarded for their nutritional benefits, refreshing taste and pleasant flavor. In this context, the present study was undertaken in an attempt to develop grapes RTS. The extracted fresh juice was analyzed for pH, titratable acidity and total soluble sugar (TSS). The grapes were boiled & mashed (40±5 °C) to extract the juice. The freshly extracted juice was evaluated for pH (3.52), titratable acidity (0.9%) and TSS (11.8 °brix). The TSS of the juice was enhanced with addition of sugar syrup to meet the commercial standards. The product developed was also analyzed for its physicochemical and sensory properties. The sensory characterization of RTS was done by semi-trained panelists using 9-point hedonic scale. The product prepared was liked greatly in term of color, taste, flavor and overall acceptability (OA). The product secured overall 7.5 points on hedonic scale and showed a pH of 3.52, titratable acidity (0.21%) and TSS (16.27 ° brix).

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PHYSICO-CHEMICAL AND SENSORY EVALUATION OF ORANGE MARMALADE SUPPLEMENTED WITH ALOE VERA GEL

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Marmalade, a fruit preserve resembling jelly, is typically made using citrus fruits strained juice, peel, and sugar. The oranges being high in vitamin C, flavonoids, carotenoids, and antioxidants have the potential for high value addition and being utilized for marmalade formulation. The aloe vera gel was incorporatedto impart anti-inflammatory and antioxidant properties to marmalade. The orange peel added provides additional nutrients and caused a reduction in citrus waste. In the present study, marmalade was prepared using oranges and aloe vera gel, and the effect of addition of aloe vera (0, 1, 2, 3, 4 and 5%) was investigated. A gradual increase in titratable acidity (0.55 to 0.64%) and moisture (23.12 to 27.08%) was observed on increasing aloe vera concentration and subsequent decrease in pH (3.97 to 3.31) and TSS (68 to 59 °brix) was noticed. No significant effect of aloe vera addition on protein and fat was observed. Sensory evaluation of the prepared marmalades was done by semi-trained panelists on 9 point hedonic scale to compare the overall acceptability (OA). The parameters like color, taste, flavor, texture, and OA were evaluated. Among all the formulations, the sample with 1% aloe vera incorporation found most acceptable. From the study it can be concluded that the addition of aloe vera gel in orange marmalade has synergistic effect on the physico-chemical & sensory characteristics of the product.

GIRISDA/AB/196/2022

DEVELOPMENT OF GLUTEN FREE VEGAN NUTRACEUTICAL NOODLES

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Generally, noodles are made up of refined flour which is unhealthy as well as not suitable for people suffering from celiac disease. Noodles are popular, instant and convenient wheat-based food items consumed throughout the world. Vegan diets are now-a-days in trend due to which food items made up of composite flour has attracted consumers as well researchers. The study focuses on noodles prepared from composite flour made up of rice flour, split and dehusked mung bean dal, chickpea flour and corn flour and it‟s impact on the nutritional, physical and sensory properties as well as overall acceptance of final product. The different combinations were made using split and dehusked mung bean dal flour, rice flour, corn flour and chickpea flour. Spices were boiled in water and this water used for binding or mixing of the noodles.

The combination made with 60% rice flour, 0-30% split and dehusked mung bean flour, 5-20% corn flour, 5-20% chickpea flour. The proximate analysis of the products showed carbohydrate, protein, fat moisture and ash were in the range of 54-58%, 2-10%,2-8%,17-26% and 0.3-1.5% respectively. Cooking properties such as optimal cooking time, cooking loss, rehydration rate, cooking yield was5-10 minutes, 0.0025-0.2%, 62-155%, 187-260% respectively. The most acceptable formulation according to the sensory analysis was with 60% rice, 20% chickpea flour, and 20% corn flour which had no split and dehusked mung bean dal and high amount of chickpea flour.

It was observed that the final product developed has similar characteristics as that of products made up of wheat flour or refined flour. Products made up of composite flour are nutritionally dense as compared to products made up of just wheat flour or refined flour.

The products made up of composite flour fulfil the functional and physicochemical properties as well as provides the health benefits.

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KNOWLEDGE OF FARMERS REGARDING BIOMIX

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The present study explored knowledge of farmers regarding Biomix. The present study was conducted in Vasmat and Aundha N. tahsils of Hingoli District. The findings of this study are based on the data collected by interviewing 120 respondents from 12 villages of two tahsil i.e. Vasmat and Aundha N. in Hingoli District. The Ex-post-facto research design was used for the study. A well structured questionnaire designed for study was used for collecting the data from respondents through personal interview method. The data collections from the respondents were edited tabulated and analyzed using suitable statistical tools like frequency, percentage, mean, standard deviation and Pearsons coefficient of correlation. There were dependent variables namely "knowledge". There were 11 independent variables viz., Age, education, land holding, occupation, annual income, socio-economic status, source of information, extension contact, social participation, risk orientation, and market orientation. The study was noticed that, 62.50 per cent of farmers belong to medium level of knowledge, whereas 30.83 per cent and 6.67 per cent of farmers were in low and high level of knowledge respectively. The characteristics namely education, occupation, extension contact, social participation had positive and highly significant relationship with their knowledge level. However, other characteristics namely age is positively non-significant and annual income is negatively non-significant with the knowledge of farmers. While land socio-economic status, sources of information, risk orientation, market orientation had positive and significant relationship with knowledge.

GIRISDA/AB/198/2022

DEVELOPMENT AND EVALUATION OF PHYSICO-CHEMICAL AND SENSORY PROPERTIES OF PLUM SQUASH

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The Squash, a ready-to-drink beverage is made using different fruits is consumed globally. The climacteric fruit plum (*Prunus domestics L.*) in its dried form is known to contain considerable amounts of vitamins, minerals, organic acids and antioxidants. Despite the facts, the fruit own poor value addition owing to its limited exploration. Keeping in view, the present study was undertaken in an attempt to formulate plum based squash blended with anardana (dried pomegranate arils). Anardana was added to deliver additional vitamins (C, K, and B_5) and beneficial phytochemicals (anti-oxidant, antimicrobial and anti-inflammatory compounds) in addition to its contribution in taste. The physico-chemical and sensory parameters of product were evaluated to make a fair comparison between different formulations and effect of addition of anardana was analyzed. The control (100% plum) was prepared using standard procedure with slight modifications. The samples were blanched (95±5 °C; 7-8 minutes) to extract the pulp and content of sugar and pectin were standardized through hit and trial method. A total of three samples were prepared comprising a control (A1) having plum and anardana in ratio 100:0 (i.e., 100% plum), A2 (90:10) and A3 (80:20). The sodium benzoate (0.04 %) was kept constant and the squash samples were analyzed for moisture content, pH, TSS, titratable acidity, protein and fat. Organoleptic characterization was done (flavor and taste, color and appearance, consistency, overall acceptability) through sensory evaluation using 9-point hedonic scale. The A3 sample containing plum and anardana in ratio 80:20 secured highest points with greater overall acceptability and was analyzed to have 56% moisture, 0.73% protein, pH 4, 46% TSS, 1.02% titratable acidity and trace amounts of fat.

GIRISDA/AB/199/2022

ANTIFUNGAL POTENTIAL OF FENUGREEK SEEDS AND LEAVES ESSENTIAL OIL AGAINST RICE FUNGI

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Protection of agricultural crops from different groups of fungi has always been a big challenge for agricultural and agro food industries as they cause huge losses in crops yields and quality.Various synthetic fungicides are available for their control. However; the ceaseless and indiscriminate use of these fungicides hascreated health problems in human beings due to their side effects. Fenugreek represents a reservoir of various biologically active compounds which can be effectively used as a source of natural antifungals agents as they are non-phytotoxic, easily biodegradable and more systemic in nature. Thus, the objective of the present study was to analyze the antifungal potential of fenugreek (*Trigonellafoenum-graecum* L.) seeds and leaves essential oils on rice fungi i.e., *Rhizoctonia solani* and *Drechslera oryzae*. Extraction of essential oils from fenugreek seeds and leaves was done with hydro distillation method using Clevenger apparatus. Characterization of extracted oil was carried out by spectroscopic techniques like GC-MS. This analysis of fenugreek seeds essential oils revealed the presence of Benzyl acetate, 9,19-Cyclolanost-24-en-3-ol(3.beta), Stigmast-5-en-3-ol(3.beta), gamma-tocopherol as major compounds and leaves essential oil revealed the presence of gamma-Tocopherol, gamma-Sitosterol, Ergost-5-en-3-ol(3.beta), Stigmast-5-en-3-ol-oleat, stigmasta-5,22-dien-3-ol, Vitamin E as a major compounds. Antifungal activity of above said essential oils was tested by poison food technique. Fenugreek seeds essential oil was found more effective having less value of ED_{50} 1500ppm and 2050ppm against *R. solani* and *D. oryzae* respectively as compared to leaves oil with ED_{50} values of 1650ppm and 2200ppm respectively. Thus, fenugreek seeds essential oil can be effectively used to control damage caused by these fungi in rice.

GIRISDA/AB/200/2022

IMPORTANCE OF *Apis mellifera* IN ONION POLLINATION

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In the absence of insects in many entomophilous crops, fruit or seed set are significantly affected even if all the cultural practices are followed properly. A better understanding of the importance and role of pollinators would enable sustainable production of agricultural products. Onions are cross-pollinated crops where self-pollination is impossible. To study the role of different pollinators in onion seed yield, we used a total of 4 treatments in our experiment, i.e., open pollination, *Apis melifera*, *Xylocopa fenestrate*, and pollinator exclusion. We found a significant difference in onion seed yield between different treatments. We propose that managed pollination with *Apis mellifera* would be useful in enhancing onion production.

GIRISDA/AB/201/2022

GENETIC STUDY OF GRAIN YIELD AND ITS CONTRIBUTING TRAITS IN BARLEY (*Hordeum vulgare* L.) UNDER NORMAL AND LIMITED MOISTURE CONDITIONS

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The present investigation was conducted to analyze combining ability, components of genetic variance, heterosis, heterobeltiosis and inbreeding depression in ten genetically diverse parents *viz.*, BH 946, RD 2592, DWRUB 64, DWRB 137, PL 426, PL 419, RD 103, RD 2035, RD 2052 and RD 2508 in barley (*Hordeum vulgare* L.) in two environments *viz.*, E_1 – normal irrigated and E_2 – limited moisture conditions at Research Farm, Rajasthan Agricultural Research Institute (Sri Karan Narendra Agriculture University, Jobner), Durgapura, Jaipur. These parents were crossed in half-diallel mating design (excluding reciprocals) in *Rabi* 2018-19 and their F_1 seeds were advanced in *summer* 2019. The evaluation trial was conducted in *Rabi* 2019-20 in which 10 parents along with their 45 F_1"s and 45 F_2"s were evaluated in a randomized block design with three replications. The significant differences among the parents and generations in both the environments for all the studied characters suggested the presence of sufficient genetic variability. Significance of GCA and SCA for all the studied characters in both the generations indicated the importance of both additive and non-additive gene action. The GCA/SCA variance ratio (predictability ratio) indicated the preponderance of non-additive gene action. An overall assessment on the basis of *per se* performance, SCA effects and heterosis, revealed that the cross RD 103 x RD 2508 in E_1 (normal irrigated) and DWRB 137 x RD 2052 in E_2 (limited moisture) environment were emerged as good cross combinations for grain yield per plant and its attributing characters. Hence, these crosses may be considered desirable under particular environment and may be used further in specific breeding programmes. An overall assessment of the result of this study advocated that restricted recurrent selection, diallel mating design and bi-parental mating could be used as effective and alternative breeding approaches for the development of superior genotype and appreciable improvement of barley in forthcoming years.

GIRISDA/AB/202/2022

ROLE OF COMBINATION FUNGICIDES IN COMBATING STEM ROT OF GROUNDNUT INCITED BY *Sclerotium rolfsii Sacc*.

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India is a leading producer of groundnut and this important oil seed crop will be infected by stem rot pathogen *Sclerotium rolfsii* Sacc.To mange this soil and seed borne pathogen seed treatment with systemic fungicides like tebuconazole is under recommendation. But this pathogen being soil borne perpetuates inside the soil and infects groundnut crop during the crop season from pre-sowing to even after harvest leading to blue disease in groundnut. High dosages of fungicides lead to persistence in the soil, recycling through produce,even some are carcinogenic.As a part of integrated disease management. Recently several new molecules with combination have been introduced into the pesticide market and these will have combination of two fungicides and can be recommended at low dosages.some fungicides have been included in banned pesticdes because of high dosages With the present aim investigation on *in vitro* of eight fungicides was studied.

In vitro efficacy of fungicides against the pathogen was evaluated by poisoned food technique .Among eight combination fungicides *viz.*, azoxystrobin 11% + tebuconazole 18.3% SC (Custodia 29.3 SC), azoxystrobin 7.1% + propiconazole 11.9% SE (Apropo 19 SE), azoxystrobin 18.2% + difenoconazole 11.4% SC (Amistar top 29.6 SC), tebuconazole 50% + trifloxystrobin 25% WG (Nativo 75 WG), mancozeb 63% + carbendazim 12%WP (Saaf 75 WP),

flusilazole 12.5% + carbendazim 25% WP (Lustre 37.5 WP), hexaconazole 4% + zineb 68% WP (Avtar 72 WP) and captan 70% + hexaconazole 5% WP (Taqat 75 WP) which were tested against mycelial growth and sclerotial production of *S. rolfsii in vitro* at lower concentration . At 100, 200 and 250 ppm concentration all the fungicides have inhibited cent per cent of sclerotial population. Zineb in zineb 68% + hexaconazole 4% and mancozeb in mancozeb 50% + carbendazim 25% combination fungicide might have inactivated sulphahydryl groups in enzymes block metabolism.

GIRISDA/AB/203/2022

SOIL HEALTH ASSESSMENT IN DIFFERENT TEA (*Camellia sinesis*) GARDENS OF NORTH WESTERN HIMALAYAS, INDIA

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The soil health assessment provides an insight into soil-related constraints and potentials for sustainable agricultural planning. In the present investigation, 37 tea orchards were selected during 2017-19 at random from tea growing areas of Himachal Pradesh to study various soil health indices/ attributes in surface (0 - 0.30 m) and sub-surface (0.30 – 0.60 m) soils and assess soil health status of tea gardens on the basis of recommended set of soil health indicators.

As regards distribution of soil health indices, physical soil attributes in surface soil *viz.*, textural class, bulk density (Mg m^{-3}), porosity (%) and water stable aggregates (%) ranged from loamy sand to sandy clay, 1.07 to 1.58, 40 to 58 and 26 to 59, whereas chemical attributes, namely soil pH (1:2.5), organic carbon (g kg^{-1}), cation exchange capacity {cmol (p+) kg^{-1}} and base saturation (%) varied from 4.4 to 6.3 (extremely acidic to slightly acidic), 7.1 to 21.3, 3.2 to 15.4 and 41 to 66, respectively. Soil biological health indicators, *viz.*, microbial biomass carbon (g kg^{-1}) and dehydrogenase activity (µg TPF g^{-1} h^{-1}) varied from 0.11 to 0.38 and 2.3 to 4.8, respectively in surface soils. As compared to sub-surface, surface soils had higher mean contents of all soil attributes except clay, bulk density, pH and BS. Further, surface soils were more fertile than subsurface soils

Soil attributes, as recommended by different workers, *viz.*, texture, bulk density, water stable aggregates, pH, organic carbon, cation exchange capacity, base saturation, microbial biomass carbon and dehydrogenase activity were selected to rate and categorize the soil health status of each tea garden. A standard rating table was prepared for assigning scores to each soil attribute in the range from 0 to 100 depending upon its suitability for tea green leaf production. Overall soil health status of tea gardens ranged from low to very high (35 to 84) in surface and low to high (30 to 66) in sub-surface soils. As regards overall soil health status, 5, 30, 51 and 14 per cent of total tea gardens studied were rated as low, medium, high and very high in surface, whereas 27, 49 and 24 per cent of tea gardens were rated as low, medium and high in sub-surface soils, respectively. Soil samples up to 0.30 m depth proved better for the assessment of soil health in tea gardens. It may be concluded that tea productivity in Himachal Pradesh can be sustained at a higher level by adopting scientific soil health management practices.

GIRISDA/AB/204/2022

ANALYSIS OF CONSTRAINTS IN PRODUCTION AND MARKETING OF RAPESEED & MUSTARD AND CHICKPEA IN HARYANA

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The present study was carried out to analyze the constraints in production and marketing of rapeseed & mustard and chickpea. This study was based on primary data collected from Bhiwani and Mahendragarh districts of Haryana based on the highest area under rapeseed & mustard and chickpea, respectively. Two blocks namely Tosham and Kairu from Bhiwani district, Kanina and Mahendragarh from Mahendragarh district selected purposively. Further two villages of each selected block were selected randomly. From each village, 10 farmers were selected randomly and finally, 80 farmers of eight villages were interviewed to excerpt all desired information. The outcomes of study revealed the major problems faced by the farmer in the production, marketing of rapeseed & mustard and chickpea in Bhiwani district were inadequate irrigation facilities 74.17 per cent followed by lack of adoption of plant protection measures *i.e.* 70.00 per cent and marketing constraints were wide fluctuation in prices 72.50 per cent followed by remunerative prices 61.67 per cent. In Mahendragarh district, major production constraint of rapeseed & mustard and chickpea were inadequate knowledge of recommended packages and practices 61.67 per cent followed by big inadequate irrigation facilities 58.33 per cent, lack of adoption of plant protection measures 55.83 per cent and marketing constraints were remunerative prices 62.50 per cent followed by wide fluctuation in prices 60.00 per cent, large number of intermediaries in marketing process 56.67 per cent.

GIRISDA/AB/205/2022

EFFECT OF FOLIAR APPLICATION OF ZINC SULPHATE ON GRAIN YIELD AND ZINC BIOFORTIFICATION IN WHEAT

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An important goal of micronutrient biofortification is to enhance the amount of bioavailable zinc in the edible seed of cereals and more specifically in the endosperm. The picture is starting to emerge for how zinc is translocated from the soil through the mother plant to the developing seed. One of the primary aspects of this transport is that all the applied zinc first goes to the vegetative parts and stored until anthesis. It is only after anthesis that the zinc is retranslocated via phloem, thus ruling out any significant effect of soil-based zinc application for achieving biofortification. In view of the above, a field study was conducted at the N.E. Borlaug Crop Research Centre, GBPUA&T, Pantnagar, India during the wheat cropping seasons of 2019–20 and 2020-21, with the objectives of evaluating the effects of different concentrations (0, 0.25%, 0.5%. 0.75% and 1%) as well as stages of application (30, 45 and 60 days after emergence) of foliar-applied ZnSO4 on flag leaf and grain zinc concentrations in wheat. Wheat variety PBW343 was used in the study. Results indicate that foliar $ZnSO_4$ application significantly increased grain yield and grain zinc content in wheat. Three sprays of 0.75% $ZnSO_4$ was found to be most effective towards increasing grain yield while flag leaf and grain zinc content was found to be highest with three sprays of 1% $ZnSO_4$. The maximum grain yield (5.71 t/ha), amounting to an increase of 17.3% over the control plants was observed with three sprays of 0.75% $ZnSO_4$ while maximum grain zinc content (19.57 mg/kg) with a 24.2% increase over control) was observed with three sprays of 1.0 % $ZnSO_4$

GIRISDA/AB/206/2022

INNOVATIVE TECHNOLOGY OF CROP IMPROVEMENT IN 21ST CENTURY

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Crop records increased dramatically in the 20th century as recorded in world averages. The vast majority of that increase has occurred since the last world war and has been powered by changes in the genetic potential of the crop and in the way in which it has been managed. Nevertheless, the challenges to feed a world population that is likely to rise to 8 billion is formidable, particularly since recent analysis suggest that the rate of increase in yields of several crops may have dropped over the last decade. Improvements in agronomy are likely to be more concerned with efficiency and elegance rather than in major breakthroughs. More sophisticated crop protection chemicals designated on the basis of vastly increased screening potentials to aid management choices which can be precisely implemented genetic improvement in the area in which to look for the major breakthroughs. The broad potential of recommended DNA technology will provide the possibility of both molecular analyses of crop productivity and ways in which it may be possible to improve that productivity. The goal of analysis may be approached in three ways: starting at the beginning by generating complete sequences of the plant genome; Starting at the end by genetic analysis of phenotypes using genetic marker technology; or starting in the middle by metabolic analysis. Improvements may be obtained by re-assorting what has been achieved through enhanced breeding technologies by randomly induced changes and by generation of totally new possibilities through biochemical engineering. The onset of genomics will provide massive amounts of information, but the success will depend on using that to improve crop phenotypes. The ability to meet the challenges of the 21st century will depend on the ability to close the phenotypic gap.

