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Theory and Principles of Integrated Pest Management

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SUMMARY

Integrated Pest Management (IPM) represents an efficient and environmentally conscious strategy for dealing with pests. It relies on a blend of practical techniques to manage pests. IPM programs harness up-to-date, comprehensive knowledge about the life cycles of pests and how they interact with their environment. IPM encompasses a wide range of pest management tools, including the cautious use of pesticides. However, an excessive reliance on chemical control methods has led to contamination of ecosystems and adverse health effects. The future of crop production is further jeopardized by the emergence of pest resistance and a dwindling supply of effective substances. Consequently, there's a pressing need to design cropping systems that are less reliant on synthetic pesticides. Therefore, the European Union has mandated the implementation of eight principles of Integrated Pest Management (IPM) within sustainable farm management. It is imperative to propose to farmers, advisors, and researchers an adaptable and dynamic approach that considers the diversity of farming situations and the intricacies of agro ecosystems. This approach can enhance the resilience of cropping systems and the capacity to adapt crop protection methods to local conditions.

INTRODUCTION

Integrated Pest Management (IPM) serves as a comprehensive "approach" or "strategy" to tackle plant pests by employing a variety of methods while minimizing the use of chemical pesticides. The primary goal is not the complete eradication of pests but their effective management, ensuring their populations remain below levels that cause economic harm. The practical application of this approach can potentially reduce the exposure of farmers, consumers, and the environment to harmful substances and address issues associated with pesticide-resistant pests. In the late 1950s, entomologists began to recognize the challenges stemming from the widespread and intensive application and the misuse and abuse of insecticides. These problems included pesticide resistance, the emergence of secondary pests, risks related to toxic residues in food products, environmental pollution, and unintended harm to non-target beneficial organisms. Key issues such as pest resistance, pest resurgence, pesticide residues, and enviecologicalards began to manimanifestingelements of IPM that had been developed long before as a redue toand-error experiences, with farmers creating various mechanical, cultural, and physical control measures for different pests. The concept of IPM only emerged when the adverse effects of chemical pesticides became apparent.

Aims of IPM: (TNAU)

- Reduce the use of synthetic organic pesticides
- That is environmentally sound
- Pest minimal risk of human health
- to-useable return on investment
- Provide consumable safe food

Principles of IPM:

✓ **Principle 1—prevention and suppression**

• Crop rotation,

• Use of adequate cultivation techniques (e.g., stale seedbed technique, sowing dates and densities, undersowing, conservation tillage, pruning and direct sowing,ng),

• Use, where appropriate, of resistant/tolerant cultivars and standard/ certified seed and planting material,

✓ **Principle 2—monitoring**

Harmful organisms must be monitored by adequate methods and tools, where available. Such adequate tools goodnclude observations in the field as well as scient, scientificallyrecasting and early diagnosi,s systems, where feasible, as well as the usande from professionally qualified advisors.

✓ **Principle 3—decision-making**

Based on the results of the monitoring the monitoring results,deci,de whether and when to apply plant protection measures. Robust and scientifically sound threshold values are essential components for decision-making.

✓ **Principle 4—non-chemical methods**

Sustainable biological, physical and other non-chemical methods ,must be preferred to chemical methods if they provide satisfactory pest control.

✓ **Principle 5—pesticide selection**

The pesticides applied shall be as specific as possible for the target and shall have the least side effechuman health, non-target organisms and the environment.

✓ **Principle 6—reduced pesticide use**

The professional user should keep the use of pesticides and other forms of intervention to levels that are necessary, e.g., by reduced doses, reduced application frequency or partial applications, considering that the level of risk in vegetation is acceptable and they do not increase the risk for development of resistance in populations of harmful organisms.

✓ **Principle 7—anti-resistance strategies**

Where the risk of resistance against a plant protection measure is known and where the level of harmful organisms requires repeated application of pesticides to the crops, available anti-resistance strategies should be applied to maintain the effectiveness of the products. This may include the use of multiple pesticides with different modes of action.

✓ **Principle 8—evaluation**

Based on the records on the use of pesticides and on the monitoring of harmful organisms the professional user should check the success of the applied plant protection measures.

