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REVIEW ARTICLE

Current Scenario of Biopesticides in India

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ABSTRACT
The biopesticides industry in India is rapidly evolving, representing increasing global agricultural trade, a changing regulatory climate, and changing customer tastes. Biopesticides currently account for 5% of the pesticide industry in India, with at least fifteen microbial species and 970 microbial formulations registered with the Central Insecticides Board and Registration Committee (CIBRC). In developed countries, a public-private collaboration approach to the development, manufacturing, and marketing of environmentally sustainable pesticide alternatives is a regular requirement. Biopesticides may benefit significantly from research in the areas of processing, manufacture, and distribution. To boost developed countries' capacity to generate and use biopesticides, further research is required to incorporate organic matter into development. Simultaneously, community-funded projects, private developers, and chemical producers must be encouraged to take over biopesticide enterprises. In developing countries, the implementation of stringent quality control systems and the availability of low-cost pesticides are also critical. As a result, different facets of biopesticides, such as the present scenario, challenges, opportunities, and control network in their successful use for the good of the human race, must be reviewed regularly.
Keyword: Biopesticide, Microbial, India, Scenario

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INTRODUCTION

For more than a century, chemical pest control has been widely used in agriculture. The use of pesticides has been shown to reduce plant damage by 39 percent worldwide on average. Post-harvest losses and poor quality due to insect repellent are major concerns in a tropical country like India. To increase the quality of their crops, farmers rely heavily on the use of organic pesticides, which have also had a significant impact on human health and the environment. Insecticides work very well, but their impact on soil and atmosphere, as well as the increase in food residues, makes them dangerous to use. Spike intolerance is another danger worldwide. As a result, biopesticides are now popular with pesticides because of their ability to control pests and new methods of action that help prevent pest resistance from spreading [1, 14].

Biocontrol agents (BCAs) are needed in India because they are expensive and therefore environmentally safe. In India, a major obstacle to the manufacture and use of pesticides is the policy of marketing and marketing policy. Due to high costs and lack of effective satisfaction, farmers are reluctant to use new products [6]**.** Every day, the world's population is growing, requiring an increase in calorie intake. The widespread use of pesticides in food processing has increased as the population has grown. The use of pesticides will remain stagnant or grow in the future. New crop processing techniques and the growth of agricultural-based products are currently being used to address food safety concerns [17].

A farmer can use crops and bring about reliable yields without much hassle due to advances in technology and the use of machinery, as well as the use of advanced agricultural pesticides. This pesticide reduces insect-related field losses and ensures that food crops are available during the year at a normal rate. Pesticides are often designed to choose to avoid working with unintended pesticides; however, finding the necessary choices can be difficult, and harmful effects can be seen in non-target species as human beings. Reducing toxins can also lead to the use of pesticides. According to Maksymiv [13], 220,000 people die each year as well as 3 million cases of pesticides. With due care and vigilance, pesticides are

useful in agriculture; however, if they are not used with extreme caution, soil, water, and air quality will suffer.

Agostine Bassi was the first to use white muscardin fungus spores (*Beauveria bassiana*) to protect its larvae from pests and diseases that killed animals in the early 1800's. Demand for biopesticides, on the other hand, has not grown as much as expected, and the market for biopesticides remains small compared to the pesticides that are being developed. Because of their effectiveness, biopesticides are superior to traditional pesticides. On the other hand, when biological pesticides are neurotoxic to mice, biopesticides are used to prevent infestation, to fight food allergies, congestion and pesticides. Biopesticides, unlike toxic pesticides found in industrial products, are made from plant fragments, seeds, microorganisms, protozoa, and minerals. They can be used to cover trees and are said to be suitable for people and the weather. Biopesticides have gained more acceptance than conventional pesticides in the current pest management system.

The combination of resistance to insects is slow due to the wide range of mechanisms of action provided by biopesticides. As a result, the development and effectiveness of biopesticides as a new source of energy for abusers is promising. The small amount of land available for agriculture requires increased crop production to feed India's ever-growing population. Feeding, the world's most aggressive population, farmers are forced to cultivate widespread use of pesticides, with a strong focus on food self-sufficiency. Chemical pesticides have undoubtedly contributed to agricultural production, improved crop safety, and yields; however, their uncontrolled use has had a profound effect on the environment. The discovery of pesticide metabolites in various ecosystems has surpassed the major gains in the chemical industry. Their unintended effects on beneficial bacteria are important for soil health, and their residues end up in food and nutrition, which pollute the environment. In India, annual pest loss is expected to reach USD 42.66 million.

