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Role of Plant Pathology in Integrated Pest Management

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Integrated Pest Management (IPM) is a paradigm that is widely adopted by all pest control disciplines but whose early definitions and philosophical basis belong to entomologists. Plant pathology research and extension work has historically emphasized integration of several control strategies and fits both historical and modern definitions of IPM. While the term IPM has been used only sparingly in the phytopathology literature, the integrated disease management strategies emphasized are now considered to be at the forefront of ecologically based or biointensive pest management. While IPM is broadly endorsed by crop protection disciplines, farmers, other agriculturalists, and consumers, the potential for Integrated Pest Management has not been fully realized. Most IPM programs reflect a package of tools and decision aids for individual crop insect, weed, nematode, and plant disease management.

Role of Plant Pathology in Integrated Pest Management

- Entomopathogenic fungi
- Entomopathogenic nematode
- Entomopathogenic virus
- Entomopathogenic bacteria
- Entomopathogenic protozoa

➢ Role of Entomopathogenic fungi in insect pest management

Fungus	Host Insect	Dosage
Metarhiziumanisopliae/	White grup, sweet potato weevil, BPH, DBM,	1-2 kg/ac spray, 10-15 kg,with 50 kg FYM/hac.
Verticillium lecani,	coffee green scale, Leaf and plant hoppers	0.4-1.0 kg/ac Foliar
Hirsutellathompsani,	Coconut Mites	1-5 g/ l of water

Trichoderma as biocontrol agent against pests:
Trichoderma is a genus of filamentous fungi widely studied and used as a biocontrol agent in agriculture on pathogenic fungi due to its ability to parasitize them (mycoparasitism), among other mechanisms of action. *T. longibrachiatum and T. harzianum parasitize* adult hemipterans of the silver leaf whitefly (Bemisiatabaci) and the tropical bed bug (Cimex hemipterus), causing mortality rates of 40% in 5 days (Anwar et al. 2016).

➢ Role of entomopathogenic nematodes

Entomopathogenic nematodes (EPNs) are soil-inhabiting, lethal insect parasites that belong to the Phylum Nematoda from the families Steinernematidae and Heterorhabditidae, and they have proven to be the most effective as biological control organisms of soil and above-ground pests.

Most biological agents required days or weeks to kill the host, yet nematodes can kill insects usually in 24–48 hours. They are easy and relatively inexpensive to culture, live from several weeks up to months in the infective stage, are able to infect numerous insect species.

Foliar applications of nematodes have been successfully used to control the quarantine leaf-eating caterpillars as *Tuta absoluta*, *Spodoptera littoralis*, *Helicoverpaarmigera*, *Pieris brassicae* on several crops and have the potential for controlling various other insect pests. Application of EPNs does not require masks or other safety equipment like chemicals. EPNs and their associated bacteria have no detrimental effect to mammals or plant.

- **Role of Entomopathological Virus**

Baculoviruses

Baculovirus have been used worldwide to control insects in agriculture. As they have been widely adopted in biological production, they are moving toward further use in integrated agricultural production systems. Baculovirus isdevided into two genera; Nucleopolyhedrovirus and Granulovirus(M.V.Regenmortelet al., 2000)

Virus	Target pest Crop	Dosage
HaNPV *H. armigera*	Tomato, Lablab, Chickpea, Groundnut, Sunflower, Tur, Cotton	250 LE/ha
SlNPV (S. litura)	Groundnut, Tobacco, Soybean, Crucifers, Cotton	250 LE/ha
MaNPV (M. separata)	Maize, Sorghum	250 LE/ha
AaNPV (A. albistriga)	Groundnut	250 LE/ha
GV C. infuscatellus	Sugarcane	250/ha

- **Role of Entomopathogenic bacteria**

Bt with its toxic proteins is very effective as a biopesticide against several pests, excessive use can lead to resistance development. Corn earworm, diamondback moth, and tobacco budworm are some of the insects that developed resistance to *Bt* toxins. Genetic engineering allowed genes that express *Bt* toxins to be inserted into plants such as corn, cotton, eggplant, potato, and soybean and reduced the need to spray pesticides. However, appropriate management strategies are necessary to reduce insect resistant to *Bt* toxins in transgenic plants. *Paenibacilluspopilliae* is commonly used against Japanese beetle larvae and known to cause the milky spore disease. Biopesticides based on heat-killed *Chromobacteriumsubtsugae* and *Burkholderiarinojensis* are reported to have multiple modes of action and target mite and insect pests of different orders.

Conclusion

There are several examples of entomopathogen-based biopesticides that have played a critical role in pest management. Significant reduction in tomato leaf miner, Tuta absoluta, numbers and associated yield loss was achieved by Bt formulations in Spain (Gonzalez-Cabrera et al, 2011).

Lecanicelliummuscarium-based formulation reduced greenhouse whitefly (Trialeurodesvaporariorum) populations by 76-96% in Mediterranean greenhouse tomato (Fargueset al, 2005). The entomopathogenic nematode, S. feltiae,reduced raspberry crown borer (Pennisetia marginata) populations by 33-67% (Capinera et al, 1986). For managing the branch and twig borer (Melagusconfertus) in California grapes, S. carpocapsae is one of the recommended options (Valera et al, 2015).

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