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INTEGRATED PEST MANAGEMENT

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Integrated Pest Management (IPM)

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INTRODUCTION

Pest - Derived from French word 'Peste' and Latin term 'Pestis' meaning plague or contagious disease. Pest is any organism that cause significant and economic damage to crops, stored produced and animals. Pest is any animal which is noxious, destructive, or troublesome to man or his interests. A pest is any organism which occurs in large numbers and conflict with man's welfare, convenience, and profit. A pest is an organism which harms man or his property significantly or is likely to do so (Woods, 1976).

Pests are organisms which impose burdens on human population by causing:

i. Injury to crop plants, forests and ornamentals.
ii. Annoyance, injury and death to humans and domesticated animals.
iii. Destruction or value depreciation of stored products.

CATEGORIES OF PESTS:

I. Insect pests are classified based on season and locality:

1. Regular pests: Occur most frequently (regularly) in a crop and have a close association with that particular crop. e.g.: Chilli Thrips *Scirtothrips dorsalis,* brinjal shoot, and fruit borer, *Leucinodes orbonalis*, Rice stem borer.
2. Occasional pests: Here a close association with a particular crop is absent and they occur infrequently. E.g.: Rice case worm, *Nymphula depuctalis* castor slug caterpillar, *Parasa lepida*, mango stem borer, *Batocera rufamaculata*.
3. Seasonal pests: Occur mostly during a particular part of the year, and usually the incidence is governed by climatic conditions. E.g.: Red hairy caterpillar on groundnut-June-July, Rice grasshoppers–June-July.
4. Persistent pests: Occur on a crop almost throughout the year. E.g.: Thrips on chillies.
5. Sporadic pests: Pests, which occur in a few isolated localities. E.g.: Rice ear head bug.

II. Insects pests are also classified based on the intensity of infestations:

1. Epidemic pests: Occur in a severe form in a region or locality at a particular season or time only. E.g.: Rice hispa, *Dicladispa armigera*, rice leafroller, *Cnaphalocrocis medinalis*.
2. Endemic pests: Pests, which occur regularly and are confined to a particular area of locality. E.g.: Rice Gall midge in Madurai district and rice stem borer Kaveri delta.

III. Pests are classified based on damage potential:

1. Key pests: These are the most severely damaging pests. The GEP is always above the EIL. Human intervention may bring the population temporarily below the EIL, but it rises back rapidly and repeated interventions (sprays) may be required to minimize damage. These are persistent pests. The environment must be changed to bring GEP below EIL. Ex.: Cotton bollworm, Diamondback moth.
2. Major pests: These are pests with the population that crosses EIL quite frequently. Economic damage can be prevented by timely and repeated sprays. E.g.: Cotton Jassids, Rice stem borer.
3. Minor pests: These are pests with a population that rarely crosses EIL and fluctuates around ETL. But these pests are easily amenable to available control measures and a single application of insecticides is usually enough to prevent economic damage (5-10%damage).
4. Potential pests: These pests normally do not cause any economic damage. Any change in the ecosystem may make them cause economic damage.
5. Sporadic pests: GEP generally below EIL. The population of these pests is usually negligible but in certain years under favourable environmental conditions, they appear in a virtually epidemic form crossing many times over DB and EIL. Under these conditions, the pest has to be controlled by undertaking suitable management strategies. These pests are highly sensitive to abiotic conditions and once the favourable season is over, only a residual population survives. Ex: White grub, hairy caterpillars, cutworm, grasshoppers.

INTEGRATED PEST MANAGEMENT [IPM]

Integrated control -Stern et al., (1959) as applied pest control which combines the biological and chemical control Managing pest population was proposed by Geier and Clark 1961 who called their concept as protective management which later was shortened as pest management Later Smith and Van Den Borsch in 1967 mentioned that the determination of the insect numbers is broadly under the influence of total agro ecosystem and the role of the principal element is essential for integrated pest management.

In 1972 the term IPM was accepted by CEQ (Council of Environmental Quality)

I - Integration is the harmonious use of multiple methods to control the impact of a single pest as well as multiple pests.

P – Pest is any organism that is detrimental to humans including vertebrates and invertebrate or weed or pathogens.

M - Management refers to a set of decisions or rules based on ecological principles, economic and social considerations. The backbone of the management of pests in an agricultural ecosystem is the concept of economic injury level.

WHY PEST MANAGEMENT?

1. Collapse of control system: After World War during the massive use of pesticides, Rachel Carson, an American biologist, warned the people about the side effects of the use of pesticides through her book entitled, Silent Spring.

   An over-reliance on chemical pesticides led to the development of pesticide resistance - a resurgence of pest

- hazards to agricultural workmen, development of multiple resistance - elimination of natural enemies - deleterious effects on the environment, the emergence of secondary pests - hazards to non-target species.