GIRISDA/AB/207/2022

CORRELATION COEFFICIENT AND PATH ANALYSIS OF ENVIRONMENTAL FACTORS INFLUENCING FORAGING BEHAVIOUR OF THREE HONEY BEES IN CORIANDER (*Coriandrum sativum* L.) AND BLACK CUMIN (*Nigella sativa* L.)

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Honeybees like *Apis mellifera, Apis cerana, Tetragonula benghalensis* are the most important and efficient pollinators of Coriander and black cumin. The eological threshold for onset and ceasing activity of each honeybees varied from one another. In general the onset of activity of all bee species started at 0900h of the day at temp (20.68°c), RH (58 %) and LI (49550 lux) while the activity ceasesd at 1700h of the day at temp (19.08°c), RH (65 %) and LI (28890 lux). Among these factors temperature and light intensity plays a major role in foraging activity of all honey bee species. Amid the onset and ceased activity of all honey bee species followed same general pattern with temperature, light intensity and nectar secretion concentration but inversely with relative humidity. Path coeffiecient analysis one of useful tool specify nectar production potential of coriander and black cumin with visitor assemblages and also the cause effect relationship of various environmental factors. Path-coefficient analysis revealed that activity of honey bee species differed in their reaction to similar set of environmental conditions depending upon the physiological adaptation of each bee species.

GIRISDA/AB/208/2022

BRUCHIDS: A MAJOR GROUP OF STORED GRAIN INSECT-PESTS

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Bruchids are commonly known as pulse beetles, pea beetles or bean beetles, and they mostly feed on the legumes of tribe Phaseoleae. The genus *Callosobruchus* is cosmopolitan and is distributed all over tropical and subtropical areas where it is found infesting seeds of mung bean, green gram, chickpea and other pulses, during pre-harvest and post-harvest stage. In India, 117 species of bruchids belonging to 11 genera have been recorded infesting different pulses, with *C. maculatus*, *C. analis* and *C. chinensis* as the predominant species. Although the beetles attack pulses in the field causing minor damage, however, when infested seeds are stored, the adults emerge and lay eggs on the neighbouring seeds and this secondary infestation is much more damaging. Female lay eggs singally on the surface of the grain sheath in field or on dried seeds during storage of grain legumes. The hatched larvae bore the seed below the lower surface of eggs, and the egg shell remains glued to the seed. Grub remain inside the seed and the appearance of capped exit hole on the seed shows the pupal stage. The adults do not need food or water, and can reproduce immediately after emergence. The pest spends its entire immature life in an individual legume seed, where they cause weight loss, decrease germination potential and diminish the market value as well as nutritional value of the commodity. Among field crops, pulses are very important, and farmers usually store pulses them modern bins as well as in traditional storage structures for their own consumption, and for seed purpose. Several insect-pests have been reported to damage stored food grains in the state, however, pulse beetle is one of the most damaging pests causing huge losses at farm and storage level.

GIRISDA/AB/209/2022

CLIMATE CHANGE INDUCED DISPLACEMENT AND MIGRATION IN INDIA: ISSUES AND CHALLENGES

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It is a change which is attributed directly and indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparative time period". Climate change poses severe threat to many countries, territories and cultural heritage of humanity on earth in the 21st century. India is no exception to the increasing impacts of climate change. The geographically diverse Indian subcontinent is particularly vulnerable to a wide variety of natural disasters. Every year thousands of people are affected and displaced at least temporarily by the impact of weather and natural disasters such as droughts, floods, cyclones and riverbank erosion. Moreover, the vulnerability of populations to climate change-related disasters goes beyond physical relocation risk. There are also economic, social and cultural fallouts from such disasters and the displacement has propelled deeper into poverty and marginalization. Besides disrupting the family life of the displaced and the social fabric of communities, it has also led to further geographical and social exclusion by denying their right to the opportunity to live with dignity as given by the Indian Constitution. However, the influence of environmental change on population displacement has largely been ignored by the standard theories of forced migration and the empirical basis of the research remains weak at the national level. This paper highlights the processes of climate change induced displacement and migration of local population in India in general and specifically focuses on the effects of Yass cyclone storm 2021 in Odisha, West Bengal and Jharkhand. It examines the post disaster rehabilitation and reconstruction measures taken by the state government to mitigate the effects and enable communities to be better prepared to deal with future climate change-related events. Climate change and variability are concerns of human being.

GIRISDA/AB/210/2022

INTERCROPPING IN MUSTARD (*Brassica juncea* L.) WITH CHICKPEA AND FIELD PEA AND THEIR EFFECT ON GROWTH, YIELD ATTRIBUTES AND YIELD

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A field experiment was carried out during the winter (*rabi*) of 2019-20 at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar to study the effect of intercropping in mustard (*Brassica juncea* L.) nine treatment combination *viz.*, T_1 : Sole mustard, T_2 : Sole chickpea, T_3 : Sole field pea, T_4 : Mustard + chickpea (1:2), T_5 : Mustard + chickpea (1:3), T_6 : Mustard + chickpea (1:4), T_7 : Mustard + field pea (1:2), T_8 : Mustard + field pea (1:3) and T_9 : Mustard + field pea (1:4) were laid out in randomized block design replicated 3 times. Mustard + chickpea 1:3 ratio (T_5) recorded significantly higher number of primary and secondary branches plant^{-1} and siliquae plant^{-1}. The sole crop of mustard (T_1) produced significantly the highest seed and stover yield in all the treatments. In mustard + chickpea/field pea intercropping system, the number of branches plant^{-1}, number of pods plant^{-1}, grain and straw yield was higher under sole chickpea (T_2)/ field pea (T_3). The higher LER (1.25) was recorded under mustard + chickpea 1:3 ratio intercropping system closely followed by mustard + chickpea 1:4 ratio of intercropping system. Significantly higher mustard equivalent yield was recorded under mustard + chickpea in 1:3 ratio (T_5), which remained at par with mustard + chickpea 1:4 (T_6) and mustard + chickpea 1:2 ratio (T_4). In case of intercropping treatments, mustard + chickpea in 1:3 row proportion recorded the maximum gross returns, net profit and benefit: cost ratio (BCR) of ₹ 1,31,273, ₹ 99,346 ha^{-1} and 4.11, respectively than rest of the treatments.

GIRISDA/AB/211/2022

COMPARATIVE ANALYSIS OF THE EXTERNAL AND INTERNAL EGG QUALITY IN UTTAR AND KADAKNATH INDIGENOUS CHICKEN BREEDS

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The present study was conducted to evaluate some parameters of external and internal egg quality of dual-purpose chicken breeds. A total of 400 eggs (200 eggs from each breed) were collected to study for egg (weight, shape index), albumen (weight, percentage), yolk (weight, percentage) and shell (weight, percentage, thickness, strength) quality. The results showed that the egg weight and egg length of Uttara were significantly higher ($P < 0.05$) than that of Kadaknath whereas difference in egg shape index between these breeds was no significant ($P > 0.05$). Differences in albumen weight, albumen percentage, yolk weight and yolk percentage of tested compared chicken breeds were statistically non-significant ($P > 0.05$). Albumen height was significantly higher ($P < 0.05$) in Uttara compared with Kadaknath and Haugh unit score were significantly higher ($P < 0.05$) in Uttara compared with Kadaknath. The significantly ($P < 0.05$) higher values of yolk height and yolk index were detected in Uttara than Kadaknath. The shell weight and proportion were affected by the breed of hen ($P < 0.05$) but there were no significant differences ($P > 0.05$) in egg shell thickness and strength.

GIRISDA/AB/212/2022

CORRELATION ANALYSIS OF TURMERIC GROWERS REGARDING KNOWLEDGE AND ADOPTION OF POST-HARVEST TECHNOLOGY

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The present study was carried out to analyze the relationship between profile of turmeric growers with their knowledge and adoption of post harvest technology (PHT). For this study, Hingoli District was selected from Marathwada region due to high area under turmeric production. In Hingoli District two Taluka viz., Vasmat and Aundha were selected purposively on the basis of maximum number turmeric grower and three villages from both Talukas were selected. From each village twenty (20) members were selected constituting the sample size 120. Ex-post facto research design was used for this study. Keeping in a view the objective of this study and well structured interview schedule was designed. This includes relevant question for seeking information in respect of independent and dependent variable. The question was asked in local language (i.e. Marathi). The data collections from the turmeric growers were edited tabulated and analyzed using suitable statistical tools i.e. frequency, percentage, mean, standard deviation (S.D.) and Pearson‟s coefficient of correlation. The study was noticed that relationship between profile of turmeric growers with their knowledge and adoption of post harvest technology (PHT). It was stated that all respondents were having medium level relationship with independent variables except annual income, cropping pattern and source of irrigation shows non-significant relationship with knowledge of PHT by the turmeric grower. And other side independent variables like cropping pattern, annual income, age and source of irrigation shows non-significant relationship with adoption of PHT by the turmeric grower.

GIRISDA/AB/213/2022

CARBON MANAGEMENT FOR SUSTAINABLE DEVELOPMENT

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Carbon management means the measurement and management of the six greenhouse gases covered by the Kyoto Protocol, including carbon dioxide (CO_2). The core aim of Carbon Management is it to examine the options and mechanisms for mitigating the causes and impacts of climate change, which includes mechanisms for reducing emissions and enhancing the removal of GHGs from the atmosphere. Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It is the effective use of resources for economic development while preserving the Environment and ecosystems so that not only the needs of present are fulfilled but also for the future generation. Changes in the concentration of certain greenhouse gases, from human activity (such as burning fossil fuels), increase the risk of global climate change. Carbon Neutrality is a mechanism where greenhouse emissions are reduced or offset by taking reduction measures and emission reductions. A carbon credit is a financial instrument that represents a tonne of CO_2 or CO_2e (carbon dioxide equivalent gases) removed or reduced from the atmosphere from an emission reduction project. Carbon Capture and storage describes the technologies designed to tackle global warming by capturing CO_2 at power stations, industrial sites or even directly from the air and permanently storing it underground. Offset Credits for eco-friendly technologies are purchased by developed nations to avoid or substitute reduction in their own emission. Energy conservation Measures are the upgrades, repairs and replacements to become more energy efficient. Mitigation methodology carbon sequestration, carbon neutrality, carbon trading concept to manage carbon emissions and to maintain an ecological balance in the Environment.

GIRISDA/AB/214/2022

CHANGES IN SOIL DYNAMICS UNDER HARAR (*Terminalia chebula Retz.*) AND AONLA (*Phyllanthus emblica* L.) BASED AGROFORESTRY SYSTEMS: A DIVERSIFIED AND ENVIRONMENTAL SUSTAINABLE APPROACH

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The present investigation was conducted at Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan (HP) during 2019. To study the physical and chemical properties of soil under *Terminalia chebula* and *Phyllanthus emblica* based agroforestry system. Experiment consist of two tree species viz. Harar (*Terminalia chebula*) and Aonla (*Phyllanthus emblica*) of age 8 years as a woody perennial along with three intercrops namely Maize (*Zea mays*), Mash (*Vigna mungo*) and Arhar (*Cajanus cajan*). Trees were planted at a spacing of 8m × 8m and agriculture crops were raised as per package and practices recommended by the Directorate of Extension Education, CSK HPKV, Palampur (HP). There were 3 treatments i.e. sole agricultural crop, agricultural crop + Harar and agricultural crop + Aonla, replicated five times under randomized block design. Standard methods were used to calculate all the physical and chemical properties of soil. The results indicated that porosity, soil moisture, pH and organic carbon were found to be affected significantly while, the bulk density and particle density remained unaffected at soil depths 0-15 cm and 15-30 cm. Results also indicated that with increase in soil depth, bulk density, particle density, soil moisture, EC and pH increased whereas, reverse trend was observed for porosity, organic carbon, available N, P and K. The nutrient status was higher under the agroforestry systems as compared to the sole agricultural crops. Among various agricultural crops, the maximum nitrogen and potassium contents were observed under maize while, the maximum phosphorus was recorded under arhar. Physical and chemical properties of the soil under different crop + tree combinations improved, yet yield of agricultural crops decreased which may be due to the shade and allelopathic effects of the trees. The increase in soil physical and chemical properties indicated that these tree-crop combinations are sustainable.

GIRISDA/AB/215/2022

IDENTIFICATION OF QTL HOTSPOTS AND TAGGING YIELD RELATED TRAITS IN BITTER GOURD (*Momordica charantia* L.) USING MICROSATELLITE MARKERS

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A genetic map spanning 1287.99 cM across 11 linkage groups was constructed following the segregation of microsatellite markers in an $F_{2:3}$ mapping population generated by crossing high yielding cultivar Priyanka (*M. charantia* var. *charantia*) and *M. charantia* var. *muricata* accession IC634896. QTLs for 24 traits including yield-contributing traits such as fruit length, breadth, weight and number, flesh thickness, node number and days taken for first pistillate flower emergence, numbers of staminate and pistillate flowers, and other seed-, vine- and leaf-related traits. Inclusive Composite Interval Mapping (ICIM) has revealed 60 QTLs on seven chromosomes, including 37 major QTLs with LOD values ranging from 3.1 to 15.2, explaining 1.8 to 35.9 % phenotypic variation (PVE%). Twenty three QTLs for fruit traits (LOD 3.1 to 7.6, PVE% 5.5 to 35.9), 13 for flower traits (LOD 3.1 to 15.2, PVE% 7.0 to 26.0), seven each for seed and leaf traits (LOD 3.2 to 10.8 and 3.5 to 6.5, PVE% 5.6 to 26.3 and 3.2 to 15.8, respectively), 10 for vine traits (LOD 3.2 to 8.7, PVE% 1.8 to 17.6), were identified. Nine QTL hotspots were identified where multiple traits were clustered. Single marker analysis identified 129 hits for the marker-trait association (LOD >3.0, PVE% 11.62 to 29.34). Using the least and best performing $F_{2:3}$ plants, markers S13, KAUBG_5 and KAUBG_11 were validated for co-segregation with fruit breadth, first pistillate flower node, and number of pistillate flowers and fruits per plant, respectively. QTL map and trait-tagged markers identified in this first report of linkage mapping in *Momordica* using microsatellites, shall significantly assist in marker assisted breeding.

GIRISDA/AB/216/2022

INFLUENCE OF DRIP IRRIGATION REGIMES AND NITROGEN LEVELS ON RELATIVE WATER CONTENT OF AEROBIC RICE

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Conventional puddled transplanted rice cultivation consumes more than 2000 mm of water and is labour, water and energy intensive. The increasing scarcity of water threatens the sustainability of rice production systems. Due to decrease in ground water level in irrigated areas, it is difficult to grow rice under submerged conditions. Therefore, a more efficient method of rice cultivation with higher water productivity like aerobic rice is the need of hour. Growing aerobic rice under drip irrigation will meet water requirement as per crop need and improve water use efficiency. Hence, an experiment entitled "Performance of aerobic rice under drip irrigation with different levels of nitrogen" was conducted during *Rabi* 2019-20 and 2020-21 on sandy clay loam soils of S.V. Agricultural College, Tirupati of Acharya N.G. Ranga Agricultural University, and Andhra Pradesh. The experiment was laid out in split-plot design with three replications. The treatments consisted of four main plots *viz*., I_1 (Drip irrigation at 1.25 Epan), I_2 (Drip irrigation at 1.5 Epan), I_3 (Drip irrigation at 1.75 Epan), I_4 (Drip irrigation at 2.0 Epan) and four sub plots *viz*., N_1 (75% RDN - 90 kg N ha^{-1}), N_2 (100% RDN – 120 kg N ha^{-1}), N_3 (125% RDN – 150 kg N ha^{-1}), N_4 (150% RDN – 180 kg N ha^{-1}). Relative leaf water content of aerobic rice was significantly influenced by irrigation regimes but not with nitrogen levels and their interaction at 60 DAS during both the years of study. Among the different irrigation regimes, drip irrigation scheduled at 2.0 Epan (I_4) recorded the higher relative water content in leaf (90.8 and 91.3 %), which was however on par with drip irrigation at 1.75 Epan (I_3) (89.6 and 90.2 %) during both the years of study. Whereas, the lower value of relative water content was registered with the drip irrigation regime of 1.25 Epan (I_1) (86.5 and 87.4%). Influence of nitrogen levels on relative leaf water content of aerobic rice was not statistically traceable during both the years of study. However, the higher relative water content was observed with 180 kg ha^{-1}(N_4) (88.9 and 89.6 %) and the lower value was with 90 kg N ha^{-1}(N_1) (88.5 and 89.2 %).Interaction effect of irrigation regimes and nitrogen levels was not statistically traceable at different stages of aerobic rice during both the years of study.

GIRISDA/AB/217/2022

ASSESSMENT OF VARIABILITY PARAMETERS FOR SEED YIELD AND ATTRIBUTING TRAITS IN F_2 AND F_3 GENERATIONS OF BLACKGRAM [*Vigna mungo* (L). HEPPER]

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Blackgram [*Vigna mungo* (L).Hepper] also known as urdbean belongs to Fabaceae family, is a short duration self fertilized leguminous pulse. Despite being loaded with abundance of nutrients and its association with health and many agro-environmental benefits, the yield and productivity is stagnant from years due to many biotic and abiotic constraints. To overcome these issues, in order to achieve goals of robust production, certain variability parameters such as PCV (phenotypic coefficient of variation), GCV (genotypic coefficient of variation), genetic advance and heritability are of paramount importance in ascertaining the inheritance of qualitative and quantitative traits which serves as a pre-requisite for a plant breeder to devise efficient breeding strategy. Keeping this in view, the research was aimed to determine the nature and magnitude of genetic variability, as well as fractions of heritability and genetic gain by considering 11 yield and associated component traits among 14 crosses and ten parents in blackgram. During *Kharif* 2018 and 2019, the experiment was conducted in the Experimental Farm of the Department of Genetics and

Plant Breeding, College of Agriculture, CSKHPKV, Palampur (H.P.) using a Randomized Complete Block Design along with three replications. Analysis of variance revealed substantial variations between genotypes for all the characters in both the generations. The biological yield per plant (g) following seed yield per plant (g) and harvest index showed high estimate of PCV and GCV values (percent). High heritability coupled with genetic progress were recorded for pods per plant, biological yield per plant, seed yield per plant, and harvest index for both the generations, demonstrating the prevalence of additive gene action and their direct selection plays significant role in the development of improved and stable genotypes during the future breeding programme.