The Indian pesticide industry has very few chemical compounds in it. This often happens as a result of a product being removed from the market for legal or economic reasons, or because of opposition [8]**.** Better solutions and products for pest control based on biological processes are urgently needed. Biopesticides are the most promising and most promising; however, in developing countries such as India, there are various barriers to the sale of biopesticides. Significant limitations include the rapid action and low survival of biopesticides after exposure to radiation, high production costs, and a lack of awareness among Indian farmers.

Also, decision-makers lacking information about the potential of biopesticides, the lack of diverse experience in critical developmental areas, the difficulty of completing materia medica tests, and the long duration of the bioactive compound process before validation and motivation are all issues that require primary care [3]**.** Chemical use in India increased by about five hundred between 2009 and 2015, according to a study. In 2015, India's chemical exports to each region were zero.29 kg / ha, much less than other countries such as China (13.06 kg / ha), Japan (11.85 kg / ha), Brazil (4.57 kg / ha), and others. Demand for biopesticides was expected to be around $ 3 billion in 2013, accounting for about 5% of the total plant protection market, with an estimated increase of more than $ 4.5 billion by 2023. As part of the Integrated Pest Management (IPM) programs. Since 2017, India has developed at least 15 microbial control agents such as biopesticides, with 970 registered factories [4]**.** According to a recent study, biopesticides account for 4.2 percent of India's chemical industry. Low penetration, insufficient capital costs, unregistered product sales, and various regulatory and commercial problems all hamper the growth of the biopesticide industry in India. Effects of natural chemicals on the environment and biodiversity.

Nowadays, agriculture is heavily dependent on the use of a variety of pesticides. "Pesticide," according to Maksymiv [13] is a drug used to control / repel or kill "trouble" such as rats, snails, weeds, flies, bacteria or fungi. The term "pesticide" has been defined by the Food and Agriculture Organization and UNEP (1990) as "a chemical intended to protect against pest infestations on plants, humans and livestock." These chemicals can be for growths, defoliants, or compounds that prevent plant products from rotting during storage.

Chemicals used to increase the levels of nutrients in plants and animals, on the other hand, do not fall into the category of chemicals [5]**.** The recent development of biopesticides and biofertilizers, which are made from insect repellents using non-toxic and environmentally friendly methods, does not seem to be a new technology [18]**.** From the beginning of human civilization, they have manifested themselves in many ways. Living animals (natural enemies) or products collected from them, known as biopesticides, do not pose a threat to the ecosystem or human health and therefore can be used to control pests. *Bacillus thuringiensis*, also known as Bt, is the most widely used microbial biopesticide. The benefits of using biopesticides in agriculture and public health are undeniable.

BENEFITS OF BIOPESTICIDE

Biopesticide is gaining popularity in Integrated Pest Management (IPM) programs due to its environmental safety, specificity specifications, efficiency, environmental decay and performance. As a result, biopesticide is one of the most effective solutions to global pollution [2]**.** Although the use of biopesticides in conservation has been well established, the growing market for organic food has increased their popularity. Although agrochemicals are needed to meet the ever-increasing needs of food, feed and fodder, biopesticides will likely be used as part of IPM in hand-picked plants and niche areas. As biopesticides are widely used in livestock and health systems, conservation will increase.

Bacterial biopesticides are generally less toxic than chemical pesticides. Unlike the broad spectrum, traditional pesticides, which harm bird species, insects and mammals, microorganisms and biopesticides often, threaten only the target pest and closely related animals.

Biopesticides are generally effective at low concentrations and decompose quickly, leading to low emissions and, in many cases, avoid complications from common pesticides [14]**.** Biopesticides reduce the use of synthetic pesticides while maintaining crop yields as they are used as part of IPM programs. To use biopesticides effectively (and safely), consumers must first learn more about pest control and adhere to all product guidelines in the manual.

BIOPESTICIDE CATEGORY

Microbial, organic chemistry, and plant-based protectors are three categories of biopesticides described by the US Environmental Protection Agency (EPA) (PIPs). Pesticides control insects that use insects throughout the body as an active ingredient, such as microorganisms, fungi and bacteria. Given the fact that each active ingredient is microbial especially to its host, it can prevent the development of various pests.

