

# Biopesticides in India

## Technology and Sustainability Linkages

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Pesticides are chemicals which are used, to control harmful and disease-causing mosquitoes, rodents, fungi *etc.*, by farmers to maintain and/ or increase the crop yield. Over half of the crop yield is lost if they do not use pesticides to control infestation caused by insects and pests. It has been reported that there is around 45% (approx) yearly loss in food production due to infestation, thus, making the use of pesticides imperative. Though pesticides are used to protect the crops from pest infestation and post-harvest losses but their continuous use without following Good Agricultural Practices has led to an increase in

### What are biopesticides and their need?

Biopesticides are green pesticides which are derived from living things or obtained from living organisms like plants, animals, certain bacteria's, viruses, fungi, parasites, pheromones, or are present in nature itself. For instance, canola oil or baking soda used for application as a pesticide, are considered as biopesticides.

Biopesticides have proven to be advantageous to growers as these are less hazardous, have almost negligible or no re-entry in to food chain and pre-harvest intervals and compatible with

their residues thus causing toxicity to human, animals and environmental health. Resulting residues enter in our food chain, including all plants, dairy and dairy products even in women's breast milk, meat and meat products, soil ecosystem and water bodies. So there is an urgent need to find out the alternatives of these chemical-based pesticides. Alternatives to be provided/ made available should be safe and effective in controlling the pest attack. Application of biopesticides to protect the crops from pest attack as well as environmental hazards can be one of the choices.

other biocontrol programs. Because of these reasons, the use of biopesticides as an alternate of chemical-based pesticides has increased by 10 per cent. Show different types of mode of actions so issues of pest resistance resolved, dejected more quickly followed by less pollution, safer than agrochemicals, ecofriendly and biodegradable in nature, target specific, safe for non-target organisms and resolve the issues of pest resistance. Biopesticides play an indispensable role in agricultural development by providing protection to plants, improves the

quality and crop production. Significant effect has been obtained in crop protection after application of biopesticides like *Bacillus thuringiensis*, *Trichoderma*, *Pseudomonas*, *Metarhizium*, *Beauveria*. In Indian market

### Types/Categories of Biopesticides

Environmental protection agency (EPA) classifies biopesticides in to three main categories i.e., biochemical, microbial and plant-incorporated protectants (PIPs). They are classified according to source of extraction and the type of molecule/compound used for their preparation.

#### Microbial pesticides

Microbial pesticides are compounds derived from microorganisms such as bacteria, fungus, viruses, protozoa, and algae that are employed in pest management. Toxic metabolites are created, which microbes employ to kill and stop the growth of pests. Some fungus, for instance, can suppress weeds, while others could destroy insects are known as bioherbicides. The most advancements have been made in biological control agents, such as *Pseudomonas* sp., *Trichoderma harzianum*, and *Bacillus thuringiensis*. The main groups of microorganisms utilized as biopesticides are fungal genera, *Chromobacterium*, *Pseudomonas*, and *Yersinia*, as well as bacteria genera. *Paecilomyces*, *Beauveria*, *Verticillium*, *Hirsutella*, *Metarhizium*, *Lecanicillium*, and nematodes from the *Heterorhabditis* and *Steinernema* genera and *Heterorhabditis*. Among the different varieties of the bacterium, *Bacillus thuringiensis* (Bt) is the most used microbial pesticides, it can produce a specific protein which is used to control harmful insects in crops such as cabbage, potato etc. It has been found that Bt is poisonous to moth and butterfly larvae, that's why its foliar application applied on plants foliage or added as genetic material in crops. Numerous Bt strains have been created, and ones that suppress fly larvae are currently accessible. Certain species of Bt are specific to controlling mosquito and fly larvae, while others control moth larvae that are present on plants. Whether a certain Bt develops a protein

microbial biopesticides categorized as fungi, bacteria, and viruses. At present, there are about 20 microorganisms registered as biopesticides with Central Insecticide Board and Registration Committee (CIB & RC).