GIRISDA/AB/218/2022

CHARACTERIZATION AND QUALITY ASSESSMENTS OF SEWAGE SLUDGE GENERATED FROM SEWAGE TREATMENT PLANTS (SPTS) BHAGWANPUR, VARANASI IN RELATION TO AGRICULTURE USE

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During wastewater treatment, namely at the sewage treatment plant (STPs), a large amount of sewage sludge is created as a result of the sedimentation of suspended particles. This sludge can be burnt, disposed of in landfills, or used as a soil additive in agriculture. In comparison to the previous two methods, land application is the most efficient and least expensive. However, before they may be used, there are several rules that must be followed. The current study was conducted to investigate the physio-chemical and biological characteristics of sewage sludge (SS) and its potential application in agricultural fields as an organic manure as a source of nutrients in order to address environmental concerns. Sewage sludge samples were collected from sewage treatment plant (STPs) at Bhagwanpur, Varanasi, Uttar Pradesh, India, and passed through a 2 mm screen before being analysed for various physical and chemical characteristics. The processed sewage sludge contains both major and micro nutrients, as well as a significant amount of organic matter. The use of this sewage sludge has the potential to improve the physical, chemical, and biological qualities of soil, which is useful for plant growth and the creation of a sustainable soil environment. It does However, depending on the source of the sewage sludge and the treatment procedure of the sewage sludge, it also contains a certain quantity of hazardous heavy metals and organic pollutants that might harm the soil ecosystem. Metals and organic contaminants that, depending on the origin source of the sewage sludge and the sewage sludge treatment procedure, may have a negative impact on the soil environment. However, in order to increase soil health without posing an environmental risk, sewage sludge must be carefully evaluated before being applied to soil. Analysis showed that concentrations of heavy metals such as Zinc, Copper, Lead, Chromium, Mercury and Nickel were below the regulatory limits for sludge to be used in agriculture

GIRISDA/AB/219/2022

PATH COEFFICIENT ANALYSIS IN THREE F_2 POPULATIONS OF GROUNDNUT (*Arachis hypogaea* L.)

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Path coefficient analysis was performed in three F_2 populations by partitioning the phenotypic correlation coefficients of each character into the direct and indirect effects of the characters on pod yield per plant. Among the ten characters studied, SCMR @ 60 DAS, pods per plant, pod yield, SMK percentage and shelling percentage exhibited high positive direct influence on pod yield per plant in two crosses *viz*., NRCG 12568 × NRCG 12326 and GKVK 4 × NRCG 12274 whereas in other cross GKVK 4 × NRCG 12473, only pod yield and shelling percentage registered highly positive direct effect on pod yield. Specific leaf area exhibited a negative direct effect on pod yield in all the three crosses. Almost all the characters were unveiled moderate to high positive indirect effect through kernel yield per plant on pod yield per plant in all the three crosses. By considering above results of the path coefficient analysis in the present experiment suggested the selection of traits such as SCMR @ 60 DAS, pods per plant and kernel yield would be more rewarding for improvement of pod yield in all three crosses of groundnut.

GIRISDA/AB/220/2022

STAPLE FOOD FORTIFICATION: THE NEED OF THE HOUR

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Deficiency of micronutrients, also known as “Hidden Hunger” is a serious health risk, which must be addressed to secure the nutritional securities. Food fortification is one of the mostcost economic and highly beneficial efforts which have been made to tackle the alarmingly high prevalence of vitamin and mineral deficiencies. As per FSSAI, fortification is the addition of key vitamins and minerals such as iron, iodine, zinc, and vitamins A & D to staple foods such as rice, wheat, oil, milk and salt to improve their nutritional content. These nutrients may or may not have been originally present in the food before processing or may have been lost during processing. Food fortification has various advantages such as highbenefit-to-cost ratio, cost-effective intervention along with maintaining the physical and sensorial integrities of food. Various organizations such as FFRC (FSSAI), FFI, GAIN, WFP, PATH, NI and CEFFhave been working in collaboration with all the states to achieve the nutritional securities through the fortification of food in India.Several safety net programs have been utilized to promote the concept of food fortification which include, Integrated Child Development Services (ICDS), Mid-Day Meal (MDM) and Public Distribution System (PDS).Fortification of the staples like wheat, oil and milk requires the simplest processing such as solid-liquid or liquid-liquid blending, whereas extrusion and stabilization are required for rice and double-fortified salt respectively. Nevertheless, the cost of fortification of all the staples is less than ₹1 per kg. The prevalence of micronutrient deficiencies of iron, folic acid, vitamin A and B12, etc., proves the dire need of popularization of this cost-effective technique in all the food organizations – industries and institutes. Thus, staple food fortification is a potential strategy to minimize micronutrient malnutrition and achieve the motive of „nutrition“ for all in the country.

GIRISDA/AB/221/2022

EFFECT OF DIFFERENT DATES OF SOWING ON DIFFERENT GENOTYPES OF MAIZE CROP UNDER CLIMATIC CONDITIONS OF KANGRA DISTRICT OF HIMACHAL PRADESH

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The field experiment on effect of different dates of sowing on different genotypes of Maize under climatic conditions of Kangra district of Himachal Pradesh was conducted during *Kharif* season of 2013 and 2014.The experiment was laid out in Randomized block design, comprising of four dates of sowing viz., May 30th , June 10th ,June 20th and June 30th and three genotypes viz., Girija, BajauraMakka and HQPM-1 cultivated in silty clay loam, acidic soil and medium in available nitrogen, phosphorus, potassium and organic carbon. The study concluded that Maize crop with different genotypes sown on 10th June gave 20.0, 19.3 and 28.7 percent more grain yield over subsequent dates of sowing respectively. The variety HQPM-1 yielded out more than other genotypes whereas yield of Girija and Bajaura Makka were at par with each other.

GIRISDA/AB/222/2022

IMPACT OF PLANT GROWTH PROMOTING MICROBES COUPLED WITH MARIGOLD FLOWER EFFLUENT ON GROWTH AND YIELD OF POTATO UNDER GREENHOUSE CONDITIONS

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With increasing crop water demand and decreasing soil fertilitythere is a need for sustainable agricultural practices. To rule out these constraints, a study was taken up where in, amarigold processing industrial effluent (MFE) was applied along with plant growth promoting microbes (PGPM) to soil for increasing the yield of potato. The physical, chemical and biological properties of Treated and Untreated MFEwere analyzedand Irrigation Water Quality Index (IWQI) was computed to determine their suitability for irrigation purpose. IWQI of TMFE was 10.508, indicating excellent and UMFE was 45.262 indicating good for irrigation. A pot experiment was taken up in greenhouse with potato as test crop provided strong evidence that application of 50% diluted Untreated marigold flower effluent in combination with RDF and PGPM consortia (*Azotobacter chrococcum* + *Bacillus megaterium* + *Pseudomonas fluorescens*) promotes better plant height (90.75 cm), number of shoots (5.71), number of leaves (14.97) and chlorophyll content (59.77 SPAD units) at flowering.Ultimately, greater physiological factors resulted in higher yields with 8.24 tubers per plant of weight 2.38 kg per pot. It was noticed that same treatment had greater difference in soil NPK at the time of sowing to harvest, might be due to higher plant nutrient uptake.Increased soil enzyme activity was noticed at flowering stage with dehydrogenase activity (52.39 µg TPF g^{-1} h^{-1}), Urease (15.19µg NH_4-N g^{-1} hr^{-1}), acid phosphatase (57.77µg PNP g^{-1} h^{-1}) and alkaline phosphatase (39.77 µg PNP g^{-1} h^{-1}) in addition to higher bacterial, fungal, actinomycetes, N-fixers, PSB and *P. fluorescens* population. The soil enzymes dehydrogenase and urease was more due to the

application of *A. chrococcum* that helps in nitrification. The increase in phosphatase activity is mainly due to addition of *B. megaterium* (Phosphorus solubilizer).The use of agro industry effluent mainly untreated effluent on dilution, for one time application as organic amendment can be beneficial with the provided, combined with PGPM, by way of greater returns to farmer. This work benefits the farming communities by increasing yields as well as to industry, by reducing the cost of water treatment and disposal problems.

GIRISDA/AB/223/2022

DISEASE AND PEST MANAGEMENT IN ORGANIC FARMING

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Organic farming is all about building healthy soil and using optimal cultural practices to prevent insect, disease and weed problems, the emphasis is on biodiversity and system approach. We can go for cultural, physical, biological methods and organic pesticides to manage the disease and pest infestation in organic farming. Organic farming systems utilize carbon-based amendments, diverse crop rotations, and cover crops to maintain the soil fertility. These practices increase biologically available soil organic matter and beneficial soil microbe and invertebrate activities, improve soil physical properties, reduce disease potential, and increase plant health. In organic farming, cultural practices that prevent pest problems like maintenance of biological diversity and soil health by balanced crop rotations, including nitrogen fixing and cover crops, inter crops, trap crops, additions of manures and reductions in soil tillage, flaming, vacuuming, mulches, sanitation, resistant cultivars, composting, companion planting are the first line of defense for farmers. Physical control methods include manual control, physical barriers like bagging, crawling pests, trenches, baits traps, repellants and lures. By increasing population of beneficial predators like wheel bug, lady bird beetles, predatory flies, *Trichogramma* spp. we can go for biological control methods. Bio-pesticides such as *Trichogramma* or *Pseudomonas* formulation @ 4g/kg manage most of the seed and soil borne diseases. *Azadirachta indica* (Neem) can affect more than two hundred insects species, nematodes, fungi, bacteria and viruses, it can be used as neem oil or neem cake. Being a type of sustainable agriculture the purpose of organic farming can be expressed by a mini-max function, maximizing production and minimizing the negative agricultural activities on the environment.

GIRISDA/AB/224/2022

ECO- FRIENDLY MANAGEMENT OF PLANT PARASITIC NEMATODES BY USING VARIOUS ORGANIC AMENDMENTS

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Plant parasitic nematodes (PPNs) cause substantial problems to major agricultural, horticultural, plantation crops etc. throughout the world. The most damaging species of nematodes are sedentary endo-parasitic forms which move inside host root and damage the internal plant root parts i.e. *Meloidogyne* spp., *Heterodera* spp., *Globodera* spp. etc. Organic amendments are mainly bio-products and wastes from agricultural and their associated activities. Use of organic amendments is a traditional agricultural practice for improving physical and chemical soil properties like soil structure, soil texture, temperature and humidity as well as these enhance nutrients content which are needful for plants growth. Application of organic materials to soil can cause a change in soil micro-flora and micro-fauna including soil nematodes. Relatively rapid declines in nematode population levels may occur when decomposing materials release toxic compounds, while longer-term effects might include increases in nematode antagonists. Nematode population suppression can depend on variety of factors such as material used, processing/composting of material, application rate, crop rotation and agronomic practices, soil type, climate, and other environmental factors. Neem and castor oil-cakes were the most effective in reducing PPNs. -The use of organic

amendments that are disease-free and with a narrow C: N ratio will improve soil fertility while more efficiently reducing the level of nematodes and minimizing the risk of increasing the level of another soil borne pathogens and pest. However, organic amendments can provide an environment friendly alternative to the use of chemical nematicides, which are often expensive, of limited availability in many developing countries and are environmentally hazardous.

GIRISDA/AB/225/2022

LAVENDER CULTIVATION AS A VIABLE INCOME GENERATING UNIT FOR LIVELIHOOD SECURITY UNDER AROMA MISSION AT JAMMU AND KASHMIR: A SUCCESS STORY

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To make agriculture sustainable, the price of agricultural commodities must be sufficient but variations in price may occur depending on market demand. So, by adopting lavender cultivation sat rural level farmers may minimize the price gap by price of their medicinal plants and ultimately people get good quality of lavender plant based products like cosmetic oil, incense sticks at rural level. This sets good example and also increases extra income from the agriculture at rural level by youth. Smell the lavenders Purple Revolution‟ changes fortunes of J&K farmers under Aroma Mission or Purple Revolution‟, is an initiative of the Central government to transform the lives of the farming community in Jammu and Kashmir. Pertinently, the Purple or Lavender Revolution was launched in 2016 by the Union Ministry of Science & Technology through the Council of Scientific & Industrial Research‟s (CSIR) Aroma Mission. The mission aims to support the domestic aromatic crop-based agro-economy by moving from imported aromatic oils to home grown varieties.

GIRISDA/AB/226/2022

GENETIC DIVERGENCE ANALYSIS IN BREAD WHEAT (*Triticum aestivum*L.)

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The study was conducted during Rabi 2017-18 at the Research Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner to assess the genetic diversity among 55 genotypes of bread wheat. The genetic diversity analysis revealed the formation of sixteen clusters suggesting the presence of wide genetic diversity. The clustering pattern indicated that geographic diversity was not associate and with genetic diversity. The analysis of per cent contribution of various characters towards the expression of total genetic divergence indicated that biological yield per plant followed by number of effective tillers per plant, spike length, 1000-seed weight, harvest index, number of grains per spike, days to heading, plant height and days to maturity contributed maximum towards total genetic divergence. Based on the maximum genetic distance, it is advisable to attempt cluster XIII with V and XII would be useful for inducing variability in respective attributes and their rational improvement for increasing the grain yield in bread wheat.

GIRISDA/AB/227/2022

VARIABILITY IN IVY GOURD GERMPLASM FROM SUB-HUMID ARAVALLI HILL REGIONS OF RAJASTHAN

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Ivy gourd (*coccinia grandis*) also known as coccinia, kundru, little gourd, tindori, tondli, tindla, kovai, giloda is an under- exploited cucurbit vegetable originated in India. It is a dioecious perennial grown in southern and eastern states of India. The crop is raised by planting three nodded cutting taken from female plants, yielding fruits in summer and rainy season. In South and Central India, fruiting is round the year, while in North India, fruiting terminates when the temperature comes down in November. Fruits are good for diabetic patients. Considering the above said facts, an attempt has been made to collect the available variability in this crop from Southern Rajasthan for further improvement. Sixteen diverse germplasm were collected during August-Sept.2013 from different villages of Aravalli hills region of Udaipur (Raj.) and evaluated for different characters like fruit diameter, fruit length, weight, volume, specific gravity, moisture percentage in fruit, T.S.S., number of seed per fruit, and pedicle length. The result revealed a significant difference for all the characters under study. The economically important parameters like fruit diameter ranged from 17.8 (CG-7) to 32 mm (CG-1), fruit length ranged from 36.7 (CG-8) to 54.9 mm (CG-14), highest fruit weight and volume was observed in CG-1 (35.4 gm) and (42.8 ml/100ml) respectively. Specific gravity was highest in CG-8 (1.46 gm/cc). Moisture content in Ivy gourd fruits was found in the range of 82.1 to 90.8 %. T.S.S. varied from 2.7 to 4.6 ^{0} Brix, number of seeds per fruit was highest in CG-14 (106).CG-2 germplasm recorded the highest pedicle length 6.02cm followed by germplasm CG-6 (4.4 cm) .This germplasm will be propagated at experimental site of MPUAT, Udaipur for further evaluation and utilization.

GIRISDA/AB/228/2022

EVALUATION OF INDIAN MUSTARD (*Brassica juncea* L., CZERN AND COSS) RILS UNDER SALINITY STRESS

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To explore the effect of salt stress in Indian mustard, 250 stabilized F8Recombinant Inbred Lines (RILs) mapping population developed by crossing CS 614-1-1-100-13 x CS 56 genotypes were evaluated under irrigation water salinity (optimal, and salinity EC*iw* 12 condition) in pots for two *Rabi* seasons during 2019-2021 in a completely randomized block design (CRBD) with three replications at ICAR-CSSRI, Karnal, Haryana, India. The parent CS 56 is a highly salt tolerant variety released by ICAR-CSSRI and CS 614-1-1-100-13 is a highly salt sensitive mutant. The Na^+ and K^+ in shoot and root was measured using Flame photometer-128 model. Mean squares of the salinity levels under pot study were significant for all the traits under study indicating significant differences of these traits for control and salinity. Results suggested that FW (fresh weight) of shoot and root, Na^+ and K^+ in shoot and root, yield per plant decreased substantially in the all RILs evaluated at higher salinity (EC*iw* 12 dS m^{-1}) as compared to control. There was approximately 28.50 per cent reduction in yield per plant across the environment indicating the mapping population having scope for salt tolerant variety identification. The best five RILs was selected on this basis of yield per plant was RIL170 (61.65g), RIL217 (57.80), RIL72 (57.58g) and RIL87 (57.50g), RIL 32 (57.21g), which can be used for variety release for salt affected areas. This RILs performed better under imposed salt stress due to differential regulation of Na^+ accumulation in the roots and shoot, restriction of Na^+ influx from root to shoot. The manipulation of some of these selected RILs in Indian mustard crop improvement program might help to mitigate the ionic toxicity effects and cellular ionic homeostasis along with conditioning of photosynthetic attributes leading to a promising yield under salinity stress.

GIRISDA/AB/229/2022

EFFECT OF FEEDING POULTRY LITTER WASTE ON PHYSIOLOGICAL PARAMETERS OF CROSSBREED DAIRY COWS IN WINTER

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In the recent decade, livestock development in tropical and subtropical countries has risen exponentially to fulfil need of increased populations demand. Despite the various challenges that animal producers face, environmental challenges and feed challenge etc. are important. Generally, the use of agricultural by-products and waste materials provides animal nutrition, economic advantages, reducing environmental hazard. Poultry litter having the good amount of nutrients that can be converted as a human food like milk and meat with the help of ruminant animals. So, in this study poultry litter fed to the crossbreed dairy cows for maintain their nutritional requirements and production. Poultry litter feeding may effect on certain physiological parameters such as heart rate (HR), respiration rate (RR), rectal temperature (RT) and ruminal motility (RM). The data of HR, RR, RT and RM from this study was acquired from 20 crossbred dairy cows. Total number of animals divided into four groups with non-significantly different in weight and lactation i.e., 5 animals in each group. T_1 - Control (fed as needed), T_2 - concentrate replaced with 10 percent poultry litter waste, T_3 - concentrate replaced with 20 percent poultry litter waste and T_4 - concentrate replaced with 30 percent poultry litter waste. This research was carried out over a period of 120 days during the winter season (November to February). The results were observed that HR, RR, RT (^{0}F) and RM (motility/3 min) in T_1 – 68.11±0.35, 21.10±0.84, 100.76±0.16 and 4.28±0.48 in T_2–67.82±0.28, 20.79±0.64, 100.25±0.87 and 4.36±0.94, in T_3 –67.32±0.74, 20.47±0.86, 100.12±0.17 and 4.58±0.45 and in T_4 – 68.42±0.12, 21.7±0.26, 101.1±0.29 and 5.24±0.24, respectively. The study observed that replacement of concentrate mixture with poultry litter waste gives $p<0.05$ among the all-physiological parameter in all treatment groups.

GIRISDA/AB/230/2022

OPTIMIZATION OF THE EXTRACTION PROCESS OF *Moringa oleifera* FLOWER BY USING DES (DEEP EUTECTIC SOLVENTS) FOR OPTIMAL THERAPEUTIC PROPERTIES

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*Moringa oleifera*is a native plant of India. Its flowers are great source of phenols, flavonoids, and antioxidants.DES (Deep Eutectic Solvents) based solvents have a vast majority of benefits, such as they are non-toxic, green solvents, with highly efficient method of extraction of phenolic, antioxidant and flavonoid compounds. DES solvents are made by combining two different kinds of solvents out of which one has to be hydrogen bond donor (HBD) and another one is hydrogen bond acceptor (HBA). On combining these two types it reduces the melting point of solvents. In these study six different types of Deep Eutectic Solvents (DES) combinations were used in different ratios, for the optimization of extraction process. The six combinations used were Chcl:Gly, Chcl:MA, ChCl:LA, ChCl:Glu, Pro:Gly, Pro:LA.Total phenolic, flavonoid content, antioxidant activity and amylase activity of *Moringa oleifera* flower (MOF‟s) extracts were calculated at different temperatures ranging from 50-80 ℃ by using the statistical tool Anova single factor. Maximum yield, phenolic and flavonoid content and antioxidant activity of the flower extract

was found on 70℃ and the DES combination used was Pro: Gly in 1:2 ratio. Phenolic content (32.4±0.002), Flavonoid content (42.1±0.002), antioxidant activity (65.82±0.002) was found to be highest with DES combination Pro: Gly at 1:2 ratio.