Inorganic chemical, microbial, and natural products are used from a variety of sources, such as plant extracts or fermentation products. Non-toxic methods are used for these insects.

The following ingredients are commonly used in natural pesticides:

a) Semiochemicals (hormone mimics), pheromones of insecticides that interfere with sexual function and human development;
b) hormones, moult hormone (ecdysteroids), and baby hormones (IGR);
c) regulators of natural plants, auxins, gibberellins, cytokinins and inhibitors;
d) fragrant (attractive) emissions in the form of small molecules used as traps and edible fats **[3].**

Plant protectors (PIPs) are compounds that are composed of molecules that are naturally produced from genetically modified (GM) plants. Bt cistron, enzyme substance cistron, lectins, chitinase, and other genes can be combined with plant extraction while using transgenic plant samples. Humans and animals are not affected by the macromolecule material produced by these flexible plants to improve resistance to pests.

Biopesticides are released from the *Bacillus thuringiensis* (Bt) microorganism, which produces a toxin (Bt toxin) that binds to intestinal macromolecule insects and disrupts the intestines after ingestion. Both types of biopesticides are derived from the microorganism and its toxins (microbial, organic chemistry, and PIP).

Mode of Entry and Action

Each chemical has its own mechanism of action and an entry point into the victim's body. As a result, they are classified into different types, such as non-systemic, systemic, stomach contaminants, expulsions, and chemicals [4]**.**

Non-systemic pesticides

Non-systemic tormentoricides are also known as touch pesticides because they can come in close contact with an insect intended to kill us. Diquat and killer kilib dibideide are examples of this type of compound.

Pesticides are systemic

This category of pesticides will be introduced by plants and animals and will attack untreated tissues. A common chemical, for example, will travel through the body of a plant and enter the roots, stems or leaves that have not been treated. The flow of chemicals may be varied or varied. As a result, these tormentoricides can invade part of the plant and kill the bug. Similarly, common pesticides are effective against flies, lice, and similar warbles, and they can be used to kill themselves if they are exposed to the animal. Glyphosate and 4-dichlorophenoxyacetic acid are common pesticides (2,4-D).

Stomach Poisons

Stomach toxins are tormentoricides that poison and kill insects by entering the insect's body through the mouth and systema alimentarium. Vectors including edible insect larvae and blackfly larvae can be controlled by these insects. When these poisons are used in water, they kill the midday or vector stomach. An insecticide is a clear example of this type of chemical.

Opponents

These pesticides do not kill insects, but they drive them away from the treated area. Otherwise, the evicted person prevents the abuser from tracking the harvest.

Floods

Any tormentoricides use toxic chemicals and lungs to destroy the problem after it is added. Pesticides of this type are known as fumigants. Toxic gases enter the body of the abuser's device, causing toxicity.

These active ingredients of pesticides are also liquids that are regenerated into gas at the time of application. Fumigants are well used to get rid of rodents that begin to settle on plants, vegetables and fruits. The use of fumigants can also be used to combat soil pests.

Separation is supported by Types of targeted victims

Chemical pesticides are, in general, designed to control a specific type of insecticide [5]**.** For this reason, they are organized into a system of extreme isolation where each chemical element is given a special name that represents its function in the intended tormentor. The Latin word "cide" (meaning "killer" or "murderer") is used to give a chemical reputation until the identity of the perpetrator is known**.** Some combinations, however, do not have the word "cide" in their names. These pesticides are classified according to their performance statistics. An herbal agent that controls insect expansion, decontamination chemicals, sedative seduction, and chemosterilant sterilization are examples of these tormentoricides.

As a result of their ability to control various pests, certain pesticides can be grouped into more than one group. Aldicarb is an excellent example of this chemical because it kills flies, worms and nematodes. As a result, it can be used as a toxin, acaricide, and nematicide.

Chemical composition of chemical pesticide

It is a basic but very important method of distinguishing completely different pesticides according to the chemical structure and the various ingredients used [18]**.** Such pesticides show themselves in terms of their physical and chemical properties, mechanism of action, and function. These pesticides can be divided into four main groups depending on their chemical composition: organophosphorus, organochlorines, artificial pyrethroid and carbamate.

