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Integrated Disease Management in Agriculture

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ABSTRACT:

In this review we have described the history, biotic and abiotic stress of plant disease, types of plant disease, and its integrated management. The history of plant disease management is showing the traditional, chemical and integrated approach for the plant disease management. The abiotic means environmental factors while biotic includes microbes, phanerogamic plants, viruses, nematodes *etc*. These abiotic and biotic factors cause several diseases in plants like necrotic symptoms, abnormal growth and development of plant tissues, gummosis, wilting, rust, mildews etc. A number of factors responsible for the transmission of these diseases, they are described under this chapter. Besides, disease triangle and disease cycle are also described. Furthermore, disease diagnostic procedure has been given in fragment of sample collection method, sample submission method etc. Integrated disease management has been described here which comprises cultural, physical, mechanical, genetic, biological and chemical. Institutional, sociological, economic and political constraints in integrated disease management are also mentioned.

Key Words: *Plant Diseases, Cultural practices, Physical and Mechanical practices, Biological control, Chemical control.*

Introduction

Any biotic or abiotic agents, which induce the disease in plant, are referred as the cause of diseases. Organisms that cause infectious disease include fungi, bacteria, viruses, viroids, virus like organisms, phytoplasmas, protozoa, nematodes and parasitic plants and environmental conditions such as lack or excess of nutrients, moisture, light *etc*. to presence of toxic chemicals in air or soil. Plant disease can be defined as "a series of harmful physiological processes caused by continuous irritation of the plant by a primary agent" or "physiological or structural dis-balance in plant caused by certain external agencies.

Integrated plant disease management can be defined as a decision-based process involving coordinated use of multiple tactics for optimizing the control of pathogen in an ecologically and economically. In most cases IDM consists of scouting with timely application of a combination of strategies and tactics. These may include site selection and preparation, utilizing resistant cultivars, altering planting practices, modifying the environment by drainage, irrigation, pruning, thinning, shading, etc., and applying pesticides, if necessary. But in addition to these traditional measures, monitoring environmental factors (temperature, moisture, soil pH, nutrients, *etc.*), disease forecasting, and establishing economic thresholds are important to the management scheme.

These measures should be applied in a coordinated integrated and harmonized manner to maximize the benefits of each component. For example, balancing fertilizer applications with irrigation practices helps promote healthy vigorous plants. However, this is not always easy to accomplish, and "disease management" may be reduced to single measures exactly the same as the ones previously called "disease control." Whatever the measures used, they must be compatible with the cultural practices essential for the crop being managed. The basic objectives of any IDM program should be to achieve at least the following:

- Reduce the possibility of introducing diseases into the crop
- Avoid creating conditions suitable for disease establishment and spread
- Simultaneous management of multiple pathogens
- Regular monitoring of pathogen effects, and their natural enemies and antagonists as well
- Use of economic or treatment thresholds when applying chemicals
- Integrated use of multiple, suppressive tactics.

Importance of The Plant Disease

Plant disease sometimes spread as epiphytotics and destroy the crops growing in the very large areas. They damage the crop growing in the field as well as stored products in the storage. The disease can occur any time and at any stage of the plant growth from the

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time of sowing of seeds to the storage of the products and cause a great economic loss. In Asia alone, the food grains amounting millions of dollars are being destroyed every year due to crop diseases. One such case, which is often quoted in the plant disease history is an example of famine caused due to plant disease. Such diseases include late blight of potato by fungus *Phytophthora infestans* in Ireland (1847), coffee rust by *Hemileia vastatrix* in Srilanka (1870), sigatoka leaf spot disease of banana by *Mycosphaerella musicola* in Central and South America (1930). In India, the famous Bengal famine in 1942 was due to leaf spot disease of rice caused by *Helminthosporium oryzae* and approximately two million people died of starvation. Due to impact of plant disease and economic losses caused by them, the science of plant pathology is attracting interest of all most all the countries of the world.

Milestone in Disease Management

Farmers have been at the mercy of plant diseases since plants were first domesticated. The mysterious appearance of blights and mildews, apparently coming from nowhere, led to theories of gods, vapors, demons, and decay as causes of disease. Beginning in the early 1800s, plant pathogen resistance towards the fungicides, have been the compelling reasons for moving away from the total dependence upon the fungicides and to adopt IDM strategies that would involve one or more than one concepts of plant disease management. Use of such integrated approach in plant disease management is cost effective, renewable, eco-friendly and non-toxic to the plants as well as non-target organisms.

