Vol. 5 Issue- 2, October 2024 (e-ISSN: 2582-8223)

Climate Resilience Crop Pest Management

Ruprekha Buragohain
M.Sc Scholar, Dept of Horticulture, Assam Agricultural University, Jorhat-785013, Assam

ARTICLE ID: 08

Introduction

Climate change is affecting the biology, distribution and outbreak potential of pests in a vast range of crops and across all land uses and landscapes. Up to 40% of the world's food supply is already lost to pests; the reduction in pest impact is more important than ever to ensure global food security, reduced application of inputs and decreased greenhouse gas emissions. Climate resilience pest management (CRPM)is an approach that aims to reduce pest-induced crop losses, enhance ecosystem services, reduce the greenhouse gas emissions intensity per unit of food produced and strengthen the resilience of agricultural systems in the face of climate change. For the implementation of this approach, crop production, extension, research and policy act in coordination towards more efficient and resilient food production systems. The concept of CRPM is new and encompasses a set of interdisciplinary approaches and strategies needed for primary production to adapt, with its supporting functions (e.g. extension and research) and enabling environment (e.g. policies, infrastructure and social/human capital), to the changing climatic environment, which, together with land use characteristics, sets and influences the boundaries for geographical distributions of species (crops, pests and natural enemies). Implementing the CRPM concept enables more effective management of the increased threat posed by new and existing crop pests to agricultural production and ecosystem services, and therefore increases resilience of farmer livelihoods and overall local and national food security to climate change. CRPM also contributes to mitigation of climate change through improving overall greenhouse gas (GHG) balance; a reduction in pest-related yield losses, for example, decreases the GHG emissions intensity per unit of food produced.

Effect of Climate Change on Crop Pest-

Climate change is directly and indirectly influencing the distribution and severity of crop pests including invasive species which is further effecting crop production. Predicting the direct effects of climate change on pests is complicated by the interacting influences of increasing atmospheric CO2 concentrations, changing climatic regimes and altered frequency/intensity of extreme weather events. Projections are further challenged by the fact that climate change can exert its effects on pests indirectly. For example, the differing responses of host crops and pest natural enemies, as well as changes in efficacy of pest control strategies (e.g. biological control, synthetic pesticides), also affect pest responses.

- **Changing precipitation (excessive or insufficient):** It can have substantial effects on crop–pest interactions. For example, warm and humid conditions favour many species, including plant pathogens while crops suffering from water stress are more vulnerable to damage by pests.
- **Increase temperature:** Higher temperature mean that more number of pests will survive the winter season. Higher temperatures will lead to a poleward spread of many pests and diseases in both hemispheres. This will lead to more attacks over longer periods in the temperate climatic zone. Increase in temperature can augment the severity of diseases caused by pathogens, and can also reduce the effectiveness of pesticides. Pest populations often increase as temperatures rise, which can lead to increased applications of pesticides and fungicides, with negative external effects on the environment and human health.
- **Increase CO_2 levels:** Elevated CO2 can increase levels of simple sugars in leaves and lowers their nitrogen content which increases the chance of damage caused by many insects, who will consume more leaves to meet their metabolic requirements of nitrogen. Thus, any attack will be more severe.
- **Extreme weather events can influence the interactions between crops and pests in an unpredictable way**: potentially resulting in the failure of some crop protection strategies. Droughts can reduce populations of beneficial insects, with knock-on effects on pollination and pest infestations, while strong air currents in storms can transport disease agents (and insect pests) from overwintering areas to areas where they can cause further problems. Ecosystems that have been disturbed following extreme climatic events are also more susceptible/vulnerable to invasions of alien and native species.
- **Greater risk of invasive alien species:** According to the Convention on Biological Diversity (CBD), invasive alien species are the greatest threat to loss of biodiversity in

the world and impose high costs to agriculture, forestry and aquatic ecosystems by altering their regional structure, diversity and functioning. It is expected that global warming may exacerbate ecological consequences like introduction of new pests by altering phenological events like flowering times especially in temperate plant species as several tropical plants can withstand the phenological changes. Invasion of new insect-pests will be the major problem with changing climate favoring the introduction of insect susceptible cultivars or crops.

- **Breakdown of host plant resistance:** Expression of the host plant resistance is greatly influenced by environmental factors like temperature, sunlight, soil moisture, air pollution, etc. Under stressful environment, plant becomes more susceptible to attack by insect-pests because of weakening of their own defensive system resulting in pest outbreaks and more crop damage.