Organophosphorus

Organophosphorus pesticides are one of the most widely used pesticides because they have many functions and control a wide range of pests. In some pesticides, the resistance level of the aggressors is surprisingly lazy, and it often decays, contributing to the small amount of damage to the environment. These pesticides are good for invertebrates and vertebrates because they contain enzyme inhibitors that cause loss of consciousness, leading to paralysis and death. Diazinon, glyphosate, insect repellent, and parathion, are the most basic insecticides of organophosphorus.

Organochlorine

Organochlorine hydrocarbon-containing pesticides containing a composite compound containing more than 5 [18] electrical atoms. Pesticides were the first to be manufactured and used in agricultural activities that came into the group. The mechanism of action of such chemicals is to eliminate insect processes, which have led to paralysis and death. Aldrin, chlordane, dieldrin, endosulfan, lindane, and pollutant, are some examples of organochlorine pesticides. The most serious problem with such pesticides could be their long-term environmental effects.

Synthetic Pyrethroids

Synthetic pyrethroids are created by mimicking the structure of natural pyrethrins, making them stronger and more potent than natural pyrethroids. Pyrethrins I and II, along with a few other chemicals including jasmolin and cinerins, are the most effective ingredients for artificial pyrethrins. These insects make it easier to control insects and fish. However, since these pesticides are not resistant and can be distinguished by images, they are considered natural. Permethrin and cypermethrin are two examples.

Carbamates

The mode of action and localization of carbamates is very similar to pesticides [2]**.** On the other hand, they are derived from acids, while organophosphates are derived from orthophosphoric acid. These pesticides rot easily too. Aminocarb, carbaryl, Carbofuran, and propoxur, are just a few examples of this type of pesticide. In the Government of India, there are restrictions on the production of microorganisms biopesticides. Despite the many benefits that microorganism pesticides derives from conventional asset management products, they still have to reach a significant level of economic growth and implementation in the Government of India.

The Indian pharmaceutical market is limited by a variety of factors. Internal quality security issues, as well as low microorganism counts leading to poor service delivery, shortages of large production facilities, and the sale of unregistered assets in the business district, have all been identified as major

barriers. According to a NBAIR study, 50-70% of microorganism-based products in the Government of India have problems such as fewer compounds than those described in the bottle, the content of the solids, or the contamination, and therefore fail to comply with CIBRC requirements.

According to a new study conducted by the National Chemical Manufacturers Association, several items sold on the shelf lack the company number or address, as well as the active ingredients in a bottle [16]. Within the study, the problem of unregistered or counterfeit pesticides was rampant in the state, local, Karnataka, Tamil Nadu, Madhya Pradesh and Gujarat states. For certain biopesticides of the microorganism, time is also limited, especially in rural areas where access to modern retail and cold storage is limited. Several fluid formations do not work due to the lack of proper storage conditions, and the dry form of entomopathogenic fungi and nematodes is healthy on a shelf for up to a year when stored cold. Periods of slow killing, lack of field persistence due to high levels of UV light, and low melting of water are some of the barriers to creating commercially viable pesticides. Finally, the time-consuming process of the registration of the Government of India slows down the spread of microorganism biopesticides.

In the Government of India, the period between the granting of patents and the completeness of biopesticide production is currently more than five years. This could be one of the main reasons for the sale of unregistered, low-quality goods. Despite various obstacles, we acknowledge that the chemical industry in the Government of India has a promising future [7]. Biopesticide research on landmass is still in its early stages, but is progressing rapidly, with increasing emphasis on finding effective autochthonal separators, as well as construction and processing methods that reduce costs and prolong product life. Additional markets should be studied.

For example, there is no focus on the use of biopesticides for post-harvest applications, such as grain silos and food storage systems, where blighter loss is a problem. As rural farmers in the Government of India receive basic education or agricultural training, universities, government and non-governmental organizations, chemical producers and distributors must partner with farmers and other stakeholders to increase awareness and acceptance of biopesticides. In the production, proliferation, distribution and utilization of microorganism biopesticides, some current interventions may be helpful. Plots for plots and chemical dealers accessing programs that transform farmers (implant retailers) are two [12] examples. This includes opportunities to educate farmers about IPM and how to distinguish between licensed or unregistered or counterfeit biopesticides. Sheepskin in the program Agricultural Extension Services for Input Dealers (DAESI) was started by the National Institute of Agricultural Extension Management (MANAGE), a company of the Department of Agriculture and Farmer Welfare, Government of the Government of India , in 2003.