Scope of Integrated Disease Management

Several synthetic fungicides have been used for the management of diseases of commercially important agricultural crops. However, their continuous use in agriculture system causes several side effects in agro-ecosystem as well as in consumer's health. Numerous health and environmental reasons to use non-toxic alternatives to pesticides exist. Use of integrated disease management strategies can be certainly an answer to these problems. The principles of plant disease management should always be based on the integration of basic concepts such as avoidance, exclusion, eradication, protection, resistance and therapy. Adoption of Integrated disease Management against the diseases encountered in crops is of utmost importance because dependency on chemicals for

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the management of various diseases is a great health hazard to the consumer. This assumes greater importance in the developing countries where the farmers are not educated enough to follow some cutoff date for application of chemicals to the standing crops. All these factors along with the growing awareness among the users regarding fungicides residues, pollution to the environment and sub-soil water and increased problem of different part of the world.

Concept Of Plant Disease

The *Greek* philosopher Theophrastus (300, B.C) was the first to study and write about diseases of trees, cereals and legumes. He believed that god controlled the weather that brought diseases. Plant diseases were a manifestation of the worthm of God. It is due to religious belief, superstitions or it is the effect of star moon and bad wind. E.g. Romans actually created a special rust God called *Robig*o for rust diseases of grain crops. They offered sacrifice of red dogs and sheep. After invention of compound microscope in the mid1600 scientist enable to see many microorganisms associated with diseased plants and they come to believe that the mildews, rust, and other symptoms observed on plants and microorganisms found on diseased plant. Louis Pasteur (1860-63) provided irrefutable evidence that microorganisms arises only from pre-existing microorganisms and fermentation is a biological phenomenon not just a chemical one. It is accepted that a plant is healthy or normal when it can carry out its physiological functions to the best of its genetic potentials. The pathogen may cause disease in plant by:

- Weakening the host by continuously absorbing food from the host cells for their own use.
- Killing or disturbing metabolism of host cells through toxins enzymes or growth regulating substances, they secrete.
- Blocking the transportation of food, mineral, nutrients and water through the conductive tissues.

A. Disease triangle

The interactions of the three components such as host, environment (physical *viz.*, climatic, soil and topographical and biotic) and pathogen of disease have been visualized as a triangle generally referred to as the "disease triangle". Each side of the triangle represents one of the three components.

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The length of each side is proportional to the sum total of the characteristics of each components that favour disease *i.e.* if the host is resistant, matured and widely spaced, the host side and amount of disease would be small or zero, whereas if the host or plants are susceptible, at susceptible stage of growth or densely planted, the host side would be long and the amount of disease could be great. Similarly the virulent, abundant and active the pathogen, the longer the pathogen side and greater is the amount of disease. Also more favourable the environmental conditions (*e.g.* temperature, moisture and wind) help the pathogen or that reduces the host resistance, longer will be the environmental side and greater will be the amount of disease. When these three components of the disease triangle are quantified, the area of the area of the triangle represents amount of disease in a plant or in a plant population. If any of the three components is zero, there can be no diseases.

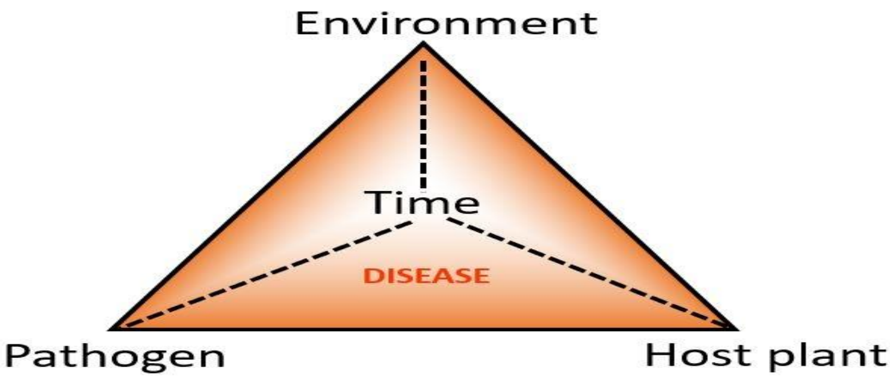

Fig. 1.Disease Triangle

B. Mode of disease transmission

Transport of spores or infectious bodies, acting as inoculum, from one host to another host at various distances resulting in the spread of disease, is called transmission or dissemination or dispersal of plant pathogens. There are 2 major types of transmission of plant pathogens *i.e.* direct and indirect transmission

1. **Direct transmission**: Disease transmission, where the pathogen is carried externally or internally on the seeds or planting materials like cuttings, sets, tubers, bulbs, *etc*.