Benefits of Climate Resilience Pest Management (CRPM)-

- **Food security:** CRPM leads to effective and cost-efficient management of new and existing crop pests, thereby reducing crop losses and increasing both food security and farmers' incomes.
- **Adaptation:** CRPM decreases negative impacts on the broader ecosystem, making farming systems more resilient to climate change. At national and global levels, CSPM revitalises the important role of extension, research, and the public and private sectors for pest forecasting, surveillance, detection and control, which are vital services to increase resilience.
- **Mitigation-**: CRPM contributes to making agricultural production more efficient and promotes a rational use of agricultural inputs, thereby decreasing GHG emissions intensity of crop production.
- **Delivery of Sustainable Development Goals (SDG)-** CRPM directly contributes to a number of SDGs such as No Poverty and Zero Hunger (through its direct impact on crop production and income); Responsible Consumption and Production (through reduction of food losses at the primary production stage). Climate Action (through, among others, improving GHG efficiency per unit of food output); and Life on Land (through conserving biodiversity and maintaining ecosystem services).

Implementation Of Climate Resilience Pest Management (CRPM)-

Many practices adopted under CRPM is not new and in terms of production, the approach includes many of the carefully researched and locally adapted, field, farm and landscape based sustainable pest management or IPM practices that are already being practiced by farmers. The implementation of CRPM therefore does not necessarily pose a significant amount of additional work or investment for farmers. The key issue is ensuring that these practices are improved in the context of a changing climate, which necessitates the integration of local climate observation and forecasting, as well as pest risk assessment, into the pest management planning process. Implementation of CRPM practices can, however, be a challenge because CRPM is highly context-specific and depends on the climatic, agricultural, ecological, social, economic and political environment, at the household, farm, community and national levels. Thus, the implementation of CRPM can be categorized into different steps as follows-

STEP 1: To conduct a thorough appraisal of the local environment and perspectives. Since there is no 'one size fits all' strategy for CSPM, the Toolbox of CRPM includes strategies as given in the box below-

1	Proper climate and pest monitoring to be able to predict and respond rapidly to new, emerging and existing pests
2	Agroecosystem management to support ecosystem services and enhance resilience of farm and landscape to changes in climate and pest pressure
3	Mechanical, cultural, biological and chemical (last option) approaches to reduce pest damage and pest-induced crop losses
4	Conduct basic research to determine likely impacts of climate change on pest establishment, development, phenology, behaviour, interactions with host and natural enemies, etc. in specific agricultural settings
5	Improve farmer networks and organisations and promote links to technology providers to enhance knowledge sharing and improve access to information about climate- smart pest management technologies and practices, thereby facilitating their uptake
6	Develop new climate-smart technologies and approaches based on current needs and local contexts

7	Establish national special funds for developing and implementing local adaptation plans that include of climate smart pest management
8	Enhance availability and accuracy of climate information (down-scaled historical, monitored and predicted) to enable farmers to make informed decisions, better manage risk, take advantage of favourable climate conditions and adapt to change
9	Implement studies and develop methodologies to assess GHG emission reduction potential for pest management approaches

STEP 2: Evaluating the above strategies in the local context in order to assess how well they will achieve their goals. The implications for other farm management decisions should also be considered. For example, changing to a pest-tolerant crop variety may require only minimal investment and knowledge, whereas changing crops because of a new pest invasion may involve investing in new seeding and harvesting equipment, implementing new crop rotation practices and sourcing new buyers and markets for the produce.

STEP 3: Interlinking CRPM activities and stakeholders to overcome barriers that hinder its implementation. Enhanced linkages between extension, research and the public/private sector to provide the data and resources required to improve diagnosis of new and emerging pests, inform strategy and research, and reduce response time to these pest threats.

STEP 4: Continual monitoring and evaluation to assess the implementation and short-term outcomes/impacts of CRPM interventions, and to allow continual re-evaluation of tools and approaches.

PEST MANAGEMENT STRATEGIES FOR CLIMATE CHANGE-

- **Breeding climate-resilient varieties:** To minimize the impacts of climate and other environmental changes, it will be crucial to breed new varieties for improved resistance to abiotic and biotic stresses. Considering late onset and/ or shorter duration of winter, there is chance of delaying and shortening the growing seasons for certain Rabi/ cold season crops. Hence, we should concentrate on breeding varieties suitable for late planting and those can sustain adverse climatic conditions and pest and disease incidences.
- **Alternation in sowing dates of crops:** Global climate change would cause alternation in sowing dates of crops which alter host-pest synchrony. There is need to explore

JUST AGRICULTURE
multidisciplinary e-Newsletter

changes in host plant interaction under early, normal and late sown conditions in order to recommend optimum sowing dates for reduced pest pressure and increased yield.