Components of IPM

- Legislative management practices
- Cultural management practices.
- Mechanical/ Physical management practices
- Genetical management practices.
- Biological management practices
- Semi chemical and other novel approaches
- Chemical management practices.

Legislative management practices:

The first quarantine act in U.S.A. came into operation in 1905. The legislative measures in force now in different countries can be grouped into the following five categories Legislation to prevent the introduction of foreign pests, diseases and weeds. Ex -the grapevine phylloxera got introduced into France from America by about 1860.

Phytosanitary certificate-The consignment should also be accompanied with the certificate issued by the Officers of agriculture department of the exporting country so as confirm that the consignments are pest free

The **DIPA, 1914**, have empowered the states to enact such laws as are necessary to prevent the spread of dangerous insects within their jurisdiction

Cultural management practices

- The main fields free from pest infestation by removing plant debris, trimming of bunds, treating of soil and deep summer ploughing which kills various stages of pests.
- Testing of soil for nutrients deficiencies on the basis of which fertilizers should be applied.
- Selection of clean and certified seeds and treating seeds with fungicide or biopesticides before sowing for seed borne disease control.
- pest resistant/tolerant varieties should be used which play a significant role in pest suppression.
- Adjustment of time of sowing and harvesting to escape peak season of pest attack.

Mechanical / physical management practices

- Removal and destruction of egg masses, larvae, pupae and adults of insect pests and diseases parts of plants wherever possible.
- Installation of bamboo cage cum bird perches in the field.
- Use of light traps and destruction of trapped insects. Ex- moths, flies and beetles etc.
- Use of rope for dislodging leaf feeding larvae e.g. caseworm and leaf folders.

Genetically management practices

- Selection of high yielding varieties for different crops
- Selection of comparatively pest resistant/tolerant varieties
- Release of sterile males of insects in sufficient number in field to compete with fertile males. Sterility in males is induced in laboratory either through chemosterilants or through radiation.

5. Host plant resistance: One IPM strategy is to grow crop varieties that are resistant to pest damage. Crop varieties that are resistant to pest damage are said to have host plant resistance-
Host plant resistance can be broken down into three categories: **non-preference**, **antibiosis**, and **tolerance**.

Biological management Practices

Biological control of insect pests and diseases through biological means is most important component of IPM.

- **Parasitoids:** These are the organisms which lay eggs in or on the bodies of their hosts and complete their life cycles on host bodies as a result of which hosts die. Example are different species of *Trichogramma, Apanteles, Bracon, Chelonus, Brachemeria, Pseudogonotopus* etc.
- **Predators:** These are free living organisms which prey upon other organisms for their food. Examples are different species of spiders, dragon flies, damsel flies, lady bird beetles, Chrysopa species, birds etc.
- **Pathogens:** These are micro-organisms which infest and cause diseases in their hosts as a result of which hosts are killed. Major groups of pathogens are fungi, viruses and bacteria. Some nematodes also cause diseases in some insect pests.

Chemical management practices

Use of chemical pesticides is the last resort when all other methods fail to keep the pest population below economic loss. Examples: stomach poison- effective against biting and chewing insects like (beetles, catterpillars). Ex- Spinosad.

- Systemic poison: effective against sucking pest like (aphid, leafhopper). Ex- imidacloprid and thiacloprid.
- Contact poison: effective against orthropods such as aphids. Ex- acephate, carbaryl, fipronil, pyrethrins etc.
- Fumigants: chlorinated hydrocarbons
- Organophosphates: carbamates
- Synthetic pyrethroids: deltamethrin, cypermethrin.

CONCLUSION

Relevance of IPM practices are more important in vegetable and fruit crops because of their unique mode of consumption by human being. Pesticides which are generally highly toxic and are known to have toxic residual effects could not be recommended off hand. To get more profit, farmers do not wait until waiting periods of pesticides and harvest the crop to market the same. This leads to pesticides poisoning, chronic effects, in some cases even deaths. Thus, we have to be more careful and cautious in applying pest control practices in field crops.

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