GIRISDA/AB/231/2022

PROPAGATION OF MARIGOLD (*Tagets erecta* L.) THROUGH HERBACEOUS SHOOT CUTTING

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A nursery experiment was conducted at Ornamental nursery, Krishi Vigyan Kendra, Anand Agricultural University, Anand during the year 2017-18 with a view to study the "Effect of rooting media on propagation of African marigold (Tagetes erecta L.) cv. Calcutta Selection" through herbaceous shoot tip cutting under shade net condition. The herbaceous shoot tip cuttings of african marigold were planted in nine different growing media including soil (control), sand, vermi-compost, FYM, Cocopeat + Vermiculite (1 : 0.25), Soil + Sand (1 : 1), soil+vermi-compost (1:1), Soil + FYM (1 : 1) and Soil+Cocopeat + Vermiculite (1:1:0.25) in plug trays. Before planting marigold shoot tips (Cut base portion) were dipped in rooting media IBA 150 mg per litre. The results pertaining to growth parameters with respect to herbaceous shoot tip cutting of African marigold planted under different rooting media on number of roots per plant, root length, plant height at 20 and 30 DAP and survival percent were found significant. Among the different media significantly maximum number of roots per plant 60.33 and 72.78, root length 5.15 and 10.55 (cm), plant height 9.86 and 14.06 (cm) at 20 and 30 DAP, respectively observed under vermi-compost media. The survival percentage was found maximum in Vermi-compost i.e. 91.11 % followed by Soil + Vermi-compost (1: 1) i.e. 87.22 %, Soil + FYM (1: 1) i.e. 86.67 % and FYM alone i.e. 84.44 %, respectively. This experiment showed that vermi-compost alone or soil+vermicompost (1:1) media-mixture or Soil + FYM (1: 1) media-mixture or FYM alone media can be optimum for better rooting success in marigold herbaceous shoot tip cuttings.

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INTEGRATED DISEASE MANAGEMENT OF WHITE RUST OF INDIAN MUSTARD INCITED BY *Albugo candida*

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The oilseed crops especially rapeseed -mustard play a vital role in agricultural economy of the world. Many biotic and abiotic stresses are liable for reducing the production and productivity of Rapeseed - mustard. Of all the biotic and abiotic stresses that threaten mustard crop, white rust caused by an obligate biotrophic fungus Albugo candida is one of the most devastating. The obligate biotrophic fungus (A. candida) highly variable nature of the pathogen poses a challenge for the eco-friendly management of the disease. A limited work has been done in the world/India on this pathogen. The experiments were conducted at Guru Kashi University, Talwandi sabo, Bathinda (Punjab) under the field, screen house and laboratory conditions to study the integrated management of white rust during Rabi season 2018-2019. The results revealed that in field plots, overall mean of disease intensity (PDI) was 26.68 Percent in 5th November sown crop, whereas it was only 19.82 percent in 22 nd October sown crop. Hence it means dates of sowing significantly affected the disease severity of white rust in mustard and disease severity was increase with delay in date of sowing. Under technique of detached leaf inoculation, directly spores picking method has found to be the finest and

swift method. Therefore, directly spores picking method was used to check the antifungal activity of different components namely, fungicides (Mancozeb, Ridomil, Carbendazim), biocontrol agent (Trichoderma viride) and botanical (Neem oil) at different concentrations on sporangial germination of Albugo candida under two type of treatments. Results from all the fungicides Mancozeb was significantly superior result in inhibition of fungus spores. All the fungicides and T. viride were performed better in Pre Treatment than Treatment. After Disease Infection while Neem oil was less effective in Pre Treatment. Hence proved that, IDM is an ecologically and economically viable option to enhance the crop production and productivity, nutritional security, reduce the incidence or severity of the disease incited by the plant pathogen, upliftment of farmer community and reduce the environmental degradation.

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ASSESSMENT OF DISEASE INTENSITY OF POWDERY MILDEW OF PEA AND ITS MANAGEMENT

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The experiment was conducted at University College of Agriculture, Guru Kashi University, Talwandi Sabo, Bathinda (Punjab) during 2020-22 against powdery mildew of pea caused by Erysiphe pisi. Powdery mildew of pea is an air born disease and more damage can be seen in late sown (November) and late cultivars. Disease can cause 25-50% yield loss. The experiment was conducted to check the efficacy of different fungicides, bio-logical agents, plant extracts and endophytes against powdery mildew of pea. Seven different fungicides were evaluated under in vitro condition, among all Propiconazol and Azoxystbin+Tebiconazol gave best result in controlling the disease. Among bio-agents Trichoderma harizianum show myco-parasitism. Eight different plant extracts were tested; out of them ginger @ 10% concentration gave bet result. Endophytic bacteria and fungi extracted from Eucalyptus and neem were used against powdery mildew of pea, among them fungal endophyte obtained from eucalyptus can altered the morphological charactertics of the pathogen. Under in vivo condition plant disease intensity and plant disease index were measured with factors such as sowing time, different cultivars, spacing and environmental factors. Epidemiological studies revealed that disease intensity was high in late sown crop (November) as well as the cultivars sown with less plant to pant and row to row spacing.

GIRISDA/AB/234/2022

FINANCIAL PERFORMANCE OF THE REGULATED MARKETS IN PUNJAB

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A financially efficient market creates the better infrastructure in the market yard which further attracts more market arrival and increases the income of the farmers. Thus the present study was conducted to examine the financial efficiency of the regulated markets in Punjab based on the primary data. The stratified random sampling technique was used to select the sample of nine markets from the three agro-climatic zones of the Punjab belonging to small, medium and large size. Results revealed that the income and expenditure of the regulated markets had increased during the study period and the major source of the income was market fee and expenditure was establishment works. It was found that both the income and expenditure were directly proportional to the size of the markets. Further, to check the efficiency of the markets, income-expenditure ratio, income-establishment expenditure ratio and income-construction ratio were calculated and it was studied that large and medium markets were financially more efficient as

compared to small ones. The financial ratios were more than one for the selected markets which means income was greater than expenditure and during the last eight years, market committee had gained profit and had worked efficiently. Zone-wise analysis stated that markets of Zone-I was not financially efficient as compared to Zone-II and Zone-III due to less market arrival in the markets which consequently had the lesser market income from the market fee.The study concluded that an efficient agricultural marketing system can be evolved by improving, strengthening and optimally utilizing the existing funds of regulated markets.

GIRISDA/AB/235/2022

ACTIVITY OF ESSENTIAL OIL ENCAPSULATED ZINC OXIDE NANOPARTICLES ON DISEASE INCIDENCE OF ALTERNARIA LEAF SPOT

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Alternaria leaf spot is a destructive disease of strawberry which causes damage both in leaves and fruits. The symptoms were observed on leaves as minute dark brown to black spots and on fruits also, which forms enlarged concentric rings from small to large with collapsing of spots. The isolation of pathogens was done from infected leaves and pathogenicity was established on healthy plants of strawberry. On the basis of morphological and microscopic examinations the pathogen was identified as Alternaria alternata. Essential oil encapsulated ZnO nanoparticles were synthesized in biotechnology laboratory, University of Agriculture. The various treatments were evaluated under in vitro conditions to evaluate the fungus growth on petri plate. Both essential oil and ZnO nanoparticles were evaluated. The maximum disease incidence 39.43% was recorded in (T0= Control) treatment followed by (T2= 150 ppm ZnO) treatment 36.25% and the minimum disease incidence was recorded in (T1= 1% Essential oil) treatment 15.49%. The lowest fungal growth was observed in T6 with highest fungus mycelial growth inhibition (56%) followed by T1 (39%) as well as the highest fungal growth was recorded and also no inhibition of fungal growth was observed in T0 and T2.

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EFFICACY OF BIO-PESTICIDES AGAINST *Maconellicoccus hirsutus* (GREEN) UNDER LABORATORY CONDITION

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The present study was conducted to evaluate the effect of bio-insecticides i.e. Verticillium lecaniiand Metarhizium anisopliae (spore count of both was 1.0 x 10 7 spores/ml) against thelarval stage of Maconellicoccus hirsutus. The topical application of these bio-insecticides was done. T1: M. anisopliae @ 2ml, T2: M. anisopliae@ 2ml + wetting agent @ 1ml T3: V. lecanii@ 2ml, T4: B. bassiana @ 2ml + wetting agent @ 1 ml, T5: Control (water spray). The result revealed that T4: V. lecanii@ 2ml + wetting agent @ 1 ml was showing maximum mortality (87.5 %) followed by T2: M. anisopliae @ 2ml + wetting agent @ 1ml (81.5 %), T3: V. lecanii@ 2ml (72.0%), T1: M. anisopliae @ 2ml (65.5 %). Whereas the T5: Control was showing no mortality. Therefore, the use of bio-pesticides along with wetting agent is effective eco-friendly alternative against M. hirsutus.

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NEW EXTENSIONIST: CHANGING ROLE OF CHANGING AGENTS

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Over the last few years, Indian agriculture has witnessed a prodigious rate of growth. From Individual attempts of agricultural development in the pre-independence era, we went on to community development programmes to various government schemes and now to an era of digital agriculture. Meanwhile our extension systems have also evolved. We have developed different methods to reach out to the farmers who are our ultimate clients. But certain studies have shown that in India, there is only 1 extension worker for 2879 farmers which makes it almost impossible for that worker to reach out to each farmer. Thus, a sort of revolution has been brought in the extension system by connecting it to digital systems. Now the role of extension workers has changed from going home to home to developing digital skills among farmers and get each and every farmer connected to the extension agency through digital platforms. These things require the conventional extension worker to develop skills and competence to deal with the new communicating innovations and to diffuse them among farmers. Now, they are being identified as New Extensionists who are equipped with digital skills themselves and are bringing a big change in Indian agriculture. Roles and responsibilities of extension workers are changing. With the advent of Social Media, UAV, Artificial Intelligence, Precision Agriculture, AgriBots etc., the new extensionists are expected to perform even better to make farmers learn and adopt these technologies so that they can understand modern agriculture and its complications more readily. Developed countries like USA, Denmark, Israel, and Australia are doing excellently but the developing economies like China, Brazil, Rwanda, Senegal etc. are also pacing up and trying to match their level to the par. Recently, the adoption of RFLD system by Pakistan, Smart irrigation systems of Greece (IRMA_SYS), Precision Agriculture in Kenya, China‟s advanced spray UAVs etc. are some good examples to be cited and followed upon. India too, has the potential and is on a progressive path but we still have miles to go to attain a proficiency and success in digitalization of agriculture of which New Extensionsts are a valuable part.

GIRISDA/AB/238/2022

PERSISTENCE OF ACEPHATE, CHLORPYRIPHOS, QUINALPHOS AND TRIAZOPHOS IN CUCUMBER

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The study aimed to assess the level of pesticide residues in cucumber fruits, the effect of processing on residues and the accumulation of insecticides in the soil. The persistence study on cucumber fruits recorded initial deposits due to single dose of acephate (560 g a.i. ha -1), chlorpyriphos (300 g a.i. ha -1), quinalphos (250 g a.i. ha -1) and triazophos (300 g a.i. ha -1) as 0.640, 0.980, 0.628 and 0.985 mg kg -1, respectively. However, at the double dose, the initial deposits were 1.123, 1.860, 1.126 and 1.906 mg kg -1 for respective insecticides. The initial deposits of 0.076, 0.112, 0.189 and 0.098 mg kg -1 at the single dose and 0.161, 0.198, 0.146 and 0.189 mg kg -1 at the double dose were observed for acephate, chlorpyriphos, quinalphos and triazophos, respectively, in cucumber cropped soil. Acephate and quinalphos residues persisted in cucumber fruits for up to 5 and 7 days at single and double doses, respectively. Whereas, chlorpyriphos and triazophos persisted for 7 days at the recommended dose and 10 days at double the recommended dose. The residues of acephate, chlorpyriphos, quinalphos and triazophos in fruits were reduced to half in less than 2 days. The waiting periods for the respective insecticides were worked out at their limit of determination (0.05 mg kg -1) due to the lack of MRL value in India. The safe waiting periods on cucumber were suggested as 9, 10, 8 and 11 days for acephate, chlorpyriphos, quinalphos and triazophos, respectively. Among various

decontamination processes, peeling was found most effective which provided up to 91.36 per cent relief followed by vinegar dipping (71.60 per cent), saline water dipping (56.49 per cent), lukewarm water washing (40.34 per cent) and tap water washing (30.74 per cent) from insecticide residues in cucumber.

GIRISDA/AB/239/2022

COST-BENEFIT ANALYSIS OF TOMATO PRODUCTION IN HIMACHAL PRADESH

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The present study attempted to analysis the cost benefit ratio of tomato production in Himachal Pradesh. A total of 120 farmers were selected randomly from two developmental blocks namely Balh and Kangra block. Agriculture in Indian economy is main source of livelihood security because more than 50 percent of population depends upon agricultural sector directly or indirectly. Vegetables are a source of income support as well as important for food security of the people of India. So cost-benefits analysis is very essential in economics because this tell us about the benefits and losses of a particular field. The total cost of cultivation of Tomato was Rs. 156184.57/ha while Cost A 1 was Rs. 92856.41/ha and Cost B 2 was Rs. 109652.15/ha The cost benefit ratio was more than unity (2.11) that means when one rupee spent on Tomato production, it would leads to give the returns of Rs. 2.11 which indicated that tomato cultivation was profitable enterprise. Tomato break-even yield was 29.16 qlt/ha, indicating that this yield level exhibited no profit and no loss in tomato cultivation and for profitable tomato production output should be higher than this break-even yield. The study suggests that Indian government should give priority to tomato production, processing and exports.

GIRISDA/AB/240/2022

EFFECT OF AUXIN CONCENTRATIONS ON ROOTING OF WILD POMEGRANATE CUTTINGS

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Present investigation aimed at the testing effect of different auxin concentration on the rooting of stem cuttings of wild pomegranate. Cuttings were collected from four sites viz., Narag, Waknaghat, Jonaji and Nauni, each with three middle-aged genotypes. The design was laid out using CRD with four treatments viz., IBA @ 500 ppm, IBA @ 1000 ppm, IAA @ 500 ppm and IAA @ 1000 ppm, under mist chamber conditions using polybags. The maximum rooting percentage (86.11 %), number of sprouts per cutting (2.33) and number of leaves per cutting (28.65) were recorded in IBA @ 1000 ppm. Cuttings collected from Waknaghat site showed highest rooting percentage (93.52 %), number of sprouts per cutting (2.33) and number of leaves per cutting (25.65). These findings suggested that dipping cuttings in 1000 ppm IBA was the most effective treatment for enhancing establishment and growth of pomegranate stem cuttings.

GIRISDA/AB/241/2022

EXTRACTION OF BIOACTIVE COMPOUND FROM VEGETABLE WASTE THROUGH GREEN EXTRACTION TECHNIQUES

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Food wastes imply significant greenhouse gas (GHG) emissions that increase the challenge of climate change and they also impact food security; an estimated 14% of the world‟s food is lost and wasted from the point of harvest to the retail level. This has become a major global issue on environmental sustainability, food safety, and the necessity of feeding a world population that grows every day. The food that is wasted is associated with approximately 3.3 gigatonnes of CO2 equivalent, corresponding to 7% of total global GHG emissions. Asia are the main contributors of food loss with 20-21% of waste, while Australia and New Zealand only have an approximate of 5-6% of food wasted. One of the main food wastes is fruit and vegetable waste (FVW), representing 0.5 billion tons per year, of the 1.3 billion tons of total food waste. The wastes that can be obtained from vegetables are seeds, core, rag, peels, rind, vine, shell, skin, pomace, stones, and pods. There are plenty of valuable components that are found in vegetable waste, with many properties that impact positively in human health, these components are known as bioactive compounds, such as carotenoids, alkaloids, glucosinolates, flavonoids, and phenolic acids. Currently, the use of vegetable waste to obtain bioactive compounds, through green extraction techniques. These extraction techniques report higher yields, reduce the use of solvents, employ less extraction time, and improve the efficiency of the process for obtaining bioactive compounds. Once extracted, these compounds can be used in the cosmetic, pharmaceutical, or food industry, the last one being focused on improving food quality.

GIRISDA/AB/242/2022

PROFITABILITY OF ORGANIC TOMATO IN MID HILL ZONE OF HIMACHAL PRADESH

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Vegetables and other cash crops play a crucial role in agriculture development in the state. Due to the congenial agro-climatic conditions the state has a comparative advantage in production of vegetables during the time when these vegetable crops cannot be produced in the plains. Simple random sampling technique was adopted to draw the ultimate sample from the population. A final sample of 60 farmers was drawn randomly. The study revealed that the per hectare cost of cultivation of organic tomato was Rs. 94767.22, the gross returns from organic tomato were Rs. 320568.37 and net returns were obtained Rs. 274198.78. The output – input ratio was found to be 2.89 which means that an investment of Rs. 1 on organic tomato cultivation in study area were getting Rs. 2.89 as return. These measures clearly indicate that the organic tomato farming is a profitable venture in the study area. Hence, training on modern organic farming methods of production should be provided to the farmers so that they can fetch good prices in the market.

GIRISDA/AB/243/2022

EFFECT OF DRIED LEAF/SEED POWDER OF TEST PLANTS ON PLANT GROWTH PARAMETERS AND FRUIT YIELD OF TOMATO AND POPULATION OF *Meloidogyne incognita*

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Products of six indigenous plants from mid-hill region of Himachal Pradesh, viz., shade dried leaves of calotropis, lantana, castor, neem and parthenium and seeds of duranta (@ 150 g per m^2 15 days prior to transplanting) were tested for their efficacy in powder form under field conditions against *M. incognita* infecting tomato crop. Best results in terms of plant growth, reduced juvenile count at termination, reduced root gall index and improved fruit yields were recorded in plants raised in soil amended with neem leaf powder followed by calotropis treatment. Despite the fact that minimum juvenile population and root gall index were recorded in castor leaf powder treated plants, their vegetative growth remained stunted. Still, the fruit yields attained in this treatment were not at par with that of neem treated plants. These observations are indicative of the fact that the nematode antagonistic principles (ricin and ricinin), though, most toxic to the test nematode, either themselves hampered the plant growth or some other chemicals present in castor were responsible for stunted plants. Neem, on the other hand, possessed some active principle that enhanced the vegetative growth in addition to many anti- nematode compounds. Since all the control measures are adopted with the sole objective to achieve high crop yields, the referred test plants were also rated on the basis of crop yield attained in respective treatments. In this respect the order of efficacy was neem > calotropis > castor > lantana > parthenium > duranta powders.

GIRISDA/AB/244/2022

MINERALS AND ENVIRONMENT: AN OVERVIEW

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A mineral is a naturally occurring combination of particular elements arranged in a specific repeating three-dimensional lattice. The study of minerals is important as it provides the basis for the understanding of geological processes and these provide basic raw materials to many important industries like power generation, iron and steel, cement, petroleum, fertilizers, precious stones for jewellery, medicines etc. Mining is the extraction of valuable minerals from the earth, which forms the mineralized package of economic interest to the miner. Mining, surface or underground, poses both positive and negative impacts on environment. Positive impacts include employment opportunities to local communities, increase in economic growth of a country, production of goods, services and infrastructure that improve the quality of lives. Negative impacts include deforestation, air, water, noise and soil pollution, habitat destruction, loss of biodiversity, displacement of homes, serious health issues to mine workers. It also leads to mine subsidence, formation of sinkholes and landslides. Exposed rocks containing sulphur bearing minerals react with air and water to form sulfuric acid which leads to acid mine drainage that contaminates drinking water resources, disrupts growth and reproduction of aquatic plants and animals. Mining activities also release heavy metals in the environment such as arsenic, cadmium, lead, mercury. Once in the environment, these heavy metals can remain present for long time and can be transported from one place to another, either by the wind or washed away by water posing serious threats to the environment. Moreover, the dust and run-off water from the mines can approach the nearby fields, changing their nutrient content thereby reducing the fertility of soil. Minerals are indispensable components for the individual, society and for the development of the nations. Mining is one of the core sectors and growth driver of any country‟s economy. Therefore, sustainable mining is essential for the survival of humankind. Mitigation measures should be adopted during various mining operations and mineral development in a region should be carried out within its environmental carrying capacity and mined area should be reclaimed for future use.