- **Rescheduling of crop calendars:** As such, certain effective cultural practices like crop rotation and planting dates will be less or non-effective in controlling crop pests with changed climate. Hence there is need to change the crop calendars according to the changing crop environment. The growers of the crops have to change insect management strategies in accordance with the projected changes in pest incidence and extent of crop losses in view of the changing climate.
- **GIS based risk mapping of crop pests:** Geographic Information System (GIS) is an enabling technology for entomologists, which help in relating insect-pest outbreaks to biographic and physiographic features of the landscape, hence can best be utilized in area wide pest management programmes. How climatic changes will affect development, incidence, and population dynamics of insect-pests can be studied through GIS by predicting and mapping trends of potential changes in geographical distribution of agro-ecological hotspots and future areas of pest risk.
- Evolve temperature tolerance strains of natural enemies
- Awareness regarding impacts of climate change

Contribution of CRPM to Climate Resilience Agriculture (CRA)-

- The ability to predict and recognise future pest outbreaks- Because of upslope and poleward migration of pests, CRPM strongly emphasises the need to develop and implement more effective diagnostic processes for the identification of pests and their natural enemies in order to be able to make pest management decisions going forward. Right prediction at the right time can control losses to a large extent.
- The ability to suppress pest outbreaks and pathogen transmission- Pests are expected to respond to changing climate conditions faster than plants, so CRPM aims to ensure that pest management is ready to either prevent or withstand the pests that move into an area and manage those existing populations that are increasing in numbers.
- A healthier and more pest-resilient farm and landscape- Farmers following the approaches of CRPM will work proactively to increase the level of biodiversity across their farm and surrounding landscape as this has been shown to increase resilience of agroecosystems to climate change impacts. Thus, increasing biodiversity surrounding

JUST AGRICULTURE
multidisciplinary e-Newsletter

the main production field will create a better environment and also provide additional income in certain situations. For example, crop diversification, which enhances farm biodiversity, promotes a greater abundance of natural enemies that contribute to pest suppression and reduces the risks of pests becoming more severe as a result of climate change.

- CRPM aims to increase farmer resilience through the establishment of a climate-responsive national extension system, and through building functioning links between science and technology and farmers as a means to overcome the structural disconnect between research and end-users.

Challenges to CRPM-

Uptake of more sustainable, climate resilience pest management practices remains slow. Barriers to uptake exist at both farm level and at the institutional level. These are somewhat similar to the obstacles of IPM adoption.

- **Crop production (farm and landscape):** Barriers that impede rates of adoption of CRPM practices include lack of sufficient knowledge about climate-smart practices, lack of resources, small land sizes, lack of awareness and potentially high associated costs. The development of locally-adapted CRPM approaches at farm and landscape levels should therefore follow a participatory, bottom-up approach that engages the farming community, extension personnel and researchers.
- **Extension:** To support farmers with the reorientation of pest management practices under climate change, extension services need to be effective, responsive, accessible and well- informed – but in many countries they are not. This indirectly limits farmers' adaptation capacity. Some documented reasons for these shortcomings include: lack of climate literacy, chronic understaffing, limited operational funds, weak linkages to other stakeholders (such as research), inconsistent dialogue between farmers and those who support them.
- **Research:** Research institutes undertaking needs-based research are a necessary prerequisite to the development and implementation of novel and responsive CRPM strategies. However, a variety of barriers prevent this vital service from functioning as it should, such as reduced funds availability, a decline in relevant specialist expertise, inadequate education and training in crop protection, lack of research attention for

specific sustainable management practices and poor regional research collaboration and coordination.

- **Public sector:** Government policies and regulatory instruments need to provide clear direction and guidance to all stakeholders to enable appropriate planning for climate change adaptation and mitigation, as well as the effective creation and targeting of resources and funds. However, challenges to making this a reality include the fact that existing policies are not informed by research evidence on local needs and constraints, a lack of funds, and a shortage of relevant expertise in the field of crop protection.

Conclusion:

In India, pest damage varies in different agro-climatic regions across the country mainly due to differential impacts of abiotic factors such as temperature, humidity and rainfall. It will have serious environmental and socio-economic impacts on rural farmers whose livelihoods depend directly on the agriculture and other climate sensitive sectors. Dealing with the climate change is really tedious task owing to its complexity, uncertainty, unpredictability and differential impacts over time and place. Understanding abiotic stress responses in crop plants, insect-pests and their natural enemies is an important and challenging topic ahead in agricultural research. Through CRPM, farmers will have the information and tools in hand to immediately and proactively put into action practices (e.g. crop diversification, establishment of natural habitats, careful water management, etc.) that will enhance the health of his/her farm and surrounding landscape, and reduce its susceptibility to pest-induced disturbance. Moreover, through climate and pest monitoring, in combination with climate and pest risk forecasting information, farmers will be able to proactively implement pest prevention practices (e.g. use of pest resistant varieties, careful selection of planting, pruning and harvesting times, push-pull techniques, etc.) in order to prevent the occurrence and/or build-up of expected pest problems. In cases where pest populations do reach economic injury levels, then CRPM enables farmers to make rapid, informed decisions regarding the most appropriate reactive pest control strategy.

References-

1. WWW.Wikipedia.Com
2. Https://Www.Fao.Org/3/BU464EN/Bu464en
3. Https://Www.Researchgate.Net/Publication/331329546_Climate-Smart_Pest_Management