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(a) Germinative transmission, where plant pathogens are transmitted by seeds or propagules

of host plants, *e.g.* loose smut of wheat, loose smut of barley, leaf blight of wheat and TMV *etc*.

(b) In vegetative transmission pathogens are transmitted through tubers, bulbs, rhizomes, cuttings, graft, e.*g*. ring and brown rot of potato, late blight of whip smut red rot of sugarcane *etc*.

(c) In adherent transmission the propagules of the pathogens are carried over the surface of the

seeds or vegitatively propagated parts e.g. Bunt of wheat, covered smut of barley, ergot of rye and bajra, wart disease of potato *etc*.

2. **Indirect transmission**: The pathogen spreading itself by way of its persistent growth or certain structures of the pathogen carried independently by natural agencies like wind, water, animals, insects, mites, nematodes, birds, *etc*. are the different methods of indirect transmissions.

(a) Autonomous transmission. Some root rotting fungi infecting certain seasonal crops also are transmitted by this method. Wood rotting fungi such as *Armillaria, Fomes, Polyporus etc*. migrate from plant to plant through soil. Others include root rot of cotton and wilt disease caused by *Phymatotrichum omnivorum and Fusarium sp. etc.*

(b) Wind dispersal: Pathogens causing powdery, downy mildews, leaf spots, blasts, blights and rust diseases are transmitted through wind.

(c) Water dissemination: Certain soil inhabiting pathogenic fungi and bacteria causing root and collar rots, wilts, foot, rots, *etc*. are likely to be transmitted to much longer distances through the agencies like irrigation water, streams and rivers *etc.*

(d) Transmission by insects, mites and nematodes: Most of the viral diseases of plants are transmitted through the agency of different insects (Fig. 2). Both types of insects viz., sucking and chewing or/biting are capable of transmitting viral diseases. Insects in such cases are called the `vectors' for the particular viral pathogen.

The insects responsible for transmission of viral diseases belong to the species of aphids, thrips, jassids (leaf hoppers), whiteflies, mealybugs, *etc*. Certain bacterial and several fungal pathogens are also known to be carried by insects. Many bacterial diseases such as cucurbit wilt, black leg of potato are transmitted by maggot and fire blight of apple is transmitted by bees. It is suspected that some viral diseases of chillies, tomato, brinjal and pigeon pea *etc.* have vector relationship with mites. Nematodes are soil borne organisms which some times act as agent for dissemination of bacterial, fungal and viral pathogens. For example yellow ear rot disease of wheat is transmitted by ear cockle nematodes.

C. Biotic and abiotic stress

There are so many agents which initiate the reactions in host plant causing diseases. Such agents are called causal agents of the disease and are basically two types *i.e.* biotic and abiotic.

Abiotic disorders are caused by nonliving factors, such as drought stress, sunscald, freeze injury, wind injury, chemical drift, nutrient deficiency, or improper cultural practices, such as overwateringnor planting too deep. Mango necrosis or black tip of mango is caused due to brick kiln fumes containing SO_2, coal gas and chlorine. Despite of these problems, excessive mineral or deficiency of minerals are also responsible for major diseases. Some mineral deficiency symptoms includes red leaf of cotton (nitrogen), dwarfing of cotton (phosphorus), cotton rust and little spot of alfalfa (potassium), heart rot of beet, brown heart of cabbage, internal cork of apple (boron), die back of citrus (copper), gray speck disease of oat (manganese), whiptail disease of cauliflower (molybdenum) and *khaira* disease of rice (zinc).

Biotic plant problems are caused by living organisms, such as fungi, bacteria, viruses, nematodes, insects, mites, parasitic flowering plants and animals. Unfortunately, the damage caused by these various living and nonliving agents can appear very similar. D. Parasitism and pathogensis. An organism that lives on or in some other organism and obtains its food from the latter is called a parasite. Parasitism is the removal of nutrients from a host by a parasite.

