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Non- Chemical Approaches in Integrated Pest Management

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Abstract

Pesticides, crop protection systems, crop yields, and cropping practices may all be improved by employing pesticides. Insect resistance and a decreasing supply of active chemicals both represent future challenges to crop productivity. As a result, agricultural systems that rely less on synthetic pesticides must be developed. The environmental impact of pest management strategies must be reduced. Changes in plant protection practices against the harm caused by insect pests are also impacted by increased concerns about the potential health repercussions of pesticides, a loss in arable land per person, and the emergence of new pest complexes, which is expected to be accelerated by climate change. Although pesticides remain an important weapon in the fight against insect pests, their unregulated use has resulted in a number of negative consequences, including contamination of the environment, toxic residues, pest comeback, resistance to pesticides, disruption of natural enemies, and so on. This might be accomplished by combining a non-chemical, safer delivery system that is also more environmentally friendly, allowing the pest to be dealt with while causing the least amount of interruption to its natural adversaries. This situation enhances the necessity for alternative pest management approaches such as physical controls, mechanical controls, botanical controls, and bio-rational controls.

Keywords: Botanical, Environment, Non-chemical, Resurgence.

Introduction:

Insecticides made from chemicals are mostly used to control insect pests in agriculture. Farmers frequently use chemical pesticides in big quantities on a regular basis to reduce crop loss due to pests. Despite the use of large amounts of insecticides, crop loss rises for a variety

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of reasons, including the emergence of pest resistance, pest revival, and pest replacement, in addition to having a detrimental impact on the environment and human health by leaving harmful residues. As a result, eco-friendly management techniques must be developed. The use of chemical pesticides in agriculture has been reduced in recent year's thanks in large part to the increased interest in biological management of pests and diseases that harm farmed plants. Microbial control of pests is mediated by natural enemies like predators and parasitoids and microbial control is achieved utilizing beneficial microbes such as insect pathogenic bacteria, fungi, viruses, protozoa and nematodes. However, the demand for contaminant-free, high-quality crops has led to a movement towards non-chemical pest management and sustainable crops cultivation. To restore the productivity and sustainability of soil as well as plants, efforts have been made to implement alternative, eco-friendly and cost-effective pest and disease management strategies. CABI and TTRI are conducting a scientific study to evaluate the environmental and economic feasibility of applying biological or non-pesticide methods for plant protection. There is need to reduce the negative impacts of pest control methods on the environment. Increased concerns about the potential effects of pesticides on health, the reduction in arable land per capita **(Novartis, 1997)** and the evolution of pest complexes likely to be accelerated by climate changes also contribute to change in plant protection practices.

Components of Non- Chemical Approaches:

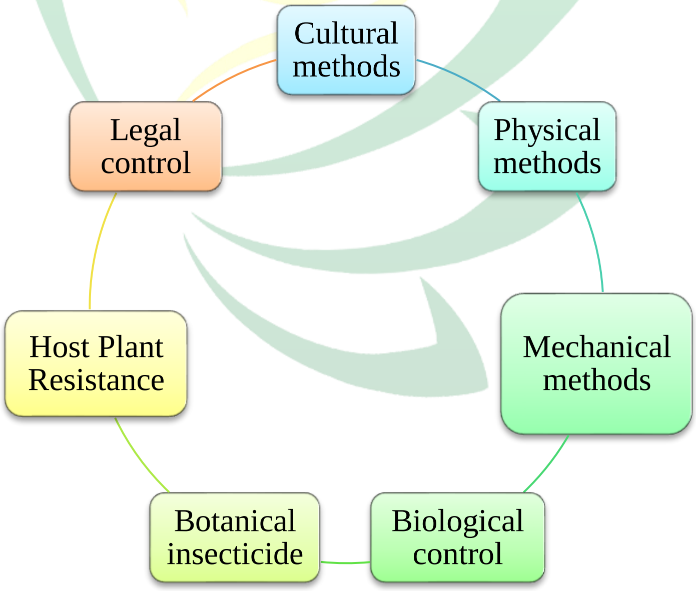

Fig:1 Components of Non- Chemical Approaches

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a) **Cultural Control:** Cultural control refers to the control of insects through the adoption, at the appropriate time, of conventional form practices in such a way that the insects are either destroyed or decreased in a population.