GIRISDA/AB/245/2022

EFFECT OF TREE SPACING AND FERTILIZERS APPLICATION ON MARIGOLD UNDER *Mangifera indica* BASED AGROFORESTRY SYSTEM

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The present investigation entitled "Effect of tree spacing and fertilizer application on marigold under Mangifera indica based agroforestry system." was conducted at RHRTS, Jachh Distt. Kangra (H.P) during 2020-2021.with the objectives to study Effect of tree spacing and effect of organic and inorganic fertilizers on marigold under Mangifera indica (Amarpali cultivar) based agroforestry system. Experiment was laid out in Randomized Block Design with nine organic manure doses viz. FYM 40 t/ha + Nitrogen 300 kg, FYM 40 t/ha +Nitrogen 400 kg, FYM 40 t/ha + Nitrogen 500kg, FYM 50t/ha + Nitrogen 300 kg, FYM 50 t/ha + Nitrogen 400 kg, FYM 50 t/ha + Nitrogen 500 kg, FYM 60 t/ha + Nitrogen 300 kg, FYM 60 t/ha + Nitrogen 400 kg, FYM 60 t/ha + Nitrogen 500 kg and control per tree Spacing and three tree spacing viz. 2×2 m 2 , 2.5×2.5 m 2 , 3×3 m 2 . The present study revealed that the maximum fruit yield, fruit size and branch wood biomass was recorded in 3×3 m 2 spacing. Growth and flower production parameters of Marigold were suppressed under the close spacing. Whereas, flower parameters were recorded to be highest under the 3×3 m 2 spacing of Mangifera indica (cv-Amarpali). Under close spacing flowering was initiated 15-20 days earlier and had a prolonged duration of flowering. FYM and Nitrogen showed a remarkable effect on growth and flower production parameters on Marigold as compared to control. Among organic manure doses FYM 60 t/ha + Nitrogen 300 kg dose was found to be the best dose. Growth and flower production parameters of under crop were also found to be highest in 3×3 m 2 tree spacing. However the overall net returns were found to be the maximum of 7.18 lakh ha-1 in 2 x 2 m2 tree spacing and FYM 40 t/ha +Nitrogen 400 kg dose to the marigold as under crop. Therefore integrating winter annual flower crop with Mangifer indica offers an excellent opportunity for diversification and more income generation than the monoculture. It will also open new vistas for the research to evaluate the performance of flower crop under tree canopy.

GIRISDA/AB/246/2022

ROLE OF BIOLOGICAL CONTROL IN THE MANAGEMENT OF DAMPING OFF OF TOMATO UNDER *IN VITRO* AND POT CONDITIONS

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Damping-off is a serious disease in nursery crops has the potential to cause severe loss in greenhouse and field conditions. Major soil borne pathogens responsible for this disease are *Pythium ultimum*, *Fusarium oxysporum*, *Rhizoctonia solani* and *Sclerotium rolfsii*. These are capable to survive in all type of soil conditions even without a host and make resistant structures for survival of longer periods of time. Structures of THESE PATHOGENS are motile and therefore able to travel through irrigation water and runoff. Currently, no tomato varieties with resistance to damping-off are available. In addition, the agriculture industry is striving for sustainable and biological methods of control of plant pests and pathogens. Therefore, biological controls that are capable of simultaneously protecting plants from pathogens and pests are needed. To that end, this investigation for biological control of tomato damping-off involves the use of biological control agents under *in vitro* and pot conditions to check the mycelial growth inhibition and disease incidence respectively. Among different fungal and bacterial antagonists evaluated against the pathogens, *T. harzianum* caused maximum mycelial growth inhibition followed by *T. viride*. Among the bacterial antagonists, maximum mycelial growth inhibition was recorded by *Bacillus licheniformis* followed by *B subtilis* under *in vitro* conditions. There was a significant reduction in the incidence of damping-off of tomato when fungal and bacterial antagonists were applied in the soil during the pot experiment. The antagonist *T. harzianum* resulted in

minimum disease incidence and was significantly superior from other treatments. Among the bacterial antagonists, *Pseudomonas fluorescence* resulted in minimum disease incidence followed by *Bacillus subtilis*. From this study it was observed that use of biological control agents are beneficial for the control of damping off disease in tomato.

GIRISDA/AB/247/2022

COMMON PROPERTY RESOURCES: MICROLEVEL EVIDENCES FROM CHANGAR AREA OF HIMACHAL PRADESH

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Common property resources include all such resources which are meant for common use of the community. It includes all resources like community pastures, grazing grounds, common forests and woodlets, protected and unclassed government forests, wasteland, common threshing ground, watershed drainage, ponds and tanks, rivers, rivulets, water reservoir, canals and irrrigation channels. The study revealed that 94.96 % of the selected households were engaged in the collection of fuel wood, 79.03 % in tree fodder & grasses, 75.56 % in leaf litter, 68.60 % in fruit & nuts and 62.74 % in herbal plants. On the basis of farm category the marginal farmers were found more dependent on CPRs for the collection of green fodder (38.04%) and dry fodder (27.04%) as compared to small and medium farmers. Tree fodder was consumed more in winter (2.49 quintals), followed by summer (1.72 quintals) and monsoon (0.72 quintals). Hay fodder requirement was found higher in monsoon (2.64 quintals) followed by winter (1.88 quintals) and summer (1.18 quintals) per farm. On the basis of farm category marginal farmers were found more dependent on common pasture as compared to small and medium farmers. On grazing practice in the study region on an average there were 369 grazing days per year per household which indicate the higher pressure on the grazing lands. The study revealed that the highest share of CPR income was reported in Lambagaon block (Rs. 12494) than in Dehra block (Rs. 11331) respectively. The inequality of income derived from CPRs among medium farmers was found lower than that of the marginal and small farmers. The Gini coefficient of total income in case of small & medium farmers was 0.29 and in the case of marginal farmers was 0.36. On an average the employment generated through CPRs based activities were found 863 hours per year per household i.e. 108 man days. The main factors responsible for the decline and degradation of CPRs were: increasing population of stray animals, excessive lopping for firewood, forest fires, deforestation, construction of buildings and overgrazing. Solution of CPRs problem in the study area lies in strengthening the village based participatory management

GIRISDA/AB/248/2022

MICROPROPAGATION: AN IN-VITRO METHOD FOR RAPID MULTIPLICATION IN PLANTS

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Micropropagation is the artificial process of producing plants vegetatively through tissue culture or cell culture techniques. In this artificial process of propagation, plants are produced invitro by asexual means of reproduction or by vegetative propagation. The propagation of plants by growing plantlets in tissue culture and then planting them out. IT is the practice of rapidly multiplying stock plant material to produce many progeny plants, using modern plant tissue culture methods. In nature asexual reproduction takes place either by vegetative means (or) by apomixis. The vegetative reproduction produces genetically identical plants and is widely used for the propagation and multiplication of horticultural important plants. The process of Micro propagation involves 4 distinct stages1.Selection of suitable

explants, their sterilization and transfer to nutrient medium for establishment 2. Proliferation of shoots from the explants on medium 3. Transfer of shoots to a rooting medium 4. Transfer of plants to soil/normal environment

For the in vivo propagation of specific plants, asexual reproduction via multiplication of vegetative parts is the only resort since they do not generate functional seeds as seen in figs, grapes, bananas etc. Successful application of clonal propagation is observed in Banana, Strawberry, Pomegranate and many other plants.

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MODERN CROP GEOMETRY AND CANOPY ARCHITECTURE DEVELOPMENTS IN FRUIT CROPS

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In countries that produce fruit, there is currently a global trend to increase the number of fruit plants per unit area by adjusting tree spacing and growth using canopy management techniques to control the tree growth and shape, ultimately limiting the size of the tree while still maintaining high fruit production of desired quality. Crop geometry is the arrangement of plants on the ground or the form of the space that each plant has in a field of crops. Additionally, it describes how the area allocated for particular plants is shaped. Fruit trees that are not spaced properly will develop slowly, provide fewer fruits of lower quality in less quantities, and be more susceptible to various diseases and insect pests. A fruit tree's canopy is its physical structure, which includes its stem, branches, shoot, and leaves. The density of the canopy is influenced by the number and size of the leaves. Management of canopy architecture generally refers to the positioning and care of tree framework in connection to the best fruit production. A variety of approaches are used in canopy management to change the position and quantity of leaves, shoots, and fruits in space, which in large part dictates the geometry of the plant, including the spatial distribution of leaf area and leaf orientation. Fruit production depends on the capture and transformation of sunlight into fruit biomass. The green leaves capture the sun's energy to create sugars and carbohydrates, which are then transported to the places where they are needed, such as buds, flowers, and fruits. In order to maximize carbon allocation in fruit sinks while preserving growth and development in other parts of the tree, canopy management must achieve this. The development of tree canopy forms and a new manufacturing system have undergone significant development and strong formation in recent years. Such systems result in high fruit yields of high quality, which is a result of the canopy's efficient absorption and dispersion of light. In order to benefit from such interventions, canopy architectural elements management must be implemented since it is a key factor in current fruit growing.

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ECONOMIC IMPACT OF CLIMATE CHANGE ON HORTICULTURE IN HIMACHAL PRADESH

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Climate change is the biggest threat to civilization in the twenty- first century and poses serious impacts on agriculture, horticulture, environment, and health all over the world. It is predicted that by 2080 the cereal production could be reduced by 2%–4%, meanwhile, the price will increase by 13%–45%, and about 36%–50% of the population will be affected by hunger (FAO, 2009). The North West Himalayan provides a congenial climate with favorable

microclimatic conditions for the production of horticultural crops such as apples, plums, peaches, bananas, mangoes, pineapples, citrus fruits, walnuts, and other fruits and vegetables. However, due to its high biological and socio-cultural diversity, the Himalayan ecosystem is susceptible to natural hazards caused by drastic changes in climatic conditions. Due to climate change, the variation in temperature and precipitation was significantly observed by the various scientists in the Himalayas. Being located in the Himalayan ecosystem, Himachal Pradesh is placed among the vulnerable state to climate change. Horticulture in the state is a vibrant sector of agriculture, distinguished by the scale of production and commercialization. The role of the horticulture sector in the state‟s nutritional security, poverty alleviation and employment generation programmes is becoming increasingly important and emerged as an important source of earning livelihood for small and marginal farmers. The last decade was called a "golden revolution" in horticultural production because of exceptional achievements in the field. The state has witnessed the shift in the area from food grains towards horticulture crops over the last five years (from 2012-13 to 2017-18). The area under fruits, which was 792 hectares in 1950-51 with a total production of 1200 tonnes has increased to 2, 32, 139 hectares during 2018-19 with a production of 4.95 lakh tonnes. Whereas, the area reported under vegetables was 88,367 hectares with a total production of 18 million tonnes for the year 2018-19 (Economic Survey, 2019-20). The share has been declining on account of relatively higher growth performance of non-agricultural sectors and shifting of the population to non-farm activities due to climatic variations over the years. Nonetheless, this high contributing sector has a wider exposure to climate change when compared to its close associate agriculture sector, but with a relatively smaller carbon footprint.

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MANAGEMENT OF RICE BLAST DISEASE CAUSED BY *Pyricularia oryzae* THROUGH APPLICATION OF BIOCONTROL AGENTS AND FUNGICIDES ALONE AND IN POSSIBLE COMBINATION

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Evaluation of biocontrol agents and fungicides against *Pyricularia oryzae* was conducted under laboratory and field conditions of Jammu, Jammu and Kashmir, India to evaluate the efficacy of bio-control agents *viz.*, *Trichoderma harzianum* and *T. viride* and fungicides *viz.*, Tricyclazole and Tebuconazole 50% + Trifloxystrobin 25%, alone as well as in possible combinations against rice blast disease. *In vitro* studies revealed that among biocontrol agents, maximum growth inhibition (43.99%) was recorded in *T. harzianum*. Among fungicides, Tricyclazole was found most effective in inhibiting the growth of *P. oryzae* at all concentrations. Under field conditions, combination of seed treatment with Tricyclazole @ 2g/kg of seed with two foliar sprays of combination fungicide (Tebuconazole 50% + Trifloxistrobin 25%) @ 0.1 per cent significantly managed the disease with the highest disease control (83.09 and 77.37%) and gave highest grain yield 29.70 and 29.45 q/ha during *Kharif* 2018 and 2019, respectively.

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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH AND YIELD OF WHEAT (*Triticum aestivum* L.) UNDER IRRIGATED CONDITIONS

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An experiment entitled "Effect of Integrated Nutrient Management on Growth and Yield of Wheat (*Triticum aestivum* L.) Under Irrigated Conditions" was carried out at Research Farm Department of Agriculture, Baba Farid College, Bathinda during *Rabi 2018 – 19.* The experiment was laid out in randomized block design with three replication and ten treatments *viz*. T_1.Control, T_2. - 50% RDN through urea+ 10 t ha^{-1} FYM, T_3. 75% RDN through urea + 10 t ha^{-1} FYM, T_4. 100% RDN through urea + 10 t ha^{-1} FYM, T_5. 50% RDN through urea + 10 t ha^{-1} Vermicompost, T_6. 75% RDN through urea + 10 t ha^{-1} Vermicompost, T_7. 100% RDN through urea + 10 t ha^{-1} Vermicompost, T_8. 50% RDN through urea + 5 t ha^{-1} FYM + 5 t ha^{-1} Vermicompost T_9. 75% RDN through urea + 5 t ha^{-1} FYM + 5 t ha^{-1} Vermicompost t and T_{10}. 100% RDN through urea + 5 t ha^{-1} FYM + 5 ha^{-1} Vermicompost. The highest yield attributes and yield of wheat was achieved with application of 100% RDN through urea + 5 t ha^{-1} FYM + 5 ha^{-1} Vermicompost but it did not differ significantly with application of 100% RDN through urea + 10 t ha^{-1} FYM and the treatment 100% RDN through urea + 10 t ha^{-1} Vermicompost was applied. T_{10} produced 94.96 percent higher number effective tillers, 34.14 percent taller spike length, 25.47 percent more test weight, 165.21 percent higher grain yield and 157.13 percent higher straw yield of wheat over control.

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THE EFFECT OF VARIOUS INSECTICIDES ON THE MUSTARD APHID AND YIELD CHARACTERISTICS OF INDIAN MUSTARD

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Lipaphis erysimi Kalt is one of the major pests associated with various phenological stages. Considered one of the most destructive insect pests. We conducted an experiment at the farm and lab of the University College of Agriculture Guru Kashi University, Talwandi Sabo, (Punjab) during the Rabi season in 2021-2022. The aim of the study is to examine the "effect of insecticides in controlling aphid populations and in increasing the yield attributes of Indian mustard." The experiment was laid out in a randomised block design (RBD), with nine treatments, including a control treatment. A field experiment showed the highest reduction of Lipaphis erysimi (Kalt.) population by Beauveria bassiana @ 15 g/L pesticide, followed by Neem oil @ 5% (T4). Both Dimethoate 30% EC (Rugor) @ 2ml/L (T2) and Imidacloprid 17.8% SL (Victor) @ 2ml/L (T3) were found effective as well as remunerative, as the yield increased with the application of these insecticides. Thus, the above three insecticides may be the best option for Lipaphis erysimi (Kalt.) population management.

GIRISDA/AB/254/2022

STUDIES ON ALTERNARIA LEAF SPOTS ON DIFFERENT GENOTYPES OF CAULIFLOWER AND ITS MANAGEMENT

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Alternaria leaf spot is one of the most destructive disease of cauliflower (*Brassica oleracea*). The highest disease incidence (61.12%) and severity (52.43%) was recorded in V1- Desi variety, the disease incidence and severity varies according to transplanting time. Minimum disease severity and incidence recorded among V3- Garima variety at different transplanting time. Characteristic symptoms on leaves were observed as minute dark brown to black spots, which forming enlarged concentric rings from small to large. The pathogens associated with the disease were isolated and pathogenicity established on detached young leaves of cabbage. Based on morphological characters, pathogenicity and comparison with the authentic description the pathogens were identified as *Alternaria brassicicola*. Among the four fungicides tested *in vitro*, carbendazim was found to be most effective and showed maximum inhibition of mycelial growth (85.5%) followed by mancozeb (81.2%) and hexaconazole (65.87%) against *A.brassicicola* respectively. Captan was found to be least effective. Among two fungal antagonists, tested *in vitro*, *Trichorderma viride* was found to be most promising showing maximum inhibitory effect on the mycelial growth (40.21%) of *A. brassicicola*, respectively. *Trichoderma harzianum* (34.27) was found to be next best antagonist.

GIRISDA/AB/255/2022

PREPARATION OF ETHNOVETRINARY MEDICINES BY FARMERS & TRIBAL'S OF DISTRICT SAMBA, J&K (INDIA)

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The paper presents some commonly used ethno veterinary medicines to trat various ailments of domestic animals. The data was collected from the local farmers and Tribals (Gujjars and Bakerwals) of the District Samba. The initial study reported 25 types of animal diseases and 30 species of plants belonging to 30 Genra and 22 families used for the preparation of ethno medicine for the animal ailments. The species, and vernacular name, plant part, medicine preparation habit and the disease condition of the animals are studied.

GIRISDA/AB/256/2022

ORGANIC FARMING WITH RESIDUE-FREE PRODUCTION

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Organic farming, agricultural system that uses ecologically based pest controls and biological fertilizers derived largely from animal and plant wastes and nitrogen-fixing cover crops. Due to widening horizon of digital media and easy access to a lot of content, people have been influenced to become more health cautious leading to a drastic change in their eating habits. In today‟s era staying healthy is the need of the hour which has led people to choose a health friendly diet. In order to cater to the huge segment of health conscious people, there has been a sharp rise in the consumption of residue free and organic vegetables, thus giving an opportunity to young entrepreneurs to enter the space of residue free framing Residue Free Farming- The Concept Residue free farming can be phrased as the use of

organically derived biocides and bio fertilizers to protect the crops and augment their growth.In today‟s era where technology plays a pivotal role in each and every sector, it‟s important to understand the use of technology in the field of agriculture. By adopting modern day agri-technologies like greenhouses, drip irrigation system, fertigation, integrated fertilizers management, ipm- integrated pest management, residue free production, rain water harvesting, high density plantation, contour farming, waste land utilization, etc., it becomes relatively easy to maintain the quality of the produce and also add to the nutritional value to the same. The Hazards to Nature -Use of strong chemical fertilizers has been a predominant factor in the agriculture sector since quite a long time. This use of toxic chemical fertilizers has had a very negative impact on the environment leading to a potential damage to the agriculture products as well as the health of masses who consume it. The extensive abuse of chemical fertilizers has led to a change in the health of the soil leading to the depletion of the nutritional value of the product and thus creating a hazardous impact on the consumers of the product.

Due to rapid evolution and increased awareness in the health segment, people are now focused on the benefits of consumption of fresh and residue free food. In order to support this change, it is necessary to adopt the practice of residue free farming where in the food that is produced is pure, fresh, healthy and nutritious. This produce is grown in an eco-friendly way and without the use of any hazardous chemical fertilizers in order to benefit the end consumer in the best possible way.

GIRISDA/AB/257/2022

OPTIMIZATION OF ARTIFICIAL DIETS FOR MANAGEMENT OF *Apis mellifera* L. COLONIES.

