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Biological Pesticides for Control of Crop Pests

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Abstract

The biotic and abiotic components of the environment are greatly impacted by chemical pesticides. Due to the adverse effects of chemical pesticides, crop production in the current situation is essentially required through sustainable and environmentally friendly management. Biopesticides are a potent tool for the next generation of environmentally friendly agricultural products and a substitute for chemical pesticides. Biopesticides are a blend of naturally occurring materials that control pests in a non-toxic and environmentally friendly manner. The National Farmer Policy of 2007 strongly suggests the promotion of biopesticides as a way to increase agricultural productivity while preserving the environment and farmer health.

Introduction

The usage of biopesticides has increased dramatically over time in India, with a total of 8847 and 8645 metric tonnes in 2019–20 and 2020–2021, respectively (Yadav, 2022). They have a small target range, slow movement and very focused action. Compared to conventional pesticides, they generally pose less risk to humans and the environment. They don't have any residue problems, friendly to non-target species and comparatively less expensive. The five most significant classes are namely microbial pesticides, plant-incorporated protectants, biochemical pesticides, botanicals and biotic agents.

Microbial pesticides

These will only have a toxic effect on a particular group or species of insect pests; they do not directly harm beneficial insects such as pollinators, parasitoids, predators, and parasites in treated areas. The microbial product can be used in conjunction with synthetic insecticides to enhance root and plant growth, increase yield, and promote the growth of beneficial soil microflora without deactivating the latter. Microbial pesticides are classified into four categories, according to Gupta and Dikshit (2010): bacterial, fungal, viral, and protozoan biopesticides.

i. **Bacterial biopesticides**: of all the microbial pesticides, bacterial biopesticides are the most widely used. The control of diseases and insects involves the use of both spore-forming and non-spore-forming bacteria. Bacteria disrupt the digestive system of a specific insect by producing endotoxins or insecticidal proteins that are specific to that particular insect. Many insect pests in forestry and agricultural fields have been found to be effectively controlled by the most widely used bacterium, Bacillus thurigiensis. *Bacillus thuringiensis* is effective at controlling diamond back moths on tomato, cotton, and pigeon pea.

ii. **Fungal biopesticides:** *Beauveria bassiana, Metarhizium anisopliae, Verticillium lecanii, and Nomuraea rileyi* are the most commonly used species of fungus biopesticides because they are effective against a wide range of plant diseases and insects known as entomopathogenic fungi, which are facultative or obligate, symbionts or commensals of insects. The fungi will attack the host and establish their conidia in the integument and the joints.

iii. **Viral biopesticides**: Lepidopterous pests of rice, cotton, and vegetables are controlled with viral biopesticides. The virus's protein coat rapidly breaks down in the larval gut, allowing the DNA to infect digestive cells. The host larvae will weaken and eventually die within a few days because they are unable to digest the food (Thakur, 2007). Baculoviruses (Bvs) are one example of a type of virus that can control hymenopterous and lepidopterous pests.

iv. **Protozoan biopesticides**: Targets of protozoan biopesticides will experience long-term effects. However, protozoa are not successfully used. Eg: Vairimorpha and Nosema will attack lepidopteran and orthopteran insects.

Biochemical pesticides

Biochemical pesticides, which include substances like pheromones or plant growth regulators, can occur naturally, reduce pests through non-toxic mechanisms, and protect the environment from pesticidal pollution. Oils derived from different plants are toxic to different insect pests, such as *Nigella sativa*, which can control *Callosobruchus chinensis*.

Plant-Incorporated are created by plants using genetic material that has been incorporated into the plant. These plants will eventually perish as the pest feeds on

them. The first transgenic plants (Bt plants) with insecticidal endotoxins derived from *Bacillus thuringiensis* were commercially produced in 1996. The genes that code for insecticidal crystal proteins have been transferred to various crops. Osmotic cell lysis results from transmembrane pores formed by cry proteins. The Cry3Bb1 protein, which is used to control *Diabrotica* spp. (Coleoptera) and the Cry1Ac protein, which is used to control *Helicoverpa* spp. (Lepidoptera), were expressed in maize hybrids that were developed in North America. Cry3A or Cry3C protein expression was developed in potatoes in order to control the Colorado potato beetle (Coleoptera).

Botanical pesticides

These are natural plant material that is ground from plant parts to create a powder or dust that can be applied in a carrier like talc, clay, or diatomaceous earth at full strength or diluted. This type of pesticide is known as a botanical. Numerous plant-based insecticides are employed, including rotenoids, natural pyrethrins, nicotinoids, and neem products. "Azadirachtin" is one example, which affects the reproductive and digestive systems of pests.

Biotic agents/Natural enemies

Natural enemies and biotic agents include predators that eat a large number of prey during their life cycle, are free-living, and are typically as large as or larger than their prey. A few examples are the lady bird beetle, whose larvae and adults consume scales, mites, mealybugs, aphids, whiteflies, woolly aphids, thrips, leafhoppers, psyllids, small caterpillars, and insect eggs. Other examples include the lacewing. The development of parasitoids always results in the death of the host insect and they are nearly the same size as their hosts. One or more eggs are laid into or onto the body of a host insect by an adult parasitoid, or else somewhere in the host's environment.

Benefits of biopesticides

More expensive but requiring fewer applications; primarily biodegradable; self-sustaining; delayed knockdown effect; less damaging to beneficial pests; primarily host-specific; preventive; reduced recurrence of pests; and shorter shelf life.

Disadvantages of biopesticides

Biopesticides act very specifically, necessitating a precise pest identification. They also work slowly, making them inappropriate for treating crops right away. The natural materials used to make biopesticides, such as plant bacteria, may raise ethical and environmental concerns. It will be challenging to culture a big amount.

Application of biopesticides

Biopesticides are usually applied in a similar manner to chemical pesticides but in environmentally friendly way. For effective control, a microbial agent requires appropriate formulation.

Conclusion

Developing countries such as India are vastly dependent upon agriculture. Many disadvantages associated with chemical pesticides such as reduction of valuable species, damage to the ecosystem and many serious health related diseases is overcome with the use of biopesticides. The demand for biopesticides is increasing progressively in all over the world. The use of biopesticide will work on enormous improvement in coming years. Biopesticides evidently have a potential role to play in development of future integrated pest management strategies. Further research and development of biological pest control methods must be given priority and people in general and agriculturists in particular must be educated about the handling and use of such control measures.

Reference

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