There are two major types of parasitism: obligate and non-] obligate.

- **Obligate parasites** are biotrophs depend on living cells for their existence. This group includes rust and mildew fungi, viruses, viroids, mollicutes, fastidious bacteria, nematodes, protozoans, and parasitic plants.

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- **Non-Obligate parasites** can be biotrophic or necrotrophic. Necrotrophic pathogens kill their host's cells in advance of colonization. The necrotrophs typically use enzymes and toxins to kill the cells they feed on.

Facultative saprophytes are parasites that typically depend on living material, but can utilize necrotic materials in situations where no live material is available. Facultative parasites live predominately as saprophytes, but under specific conditions can parasitize living organisms. Pathogenicity is the ability or capacity to incite disease. Relating to pathogenicity, the terms virulence and aggressiveness are often used. Aggressiveness is the relative ability to colonize and cause damage to plants. In short, it's whether the pathogen causes a little or a lot of disease under standard conditions. Virulence is the degree of pathogenicity of a given pathogen. Pathogenesis is the sequence of progress in disease development from the initial contact between a pathogen and its host to the completion of disease symptoms. The event of pathogenesis consisted of three steps *i.e.* pre- penetration, penetration and post penetration. Pre- penetration is the stage that includes the interaction of host pathogen before entry of pathogen into the host. Once a pathogen reaches a suitable infection site at the plant surface, it must breach a series of barriers to gain entry into its host before establishing a parasitic relationship during the penetration stage. After successful penetration, the pathogen proceeds further to establishment of proper infection. This stage is called invasion. After successful infection, the pathogen derives its nourishment from the host, starts multiplication and secretes some chemical substances to express the symptom of the disease. The haustoria absorb nutrients from the host and supply it to the main body of pathogen. These pathogens soon start reproduction and multiplication.

D. Disease cycle

Plant disease cycles represent pathogen biology as a series of interconnected stages of development including dormancy, reproduction, dispersal, and pathogenesis. The progression through these stages is determined by a continuous sequence of interactions among host, pathogen, and environment. The main events of stages comprising the disease cycle include the following: production and dissemination of the primary inoculum, primary infection, growth and development of the pathogen, secondary infection, and overwintering (Fig. 3).

1. The primary inoculum is the part of the pathogen (that is, bacterial or fungal spores or fungal mycelium) that overwinters (over- seasons) and causes the first infection of the season, known as primary infection.

2. Dissemination refers to the spread or dispersal of the pathogen from an inoculum source to a host. Dissemination can occur by wind, splashing rain, insects, infested pruning tools, infected or infested transplants, and other means.

3. Primary infection occurs when the pathogen comes into contact with a susceptible host under favorable environmental conditions. Most fungal and bacterial pathogens require free water for spore germination; consequently, infection is favored by prolonged warm, wet periods with high relative humidity.

4. Growth and development of a pathogen usually occurs on or within infected plant tissue. Fungi grow and spread within their host by means of mycelium. Bacteria spread by rapidly increasing in numbers.