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The studies were conducted during 2017-19 in the apiary of AICRP (Honeybee and Pollinators), Division of Entomology, SKUAST-Jammu to determine the effect of artificial diet on colony performance parameters, incidence of diseases and enemies and palynological analysis of pollen loads to determine the major floral sources of *A. mellifera* colonies. Six diets viz. Diet -I [(Defatted soya flour (20g) + skimmed milk powder (25g) + sugar (5g) + pollen (5g)+glucose (10g) + honey (35g)] ; Diet –II [(Black gram (20)+ Yeast (20gm) + Pollen (20g) + Honey (20gm) + glucose (20g)]; Diet –III [Brewer‟s yeast (42 g) + Gram (4g) + Skimmed Milk Power (4g) + Sugar (50g) + Pollen (10 g)] ; Diet –IV [Soybean flour (60 g) + Honey (35 g) + Yeast (5g) + Vitamins (1 g/kg)]; Diet-V [Soybean flour (25 g) + Yeast (10 g) + Pollen (15 g) + Skimmed milk powder (5 g) + Honey (22.5 g) + Sugar (22.5 g)];Diet-VI [Control (sugar feeding)] were tested for their performance. The *A. mellifera* exhibited differential consumption pattern during different weekly intervals throughout the season as per the needs of the colony. The preference of different diets was in the order Diet III > Diet IV> Diet II> Diet V> Diet I> Diet VI. The net consumption of diet III was (67.85g) followed by Diet-IV (61.06g), Diet II (52.44), Diet V (47.86), Diet-I (45.72g) and Diet VI (25. 74g).

The studies on impact of artificial diets on brood development revealed that all the diets have significant effect on brood development. The maximum brood development was recorded in bee colonies fed with Diet IV (790.70 cm^2) while the minimum was recorded in Diet VI (526.80 cm^2). The significant impact on the number of frames covered by bees was recorded. The colonies fed with Diet III and Diet II had maximum strength (5.8 frame of bees) while the lowest bee strength (5.1 frame) was observed in colonies fed with diet I The studies on effect of artificial diets on disease and enemies incidence in *A. mellifera* colonies revealed that colonies fed on different diets were able to maintain sufficient strength.The studies revealed that *A. mellifera* colonies were attacked by various brood diseases which included American foul brood (AFB), European Foulbrood (EFB), Sac brood disease (SBV), adult diseases such as Nosema disease, several species of ectoparasitic mites such as *Varroa destructor*, *Tropilaelaps clareae*, phoretic mite *Neocypholaelaps indica*, wax moths *Galleria mellonella* and lizards *Varanus spp.*

GIRISDA/AB/258/2022

SPEED BREEDING: SHIFTING PARADIGM IN CROP IMPROVEMENT

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Burgeoning population, ever changing lifestyles and advancing climate change has made it mandatory to revamp the currently available crop cultivars so as to secure food & nutritional security worldwide and accomplish other market driven traits. Although a lot of appreciable work has been done to produce high yielding and nutrient-rich strains of a panoply of food and fiber crops, the pace of breeding superior varieties is yet to match the demand for the same. The duration of the seed-to-seed cycle, which is 10-12 years in case of conventional approaches, is one of the crucial bottlenecks in the progress of modern plant breeding ventures. The concept of Speed Breeding serves as a saviour here by drastically reducing the time required for cultivar development, release and commercialization to nearly half. It is a suite of techniques that involves the manipulation of environmental conditions under which crops are grown, aiming to accelerate flowering & seed set and advance to the next breeding generation as quickly as possible. It encompasses manipulation of day/night temperature, available light spectrum & intensity, photoperiod duration, soil moisture, use of PGRs, adjusting CO_2 & O_2 levels in air and high-density plantings in order to reduce time to floral initiation, hasten embryo development and seed maturity. Recent research has shown the power of combining emerging techniques, such as gene editing using CRISPR/Cas9, high-throughput phenotyping and genotyping, genomic selection, and MAS, with SB for boosting genetic gain. There are few key challenges limiting the deployment of speed breeding techniques in developing countries, including the high costs of infrastructure, required expertise & skill set and continuous financial support for research and development to maintain this as a sustainable operation. However, the existing constraints can be resolved by further optimization of the SB protocols for critical food crops and their efficient integration in plant breeding pipelines. Collaborative international research endeavours involving multi-disciplinary teams are needed to encourage the integration of SB systems in basic and applied research. Nonetheless the technique of Speed breeding will come out as the next breakthrough of the century and become the part and parcel of modern breeding manoeuvres.

GIRISDA/AB/259/2022

PERFORMANCE OF SOILLESS GROWING MEDIA IN RELATION TO DIFFERENT FERTIGATION LEVELS ON DIFFERENT YIELD CONTRIBUTING COMPONENTS IN SWEET PEPPER (*Capsicum annuum var. Grossum*) CULTIVAR OROBELLE GROWN UNDER NATURALLY VENTILATED POLYHOUSE

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The research trial was carried out to study the Performance of soilless growing media in relation to different fertigation levels on sweet pepper (*Capsicum annuum* var. *grossum*) cultivar orobelle grown under naturally ventilated polyhouse in the year 2021 at Experimental Farm Chhapang of Dr. Khem Singh Gill Akal College of Agriculture, Eternal University, Baru Sahib. The experiment was laid out in Randomized Block Design with three replications and nine treatment combinations. Growing media M_1 [Vermicompost + Sand + (3:1)] recorded best results for quantitative characters (fruit length, fruit breadth, fruit weight, number of fruits per plant, number of fruits per plot, fruit yield per plant, fruit yield per plot, fruit yield per hectare and harvest duration). Fertigation level F_3 F_3 [200 kg NPK/ha] showed best results for quantitative characters (fruit length, fruit breadth, fruit weight, number of fruits per plant, number of

fruits per plot, fruit yield per plant, fruit yield per plot, fruit yield per hectare and harvest duration). Treatment combination M_1F_3 [Vermicompost + Sand + (3:1) + 200kg NPK/ha] performed best for (fruit length, fruit breadth, fruit weight, number of fruits per plant, number of fruits per plot, fruit yield per plant, fruit yield per plot, fruit yield per hectare and harvest duration).

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ORGANIC FARMING WITH RESIDUE FREE PRODUCTION

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Organic farming is a type of farming where chemicals are not used for the production of crops. Its aim is human welfare without harming the environment and follows the principles of health, ecology, fairness and care for all including soil. Organic farming can diminish energy consumption by 30.7% per unit of land by abolishing the energy required to manufacture synthetic fertilizers and pesticides and by using internal farm inputs. India can emerge as global leader because of the presence of large number of organic producers and they need to be supported with technical knowledge, subsidies and inputs besides marketing infrastructure. The organic agriculture technique is known to be ecological sustainable by improving soil structure, fertility and productivity through the use of crop rotations, organic manure, mulches and the use of fodder legumes for adding nitrogen to the soil fertility cycle. Prevention of soil erosion and compaction by protecting the soil planting mixed and relay crops. Advancement of biological diversity through the use of natural pest controls such as biological control, plants with pest control properties rather than synthetic pesticides which, when misused, are known to kill beneficial organisms (e.g. natural parasites of pests, bees, earthworms), cause pest resistance, and often pollute water and land. Performing crop rotations, which include a diversity of food crops, fodder and under-utilized plants; this, in addition to improving overall farm production and fertility, may assist the on-farm conservation of plant genetic resources. Recycling the nutrients by using crop residues (straws, stovers and other non-edible parts) either directly as compost and mulch or through livestock as farmyard manure. Organic farming helps in active promotion of soil microorganisms.A good nutrient supply to crops is just as important in organic farming as in conventional farming. However, the supply of nutrients in organic farming differs fundamentally from that in conventional farming.

GIRISDA/AB/261/2022

PRECISION AGRICULTURE, SOIL AND WATER CONSERVATION FOR A SUSTAINABLE AGRICULTURAL SYSTEM

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India is an important agricultural country. India has wide agricultural land and majority of the people in this country are working in this sector. The farmers still use conventional farming system by applying same treatment to their crops. Limited natural resources are available on the earth under immense pressure due to the ever – increasing population and changing climate. Soil and water are fundamental natural resources for the agricultural production system. In India, about 68.4% of the total land area has been degraded by the water erosion process. Likewise, increased exploitation of ground water resulted in depletion of ground water level. Hence, judicious management of soil and water resources is valuable for agricultural sustainability as well as for the protection of the natural ecosystem. So, agricultural production is decreasing day by day and we need to go for new techniques. Precision agriculture, soil and water conservation technologies are best to enhance the production of the crops as well as productivity. The effort to increase agricultural production is to implement precision agricultural technology, Soil and Water Conservation technique and also for sustainable agricultural system to get the optimization and the cost

efficiency of land and water management. Precision agricultural aims to optimize field- level management with regards to Crops- Matching farming practices more closely to crop needs such as fertilizer inputs. Precision agriculture benefits to the environment come from more targeted use of inputs that reduce losses from excess applications and from reduction of losses due to nutrient imbalances, weed escapes, insect damage, etc. Other benefits include a reduction in pesticide resistance development. Precision farming is an approach where inputs are utilised in precise amounts to get increased average yields, compared to traditional cultivation techniques. In India, one major problem is the small field size. More than 58 percent of operational holdings in the country have size less than one hectare. Only in the states of Punjab, Rajasthan, Haryana and Gujarat do more than 20 percent of agricultural lands have an operational holding size of more than four ha. Commercial as well as horticultural crops also show a wider scope for PA in the cooperative farms. Sustainable PA in this century most valuable innovation in farm management that is based on using Information and Communication Technology (ICTs). This is the most recent innovation technology based on sustainable agriculture and healthy food production and it consists of profitability and increasing production, economic self-sufficiency and the reduction of side effects on the environment.

GIRISDA/AB/262/2022

EVALUATION OF RICE HUSK BIOCHAR TO INHIBIT THE CARPOGENIC GERMINATION OF *Sclerotinia sclerotiorum*

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Use of biochar in agriculture is gaining a lot of attention nowdays. It is an organic product resulted from anaerobic or limited oxygen availability for decomposing of biomass. In the present scenario biochar obtained from agricultural crop residues is successfully utilised in enhancing soil health. Biochar has been observed as a source of carbon sequestration in soil leading to good soil health which consequently promotes better plant health and thus minimising the disease incidence by plant pathogens. *Sclerotinia sclerotiorum* is a soil borne plant pathogen with wide host range infecting about 500 host plant species. Different concentrations of Rice husk biochar: 1%, 3% and 5% were tested against the carpogenic germination of sclerotia of *Sclerotinia sclerotiorum.* Ten sclerotia were placed in each petri plate containing 40 g of sterilised soil. The percent sclerotial germination was calculated and it was found that all three concentrations were highly effective in inhibiting carpogenic germination of sclerotia as compared to that of control. Rice husk biochar suppressed the carpogenic germination of pathogen and thus may prove to be an effective disease management strategy and can be successfully utilised to reduce the disease incidence by *Sclerotinia sclerotiorum.*

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ORGANIC FARMING WITH RESIDUE FREE PRODUCTION

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Organic farming aims for human welfare without harming the environment and follows the principles of health, ecology, fairness and care for all including soil. The modern concept of organic farming combines the tradition, innovation and science. Globally, organic agriculture is practiced in 162 countries and 37 m ha of land are managed organically by 1.8 million farm households. The global sale of organic food and drink reached 62.9 billion US dollars in 2011. In 1905, the British botanist Sir Albert Howard, often referred to as the father of modern organic agriculture, documented traditional Indian farming practices, and came to regard them as superior to conventional agriculture science. The countries with the most organic agricultural land are Australia (12 million hectares), Argentina (3.8

million hectares) and the United States (1.9 million hectares). Organic farming can minimize energy consumption by 30.7 % per unit of land by eliminating the energy required to manufacture synthetic fertilizers and pesticides and by using internal farm inputs, thus reducing fuel used for transportation. India can emerge as global leader due to the presence of large number of organic producers (almost 7 lakh producers) and they needs to be supported with technical knowledge and inputs besides marketing infrastructure. The major impediment for growth of organic farming in India is yield reduction in the initial years due to swift switch over from inorganic to organic, wide gap between availability of organic source of nutrients and requirement and lack of pest and disease management options. Most of the organic growers have expressed that lack of support price for organically grown crops and marketing infrastructure as the major constraint in promotion of organic agriculture. With the increasing awareness about the safety and quality of foods, long term sustainability of the system and accumulating evidences of being equally productive, the organic farming has emerged as an alternative system of farming which not only addresses the quality and sustainability concerns, but also ensures a profitable livelihood option. Although, much progress on research in organic farming has been done, the new emerging areas of human health benefits, understanding the economics with environmental markets, climate friendly farms and carbon farming with organic farming system models needs to be addressed in future.

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ORGANIC FARMING: THE ONLY WAY FOR HEALTHIER LIFE.

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Food quality and safety are the two major factors that have gained ever-increasing attention from general consumers. Conventionally grown foods have immense adverse health effects due to the presence of high volumes of pesticide residues, heavy metals, and fertiliser residues. Today we use a high volume of agrochemicals to enhance the quantity of the product, but the quality of the product decreases drastically due to the residue effects of the chemicals used. The high volume of consumption of agrochemicals affects the consumer‟s health, soil health, and also the environment. With the use of these chemicals, we can enhance the yield once for a short time, but the end results of these are very scary. The consumers of the product are facing serious health problems. To overcome all these problems, humans are using different techniques to enhance crop yields from many years ago. But in present times, traditional techniques are not completely fruitful according to the ever increasing demand for food because this type of farming has many drawbacks like diseases and pest management, making them economically less beneficial. So, new techniques are trying to get more yields from crops with reference to environmental health. In new techniques, organic farming is gaining popularity due to its environmental benefits: yield enhancement, nutrient management, health and safety, economic benefits, and most importantly, pest and disease management. If the government of India takes some major steps in favour of organic farming to get it popular among farmers, this technique will surely play a major role in getting better results in agriculture. Along with the help from non- govt. organizations, there should be support from government organisations in the form of subsidies, exemption from taxes, and training to framers so that they can easily adopt the new technique. By this method of organic farming, we can grow more and safer food for our health as well.

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NANO AGRICULURE: A GREAT WAY FOR MODERN AGRICULTURE

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During the climate change phase, global agriculture systems are confronting a variety of unexpected dangers. Advanced nano-engineering is a valuable tool for increasing agricultural yield and ensuring resistance in order to attain food stability. Nanotechnology strives to boost agricultural output by improving input performance and reducing waste. Nanomaterials expand the specific surface area of fertilisers and insecticides. Furthermore, nanoparticles as specialised carriers of agrochemicals offer site-targeted controlled nutrient delivery with increased crop security. Because of their specific and intended uses in the exact control and regulation of inputs (fertilisers, pesticides, herbicides), nanotools, such as nano biosensors, support the construction of high-tech agricultural farms. Nonsensors' ability to detect and understand environmental variables or limitations has been greatly increased by the incorporation of biology and nanotechnology.

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SOIL HEALTH: A BETTER SUSTAINABLE APPROACH FOR FOOD AND SOIL SECURITY

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Soil health, soil quality, and soil security, all the three mainly focused on the status of the soil fertility that is essential for all living things in the terrestrial environment. Soil health can define as the capacity of soil to function as a vital living system within land use boundaries. This function which sustains biological productivity of soil also maintains the quality of surrounding environment and human health. Thus, the term is used to distinguish that, soil health presents the soil as a finite non-renewable and dynamic living resource. Due to several anthropogenic and natural sources, soil degradation is one of the major constraints for agricultural productivity. Around 40% of the arable land is already degraded for various factors including urbanization and soil sealing, soil acidification, salinization, soil erosion, soil contamination, etc. The theme for World Environment Day 2012 encompasses various aspects of human living, ranging from transport to energy to food to sustainable livelihood. Green technology, an eco-friendly clean technology, contributes to sustainable development to conserve the natural resources and environment which will meet the demands of the present and future generations. Despite there is a link between soil quality and food productivity, the status of global food production has been updated regularly rather than the status of world soil resources. Both the UN Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) emphasized to ensure the food security globally as we need to serve more than 9 billion people by 2050. Further, the soil acts as a carbon sink efficiently rather than aquatic ecosystems in many parts of the world, which will help to mitigate the climate change. Hence, the soil protection is of the utmost importance for all the securities especially water, food, and energy. Sustainable soil management and agricultural practices such as efficient water utilization, climatesmart agriculture, Aero Farms, and organic farming are the key aspects to ensure the food security globally.

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RISKS AND OPPORTUNITIES OF INCREASING YIELDS IN ORGANIC FARMING

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Current organic agriculture performs well in several sustainability domains, like animal welfare, farm profitability and low pesticide use, but yields are commonly lower than in conventional farming. There is now a re-vitalized interest in increasing yields in organic agriculture to provide more organic food for a growing, more affluent population and reduce negative impacts per unit produced. However, past yield increases have been accompanied by several negative side-effects. Here, we review risks and opportunities related to a broad range of sustainability domains associated with increasing yields in organic agriculture in the Northern European context. We identify increased N input, weed, disease and pest control, improved livestock feeding, breeding for higher yields and reduced losses as the main measures for yield increases. We review the implications of their implementation for biodiversity, greenhouse gas emissions, nutrient losses, soil fertility, animal health and welfare, human nutrition and health and farm profitability. Our findings from this first-of-its-kind integrated analysis reveal which strategies for increasing yields are unlikely to produce negative side-effects and therefore should be a high priority, and which strategies need to be implemented with great attention to trade-offs. For example, increased N inputs in cropping carry many risks and few opportunities, whereas there are many risk-free opportunities for improved pest control through the management of ecosystem services. For most yield increasing strategies, both risks and opportunities arise, and the actual effect depends on management including active mitigation of side-effects. Our review shows that, to be a driving force for increased food system sustainability, organic agriculture may need to reconsider certain fundamental principles. Novel plant nutrient sources, including increased nutrient recycling in society, and in some cases mineral nitrogen fertilisers from renewable sources, and truly alternative animal production systems may need to be developed and accepted.

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ORGANIC INTERVENTIONS CONFERRING STRESS TOLERANCE AND CROP QUALITY IN AGROECOSYSTEMS DURING THE UNITED NATIONS DECADE ON ECOSYSTEM RESTORATION

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Excessive use of synthetic chemicals in conventional agriculture largely degraded the agroecosystems that constitute approximately 40% of the global terrestrial ecosystems. Moreover, changing climate resulted in a substantial loss in agricultural productivity (both in quantity and in quality) mainly due to diverse abiotic and biotic stresses. This draws public awareness about depleting natural resources, viz., soil, land, and water due to unsustainable agricultural practices and equivalently concerns for food-related animal and human health risks. Modern organic agriculture has

shown positive impacts in terms of food/biomass production, climate resilience, soil health, biodiversity, nutritional security, and good quality of life; and is of prodigious demand for nutrient-rich organic food products. In the ensuing decade, owing to the principal focus for the quality aspects or health benefits of organic agriculture, this review explores how organic interventions affect the nutritional value and yield quality in a production system; enable plants to adapt to adverse futuristic environmental conditions, and address the global food and nutritional security challenges. The chronological emergence, current global status, public perceptions, and key components of organic agriculture with their attached health benefits are inextricably synthesized herein. Fostering the ethos of organic agriculture under the UN Decade on Ecosystem Restoration (2021–2030) is highly imperative for agroecosystem restoration and its sustainable management. Moreover, the multidimensional paybacks of organic agriculture help in attaining important global goals and targets such as the Bonn Challenge and United Nations Sustainable Development Goals (UN-SDGs) by the year 2030. Therefore, invigorating the escalation of organic farming as a concurrent strategy of soil, land, and ecosystem restoration is the need of the hour.

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LEGUMES: A PROTECTIVE SHIELD FOR SUSTAINABLE SOIL HEALTH

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Legumes have a great potential to enhance crop diversity as well as productivity and to reduce dependence on exterior inputs as legumes are well known for their illustrious capabilities such as nitrogen (N) fixation by biological means, increase in soil organic matter (SOM), efficient roles in nutrient and water retention, and improvement in soil properties which contribute to recover soil health. These manifold abilities of legumes make them potential candidates for management of agriculture in a sustainable way. Some legumes have the capability to solubilize in any other case unavailable phosphate by excreting organic acids from their roots, in addition to improving soil fertility. Legumes also assist to restoration of soil natural matter and limit pest and disease issues when used in rotation with non-leguminous crops. Research has shown that the organic nitrogen fixation procedure is the most environment friendly way to grant the giant amounts of nitrogen wished through legumes to produce high- yielding crops with an excessive protein content. The upshots of sustainable agriculture can be optimistic for higher food production and to ensure future food availability in an eco-friendly manner by reducing the usage of agrochemicals and maintaining the nutrient balances in the soil.