Crop production and protection technology is still being distributed to farmers by importers, where many farmers get their pesticides. More than 4000 eligible applicants have so far been under this program. More productive farmers can benefit from the demonstration of microorganism biopesticide technology with three crowns. As a result, farmers in the suburbs and cities in the Government of India use a wide range of biopesticides. The current form of biopesticide registration needs to be evaluated [18].

EFFORTS BY THE GOVERNMENT TO PROMOTE THE USE OF BIOPESTICIDES

Pesticides are a very important means of protecting public health and facilitating agricultural production in India. On the other hand, the overuse of pesticides has a different effect. Pesticides are important in modern agriculture, but they also create serious problems, which can be solved with strict policies. Some organizational departments oversee the use of pesticides, taking into account pesticide residues in food and water [11]. According to the world's annual Associated Nursing Survey, there are over 3 million reports of high levels of toxicity, and extreme harm caused by pesticides. It is still a major health problem in the Government of India, but the government has yet to issue any national awareness on the subject. However, the Government of India (GOI) has expressed its concern over the negative impact of the use of chemicals on human health by introducing programs such as integrated pest management (IPM), prohibition of highly harmful pesticides, restrictions on the use of toxic chemicals, and implementation of an Implementation Plan. National (NIP). The use of biopesticides is also highly recommended by the National Farmer Policy [18]. GOI has implemented IPM, which is an environmentally friendly solution for pest control, development and modernization of obsolete management strategies. Many cultural, mechanical and biological methods are used in IPM, as well as the use based on the need for pesticides, preferably biopesticides and biocontrol agents (BCA).

Thirty-one central IPM institutions are responsible for monitoring pests and diseases, producing and distributing biocontrol agents and biopesticides, as well as storing biocontrol agents, and providing basic training to farmers. Health threats associated with chronic pesticides have been widely reported

worldwide. On May 14, 2002, the Government of India signed the Stockholm Convention on Persistent Organic Pollutants (SCPOPs), one of the most important conventions to protect human health and the environment from some of the world's toxic chemicals, which were later approved on the 13th. Gregory calendar month 2006. To join the SCPOPs, the Government of India had to establish a National Action Plan (NIP) that identified practical government policies and ensured the implementation of conference commitments. The NIP guidelines include promoting and improving more DDT-resistant pesticides, promoting the integration and availability of neem-based biopesticides, developing alternative pesticides for emerging pesticides, and improving participating facilities. in the field of chemical analysis and skills development [8]**.** The Department of Agriculture regulates the manufacture, sale, transport and distribution, procurement, import and export of pesticides under the 'Insecticides Act 1968.' The Central Pesticide Board and the Government of India 's Registry Committee assist central and government governments in technical matters (CIB & RC).

The CIBRC has collected data on a variety of pesticides. Biopesticide as the only independent method of agricultural production in a private country Overuse of chemical pesticides has reduced popular farming activities. According to Jeyaratnam [9], approximately 25 million people working in agriculture in developed countries are at risk of chemical exposure each year. Ways are available to both people and nature to find different solutions to the current problem [10]**.** Although this method is not the latest, as insect biocontrol has been around since ancient times, academic and industrial research has been at the forefront of producing pesticides in the environment. According to Saxena [15], farmers in many African countries have developed live insects that are more sensitive to their crops. To control pests, they can use a predatory bird. Human resources such as minerals, as well as other species such as bacteria, plants, and animals, include biopesticides[6]**.** The natural substances or chemicals produced by them are widely used as biopesticides because they are the natural enemies of harmful insects in a plant or other host. The risks to human health and the environment are not taken into account when using biopesticides. *Bacillus thuringiensis* (bioinsecticides), *Trichoderma* (biofungicides), and fungi are the most common types used as biopesticides (such as bioherbicides).

CONCLUSION

As a result, biopesticides are currently preferred by traditional pesticides in the management of blighters due to their ability to control pests and completely new methods, which help prevent the spread of pest resistance. India prefers BCAs made in the industry because they are very effective and therefore clean the climate. Non-systemic pesticides are pesticides and need direct contact with destructive environment wherever they reach the cuticle and release toxins, causing insect death. The GOI has expressed its concern about the negative impact of pesticides on human health through measures such as integrated pesticide management (IPM), prevention of highly harmful pesticides, prevention of toxic chemicals, and the introduction of the National Action Plan and National Implementation Plan.

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