International Journal on Food, Agriculture, and Natural Resources
Volume 03, Issue 01, Page 45-49
E-ISSN: 2722-4066
http://www.fanres.org

*Review Paper*

# Future Role of Bio-Microorganism Pesticide in Pakistan

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Received: 6 March 2022; Revised: 16 March 2022; Accepted: 30 March 2022
DOI: *https://doi.org/10.46676/ij-fanres.v3i1.87*

***Abstract*—Microbial pathogens are disease-causing organisms that are spread in vast quantities in the pest population, similar to how chemical pesticides are applied. These microorganisms are utilized through introduction or inundative applications for organic control of bug bothers. Insects are vulnerable to a variety of illnesses brought about by infections, microscopic organisms, the parasite, protozoa, and nematodes, among different microorganisms. Insect microbial pathogens are being studied in depth in order to develop environmentally acceptable pest management solutions for agriculture. These days, plant protection environments and insect pest control are hampered by the development of chemical resistance and residues at higher trophic levels. Bio-pesticides have been replacing chemical pesticides to protect nontarget creatures from the harmful effects of chemicals in recent years. This research discusses the insecticidal characteristics of microorganisms, just as their potential utility in bother the board.**

***Keywords* — *Biopesticides, Plant-incorporated protectants (PIPs), biochemical pesticides, microbial pesticides***

## I. INTRODUCTION

Microorganisms are the smallest living organisms around us. They are widely distributed over the biosphere due their outstanding metabolic ability and their capacity to proliferate in a wide scope of ecological conditions [1]. Bioremediation is a process in which there is degrading, detoxifying, and immobilizing of different synthetic substances and actual contaminations from the climate by the activity of parasites, microscopic organisms, and plants [2].

Pesticides are the compounds or mixture of substances used to prevent eradicate, repel or mitigate pest. Pesticides are used to protect crops from pest damage. Chemical fertilizers and pesticides produce pollution, hurting the ecosystem and infecting people at frightening rates. Pesticides when employed in crops released into the environment where they contact directly or indirectly to humans and cattle, harming their life [3].

Pesticides found in the environment (soil, water, air, and food) are exposed to human and livestock through a variety of pathway viz., inhalation, ingestion and skin contact. Pesticide causes acute and chronic health concerns having a negative impact on living organisms [4]. Horticulture is a significant piece of Pakistan's economy, representing more than 30% of GDP. Vermin like bugs, weeds, plant illnesses, and nematodes unleash devastation on horticulture. Substance pesticides have expanded food creation, yet they have additionally had adverse consequences on the ecosystem and nontarget creatures. Furthermore, volatile pesticide residues have caused some domestic customers to be concerned about food safety. Insect pests, diseases, and a range of weeds are all controlled by biopesticides. Biopesticides compete for plant host resistance or induce it. A biochemical can be used to stop an insect pest or pathogen from growing, feeding, or reproducing [5]. Biopesticide yield on the planet aggregates around 3000 tons each year, and Pakistan has a colossal potential for biopesticide creation and use in Asia [6].

There are two critical imaginative work associations are working on biofertilizers in Pakistan, dependent upon the sort of unique fixing:

(1) The Nuclear Institute for Agriculture and Biology (NIAB)

(2) The National Institute for Biotechnology and Genetic Engineering (NIBGI).

There are three critical biopesticide classes [5]

(1) Biochemical

(2) plant-based anti-oxidants

(3) Microbial pesticides

Biopesticides can be used in agriculture to control insects, diseases, weeds and worms. These biopesticides are categorized as follows [4]

1: Microbial pesticides

2: biochemical pesticides

3: plant-incorporated protectants

4: Beneficial insectsBacterial

## II. LITERATURE REVIEW

### *A. Advantages of microbial insecticides*

- The microbial insect sprays are basically nontoxic and nonpathogenic to people and different creatures yet successful in focusing on the pest. The significant benefit of microbial insect sprays is their well-being.
- The harmful effects of microbial insecticides are generally limited to a solitary group or class of bugs, most microbial

insecticides have no direct effect on beneficial insects (such as pest predators or parasites) in that areas.