Tillage:

During the summer, deep ploughing exposes the pupa in the fields to solar heat and natural enemies, reducing the population **(Reddy D.S., 2018).**

Sowing time

Early sowing reduced gall midge and leaf folders in rice, shoot fly in sorghum, *Helicoverpa armigera* in chick pea, and aphid in mustard.

Cotton bollworm damage can be reduced by planting on time.

Seed rate:

High seed rate use was proven to minimize termites in wheat and shoot flies in sorghum.

Plant spacing:

Closer spacing increases the likelihood of plant hoppers, whereas broader spacing increases the likelihood of leaf hoppers. The population of *Helicoverpa armigera* was four times higher in a closer-spaced chickpea crop.

Water management:

Crops grown in low-lying waterlogged environments suffer greatly from whitefly and termites.

Helicoverpa armigera reduced as the frequency of irrigations increased.

Management of nutrients:

Most insect pests are substantially more prevalent when nitrogen fertilizer levels are high. Many pests are reduced by the application of potash and, in certain cases, phosphorus.Excess nitrogenous fertilizer application reduced the damage caused by the shoot fly and stem borer, *Chilo partellus*.The use of nitrogen reduced the incidence of *Helicoverpa armigera* on tomato. White fly in sugarcane rose as nitrogen application was reduced.

Crop rotation entails:

If rice is produced after jute, for example, the jute stem weevil will be suppressed and will not attack rice.

Trap Crop:

- Mustard is used as a trap crop against the diamond back moth, *Plutella xylostella* (2:25 ratio) in cauliflower or cabbage fields. Mustard should be planted in matched rows (one 15 days after planting cabbage or cauliflower and another 30 days later).
- *Helicoverpa armigera* is attracted to trap cropping Marigold after every 8 rows tomato.
- Okra is a trap crop used to eliminate *Earias spp*. and *Amrasca devastans* in cotton.

Intercropping:

- A tomato intercropped with cabbage (1:1) reduced *Plutella xylostella* egg production.
- Cotton-cowpea intercropping attracted more coccinellid predators, resulting in increased natural parasitism of spotted bollworms.
- Cowpea is intercropped in groundnut farming systems to attract red hairy caterpillars.
- Proper harvesting reduces the frequency of rice stem borer in rice crops.

Physical techniques

These strategies try to control insect populations by using equipment that physically harm them or change their physical surroundings.

Treatment with hot or cold water:

Dry heat, including exposure to sun rays, is effective in eradicating a variety of pests in seeds and stored goods during the hot summer months of April to June. Grain bugs can be destroyed by heating them to 550 degrees Celsius for three hours. Cotton seeds exposed to sunlight in thin layers for 2-3 days in April help to kill diapausing larvae of the pink boll worm. The treatment of sugarcane setts using heat therapy units, either hot water or hot air, kills the scale insects that are brought over from the plant. Treatment of plant storage organs using hot water, such as roots, corns and bulbs.

Moisture content:

The moisture content of grain and that of the store house is a very important factor for controlling insects. Food grains with a moisture level below 11% are relatively resistant to insect attack, whereas moisture absorption. Content higher than 15% makes the grains susceptible to almost all types of insect pest attack. It is therefore recommended that grains be dried in the sun before storing so that its moisture content is not more than 8%.

a) **Mechanical Control:**

Mechanical devices or manual forces are used to manage pests in this sort of control.

Sticky trap:

Use yellow/blue sticky traps coated with castor oil to catch whiteflies, aphids, leaf miners, thrips, and other pests.

Luminous trap:

Before the introduction of synthetic organic insecticides, light traps for attracting and mass-killing months and beetles were utilized as a control strategy. The traps may still be effective for monitoring the population of major insect pests in a given area. The use of light traps to capture adults has proven effective in controlling Plessey borer, root borer, and whit grub damage in sugarcane. Monitoring unit of one light trap per acre, and mass collection unit of two to three per acre.

Table 1: Light trap to attract the different species

Common name	Scientific name	Different crop	Family	Order
American Bollworm	*Helicoverpa armigera*	Mungbean, Gram, Wheat, Vegetables, Cotton, Maize	Noctuidae	Lepidoptera
Armyworm	*Spodoptera litura*	Mung bean, Gram, Wheat, Vegetables, Cotton	Noctuidae	Lepidoptera
Termites	*Microtermes* Spp.	All crops, vegetables and ornamentals	Termitidae	Isoptera
Green Bug	*Chinavia hilaris*	Mungbean, Gram, Vegetables, Cotton	Pentatomidae	Hemiptera
Grey weevil	*Myllocerus virdidanus*	Mungbean, Cotton	Curculionoida	Coleoptera

b) Biological control

According to **Paul De Bach (1964)** "The utilization of parasites, parasitoids, predators and pathogens for the regulation of host population density is called as biological control."