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ANTIMICROBIAL SUSCEPTIBILITY OF *Trueperella pyogenes* ISOLATED FROM MASTITIC MILK SAMPLES OF BOVINES FROM HARYANA

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Summer mastitis occurs in bovines is characterized by malodorous, purulent milk and causes immense damage to the dairy industry. *T. pyogenes* is one of the main bacterial causes of summer mastitis in bovines along with other anaerobic bacteria. *T. pyogenes* mastitis. The isolation and identification of *Trueperella pyogenes* bacteria from the mastitic milk samples were performed based on its morphological appearances, haemolytic pattern, Gram‟s staining and other phenotypical characteristics. A total of 20 suspected isolates of *T. pyogenes* were obtained from mastitic

milk samples. The presumptively identified *T. pyogenes* isolates were further confirmed by automated VITEK® 2 system (BioMerieux) using Anaerobic and Corynebacteria identification card (ANC) cards. Out of these, four isolates were excellently identified as *Trueperella pyogenes* by the VITEK system, while 5 five isolates shown low discrimination with *Actinomyces odontolyticus*, which is closely related to *Trueperella pyogenes* taxonomically. The remaining isolates were recognized as *Clostridium* spp.

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ORGANIC FARMING WITH RESIDUE FREE PRODUCTION

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Organic farming has been practiced since ancient times. The only diversion came when we blindly started using chemicals for agricultural purposes. The most common example of this is the notion that „organic farming is farming without chemicals". The problem is not only one of logistics and supply chain though. Organic farming brings into picture a diverse, healthy and sustainable crop production system. Organic production is not only a challenge for producers in developing countries but it offers new export opportunities as well. Organic agriculture is practiced by 1.8 million producers in 160 countries and production of organically grown food continues to increase steadily by 15 % per year. Organic production is knowledge and management intensive. Producers must be well versed in organic production standards, principles and practices which require a high degree of knowledge and skill. In organic production, it is not simply the final product but the whole production process that must be inspected and approved by the accredited certification bodies. Organic farming is more profitable and organic food appeals to consumers as both a healthy and ethical choice. This farming is based on the usage of organic fertilizers. This method of farming creates toxin-free food for consumers while also maintaining soil fertility and contributing to ecological balance. This form of farming promotes environmentally responsible, long-term economic development. The potential of organic farming is signified by the fact that the farm sector has abundant organic nutrient resources like livestock, water, crop residue, aquatic weeds, forest litter, urban, rural solid wastes and agro industries, bio-products. India offers wonderful scope for organic farming as it has local market potential for organic products. The agronomy division of Indian Agricultural Research Institute has started many course including package and practices for organic farming which can promote great career oppourtunities in organic farming.

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VETIVER GRASS (*Vetiveria zizanioides*): A METHOD OF VEGETATIVE SOIL AND MOISTURE CONSERVATION

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Soil erosion and soil conservation, two long range problems that confront farmers and their governments The annual average loss of top soil is approximately 16 tonnes/ha, far above the permissible limits of around 4tonnes/ha. The other problem is shrinking supply of ground water. Underground water reserves are not inexhaustible. Use of vetiver grass as the best-known plant, at this time, that can be used to help prevent sheet erosion and increase moisture conservation. Vetiver (Khus) is extremely hardy and can tolerate submergence for a considerable period as well as withstand drought situation. Vetiver grass can be used on river flats to prevent silt from entering the river from heavy runoff out of the fields alongside. It can also be used to maintain river levees, prevent erosion from cutting them back into the fields. Cultivation of Vetiver for 3-4 cycles improves sandy soils to a greater extent and makes them suitable for common agricultural profitably. Thus, vetiver grass is ideal for soil and water conservation and stabilization

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ASSESSMENT OF MUSHROOM BASED NUTRITIOUS FORTIFIED NUGGETS AND THEIR NUTRITIONAL IMPLICATION

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The paper is an extension of minor research project titled “Assessment of mushroom based nutritious fortified nuggets and their nutritional implication. The present study was carried out to utilize, develop and evaluate value added products like nuggets of mushroom for their sensory characteristics.

Mushroom fortified nuggets were prepared by fortifying mushroom powder in different levels of pulses among the different treatments. Nuggets prepared from 10gm fortified mushroom powder with 40 gm pulses and 40gm green leafy vegetables recorded highest scores for Organoleptic parameters like colour, flavour, texture, taste, appearance and overall acceptability even up to six months followed by nuggets prepared from mushroom powder 10gm with 80gm pulses. Overall acceptability of mushroom fortified nuggets with green leafy vegetables was 79% allowed by mushroom nuggets with pulse 73% and farmers practice 58%. Therefore, we can say that, incorporation of nutritious fortified nuggets into existing dietary pattern is very beneficial and may be helpful to overcome malnutrition because of its therapeutic benefits.

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PHYSIOLOGICAL TOOLS TO SCREW AND DEVELOP ABIOTIC STRESS TOLERANCE GENOTYPES OF *Brassica Species*

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Various stipulations are used to explain the tolerance and resistance of plants based on the mechanisms and strategies triggered in plants to survive under adverse environmental conditions. The term stress can be used as morphological, physiological and biochemical changes caused by extreme environmental conditions. Stress resistance is defined as the system which prevents an externally applied stress by active and passive mechanisms which minimize the intensity of stress. When stress is caused by non biological factors is aboitic stress like drought, heat, low temperature, salinity, sodocity, water logging, elements toxicity(like aluminum, manganese & Iron).Drought is most devastating abiotic stresses that limits plant growth and development, and productivity which resists nutrient uptake by plant organs. Mostly crop are sensitive at reproductive to seed development stages during drought. Adaptation to drought is most complex biological processes which involves numerous changes including decrease in water potential of plant tissues as well as photosynthesis, ABA, proline etc. due to impaired biophysical and biochemical processes. In this review, we have highlighted the latest reports about the impact of different abiotic stresses on different growth stages and other morphophysiological processes of important *Brassica* species such as canola/rapeseed (*Brassica napus*), Indian mustard (*Brassica juncea*), *Brassica oleracea* and *Brassica rapa*. Many researchers reported that abiotic stresses influence the important morpho-biochemical characteristics such as root and shoot length, shoot fresh and dry weight, proline and relative water contents, chlorophyll amount, antioxidant enzymes activity of important *Brassica* species. Cell injury also occurs by disturbance in normal oxidative processes due to these stresses. The present study will be useful to identify the best abiotic stress tolerant *Brassica* genotypes for further crop improvement programs.

Keywords: *Brassica*, Abiotic stress, Cell injury, Resistance

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EFFECT OF VERMICOMPOST AND FERTILIZER ON YIELD AND YIELD ATTRIBUTES OF POT CULTURED RICE

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Indiscriminate use of chemical fertilizer alone deteriorates soil health on long term, thus declining crop productivity and destruction of soil microbial ecosystem. The physico-chemical and biological properties are hampered due to application of sole doses of chemical fertilizers on soil. Declining soil productivity can adversely affect crop production as well as growth attributes and threatens the food security under sustainable agriculture. The application of organic sources along with inorganic fertilizer nutrient in balanced manner improve soil properties, restores biological activities with proper growth and enhance the yield and yield attributing characters. Application of four different levels of vermicompost (0 t ha^{-1}, 1.25 t ha^{-1}, 2.5 t ha^{-1}, 3.7 t ha^{-1}) along with three levels of fertilizer (0%, 100%, 50% Recommended Dose of Fertilizer) in rice crop variety (*Rajendra Bhagwati*) in pot culture experiment were conducted to analyze its effect on crop growth, yield and attributing characters during crop growth stages. Application of higher dose of vermicompost 3.75 t ha^{-1} combined with higher dose of fertilizer 100% Recommended Dose of Fertilizer elevated the crop yield and also enhanced growth attributes. The mineralization and availability of higher nutrients to crops boosted the crop growth and yield during harvesting of crop.

Keywords: *Fertilizer, Pot Culture, Rice, Vermicompost, Yield*

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SOIL HEALTH: NEW OPPORTUNITIES TO INNOVATE IN CROP PROTECTION RESEARCH AND DEVELOPMENT

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Soil health-based agricultural management practices are widely endorsed for preventing erosion, increasing fertilizer efficiency, improving soil structure and maintaining or increasing yields. Controlling pests and diseases is a less well-known aspect of soil health management. Soil health and crop protection have traditionally used seemingly opposed approaches, but the future is still forming and there is still time for industry growth that improves the complementarities between these management tools and amplifies their agri-environmental benefits. Three essential research and development projects should be pursued simultaneously by the crop protection community, including product and application method innovation that avoids or decreases soil health consequences. Aside from new goods that employ soil functions and communities to improve pest and disease control, biogeochemical nutrient cycling, and reduce input consumption, new products that use soil functions and communities alone or in combination with plant genetics are being developed. In addition, product innovation that enables management practices that increase soil health while minimizing sacrifices. A new project under this paradigm, "Safe- and Sustainable-by-Design", is meant to serve as a guiding principle for future chemical regulation, catalyzing the transition to chemicals, materials, and products that are designed to be intrinsically safe and sustainable. In the short time since safe and sustainable-by-design was introduced, it has become clear that appropriate criteria and assessment methodologies will be vital to its success.

Keywords: *Agri-environmental, biogeochemical, catalyst, incompatible, innovation*

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Precision Farming: A way towards Agricultural Sustainability

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Precision farming is one of the most recent trends in agriculture and it involves using an information and technology-based farm management system to identify, analyze and manage spatial and temporal variability within fields for maximum productivity, profitability, sustainability and land resource protection while lowering production costs. Precision farming could be very valuable in India, which is an agro-based country where agriculture is the backbone of the economy. As public awareness of environmental issues grows, we will need to change agricultural management practices to ensure long-term conservation of natural resources such as water, air, and soil quality while being economically viable. The application of inputs (such as chemical fertilizers and pesticides) in the correct quantity, at the correct time, and at the correct location is the main objective of precision farming. "Site-Specific Management" is the term for this form of management. In recent decades, the growth of irrigation schemes has become increasingly important in enhancing global food supply productivity, with more than a third of the world's food currently requiring irrigation for production. Overall, market-based global competition in agricultural products is putting existing agricultural systems under strain, necessitating the creation of new and dynamic production systems.

Keywords*: backbone, management, spatial, sustainability, temporal*

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STRATEGIES OF INM FOR IMPROVING YIELD AND SOIL PROPERTIES

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Poverty reduction, fulfilment of the zero-hunger aim and food security are all key concerns for agricultural planners around the world. To achieve this goal, numerous agronomic approaches must be improved as they have a significant impact on crop development and output. The use of a simple strategy of employing a minimum effective dose of sufficient and balanced quantities of organic and inorganic fertilizers in combination with certain microorganisms, known as INM, to replace a portion of chemical fertilizers with organic manure, has a bright answer in this area. Several researchers recently stated that combining chemical fertilizers with organic manure is becoming a very beneficial approach not only for preserving higher output but also for increasing crop production stability. INM also serves as a source of energy, organic carbon and accessible nitrogen for the growth of soil microorganisms and the enhancement of soil physical qualities, as well as having a significant impact on following crops. So, a key component of the INM goal is to achieve eco-friendly practice by combining the harmonious properties of both sources and creating a combination that can be used for reducing the massive use of chemical fertilizers, accumulating a balance between fertilizer inputs and crop nutrient requirements, maintaining soil fertility, optimizing yield, maximizing profitability, and, as a result, reducing pollution. Finally, INM is a tool that can provide good options and cost-effective ways to provide plants with the nutrients they require, as well as reduce total costs, create favourable soil physiochemical conditions and a healthy environment, remove constraints, protect soil nutrient balance, and find safe ways to dispose of agriculture wastes.

Keywords: *accumulation, accessible nitrogen, beneficial, environment, microorganisms*

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ECONOMIC PERSPECTIVE OF POST-HARVEST TECHNOLOGIES IN HORTICULTURAL CROPS

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Small holder farmers dominate agricultural systems in South Asian countries. Furthermore, due to their high initial costs, these farmers have limited access to pre- and post-harvest technologies. Fruit and vegetable losses range from 20 percent to 44 percent due to a lack of these technologies in postharvest processing. These significant losses are partly due to a typically deficient fundamental postharvest infrastructure for product preservation, which protects products from harm caused by inappropriate handling, transportation, packaging, and storage. Because the producer may sell less of the farm yield and the net availability of these food commodities for consumption is lowered, high postharvest losses have a negative impact on food availability, food security, and nutrition. The inadequate awareness and knowledge bases of stakeholders (researchers, farmers, governments, non-governmental organizations and merchants) in the traditional supply chains where these losses occur are an underlying source of these postharvest losses. The development of fundamental and low-cost technologies through precise research efforts has the ability to avert such massive product losses and assist in meeting the growing need for food. Furthermore, the smart development of postharvest technology has the potential to create jobs, eliminate poverty and support the growth of other connected economic sectors.

Keywords: *food security, post-harvest, packaging, technologies*

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CLIMATE SMART PRACTICES FOR AGRICULTURAL SUSTAINABILITY

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Climate change has emerged as a major source of concern in terms of ensuring food and nutritional security for the world's rising population. In India, considerable negative consequences of medium-term climate change (2010-2039) have been expected, with yields falling by 4.5 to 9% depending on the magnitude and distribution of warming. Farmers must adjust fast to increasing dangers of climatic variability such as droughts, floods and other extreme climatic occurrences in the context of climate change and variability. To make agriculture less vulnerable to the negative effects of climate change and more robust, concentrated mitigation and adaptation activities are required. Since the adaptive potential of most of our farmers is limited, commercially viable and culturally acceptable adaptation measures must be devised and deployed. Researchers have developed a variety of strategies and technology throughout the years to promote agricultural production stability in the face of seasonal changes. Farmers' adoption of such resilient techniques and technologies looks to be more of a requirement than a choice. Practices centre on effective resource use, environmental protection and long-term agricultural development are becoming more important. Farmers will be better able to cope with current climate variability if on-farm demonstrations of site-specific technologies are conducted.

***Keywords**: Climate resilience, mitigation, tolerance, vulnerability*

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Application Of In-Silico Techniques In Agricultural Sciences

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Bioinformatics is an interdisciplinary field that uses mathematical and statistical approaches to analyze biological inquiries *in-silico*. It includes gene mapping, gene sequencing, a varietal information database, and the creation of tools, such as computer programmes, that aid in the discovery of fundamental mechanisms underlying biological problems involving macromolecule structure and function, biochemical pathways, disease processes and evolution. It also looks into genomes, proteomics and metabolomics in different plant species. The ultimate goal of sustainable agriculture is to increase the volume of agricultural produce, nutritional value and disease resistance in plants among other things. Understanding the genetic and molecular basis of all biological activities in plants that are important to the species is part of plant genomics research. This knowledge is essential for the effective use of plants as biological resources in the development of new cultivars with higher quality and lower economic and environmental costs. Bioinformatics tools and databases store and analyze plant genetic resources that can be utilized to improve the quality of produce by making it healthier, more disease resistant and more productive. Bioinformatics software is now widely recognized as a critical tool for plant development.

***Keywords**: Bioinformatics, metabolomics, databases, sustainable agriculture*

GIRISDA/AB/282/2022

De-Novo Domestication- A Future Crop Breeding Tool To Feed The World

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Crop domestication is the result of long-term selection of plants by human which makes accumulation of several beneficial mutations in different landraces and cultivars for different cultivation requirement which can be either less seed shattering, erect growth, self-pollination, larger seed and shorter awn. During the early days only objective-driven targeted alleles were selected while those traits which were not objective-driven were lost on the way to domestication. So, breedersandscientists had attempted to retain the lost beneficial alleles from the wild species through re-wild breeding. Nowadays a new breeding strategy *i.e.* the de novo domestication helps in creating novel cultivars by selecting elite materials as foundation material either from wild or semi-wild plant species and to these cultivars domestication-related traits is being introduced rapidly by genetic and breeding tools. Thus, the cultivar will harbour the beneficial traits while retaining their desired features thus making the cultivar a better and noble one. Some examples are introduction of domestication-related traits into stress-tolerant wild tomato accessions (*Solanumpimpinellifolium*) using CRISPR-Cas9 genome editing tool and editing orthologues of domestication-related genes in groundcherry (*Physalispruinosa*) for increased yield.

Keywords: *Domestication, De-Novo Domestication, CRISPR-Cas9*

GIRISDA/AB/283/2022

EFFECT OF FEEDING HYDROPONIC HORSEGRAM SPROUTS ON GROWTH PERFORMANCE OF KONKAN KANYAL GOATS

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An experiment was conducted to study the effect of feeding hydroponic horse gram sprouts on growth performance of goats. Twenty Konkan Kanyal goats (4 to 6 months old) were divided into four groups and fed hydroponic horse gram sprouts*viz.*,T_1 (0%), T_2 (15%), T_3 (30%) and T_4 (45%). The result of study showed that daily dry matter intake was significantly ($p< 0.05$) higher in T_3 (667.02g) than T_1 (619.36g), T_2 (654.73), T_3 (663.59g). Digestible crude protein (g/d) and metabolizable energy (MJ/d) intake of kids was 38.28 and 4.32 in T_1, 38.36 and 4.50 in T_2, 38.50 and 4.54 in T_3 and 38.73 and 4.77 in T_4 respectively. Average daily gain was higher in T_3 (91.24g) than T_1 (85.73g), T_2 (90.89g) and T_4 (90.19g). The feed cost per kg live weight gain (Rs) was 50.71 in T_1, 65.68 in T_2, 81.97 in T_3 and 85.23 in T_4. Therefore, it is concluded that 15% horse gram sprouts with 85% basal feed found beneficial for higher growth performance and economic profitability in goats.

GIRISDA/AB/284/2022

ESTIMATION OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE AMONG CORIANDER ACCESSIONS FOR GROWTH AND YIELD ATTRIBUTES

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Coriander (*Coriandrum sativum* L., 2n = 22) is a cross pollinated dual purpose seed spice belonging to family Apiaceae and a native of Mediterranean region. Genetic variability among the population is important for judicious selection and breeding to desired plant genotypes. For better crop improvement and identification of useful traits, genetic variability among the population is a prerequisite. Twenty-four genotypes of coriander were evaluated in a randomized block design with three replications for genetic variability in growth and seed yield related traits at the Vegetable Farm Centre, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, during *Rabi* Season 2020-21. The analysis of variance revealed that the genotypes differed significantly, indicating that all of the features tested are highly variable. A wide range of variability was identified for several quantitative traits, indicating the potential for selecting good initial breeding material for subsequent improvement. The phenotypic coefficient of variation was greater than the genotypic coefficient of variation for the majority of the traits, indicating the importance of environmental influences. The genotypic and phenotypic coefficients of variation for umbellates per umbel, seed yield per plant, primary branches per plant, and test weight were moderate to high. Higher plant height and primary branches per plant are preferred for earliness in coriander, while fewer days to 50% flowering and days to maturity are preferred for earliness. The yield parameters for coriander were umbels per plant, umbelletes per umbel, seeds per umbel, and test weight. High heritability couple with high genetic advance was obtained from seed yield per plant and seed yield q/ha. Whereas moderate heritability with moderate genetic advance was obtained from number of primary branches, plant height and low heritability with low genetic advance from days to maturity and seeds per umbel. Whereas high heritability and moderate genetic advance was obtained from test weight and number of umbellates per umbel. Moderate heritability and low genetic advance from days to flowering initiation, days to 50% flowering, number of basal leaves and number of umbel per plant. The findings revealed a high degree of diversity in these features, allowing for further development through the selection of specific traits.