- The most microbial bug sprays can be utilized in the mix of manufactured compound insect sprays in light of the fact that as a rule the microbial item isn't deactivated or harmed by buildups of traditional insect poisons.
- Microbial insect poisons are utilized to gather in light of the fact that their extras represent no danger to people or different creatures.
- In rare circumstances, pathogenic organisms can set themselves up in an irritation populace or living space, giving power over succeeding nuisance ages or seasons.
- They additionally empower sound soil microorganisms, which further develop root and plant development. As a result, they contribute to the rise in agricultural yield.

*B. Disadvantages of microbial insecticides*

- Each treatment may only control a fraction of the pests in a field or garden since each microbial pesticide is harmful to only one species or group of insects. Because conventional insecticides are not equally efficient against all pests, they, too, have limitations. This is due to selectivity, and this disadvantage is frequently more apparent for general predators, chemicals, and microbial. Predators and pesticides, on the other hand, may pose a threat to other beneficial insects in an endangered region.
- Several forms of microbial insecticides lose their potency when exposed to heat, desiccation, or UV radiation. As a result, for particular goods, correct timing and application processes are very crucial.
- Some microbial pesticides require special formulation and storage processes. Although these methods may make the development and delivery of some products more difficult, they do not significantly hinder the use of widely accessible microbial pesticides. (All pesticides, including microbiological insecticides, should be stored as directed on the label.
- The expected market for these items might be restricted on the grounds that few microbial pesticides are vermin explicit. Their development, registration, and manufacturing expenses can't be dispersed across a large range of pest management products. As a result, some things are either scarce or too expensive (e.g., several insect viruses).

*C. Bacteria*

Previous study revealed that more than ninety species of Insects, plants, and soil microbes have all been isolated [4]. Among them, Bacillus thuringiensis or BT is the species widely used as microbial insecticide. BT utilized as a microbe of lepidopterous bugs like American bollworm in cotton and stem drills in rice. When BT consumed by insect larva, it produces toxins which harm mid gut of the pest, finally kill it. Main sources for the production of BT are the strain's viz., Bacillus thuringiensis var. kurstaki Bacillus thuringiensis var. galeriae Bacillus thuringiensis var.dendrolimus [7].

*1) Fungi*

Entomopathogenic fungi are fungi that kill insects by infecting and attacking their hosts. These fungi have been found as a viable biocontrol agent for controlling insect pest populations while causing minimal harm to nontarget pests. Trichoderma is an ascomycetous fungus that may be found in all soil types and has the telomorph Hypocrea. Several Trichoderma species have been discovered to have a mutualistic endophytic connection with a variety of plant species, as well as the ability to act as biocontrol agents for plant fungal infections. Mycoparasitism, i.e., the ability to attack and consume the nutrients of other fungus is a series of processes that begin with detection of the host fungi and progress through attack, penetration, and death. Trichoderma produces cell wall destroying enzymes (cellulases, chitinases, etc.) That degrades the host fungus cell wall and kills it during these processes [8].

*2) Virus*

There are around 1600 distinct viruses that infect 1100 different insect and mite species. Baculoviruses are a group of naturally occurring viruses that only infect 100 insect species and their relatives. These are virus strains that can infect and kill a variety of pests. Cotton, rice, and vegetable pests are particularly vulnerable to them. Because of the difficulties associated with large-scale manufacture, their use has been restricted to local areas. These viruses directly applied to plants that attacked by Hymenopteran, Dipteran, or Lepidopteran insects. These virus types are consumed by insect pest larvae. Virus protein capsules are dissolved and virions are liberated in the midgut of larvae. These virions infect and multiply in host cells, resulting in the production of additional virus particles. These virus particles infect a greater number of cells in the host body, resulting in the larvae's death and the release of virions into the environment [9].

