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Biopesticide Development Trends & Its usage

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Biopesticides are successful in controlling agricultural pests without causing significant damage to the ecological chain or exacerbating environmental degradation. The development and effective use of biological pesticides has reduced environmental pollution caused by pesticides. Reduce pesticide residues and increase agricultural sustainability. Since their introduction, many biopesticides have become available and many of them have played an important role in the market. The development of biopesticides will undoubtedly promote agricultural modernization and gradually replace pesticides. Many biopesticides are a good alternative to traditional pesticides that do not create pollution in agriculture, but some have some toxicity; Field researchers need to take this into account. This study discusses the current development and distribution of various classes of biopesticides, challenges encountered throughout the development process, and limitations imposed on various methods. We analyzed many studies in agriculture, demand, industry and other sectors and examined biopesticide trends.

Biopesticides, pollution -free, constraint, sustainable agricultural

INTRODUCTION

Biopesticides are living organisms that interfere with the life cycle of pests to reduce agricultural productivity. Parasites, predators and pathogenic fungi, bacteria and viruses are used as biopesticides. These are natural enemies of pests. They also complement and improve existing pest control methods. Effective biological control methods use natural organisms, animals, and bacteria to control pests. On the other hand, these biologics can be stored, stored, and measured in the laboratory for release into the field. When chemicals are placed in the field to increase their numbers, they can reduce the population of harmful species below the economic level (ETL). But the problem is that they are widely used and over time.

Pattern of Biopesticide Use in India

The Central Insecticides Board and Registration Board (CIBRC) is the primary regulatory body for the use of various pesticides in India and currently has 970 pesticide products. Bacteria, fungi, viruses, and other (plant-pheromone-based) biopesticides account for 29%, 66%, 4%, and

1% of all biopesticide production, respectively.

In India, fungal products account for the largest share of all biopesticides. Additionally, Trichoderma bacteria are frequently used in the field of antifungal drugs and there are currently 355 products in the Indian market. Although there are many Trichoderma-based biopesticides on the market, only two have been associated with biocontrol activity. Bacillus thuringiensis accounts for approximately 15% of all biopesticides used and grows at a rate of 10% per year. Only biopesticides based on nuclear polyhedrosis virus (NPV) are used for biological control of cotton boll borer in India, but their use is limited.

According to the biopesticides market report, the microbial industry is leading the Indian biopesticides market in 2021 and is expected to maintain this position during the forecast period as well. The microbiology industry is expected to grow at a compound annual growth rate (CAGR) of 13.8%. Microbial pesticides have gained popularity in recent years due to their many uses in improving crop quality and preventing external attacks by bacteria, fungi and other pathogens. According to India's national survey results, biopesticide use in the agricultural sector has increased significantly since 2019.

According to statistics (PPQS), Maharashtra uses the most biopesticides while Goa uses the least. Total use of biopesticides increased in Rajasthan and Andhra Pradesh and decreased in Odisha. While Maharashtra, West Bengal and Karnataka used the highest amount of pesticides at 5549, 4416 and 3478 metric tonnes respectively, Himachal Pradesh and Goa used the least 36 and 38 metric tonnes respectively. These findings also explain why drug use is less common in northern states than in southern states.

Biopesticides are registered and regulated under the Insecticides Act 1968. Only 12 types of biopesticides are registered in India under the Insecticides Act, 1968.

1. *Bacillus thuringiensis var. israelensis;*
2. *Bacillus thuringiensis var. kurstaki;*
3. *Bacillus thuringiensis var. galleriae;*
4. *Bacillus sphaericus;*
5. *Trichoderma viride;*
6. *Trichoderma harzianum;*
7. *Pseudomonas fluorescens;*
8. NPV of *Helicoverpa armigera;*
9. *Beauveria bassiana;*
10. NPV of *Spodoptera litura;*
11. Neem-based pesticides;
12. Cymbopogon.

Except for some agricultural biopesticides, most biopesticides are used in public health.

Advantages of Biopesticides Usage

1. Biopesticides have reduced inherent toxicity as compared to regular pesticides.
2. Unlike broad-spectrum pesticides, which can harm a wide range of creatures, including birds, insects, and mammals, biopesticides frequently only affect the target pest and closely related organisms.
3. Biopesticides function in low dosages and frequently disintegrate fast, minimizing exposure levels and avoiding

the environmental concerns associated with chemical pesticides.