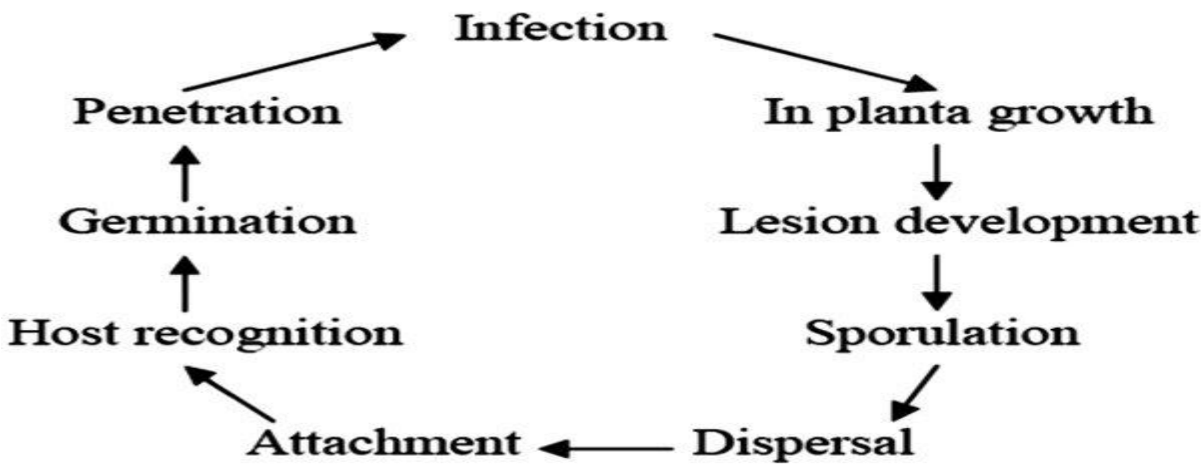

Fig. 3. Stage in disease cycle

Components of Integrated Disease Management

The major components of disease management summarized here are: host-plant resistance, cultural practices, biological control and chemical control. Even though these components will be dealt with individually, it should be mentioned that often the different components are complementary to each other with strong interaction among and between them and the environment and that it is essential to break away from relying on a single-technology and to adopt a more ecological approach built around a fundamental understanding of population biology at the local farm level and to rely on the integration of control components which are readily available to the resource-poor farmers (Thomas, 1999).

Acceptable pest level:

IDM holds that eradication or wiping out the entire population is impossible. Therefore, the emphasis should be on keeping the pathogen population at an acceptable level that is achievable, economically affordable and environmentally safe.

Monitoring:

Regular crop monitoring and record keeping provides reliable information to guide an IDM program if the crop inspection is routine and structured. To monitor effectively for disease incidence and development, it is important to inspect foliage and flowers (if present) weekly. Detecting diseases early makes control easier and may mean containing a problem with only a spot spray or other localized action.

Host-plant resistance:

Host plant resistance is an important tool to control diseases of major food crops in developing countries, especially wheat, rice, potato, cassava, chickpea, peanuts and cowpea. The use of resistant varieties is very much welcomed by resource poor farmers because it does not require additional cost and it is environment-friendly.

Late blight is considered as one of the most important biotic constraints for potato production in many developing countries including many from Latin America, which are considered as the center of origin for potato crop. Traditionally this disease is controlled by several fungicide spays, but the emergence of fungicide resistance in many locations and the increasing cost of their application, encouraged the search for other control strategies. Rusts have been known to cause serious disease on wheat since its domestication. A typical example is the yellow rust epidemics that spread from East Africa to Central and South Asia and North Africa during the 1980's and 1990's. Presently the breakdown of Yr27, a gene used to replace Yr9, and the emerging stem rust race Ug99 are threatening 80-90% of commercial wheat varieties grown worldwide (Hodson and Nazari, 2010).

Late leaf spot caused by *Phaeoisariopsis personata* and rust caused by *Puccinia arachidis* are two most destructive foliar diseases of peanut worldwide. Host plant resistance has been used recently as one control component and a number of peanut cultivars such as ICGV 89104 and ICGV 91114 are now available. Field trials conducted in India showed that these cultivars yield 55-60% more than local cultivar, and the severity of both diseases is significantly lower in these than in the local cultivar (Pande *et al.*, 2001). Similarly, peanut varieties resistant to peanut rosette virus disease which causes serious losses in Africa have been developed (Reddy, 1998).

Cultural Practices:

Cultural practices serve an important role in plant disease prevention and management. The benefits of cultural control begin with the establishment of a growing environment that favors the crop over the pathogen. Reducing plant stress through environmental modification promotes good plant health and aids in reducing damage from some plant diseases.

1. Deep ploughing of the field results in exposure of propagules to elevated temperatures and physical killing of the pathogen. This can be regarded as dry soil solarization.
2. Flooding of the field some what resembles soil disinfestation. Long-term summer soil flooding, with or without paddy culture is found to be decreased populations of soil borne pathogens.
3. Sanitation practices aimed at excluding, reducing, or eliminating pathogen populations are critical for management of infectious plant diseases. It is important to use only pathogen-free transplants.
4. In order to reduce dispersal of soil borne pathogens between fields, stakes and farm equipment should be decontaminated before moving from one field to the next. Reduction of pathogen survival from one season to another may be achieved by crop rotation and destroying volunteer plants.