2. Phases of crop protection: Smith. R.F (1969) has classified Worldwide patterns of crop protection in the cotton agro ecosystem into the following phases which are also applicable to other crop ecosystems

a. **Subsistence phase:**
i. No Irrigation and Low yields
ii. Barter system marketing
iii. Natural pest control like natural enemies and Host plant resistance and the rare usage of Chemicals.

b. **Exploitation phase:**
i. Pest control solely depend on chemical pesticides
ii. Chemical control measures were exploited to the maximum extent
iii. intensive use of pesticides resulted in higher yields

c. **Crisis phase:**
i. More frequent and higher doses applications of pesticides
ii. Excessive use of insecticides over several years led to serious problems like
1. Pest resurgence.
2. Pest Resistance.
3. Pest status change.
4. Increase of production costs.

d. **Disaster phase:**
i. Cost of cultivation got increased.
ii. Crops were not grown profitably.
iii. Frequent encounters of crop failures.
iv. Rejection of the produce due to residues.
v. Finally collapse of the existing pest control system.

e. **Integrated control phase:**
i. Control measures are to the optimum and not to the maximum.
ii. Pest management concept is followed to avoid crisis and disaster phases by
a) Combination of the resources
b) Analysis of eco- factors
c) Optimization of techniques
d) Recognizing or restoring the pest at a manageable level

3) **Environmental contamination**: The presence of residues in foods, feed, and organisms caused widespread concern about contamination of environment.

CONCEPTS OF IPM: Seeks to minimize the disadvantages of pesticide usage and maximizing socio, economic and ecological advantages.

1. Understanding the agricultural ecosystem: Lesser diversity than natural ecosystem like forests; Only 1-4 major crop species and 6-10 major pest species; Intensively manipulated by man; Subjected to sudden alterations (ploughing, inter cultivation Pesticide treatment); more susceptible to pest damage and catastrophic outbreaks. These practices are critical in pest management as pest populations are greatly influenced.
2. Planning of agricultural ecosystem: Anticipating pest problem; Alternatives to the ways of control; Integration of crop protection with a crop production system. Ex: Growing of susceptible varieties should be avoided and related crops shouldn't

be grown. Groundnut followed by soybean increases the incidence of the leaf miner.

3. Cost-benefit ratio: By predicting the pest problem and defining economic threshold level; Crop life table provide information analysis of pest damage as well as the cost-benefit ratio; Benefit-risk analysis includes the impact of Pesticide usage on society as well as the environment relevant to its benefits
4. Tolerance of pest damage: Castor crop can tolerate up to 25 percent defoliation; Exceptions occur in case of plant disease transmission by vectors; The relationship between the density of pest population and profitability of control measures is expressed through threshold values

A) Economic Injury Level (EIL): Lowest population at which the pest will cause economic damage or the pest level at which the damage can no longer be tolerated; the level at or before which the control measures are initiated; EIL is usually expressed as the number of insects per unit area.

b) Economic Threshold Level (ETL): Index for making pest management decisions; Population density at which control measures should be applied to prevent increasing pest population from reaching the EIL; When no action is taken at ETL the population reaches or exceeds EIL. E.g.:- ETL value for BPH in rice is 25 insects /hill; Rice stem borer -5% dead hearts; Gall midge of rice-5% silver shoots.

c) General equilibrium position (GEP): Average population density of insect over a long period unaffected by temporary interventions of pest control. The EIL may be at any level from well below to well above the GEP.

5. Leaving a pest residue: Absence of their respective insect hosts and indiscriminate use of broad-spectrum insecticides eliminate natural enemies leave a permanent pest residue below ETL so that natural enemies will survive
6. Timing of treatments: Pesticide spray should be need-based. Timely scheduled minimum number of sprays + Improved techniques of pest monitoring. E.g.: Use of pheromone traps for monitoring of pest population
7. Public understanding and acceptance: Simple and effective communication to the people for better understanding and acceptance; Should be economical and sustainable.

LIMITATIONS OF IPM:

- The higher degree of management
- Labour intensive
- Accurate field scouting
- Weather dependant

PRINCIPLES OF IPM:

- Identification of key pests and beneficial organisms.
- Defining the management unit, the Agro-ecosystem.
- Development of management strategy.
- Establishment of Economic thresholds (loss & risks).
- Development of assessment techniques.
- Evolving description of predictive pest models.

Tools of Pest Management: The available Techniques for controlling individual insect pests are conveniently categorized in increasing order of complexity as -

1. Cultural method
2. Mechanical method
3. Physical method
4. Biological method
5. Genetic method
6. Regulatory method
7. Chemical method