Keywords: *Coriander, Genetic variability, Genotypes, Phenotypes, Yield traits*

GIRISDA/AB/285/2022

CARBON QUALITY AND IT'S RELATIONSHIP WITH CLIMATE CHANGE IN NILGIRI HILL REGION OF WESTERN GHATS BIODIVERSITY HOTSPOTS

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Land use change (LUC) from natural forest to cultivation has declined the soil carbon pools and stocks over the years. The Nilgiris a UNESCO world heritage site and biodiversity hotspot is facing a of climate change, which is evident from recent natural hazards. Therefore, soil survey was conducted in major land uses in order to understand the dynamics of carbon pools.We discovered the LUC has altered the carbon pools and declined the carbon concentration across tea and crop land ecosystem.These ecosystems also registered a decline in the passive pool of carbon, which signals the carbon instability and thereby pave way for carbon degradation and higher CO_2 emission.Therefore,there is need for the implementation of carbon management strategies in these areas in order to maintain the soil quality and to keep the soil alive.

Keywords: *Nilgiris; carbon pools; crop land; tea plantation*

GIRISDA/AB/286/2022

IPM in Protected Cultivation

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Greenhouse vegetable crops grown are susceptible to several diseases and pest attacks as the protected crops createfavorable microclimates for growth of pest populations, which further edgeit‟s success.The natural enemies which keep checks on pests are lacking under protected environment. Due to these reasons, pest situations often become alarming in the protected environment than open environment. The damage imposed by pests on greenhouse crops differs from pest to pest and season to season. The damage level which can be tolerated is also dependent on the type of crop. Integrated pest management (IPM) is a systematic approach to accomplish insect-pests that combines a range of techniques and strategies to either reduce pest populations or decrease their economic effect. It is a site-specific strategy for managing pests which relies on correct pest identification and their biology. It is safe to visualize that an investment in IPM can surely pay for itself in a higher-quality crop for a long-term perspectiveand responsible for cleaner environment in greenhouse crop production.

GIRISDA/AB/287/2022

Response of Amaranthus on Different Rates of Potassium to Growth and Yield

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A pot experiment was conducted in three different locations viz., Kuzhithurai, Alangulam, Iynthankattalai to evaluate the response of Amaranthus to various levels of soil application of potassium, to evaluate the effect of graded levels of potassium on growth attributes of amaranthus & to evaluate the response of graded levels of potassium on yield of amaranthus. The soils were collected and analysed for physical, chemical and electro chemical properties. By analyzing physical properties, we concluded that Kuzhithurai has brown Sandy clay loam soil, Alangulam and Iynthankattalai has red Sandy clay loamsoil. Bulk density of the above soils is 1.18, 1.33 and 1.25 Mg m^{-3} respectively and particle density is 2.22, 2.22 and 2.20 Mg m^{-3} respectively. Then the above soils has pore space in terms of percentage is 47.06, 40.00 and 37.50 respectively. Available N, P, K and organic carbon of the Kuzhithurai soil are 273, 19, 135 kg ha^{-1} and 4.5 g kg^{-1} respectively. Available N, P, K and organic carbon of the Alangulam soil are 273, 22, 147 kg ha^{-1} and3.5 g kg^{-1} g respectively. Available N, P, K and organic carbon of the Iynthankattalai soil are 273, 15, 166 kg ha^{-1} and4.1 g kg^{-1} g respectively. pH of the selected soils is 7.6, 7.0 and 6.8 and Electrical conductivity is 0.12,0.11 and 0.09 (dS m^{-1}) respectively.

Subsequently, the *in vitro* study was conducted with soil application of five different levels of potassium (0, 20,25,30 and 35 kg K ha^{-1}) as Muriate of Potash in combination with the recommended dose of nitrogen @ 75 kg N ha^{-1} as Urea .The variety grown in Alangulam and Iynthakattalaiis CO 1 and CO5 variety is grown in Kuzhithurai.The varieties duration is 50-60 days.In the location Kuzhithurai the treatment 75:0:35 kg NPK ha^{-1} showed significant result in plant height, shoot length, root length, leaf length, leaf breadth, no. of leaves $plant^{-1}$, total leaf area, no. of inflorescence per plant, yield of greens per plant and dry matter production. In the location Alangulam the treatment 75:0:30 kg NPK ha^{-1} showed significant result in all the growth and yield attributes mentioned in location kuzhithurai. In the location Alangulam the treatment 75:0:30 kg NPK ha^{-1} showed significant result in plant height, shoot length and root length, the treatment 75:0:35 kg NPK ha^{-1} showed significant result in leaf length, leaf breadth, no. of leaves $plant^{-1}$, total leaf area, no. of inflorescence per plant, yield of greens per plant and dry matter production. The results on the effect of Potassium on Amaranthus revealed vividly the important role of Potassium on Amaranthus. It is concluded from the present study that soil application of 35 kg K ha^{-1} along with 75 kg N ha^{-1} proved to be effective in increasing the yield of Amaranthus in Kuzhithurai and Iynthankattalai and in Alangulam the soil application of 30 kg K ha^{-1} along with 75 kg N ha^{-1} proved to be effective in increasing the yield of Amaranthus.

Key words: *Amaranthus, Potassium & Nitrogen*

GIRISDA/AB/288/2022

SUSTANANCE OF SOYBEAN IN HIGH PHOSPHORUS SOILS

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Nutrient dynamics of soybean in high phosphorus soil was less deciphered area. Hence an investigation entitled "Nitrogen and Phosphorus Requirement to Soybean in High Phosphorus Soils" was carried out at Agricultural Research Institute, Rajendranagar to determine the N and P requirement to soybean under in high phosphorus soils. The experiment was conducted employing different nitrogen and phosphorus levels. We observed that the application of 80 kg N ha^{-1} and 70% RDP to all high P soils helped in maintaining relatively higher yield when compared to other combination.

Keywords: *Soybean; Phosphorus; Yield*

GIRISDA/AB/289/2022

Serological detection of cucumber mosaic virus (CMV) affecting cucumber from sub-tropical region of Jammu

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Cucumber (*Cucumis sativus* L.) is one of the most important vegetable crops of the family *Cucurbitaceae*, grown extensively in tropical and sub-tropical parts of the country. Cucumber production is greatly hampered by Cucumber Mosaic Virus (CMV). CMV is transmitted by mechanical inoculation and by aphid vectors in non-persistent manner. An extensive survey were undertaken in selected locations of Jammu (R.S. Pura, Bishnah, Udheywala, Marh and Akhnoor), Samba (Vijaypur, Rajpura, Samba, Jatwal and Nud) and Kathua (Nagri, Kathua, Keerian Gandyal, Barnoti and Hiranagar) districts of Jammu division during cropping season of 2019 and 2020, to assess the incidence of mosaic disease on cucumber. The result revealed that the disease incidence was maximum (34.66 %) in Bishnah of Jammu district and minimum (21.33 %) in Hirangar of Kathua district during 2019 while during 2020, the maximum disease incidence of 36.00 per cent was recorded from Akhnoor of Jammu district and the minimum, 20.00 per cent was recorded from Hirangar of Kathua district. Infected samples showing mosaic symptoms were also brought to laboratory of Division of Plant Pathology SKUAST-J for confirmation of CMV by serological means through Double Antibody Sandwich ELISA (DAS-ELISA).The overall result during both the years revealed positive reaction with CMV specific antibody, thus confirming the presence of cucumber mosaic virus.

Key words: *CMV, disease incidence, serology, DAS-ELISA, detection*

GIRISDA/AB/290/2022

Plant Disease Detection Using Machine Learning

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India's population is growing quickly, and as a result, so is the need for agricultural products. A significant amount of data is added from diverse agricultural fields. These data can be used to estimate agricultural production, examine soil quality, identify plant diseases, and determine how weather influences crop productivity. Crop protection is essential for keeping agricultural products in good condition. The decrease in productivity in agricultural output is caused by pathogens, pests, weeds, and animals. Automatic identification of plant diseases from visual symptoms in the plant is made possible by machine learning techniques as Random Forest, Bayesian Network, Artificial Neural Network, Decision Tree, Support Vector Machine, and others. Automatic disease detection in plants aids in early disease identification and prevention, which helps to increase agriculture productivity.

Key words: *Agriculture, Machine Learning, Disease Detection, Classification.*

GIRISDA/AB/291/2022

Relative efficacy of different culture media for *in vitro* regenerationof *Aloe vera*

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Multiplication of a plant using *in vitro* culture technique greatly influences with the composition of culture media. Identification of suitable culture media is pre-requisite for getting maximum pace of micropropagation. Therefore, the efficacies of six different culture media for multiplication of *Aloe vera* were evaluated under *in vitro* condition using lateral shoot explant. An optimum level of BAP and IBA were used for shoot proliferation and root induction, respectively. Significant variation was obtained in all media types for all the characters studied. MS medium was found best for direct shoot proliferation as it induced highest number of shoot (6.30±0.23) per explant with longest shoot length (3.17±0.09 cm). The order of efficacy of different media for shoot proliferation was as MS medium > Woody plant medium > Nitsch and Nitsch medium > Whites medium > Knudson Solution-C > Schenk and Hildebrandt medium. For root induction, Woody plant medium revealed maximum number of roots (6.10±0.23) per explant, followed by MS medium. The effectiveness of different media for root proliferation were as Woody plant medium > MS medium > Nitsch and Nitsch medium > Whites medium > Knudson Solution-C > Schenk and Hildebrandt medium. Highest survival rate (85 %) during hardening and acclimatization was also obtained in Woody plant medium mediated rootlets. The identified culture media can be recommended for high frequency large scale multiplication of *Aloe vera*.

Keywords: *Aloe, Culture media, Micropropagation, Root induction, shoot proliferation, Woody plant medium*

GIRISDA/AB/292/2022

A Comprehensive Evaluation of Total Phenolics, Saponin Content and Antioxidant activity of Selected Cereal Crops

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The dry mature grains of four potentially superior genotypes/varieties each of the three selected cereal crops *viz.* wheat, barley and oats. These crops were evaluated for phenolic content, antioxidant activity and saponin content. Antioxidant activity IC_{50} was evaluatedusing the in-vitro assay *viz.*2, 2-diphenyl picrylhydrazyl (DPPH). Large significant variation was observed amongst cereal and between their varieties. Analysis was carriedout in triplicate and results presented on dry weight basis. The range of variation for phenolic constituents varied significantly *viz.* total phenols (315.33 to 652.00mg/100g), simple phenols (70.67 to 383.33 mg/100g), total tannins (198.67 to 389.33 mg/100g). Condensed tannins were present only in barley which ranged from 128.47 to 215.02 mg/100g and were not detected in oats and wheat genotypes. Significant differences were observed among the studied cereals and the following hierarchy of antioxidant activity observed: barley (IC_{50} 32.01 µg/ml) > oat (IC_{50} 64.83 µg /ml) > wheat (IC_{50} 68.34µg /ml). Saponin content ranged from 15.56 to 142.22 mg/100g. The results indicate thatcereal crops/genotype containing high phenolics may provide a source of dietary antioxidant.

Keywords: *Cereals, barley, oats, wheat, saponin, tannin, antioxidant activity.*

GIRISDA/AB/293/2022

Bonsai: The Landscaping Art

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Bonsai is a tree cultivated in a pot or container, resembling a fully grown treeon a miniature scale. It is generally believed that bonsai making and cultivation is originally Japanese art. It originated however in China. The techniqueof bonsai was known to the West towards the end of the 19th century. In London, a large and uniquebonsai show was organized in 1990. It was after the Second World War in the Pacificthat bonsai arrived in America and Japanese immigration post-war brought a major influence to cultivate bonsai. There is no reference, in particular, that indicates whenbonsai was introduced in India. However, it is believed that bonsai reached India sometime in the early part of this century. Simple bonsai is an art of growing trees, and plants proportionately in smaller containers occasionally in combination with rocks of many forms, by treating them with certain techniques in order to reproduce in miniature appearances found in nature. Bonsai comprises a tree or shrub planted for developing as a miniature plant showing the general appearance of that plant species found in nature and to be maintained for many years. It totally differs from pot plants where the foliage and flowers are important. Like a pet animal, it needs water, Sunshine & nourishment. Bonsai serves as a stress reliever and purifier and helps in maintaining good health. At present, this art has got a huge craze all over India and a number of bonsai chapters/clubs and training camps are going on.

Keywords: Bonsai, Art, Tree.

GIRISDA/AB/294/2022

Diversity of mycorrhizal fungi associated with field pea (*Pisum sativum* L.) in mid hill conditions of Himachal Pradesh

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Arbuscular mycorrhizal fungi (AMF) are soil fungi which form a mutualistic symbiosis with the roots of plants and enhanced uptake of immobile nutrients from the soil. The present study was carried out to study the association of arbuscular mycorrhizal fungi (AMF) with roots and rhizosphere of pea (*Pisum sativum*). A total of 17 AMF fungi belonging to 5 genera 17 species were isolated and identified from the rhizosphere soil. The dominant genus was *Glomus* (6 species), followed by *Acaulospora* (5 species); Boletus, *Gigaspora* (3 species), *Scutellospora* (2 species) and *Sclerocystis* represented by single species. Microscopic analyses of root samples revealed a variable degree of colonization by AM fungi. The different microscopic characters like size, colour, details of the wall layers and the nature of their subtending hyphae were also investigated during this study.

GIRISDA/AB/295/2022

Studies on Physico-Chemical Analysis of Basundi Blended with Dried Anjeer

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Basundi is traditional, concentrated and sweetened whole milk product having sweetish caramal and pleasant aroma, light to medium brown colour, thick body and creamy consistency with or without soft textured flakes that are uniformly suspended throughout the product. Dietary fiber is essential for human health which is recommended daily intake of 27-40 gm/day/adult. Dietary fibre is edible part of plants or analogus to carbohydrates that are resistant to digestion and absorption in human small intestine with complete or partial fermentation in large intestine. The study was conducted on the topic "Studies on Physico-chemical Analysis of Basundi Blended with Dried Anjeer." The different levels of dried anjeer 0, 2.5, 5, 7.5 and 10 per cent were tried in buffalo milk basundi. The requisite samples of *basundi* with different treatments were subjected for proximate analysis viz. fat, protein, Carbohydrate, moisture, total solid, sucrose and ash. The results obtained were statistically analyzed by using completely randomized design It was observed that addition of Dried Anjeer in *basundi* decreased (pH 6.40-6.04), (acidity 0.46-0.52), (moisture 56.38 to 47.75 per cent), (fat 12.05 to 10.85 per cent) and increased (protein 8.30 to 9.05 per cent), (ash 1.70 to 2.22 per cent), (carbohydrate 21.09 to 30.64 per cent), (viscosity 59.34-75.61), and (total solid 43.69 to 52.24 per cent) content significantly in treated product (T2, T3, T4 and T5) as compared to control (T1). From the present experiment study entitled "Studies on preparation of *basundi* blended with dried anjeer" it can be concluded that, among all the treatments of *basundi*, sample T3 containing 5 % of dried anjeer crush sensorily most acceptable than rest of samples. Hence the anjeer *basundi* gives superior mouthfeel, body and texture and overall acceptability than plain *basundi*. It is also rich in dietary fiber. So that dietary fiber enriched *basundi* also has more nutritional quality.

GIRISDA/AB/296/2022

CONSTRAINTS IN FEEDING AND MANAGEMENT OF CROSSBRED CATTLE IN SELOO TAHSIL OF WARDHA DISTRICT

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The present investigation constraints in feeding and management of crossbred cattle in seloo tehsil of Wardha district were carried out by randomly selecting 120 crossbred cattle owners from five villages *viz.*, Juwadi, Kanhapur, Gaimukh, Dhapki and Khapri. The major constraints expressed by the respondent were high cost of concentrates (94.16%), high cost of green fodder (86.66%), high cost of mineral mixture (87.50%), lack of scientific knowledge (94.16%), lack of technical guidance (90%), shortage of green fodder (57.50%), non-availability of labour (64.16%), lack of chaff cutter (92.50%), lack of communication (85.83%), lack of storage facility (87.50%), lack of loan facility (94.16%) and lack of interest (88.33%).

GIRISDA/AB/297/2022

Mycorrhiza as a natural Biofertilizer

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Microorganisms such as mycorrhizal fungi that live in the root system and forms a symbiotic association with majority of plants. Bio-fertilizers are the natural substances which make use of microorganisms to increase the fertility of soil. These biofertilizers are not toxic to crop plants like the chemical fertilizers. They are extract from the animal wastes along with the microbial mixtures. Microorganisms are used to increase absorption and uptake of nutrients in the plants. They empower the plants grow in a healthy environment and do not cause the pollution of any sort. Use of biofertilizers, makes the crop plants vigorous as well as shield them from getting any diseases. Bacteria, fungi, cyanobacteria are the main sources of bio- fertilizers. Such bio-fertilizers are cultured and are used for inoculating seed or soil or both under ideal conditions to increase the availability of plant nutrients. Among this mycorrhiza is an important one in agriculture field for the cultivation of many crops. Soil based pot culture is applied as a common method for production of AM Fungal inoculum. AM fungi proves beneficial to agricultural resides in their role in plant growth and nutrition. This article reviews the information on Arbuscular mycorrhizae in different fields.

Keywords: *Mycorrhiza, Biofertilizers AM diversity, AM-spores, disease resistance and stress tolerance.*

Editor's Profile

Mr. Mohit Bhardwaj is currently pursuing his doctoral research from College of Veterinary and Animal Science, GBPUAT, Pantnagar, Uttarakhand. He did his graduation in Animal Husbandry and Dairying and completed his Master degree in Animal Nutrition, both from SHUATS (Deemed to be), Allahabad, Uttar Pradesh. Mr. Bhardwaj is also Editor in Chief of Just Agriculture Magazine and Newsletter which is one of the top leading agriculture magazine of India. He is also Secretary of AEEFWS Foundation, Punjab. He is Ex- State Secretary at AIASA Foundation, New Delhi. In view of publications, he has published ten popular articles and four research papers. Mr. Mohit has also attended almost ten national and international conferences, trainings, workshops and symposium. He has an experience of nearly six months in teaching and is currently involved in various research and teaching activities.

Dr. Davinder Pal Singh Badwal is CEO & Founder of Just Agriculture Magazine & Newsletter, President Of Agro Environmental Educational Society (Regd.), Social activist, Agripreneur, Speaker. He has also received Young Professional Award. He has organized numerous national and International events under his organizations viz., trainings, workshops, expos and conferences in collaboration with ICAR, NAHEP, ICRISAT, NAARM, NIPHM, MANAGE, IRRI, PJTSAU, MPUAT and many more. He has great passion and zeal to reach the unreached one in agriculture sector for small and marginal farming communities through his grass root innovations, interventions, goals and idea of new vision with his strong weapon (pen) of Agri-journalism background score. Apart from being an Organizer of many International & National Events, Dr. Badwal has attended more than 45 National and International Conferences. He also delivered many Guest Lectures in various National and International Events. His publications include more than 31 popular articles, 15 Research & Review Papers, 6 Books. Furthermore, he is a member of many reputed agricultural societies. Due to his dream & passion Just Agriculture is now in the list of India's Top 5 Agriculture Magazines with more than 2 lakh + readers.

Dr. Utkarsha Pramod Gaware has completed her Doctorate in the discipline of Agricultural Economics from Dr. Rajendra Prasad Central Agricultural University, Pusa (Bihar). During her doctoral degree program she was awarded with Senior Research Fellowship (SRF) from ICAR. She has done B.Sc. (Agriculture) from RCSM College of Agriculture, Kolhapur under MPKV, Rahuri and M.Sc. (Agricultural Economics) from College of Agriculture, Nagpur under Dr. PDKV, Akola. She is the Vice- President of India's most rising Agriculture Magazine, Just Agriculture- the Magazine and also an executive member of AEEFWS Foundation, Punjab. Her publications include 23 research papers, 06 abstracts and numerous popular/ technical articles. She has participated and presented (Oral & Poster) her work in nearly 10 national and international conferences. She has also attended various national and international trainings, workshops and symposiums. Apart from participating in various national and international events, Dr. Utkarsha has also organized various national and international trainings, workshops and conferences.

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