*D. Protozoa*

Protozoan microorganisms contaminate a wide assortment of creepy crawly has in nature. In spite of the way that these illnesses can kill their creepy crawly has, a significant number of them are more significant for their industrious, crippling impacts. A decrease in the figure of progeny generated by infected insects is one of the most prevalent and major consequences of protozoan infection. Although protozoan diseases assume a significant part in regular creepy crawly populace control, only a handful appears to be suitable for use as insecticides. Microsporidia, like Nosema spp., are oftentimes host-specific and take a long time to work, resulting in recurring infections in the majority of cases. The natural exercises of numerous entomopathogenic protozoa are mind boggling. Merely live hosts allow them to flourish, and certain species require a transitional host.

The lifespan and recycling of Microsporidia organisms in host populations, just as their incapacitating impact on proliferation and generally wellness of target bugs, are the main advantages of Microsporidia organisms. As inundatively utilized microbial control specialists, a few animal categories have been very dynamic [10]. Some protozoan species are hurtful, for example, Nosema locustae, and the solitary grasshopper microbe that has been distinguished and monetarily settled [11]. In the mid-nineteenth century, the first

microsporidium, N. bombycis, was discovered in Asia, Europe, and North America as a disease of silkworm pébrine [12].

Pébrine is also an issue in nations that produce silk, resulting in considerable economic losses [13]. About 1,000 protozoan species, most of which are microsporidia, attack invertebrates such as grasshoppers and heliothine moths. The insect-pathogenic protozoan species Nosema spp. and Vairimorpha Necatrix is Notable [13].

Protozoans produce spores, which communicated by a variety of insect species. Nosema Spp. Spores absorbed by host and grow in the midget. The sporoplasm releases germinating spores, which assault the host's target cells, causing extensive inflammation and tissue death. The sporulation process begins anew when contaminated tissues ejected and consumed by a susceptible host, leading to an epizootic infection. Disease vectors include parasitoids and insect predators, of course [13, 14].

*1) Nematodes*

Entomopathogenic nematodes are nonsegmented roundworms with a soft body that are the obligatory or facultative vermin of bugs. Entomopathogenic nematodes are parasitic nematodes that attack insects. They live in dirt habitats and seek out their hosts. Carbon dioxide, vibration, and additional chemical stimuli elicit a response [15].

Since they are nontoxic to people, sensibly explicit to their objective bugs, and can be treated with common pesticide hardware, entomopathogenic nematodes fit well into Integrated Pest Management (IPM) programs. Two nematode families, Heterorhabditidae and Steinernematidae, have been effectively utilized as natural insect sprays in bug the executive's programs. The adolescent stage enters the host creepy crawly through spiracles, mouth, butt, or intersegmental layers in certain species. It subsequently passes through the cuticle and into the hemocoel. Both Steinernema and Heterorhabditis are mutualistically linked with bacteria of the genera Photorhabdus and Xenorhabdus, correspondingly [16]. The adolescent stage discharges advantageous microorganism cells into the hemocoel from their digestive organs. Creepy crawly hemolymph permits microscopic organisms to develop and inside 24 to 48 hours, the tainted host generally kicks the bucket. Nematodes continue to feed on host tissue after the host has died, develop, and reproduce. To reach adulthood, the offspring nematodes go through four juvenile stages. At least one ages may happen inside the host carcass, contingent upon accessible assets, and an enormous number of infective adolescents are at last released into the climate to contaminate different has and proceed with their life cycle [4].

Table 1. Microorganism their host and uses.