Physical and mechanical measures:

Mechanical and physical controls kill a pathogens directly or make the environment unsuitable for it. The common methods are:

1. Collect and destroy the disease infected plant parts.

2. Soil sterilization at 50-60ºC for about 30 min kills the all soil borne pathogens.

3. Some seed borne diseases like loose smut of wheat (52ºC for 11 min), leaf scald (50ºC for 2-3h), red rot (54ºC for 8 h) and ratoon stunting of sugarcane (50ºC for 3h), black rot of crucifer (50 ºC for 20-30 min) etc. can be treated by hot water treatment by immersing infected seeds in hot water at recommended temperature and time.

4. Hot air treatment is given to remove excess of moisture from plant organs and protect them from fungal and bacterial attack. Several virus infected dormant plants are treated by hot air treatment at a temperature ranging from 35-54ºC for 8 h.

Biological Control:

The use of bio control agents in disease management is increasing, especially among organic growers. These products are considered safer for the environment and the applicator than conventional chemicals. Examples of commercially available bio control agents include the fungi *Trichoderma viride/harzianum* and *Gliocladium virens*, an actinomycete *Streptomyces griseoviridis*, and a bacterium *Bacillus subtilis. Bacteriophages* (phages) have been found to be an effective bio control agent for managing bacterial spot on tomato. Phages are viruses that exclusively infect bacteria. *Paecilomyces lilacinus* is a common saprobic, filamentous fungus has been isolated from a wide range of habitats frequently been detected in the rhizosphere of many crops. The fungus has shown promising results for use as a bio-control agent to control the growth of destructive root-knot nematodes.

Cross protection is also a one of the modern bio- control method for the disease management. In this method mild strain of virus or microorganisms is inoculated in host plant. These provide protection of host plants from those viruses and microorganisms which may cause much more severe damage e.*g.* papaya ring spot disease, citrus tristiza disease, *etc.* One of the limitations of using bio control agents is their inability to survive in certain field conditions. However, bio control agents have the ability to improve disease management when integrated with other management options described in this document.

Table 2: Commercially available bio-control products to control plant disease.

Bio control Bacterial	**Product**	**Source**
Galltrol	*Agrobacterium radiobacter stain 8*	*Crown gall (A. tumefaciens*
Dagger G	*Pseudomonas fluroscens*	*Pythium, Rhizoctonia*
Actinovate	*Streptomyces lydicu*	Soil borne pathogens
Messeng	*Erwinia amylovora* hairpin protein	Wide spectrum
Bio-save 10 LP, 110	*Pseudomonas syringa*	*Penicillium,Postharvest Botrytis, Mucor*
Kodia	*Bacillus subtil* strain GB03	*Fusarium, Rhizoctonia Alternaria* etc.
Bio control Fungi	**Product**	**Source**
Kalisena	*Aspergillus niger*	*Rhizoctonia solan*
Aspire	*Candida oleophil 182*	*Botrytis spp. And Penicillium spp*
Trichopel	*Trichoderma harzianum* and *Trichoderma viride*	*Botryosphaeria, Fusarium, Armillaria*
Root Shield, T-22 Plante, Box	*Trichoderma harzianum* strain, KRL-AG2 (T-22)	*Pythium, Fusarium, Rhizoctonia*
Biotrox C	*Fusarium oxysporum* (non -pathogenic)	*Fusarium oxysporum*

Soil Gard (Gliogard)	*Trichoderma virens GL-2*	*Rhizoctonia solani, Pythium*
Trichodex	*Trichoderma harzianum*	*Colletotrichum, Plasmopara, Sclerotinia*

A number of botanicals are also tested against fungal disease like sheath blight. Some commercially used botanicals against plant diseases are extract of Neem (*Azadirachta indica, A. Juss*), Garlic (*Allium sativum*, Linn., Eucalyptus (*Eucalyptus globulus, Labill*.), Turmeric (*Curcuma longa Linn.)* Tobacco (*Nicotiana tabacum Linn*.) Ginger (*Zingiber officinale Rosc*.) and essential oils of Nettle (*Urtica spp*.), Thyme (*Thymus vulgaris Linn*.), Eucalyptus (*Eucalyptus globules Labill),* Rue (*Ruta graveolens Linn*.), Lemon grass (Cymbopogon flexuosus (Steud. Wats.) and Tea tree (*Melaleuca alternifolia).*

Foliar sprays with Neem gold @ 20 ml /l or Neemazal @ 3ml/l has been found to be effective in reducing sheath blight and increasing grain yield. Leaf extracts of Eucalyptus globosus (5%) and *Azadirchta indica* (5%) have been proved to exhibit greater antifungal activity against *A. brassicae* and *Albugo candida* and showed significant reduction in the severity of Alternaria blight and white rust diseases.