that can bind to a to a larval gut receptor, thereby causing the insect larvae to starve. Baculoviruses are another important microbial pesticide, they are species-specific, toxicity is related through crystalline occlusion structures that are active against eating insects, specifically caterpillars. Entomopathogenic nematodes, which are employed as biocontrol agents majorly related to species having genera *Heterorhabditis* and *Steinernema* are linked to mutualistic symbiotic bacteria of the genera *Photobacterium* and *Xenorhabditis*. Safer for environment, non-target organisms and mammals. Their commercial development as biocontrol agents has been convenient because of their ease in mass production, using in vivo or in vitro techniques, and exemption from registration.

#### Biochemical pesticides

These are the naturally occurring products, used for controlling pests *via* nontoxic mechanisms. They are further classified according to their types depending upon whether they function in controlling infestations of insect pests by exploiting pheromones (semiochemicals), plant extracts/oils, or natural insect growth regulators.

- **Phytopesticides** : They are plant-based extracts or essential oils extracted from different parts of the plants that are used for insect pest management. Type and extent of action against insects depends on various factors *viz.*, physiological characteristics of insect species, kind of plant and its extract and type of the essential oils. Phyto pesticides may behave as repellents, attractants, antifeedants. They may interfere in the process of respiration, obstruct in recognition of the host plants by insects, inhibit oviposition and decrease adult emergence due to ovicidal and

larvicidal effects. Essential oils kill insects by blocking their respiration system or functioning of cell membrane. Neem oil contains sulphur compound known to possess the fungicidal property. Due to low residual toxicity oil-based pesticides are applied directly on the plant infected by mites/insects. Oil-based pesticides are effective against soft-bodied arthropods, commonly used to control mites, aphids, whiteflies, thrips, mealy bugs, and scale insects.

- **Semiochemicals:** Semiochemicals are used by insects to find their mate, feed, host, to hide themselves from their natural enemies *etc.* They are compounds which are actively

### Benefits and drawbacks of biopesticides

Biopesticides are much more advantageous than the traditional pesticides as they are ecofriendly, target specific, biodegradable and safe for non-target organisms. On the basis of all the facts presented, it can be concluded that it's better to use biopesticides for pest management instead of synthetic chemical pesticides.

Regardless of these numerous advantages/benefits of biopesticides, they are not fully able to replace conventional synthetic pesticides from the market globally. Small life span, high cost of production and small shelf life and viability of the biopesticides. inability

### Conclusion

From this article, it can be concluded that biopesticides have successfully proved that they are much efficient, easy to use and handle, pocket friendly as well as eco-friendly for managing the population of insects-pests. They play a significant role in improving the farmers' income by increasing the agricultural produce. As they do not pose any health risks/issues while working with these products, so they are safe for handling and pose zero risk to mankind being biodegradable in nature. But due to less

used in various approaches adopted for the integrated pest management (IPM) in plant-insect or insect-insect interactions. They are safe for the environment, non-toxic in behavior, specific for their target and much safer than the traditionally used controlling agents.

### Plant-incorporated protectants (PIPs)

These are the biopesticides that are produced from genetic material of the plants and inserted into the plant genome (Meshram *et al.*, 2022). These genes help the plants to fight from pest's attack. Crops produced through PIPs are also known as genetically modified or genetically engineered.

to fulfil the market demand at global level, dose determination of active ingredients due to different climatic conditions like temperature, humidity, soil conditions *etc.*, less field efficacy limit the production, application and large scale commercialization of these products. Farmers are not interested in biopesticides because of their high specificity, which means that they work solely against the pathogens and pests that they are targeting. Multiple biological agents found in plants must be used to manage various infections and pests in the field. These products are not available for every pest or pathogen and laborious too.

demand and availability of biopesticides, their application is getting highly discouraged. Thus, providing funding or grants to scientists, business owners, manufacturers, and distributors will contribute to an increase in large scale production with enhanced shelf life to enhance its accessibility. In addition, there is a need to create awareness among the farmers to encourage them to use biopesticides instead of conventional one.