***Bacteria***

| Pathogen | Host Range | Uses |
|---|---|---|
| Bacillus thuringiensis var. kurstaki (Bt) | caterpillars (larvae of moths and butterflies) | Effective against caterpillars that eat leaves. Apply in the evening or on overcast days, and point some shower to bring down surfaces or leaves, as it deactivates rapidly in the sun. In the environment, it does not cycle widely. |
| Bacillus thuringiensis var. israelensis (Bt) | larvae of Aedes and Psorophora mosquitoes, black flies, and fungus gnats | Only works against larvae. If they eat it, it becomes active. At typical treatment rates, Culex and Anopheles mosquitoes are not suppressed. In the environment, it does not cycle widely. |
| Bacillus thuringiensis var. | wax moth caterpillars | Only used in honeybee hives to reduce wasp moth infestations. |
| Bacillus popilliae and Bacillus lentimorbus Doom | larvae (grubs) of Japanese beetle | The primary Illinois lawn grub is not vulnerable to milky spore disease, |
| Bacillus sphaericus | larvae of Culex, Psorophora, and Culiseta mosquitos, larvae of some Aedes spp., | For use against Culex, Psorophora, and Culiseta species; additionally successful against Aedes vexans whenever eaten. In sluggish or murky water, it still works. |

***Virus***

| Pathogen | Host Range | Uses |
|---|---|---|
| Gypsy moth nuclear plyhedrosis (NPV) | virus gypsy moth caterpillars | The US Forest Service is sole manufacturer and user of viral insecticides used to manage forest |

| | | |
|---|---|---|
| | | pests. |
| Tussock moth NPV | tussock moth caterpillars | |
| Pine sawfly NPV | pine sawfly larvae | |
| Codling moth granulosis virus (GV) | | Ultraviolet light causes fast disintegration in the future. |

***Protozoa***

| Pathogen | Host Range | Uses |
|---|---|---|
| Nosema locustae | European cornborer caterpillars, grasshoppers and mormon crickets | Valuable for rangeland grasshopper control, whenever : for example, terrace gardens, in light of the fact that the infection is moderate acting and grasshoppers are versatile. Besides it is likewise viable against caterpillars. |

## III. THE FUTURE OF BIOPESTICIDE

The increase in crop yield from current agricultural techniques has reached a plateau in several countries, including Pakitan, and environmental problems are becoming a major concern as a result of the excessive and indiscriminate use of chemical fertilizers and pesticides [19]. As a result, microbial-based biological control may be an alternative method that might help to achieve the goal of sustainable agriculture. Microbial biopesticides are projected to assume a significant part in the incorporated bug the board (IPM) in the present day and maintainable agribusiness for overseeing nuisances of vegetables, organic product crops, grain crops, wood vermin, and bugs of home and general wellbeing concern. Because of the rising need for environmentally friendly agricultural treatment solutions, the worldwide Biopesticide market is expected to grow in future years. Governments in various regions are putting in place regulations to encourage farmers to use environmentally friendly products. Government authorities are also promoting it through promotional initiatives. The market for Biopesticide fueled by the surge in popularity of bio-control seed treatment options. Biopesticides are becoming more popular as the cost of artificial pesticides and fertilizer raises. The rise of the worldwide Biopesticide market felled by a change of sustainable ways by increasing agricultural output in various parts of the world. Biopesticides provide a number of benefits, including improved action efficacy, long-term crop protection, and the insect population targeting [17, 18, 20].

## IV. CONCLUSION

Biological control of a variety of insect species has been linked to bio pesticides. These are pesticides that are made from microorganisms or natural sources. Bio pesticides are an important tool for addressing the growing concern about pesticide residues in food as well as the problem of pesticide resistance. As a result, the use of Bio pesticides for crop protection is becoming more popular in order to reduce the use of chemical pesticides that harm the environment as well as human and animal health. While bio pesticides have been present for more than 50 years, the market has seen the most significant rise in terms of sales and user acceptance in the last five years.

Pakistan is likewise among the world's best ten makers of wheat, cotton, sugarcane, mango, dates and kinno oranges, and is positioned tenth in rice creation. Significant yields (wheat, rice, cotton and sugar stick) contribute around 4.9 percent, while minor harvests contribute 2.1 percent to the nations all out GDP. Thus formers of our country must look after biomolecules for maximum yield of the crop and also for healthy atmosphere. To improve output, our government established the IMCCP at the NARC in capital of Pakistan. Thus, we can say that future of bio pesticide in Pakistan is very bright.

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