AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 03, Issue: 03 (March, 2026)
Available online at http://www.agrimagazine.in
©Agri Magazine, ISSN: 3048-8656

The Concept of Integrated Disease Management

*Nagajyothi N. and Anusha S.
Division of Plant Pathology, ICAR-IARI, New Delhi, 110012, India
*Corresponding Author's email: anusha_13303@iari.res.in

Plant disease is a structural abnormality or physiological disorder or both due to an organism or unfavourable conditions that may affect the plant or its parts or products or may reduce their economic value. The potential food losses due to diseases, caused by pathogenic micro-organisms and animal pests, are estimated to be up to 38.2% of total yield losses in rice and 36.5% in potatoes (Oerke ,2006). The use of synthetic pesticides has therefore become an integral part of agriculture. As such, since the discovery of the first synthetic fungicide, phenylmercury acetate in 1913, over 110 new fungicides have been developed during the last century, allowing food production to increase with a value of USD 12.8 billion in the US annually (Carvalho, 2017; Gianessi, 2006). Integrated Disease Management (IDM) is a concept derived from the successful Integrated Pest Management (IPM) systems which 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.

Goals of integrated disease management

- Eliminate or reduce inoculum
- Reduce the effectiveness of initial inoculum
- Increase resistance within the host
- Delay the onset of disease
- Slow the secondary cycles
- Uses several methods in which routine use provides disease control

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. 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.

Principles of plant disease management

Avoidance of pathogen: It comprises proper selection of geographical areas, selection of the field, sowing date, choice of disease escaping varieties, selection of diseases free seeds and planting stock and cultural practices.

Exclusion of the pathogens: It includes quarantine measures, seed certification, plant disease notification and prevention of sale of diseased plants.

Reduction and eradication of pathogen inoculum: This can be performed by adopting cultural, physical, mechanical, biological and chemical practices

Protection: Protection prevents infection by means of a toxicant or some other barrier to infection. It involves physical and chemical control methods.

Resistance: Resistance utilizes cultivars that are resistant to infection.

Therapy: Therapy cures plants that are already infected. It involves chemotherapy and thermotherapy

Components of integrated disease management

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. Rice varieties resistant to rice blast (Bonman and MacKill, 1988), bacterial blight (Mew et al., 1992), rice tungro (Azzam and Chancellor, 2002) and brown spot (Ou, 1985) are widely used.

Cultural practices

Cultural practices are the only feasible method of disease control in crops which give lower return per unit area or of which resistant varieties are not known (Singh *et al.*, 2012). Cultural practices such as cultivation techniques, mulching, intercropping, plant density, planting date, crop rotation, strip farming, timing of harvest, barrier crops, crop mixtures, roguing, healthy planting material, soil solarization, soil amendments and fertilizer management, and water management have been used singly and in combination as tools for disease management. For some crops in developing countries, such control practices may be the only economically viable method available

Physical methods

The soil is steam sterilized either in special containers or on greenhouse benches, in which steam is piped into and is allowed to diffuse through soil. At about 50˚c nematodes, some oomycetes and other water moulds are killed. At 60 ˚& 70 ˚C most plant pathogenic fungi and bacteria are killed. At about 82 ˚C most weeds, rest of plant pathogenic bacteria and viruses are killed. Hot water treatment is used to treat certain seeds bulbs to kill any pathogen with which they are infected. The temperature and duration vary with crop (Chaube and Singh, 2005)

Biological control

The use of naturally occurring bio-control agents (antagonists) of plant pathogens can be traced back to many centuries through the traditional practice of crop rotations that primarily permit the reduction of pathogens' inoculum potential in the soil below injury level. This approach is still the most important single component, in both developed and developing countries used to manage root pathogen. Success in using microorganisms against plant pathogens started with the control of crown gall with *Agrobacterium radiobacter* K84 (Kerr, 1980), and that of seedling blights caused by *Pythium* and *Rhizoctonia* with *Trichoderma harizanum* (Harman and Bjorkman, 1998), *Gliocladium virens* (Lumsden and Walter, 1995) and *Streptomyces griseus* (Cook *et al*., 1996).