4. When used as part of Integrated Pest Management (IPM) programs, biopesticides can dramatically reduce the usage of conventional pesticides while maintaining great crop yields.

Production and Consumption of Biopesticide in India

Currently, there are 410 biopesticide production facilities in India, of which 130 are commercial and 280 are government-owned. The government-controlled units include 26 Central Integrated Pest Management Center units, 31 ICAR/SAU (Council of Indian Agricultural Research Institutes/National Agricultural Universities) units, 22 Ministry of Biotechnology-funded units and various state ministries units, including Bio Prevention unit laboratories . Additionally, the Ministry of Agriculture and Farmers Welfare has assisted around 32 IPM centers and 35 companies in biopesticide production since 2010.

State agriculture and horticulture departments in Gujarat, Uttar Pradesh, Karnataka, Tamil Nadu, Andhra Pradesh and Kerala have set up various biocontrol centers to accelerate the development of some biological worker surveillance systems. Indian Council of Agricultural Research (ICAR) institutes and some State Agricultural Universities (SAUs) also produce microbial antibiotics. Only a few sources of biopesticides, including plants, insects, disease biocontrol, and pheromone baits and traps, have recently moved to northern India, and most of them were previously in southern India.

Central and state agricultural societies and various ICAR institutes are the main government institutions involved in the commercial production of different antibiotics. Central Institute of Arid Land Agriculture, Hyderabad, Council of Oilseeds Research, Hyderabad (ICAR), Kerala Agricultural University (KAU), Tamil Nadu Agricultural University (TNAU), Central Plantation Research Institute (CPCRI) in Coimbatore, Bengaluru, Horticultural Research Institute of India The Central Institute of Arid Land Agriculture in Bangalore, Hyderabad and Kerala Agricultural University (KAU) in Kerala are known to have expertise in biotechnology. Biopesticides to combat invasive pests. Indian Agricultural Research Institute (IARI), New Delhi, Punjab Agricultural University (PAU), Punjab and G.B. Uttarakhand Pant University of Agriculture and Technology (GBPUA&T) produces pesticides. The main government agencies involved in pesticide production are the Indian Institute of Sugar Research (IISR), the Central Institute of Subtropical Horticulture and the Plant Protection Quarantine and Storage Directorate, Lucknow, all of which are part of the Central Integrated Pest Management Centre. Additionally, with government support, several Krishi Vigyan Kendras (KVKs) and National Biocontrol Laboratories were established to produce antibiotics to meet local needs. NAFED (National Agricultural Cooperative Marketing Federation of India) also promotes the use of biopesticides.

The use of biopesticides in India accounts for approximately 9% of all pesticides and is expected to account for 50%

of all pesticides by 2050. Annual growth is expected to be 2.5%. However, the biopesticide market has not yet expanded as expected and is still low compared to the synthetic pesticide market. Production is limited for some economic and legal reasons. However, the 2007 National Farmers Policy encourages the use of biopesticides for permaculture.

Moreover, statistics show that India has increased its use of biopesticides in recent years. Neem is one of the most widely used biopesticides in India; While its consumption increased from 83 metric tons (MT) in 1994-1995 to 686 MT in 1999-2000, Bacillus thuringiensis increased by 40 MT to 71 metric tons in the same period. . The use of biopesticides increased more than expected, from 123 metric tons (MT) in 1994-1995 to 8,110 metric tons (MT) in 2011-2012. According to PPQS data, total biopesticides consumed in India increased by 40% between 2014-2015 and 2018-2019, reaching 8,847 tonnes and 8,645 tonnes in 2019-2020 and 2020-2021, respectively.

Permaculture-based biopesticides have gained social acceptance, increasing productivity and reducing environmental risks. These characteristics are a threefold approach to sustainable development. There are many advantages to using biopesticides. They can be blocked by a variety of mechanisms, including metabolic poisons, neuromuscular poisons, intestinal obstruction, non-multisite inhibitors, and growth regulators. The possibility of cure is completely eliminated due to the different methods of action against certain pests. Therefore, while the number of pesticides is decreasing, the demand for biopesticides is increasing. Reduced pest resistance, interaction of synthetic pesticides, environmental friendliness, low toxicity properties, specific (does not affect non-target organisms or humans), biodegradability, minimal post-harvest contamination, stability against abiotic stresses and good Integrated Pest Management (IPM) compatibility thing.