Component of Biological control:

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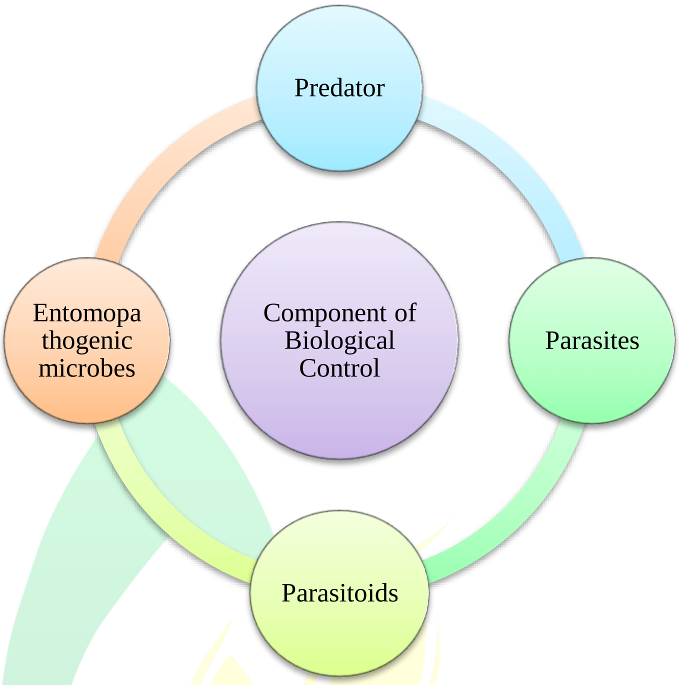

Fig-2: Components of biological control

d) Botanical insecticide:

Botanical insecticides are a viable alternative to synthetic pesticides due to their non-phytotoxicity, biodegradability, and fast decomposition **(Shivkumara *et al*., 2019).**

Botanical insecticides outperform synthetic pesticides in the following ways:

1. Have little mammalian toxicity and so pose few or no health risks or environmental damage.
2. There is no chance of building resistance while using natural forms.
3. Because they are target specific, they are less dangerous to non-target creatures such as parasites, predators, and pollinators.
4. It is not known what causes pest species recurrence.
5. It is not phytotoxic to crop plants.
6. They do not leave residues on crop produce or the environment, contributing to conservation and consumer safety.

e) Host Plant Resistance:

Insect host plant resistance (HPR) is a low-cost, ecologically friendly pest management strategy. The most enticing feature of HPR is that farmers do not need much experience with application techniques or to invest any money. Significant progress has been made in the

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discovery and creation of agricultural cultivars resistance to major pests in a variety of crops. Resistance genes must be bred into high-yielding cultivars capable of adapting to a wide range of agro ecosystems. Insect resistance should be one of the criterion for releasing varieties and hybrids to farmer cultivation. HPR can be turned into an effective weapon for decreasing insect pest losses by combining genes from wild relatives of crops with unique genes from *Bacillus thuringiensis*.

f) Legal control:

Restriction on the transportation of certain commodities within or beyond the country, or between various parts of the country, by enacting specific laws and regulations. Citrus greening, for example, is a big problem in Pokhara, and movement of seedlings and grafts from Pokhara to various parts is legal regulation**.**

Why is non-chemical insect pest treatment preferred?

To overcome the problems of following we preferred non- chemical approaches for pest management

- Insect resistance to pesticides is developing.
- The resurgence of the treated population.
- Secondary pest outbreak.
- Food and forage residue.
- Pollution of the environment and deterioration of its quality.
- Extermination of non-target animals and natural enemies.
- Dangers to human health

Conclusion:

The uncontrolled use of pesticides that are chemical-based has resulted in insecticide resistance, contamination of the environment, pest resurrection, secondary pest outbreaks, and a reduction in the number of natural enemies. In recent years, IPM-based pest control practices have become more useful and applicable for pest management. In this technique, pest populations are kept below ETL by the use of cultural, biological, physical, mechanical, and legal approaches to insect pest management. Non-chemical insect pest control is a feasible answer to this issue. In the long run, this method poses no risk to human health, the environment, or natural adversaries.

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