Chemical control:

For many decades' fungicides played an important role in disease control. In the 1960s, systemic fungicides started gradually to replace the older non-systemic chemicals with more effectiveness and specificity in disease control. Very quickly, triazole fungicides gained 24% of the total fungicides market (Hewitt, 1998). However, the non-systemic fungicides such as mancozeb and chlorothalonil plus copper and sulpher-based products continued to have a good share of the market, especially in developing countries because of their lower cost. More recently, new classes of fungicides were developed with significant impact on disease control. These include anilinopyrimidines, phenoxyquinolines, oxazolidinediones, spiroketalamines, phenylpyrroles, strobilurins and activators of systemic acquired resistance. However, the development of pathogen populations showing reduced sensitivity to many of

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the newly developed products posed a serious challenge that the traditional fungicides (*e.g.* sulpher, folpet, *etc*.) did not face. The availability of a variety of new products, with narrow and broad specificity, offer important disease control options, however, their practical application continues to face the risk of selection of resistant pathogen populations (Gullino *et al*., 2000). Experience accumulated over the last few decades clearly showed that fungicidal application had a better impact when used within an IDM strategy (De Waard *et al*., 1993). In addition, public concern has increasingly influenced the fungicide industry in developing effective products with low mammalian toxicity and environmental impact and low residues in food, to meet international health standards and compatibility in integrated pest management programs (Knight *et al*., 1997). **These are the some other constraints for the implementation of IDM**:

1. By offering seeds, fertilizers and fungicide on redit to the farmers, fungicide dealers pose a threat to IDM.
2. Pesticides companies use mass media like television and newspapers for popularizing their products through attractive advertisements.
3. Farmers are addicted to subsidy and they always look for some financial support for adopting NPM methods.
4. Bio-pesticides, bio control agents and other IDM components are not readily available.
5. Large farmers discourage small farmers in adopting IDM methods by emphasizing more on their risky and unstable nature.
6. Scientific community is constrained in recommending use of IDM technology because
farmers may ask for compensation in case of failure.

THE FUTURE THRUST

All of the above considerations illustrate that by using fungicides reduction techniques in agriculture is a wise shift in ecological steward ship. Recent market trends show the public is increasingly recognizing the need to go fungicide-free as organic sales are growing for virtually every commodity, from vegetables to pet food to lawn care products. Adopting IDM practices that emphasize fungicide reduction, and organic practices, provide real-world solutions for a healthier environment.

ADVANTAGES

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Integrated approach integrates preventive and corrective measures to keep pathogen from causing significant problems, with minimum risk or hazard to human and desirable components of their environment. Some of the benefits of an integrated approach are as follows:

- Promotes sound structures and healthy plants
- Promotes the sustainable bio based disease management alternatives.
- Reduces the environmental risk associated with management by encouraging the
- adoption of more ecologically benign control tactics
- Reduces the potential for air and ground water contamination
- Protects the non-target species through reduced impact of plant disease management activities. Reduces the need for pesticides and fungicides by using several management methods
- Reduces or eliminates issues related to pesticide residue
- Reduces or eliminates re-entry interval restrictions
- Decreases workers, tenants and public exposure to chemicals
- Alleviates concern of the public about pest & pesticide related practices.
- Maintains or increases the cost-effectiveness of disease management programs

CONCLUSION

The disease occurs in plant is by biotic and abiotic means and causes a significant loss in agriculture system. The success and sustainability of IDM strategy, especially with resource poor farmers greatly depends on their involvement in helping to generate locally specific techniques and solutions suitable for their particular farming systems and integrating control components that are ecologically sound and readily available to the Training and awareness raising of farmers, disease survey teams, agricultural development officers, extension agents and policy makers remains to be an important factor for the successful implementation of IDM strategies. IDM is a disease control approach that uses all available management strategies to maintain disease pressures below an economic injury threshold. It does not advocate a routine chemical application program to prevent disease, but promotes the integration of cultural, physical, biological and chemical control strategies. The routine application of fungicides for insurance purposes is not appropriate, as it does not focus the proper attention on the real problem and can lead to resistance and potential environmental issues. Added benefits of IDM are that disease control is greater than that achieved individual method.