Today, the use of biopesticides in agriculture, like other natural products such as biofertilizers and biostimulants, is necessary for permaculture as a balanced socio-cultural practice, industrial production and environmental protection. Therefore, we can say that the integration of public policy into these four dimensions, including technology, will be the basis of long-term development.

Biopesticides' Potential Danger to Human and Ecosystem Health

Most biopesticides are classified as low-risk or low-risk biopesticides. Many of these are used in concentrations comparable to those found in nature. Compared to pesticides that degrade slowly in ecosystems, low-risk products degrade very quickly, leaving virtually no residue in the environment or food that can harm disease.

The incidence of negative effects of microbial pesticides on human health is very low, and it has been shown that crystalline proteins must be converted to their chemical components in an alkaline environment (this occurs in intestinal bacteria, but not in most animals). may help explain the lack of toxicity in animals and humans. Additionally, the target species also displays crystal protein

binding sites that are thought to be absent in the human body.

Biopesticides based on Bacillus thuringiensis are generally considered safer and more environmentally friendly than pesticides. Commercial strains of Bacillus thuringiensis are considered nonpathogenic and there are very few human infections associated with them. Because Bacillus thuringiensis is found all over the world, people are exposed to a lot of it. In 95% of cases, B. thuringiensis was found to be an infectious disease rather than the basis for treatment that led to the collection of samples. Bacillus thuringiensis is used as a biopesticide in the United States and has been detected in cultures of human body fluids.

These bacteria have also been found in skin infections in burn patients. During the examination at the hospital, it was revealed that the disease was detected from contaminated water used in burn treatment. This strain does not contain insecticides and other microbial strains suitable for the use of B. thuringiensis as antibiotics. Although B. The Bacillus thuringiensis strains found in these strains do not result from biopesticide use, and this study suggests that these strains may have a significant impact on disease response. Additionally, according to mouse studies, repeated exposure to biopesticide aerosols can cause subchronic pneumonia, which can lead to severe lung disease.

Biopesticide Use and Its Limitations

Biopesticides have proven to be an effective alternative to pesticides; but they still have a long way to go before they can replace other products in the market. There is evidence that pesticides are effective on many crops. However, this is not without limitation.

Availability of plants: Production of biopesticides depends on the availability of plants and their culture. Until now, this plant was grown for food, medicine and other uses. Also, the production of goods requires a lot of land, most of which is already planned for cultivation, so it is not necessary to meet the demand in the right amount.

Formulation is difficult because one plant can produce many active compounds with different drugs. The extraction process requires the use of organic solvents that can be harmful to the environment when disposed of**.**

Shelf life: Their shelf life is very limited according to biodegradation rates. This has implications for construction costs, production processes and labor disputes. Microorganisms constitute a small part of the total pest community. Therefore, these microbial antibiotics can only be used against a group of pests. They also act slower than pesticides.

Efficacy: The effectiveness of microbial pesticides will be affected by extreme weather conditions. Heat, dryness, UV radiation, etc. may cause this effect. Therefore, it is important to carefully design the conveyor system. They are also less harmful to bacteria and less effective than pesticides.

The overall cost of producing pesticides is very expensive. In this sense, business and government must work together

to create, produce and distribute environmentally friendly products.

Continued discovery of active ingredients and scientific research into their design and distribution will improve the commercialization and use of biopesticides. To promote commercialization of biopesticides, the Indian government has started supplying biopesticides to farmers. However, improving the regulatory process for registration of low-risk chemicals could lead to market growth and use of biopesticides.

Conclusions

Biopesticides are safe and environmentally friendly, may not be of much concern to humans, and can help farmers reduce pesticide use. Therefore, it is recommended that the public and private sectors cooperate to develop general rules and procedures for the use of biopesticides to support farmers on the ground. Researching new chemicals and investigating their design and distribution will help the biopesticide business. More research is needed on the integration of biological agents into biopesticide production systems. Additionally, encouraging low-risk chemicals with incentives can increase the commercialization of biopesticides. However, more research is needed to investigate effectiveness for specific insect problems in different agricultural systems.

Biopesticides have proven to be a simple, effective and efficient method of controlling pests and weeds in agriculture and healthcare in India for over 50 years. They are beneficial to agriculture and the overall income of farmers. India has now become self-sufficient in biopesticide production and export services. Trichoderma viride is the most widely used species in the Indian biopesticide industry. The biopesticide has previously been used on 87 different crops to combat 70 soil-borne diseases and 18 foliar diseases.

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