Chemical control

Chemicals are generally used to protect plant surfaces from infection or to eradicate a pathogen that has already infected a plant. Soil is treated with chemicals for control of nematodes and also for soil borne fungi such as Fusarium, Verticillium and bacteria. Certain

fungicides are applied to soil as dusts, liquid drenches, or granules to control diseases. Fugicides used for soil treatments include Metalaxyl, Diazoben, Pentachloronitrobenzene, Captan etc., Stored products can be protected from becoming infected by pathogens left over by first cleaning thoroughly the storage rooms and by removing and burning the debris. Walls and floors are washed with copper sulphate solution (1 pound in 5 gallons of water). The most promising method of controlling pathogens through the use of chemicals called fumigants. Some of them including Chloropicrin, Methyl bromide etc. Nematicides used as soil fumigants as available as liquids, emulsifiable concentrates. 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).

Advantages of integrated disease management

Some of the benefits of an integrated approach are as follows:

- 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

Constraints in integrated disease management

- Lack of information on IDM among farmers and extension worker.
- Lack of training on IDM.
- Lack of funds for training farmers and extension workers on the use of IDM.
- Some farmers feel it is risky to adopt IDM compared to use of pesticides alone.
- Pesticides companies use mass media like television and newspapers for popularizing their products through attractive advertisements.
- Farmers are addicted to subsidy and they always look for some financial support for adopting these methods.
- Bio-pesticides, bio control agents and other IDM components are not readily available. Cultural practices are basic but eco-friendly way to minimize diseases.

Conclusion

Integrated disease management (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. 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. All direct stakeholders including farmers, extension workers, and local crop protection technicians should have a practical understanding of the ecology, etiology and epidemiology of the major diseases of the crop. Intensive training using participatory approaches should be used to empower farmers with the appropriate knowledge to become better managers of their own fields translating this knowledge into appropriate decision-making tools and practical-control tactics.

References

1. Azzam, O., & Chancellor, T. C. B. (2002). The biology, epidemiology, and management of rice tungro disease in Asia. *Plant Disease, 86*(1), 88–100.
2. Bonman, J. M., & Mackill, D. J. (1988). Durable resistance to rice blast disease. *Oryza, 25*, 103–110.
3. Carvalho, F. P. (2017). Pesticides, environment, and food safety. *Food and Energy Security, 6*(2), 48–60.
4. Chaube, H. S., & Singh, U. S. (1990). *Plant diseases management: Principles and practices*. CRC Press.
5. Cook, R. J., Bruckart, W. L., Coulson, J. R., Goettel, M. S., & Humber, R. A. (1996). Safety of microorganisms intended for pest and plant disease control: A framework for scientific evaluation. *Biological Control, 7*(3), 333–351.
6. De Waard, M. A., Georgopoulos, S., Hollomon, D. W., Ishii, H., Leroux, P., Ragsdale, N. N., & Schwinn, F. J. (1993). Chemical control of plant diseases: Problems and prospects. *Annual Review of Phytopathology, 31*, 403–421.
7. Gianessi, L. P., & Reigner, N. (2006). The importance of fungicides in U.S. crop production. *Outlook on Pest Management, 10*, 209–213.
8. Gullino, M. L., Leroux, P., & Smith, C. M. (2000). Uses and challenges of novel compounds for plant disease control. *Crop Protection, 19*(1), 1–11.
9. Harman, G. E., & Bjorkman, T. (1998). Potential and existing uses of *Trichoderma* and *Gliocladium* for plant disease control and growth enhancement. In G. E. Harman & C. P. Kubicek (Eds.), *Trichoderma and Gliocladium* (Vol. 2, pp. 229–265). Taylor & Francis.
10. Kerr, A. (1980). Biological control of crown gall through production of agrocin 84. *Plant Disease, 64*(1), 25–30.
11. Knight, S. C., Anthony, V. M., Brady, A. M., Greenland, A. J., Heaney, S. P., Murray, D. C., Powell, K. A., Schultz, M. A., Spinks, C. A., Worthington, P. A., & Youle, D. (1997). Rationale and perspectives on the development of fungicides. *Annual Review of Phytopathology, 35*, 349–372.
12. Lumsden, R. D., & Walter, J. F. (1995). Development of biocontrol fungus *Gliocladium virens*: Risk assessment and approval for horticultural use. In M. T. Hokkanen & J. M. Lynch (Eds.), *Biological control: Benefits and risks* (pp. 263–269). Cambridge University Press.
13. Mew, T. W., Vera Cruz, C. M., & Medalla, E. S. (1992). Changes in frequency of *Xanthomonas oryzae* pv. *oryzae* in response to rice cultivars planted in the Philippines. *Plant Disease, 76*(10), 1029–1032.
14. Oerke, E. C. (2006). Crop losses to pests. *Journal of Agricultural Science, 144*(1), 31–43.