

International Journal of Pharmacognosy and Pharmaceutical Sciences



ISSN Print: 2706-7009
ISSN Online: 2706-7017
IJPPS 2023; 5(1): 81-85
www.pharmacognosyjournal.net
Received: 11-10-2022
Accepted: 19-11-2022

Raveesha Peeriga
Vallabhaneni Venkatadri
Institute Institute of
Pharmaceutical Sciences,
Gudlavalleru, Andhra Pradesh,
India

Pavan Kumar Balagani
Gokula Krishna College of
Pharmacy, Sullurupeta,
Nellore District, Andhra
Pradesh, India

Lakshmana Rao Atmakuri
Vallabhaneni Venkatadri
Institute of Pharmaceutical
Sciences, Gudlavalleru, Andhra
Pradesh, India

Corresponding Author:
Raveesha Peeriga
Vallabhaneni Venkatadri
Institute of Pharmaceutical
Sciences, Gudlavalleru, Andhra
Pradesh, India

Prominence of Biopesticides to supersede chemical pesticides in sustainable agriculture

Raveesha Peeriga, Pavan Kumar Balagani and Lakshmana Rao Atmakuri

DOI: <https://dx.doi.org/10.33545/27067009.2023.v5.i1b.112>

Abstract

Population explosion effectuates huge burden on agriculture. To come across the burden the usage of chemical pesticides are in higher ratio which brings several challenges like pest resistance and resurgence, nutritionally altered soil structure or composition and unproductive lands and genetic variation in plants, environmental pollution. High level of usage of chemical pesticides not only shows its effect on environment even it enters into food chain. To overcome these challenges a sustainable agricultural practice is needed where biopesticides works out effectively rather than synthetic pesticides in controlling pests. Natural products are eco-friendly as they are easily biodegradable and therefore do not pollute the environment. Numerous factors have to be considered in order to develop and formulate the biopesticides. Natural products are made to be investigated to find out the chemical compounds acts against pests and Its high time to switch on to biopesticides rather than the chemical pesticides which results in sustainable agriculture and ecofriendly.

Keywords: Biopesticides, Agriculture, Ecofriendly, Sustainable, Pest Resistance

Introduction

Estimation of 9.7 billion human population by 2050 as the global population has been exploding effectuates huge burden on agriculture and allied sectors to meet food demands ^[1]. A pesticide shows eloquent asset to people in controlling pests that infringes agricultural crops ^[2]. The crisis of food supplies resulted a burden on agricultural practices to enhance yield. This crisis was overcome in a great extent by an advent of chemical pesticides ^[3]. The domination of chemical pesticides in management of pests had been taken though out the world since the discovery of DDT in 1939 ^[4]. Since 1940s, the tremendous usage of synthetic chemicals has been aroused. The prolonged usage of synthetic chemicals from many years had shown the impact on environmental aspects as their level were building, not biodegradable and results in harmful effects.

Now-a-days several challenges like pest resistance and resurgence, nutritionally altered soil structure or composition and unproductive lands and genetic variation in plants, environmental pollution have to be overcome ^[5-7]. Apart from these challenges in these modern ages, time is an essential factor. To ensure higher production of yield within short time, in agricultural practices to restrain crops against pests and bring back them to lush, green and healthy a magical treatment is required hence chemical pesticides were highly used by cultivators with no idea that it would bring ill effects in future. High level of usage of chemical pesticides not only shows its effect on environment even it enters into food chain causing pesticide poisoning, organ malfunction, immune suppression, neurotoxicity, fetal impairments, paralysis, carcinogenicity and many irreparable effects on health ^[8]. To overcome these challenges and simultaneously to meet the requirements for food and supplies the productive and sustainable agricultural practices is needed. In the other hand these agricultural practices should be novel and the improved strategies must be employed.

The decline in usage of chemical pesticides is observed as an advent of new legislation. Hence an alternate way is very much needed ^[9]. According to European Union, a biopesticide is "a form of pesticide based on micro-organisms or natural products" and in meant with US Environmental Protection Agency (EPA), they are "include naturally occurring substances that control pests (biochemical pesticides), microorganisms that control

pests (microbial pesticides), and pesticidal substances produced by plants containing added genetic material (plant-

incorporated protectants) or PIPs and their characteristics discussed in Figure 2 [10-12].

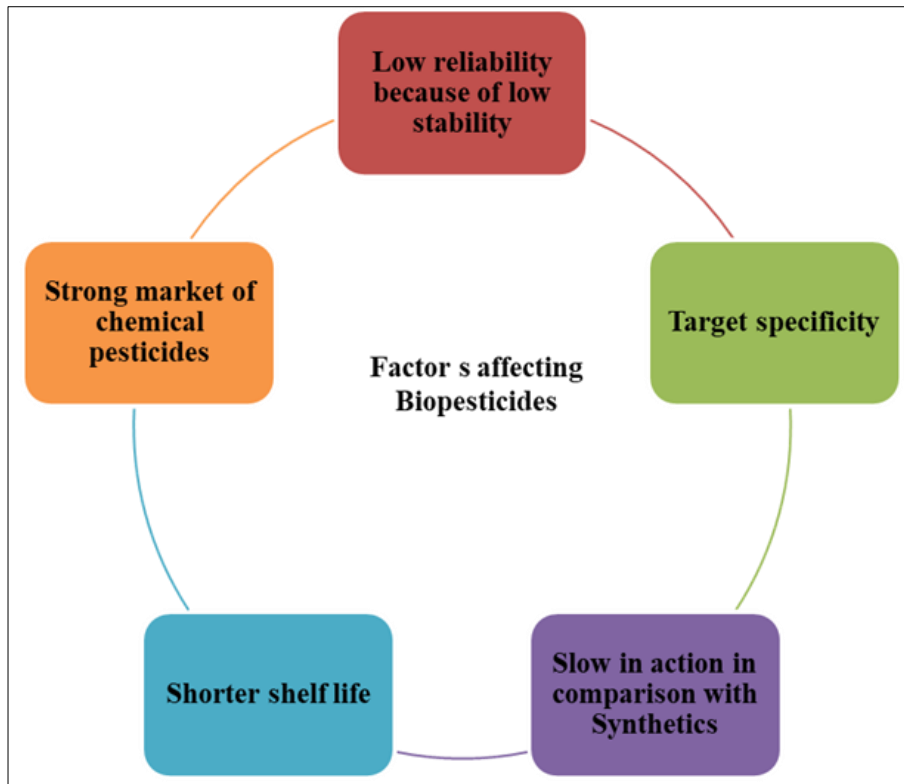


Fig 1: Factors affecting Biopesticide

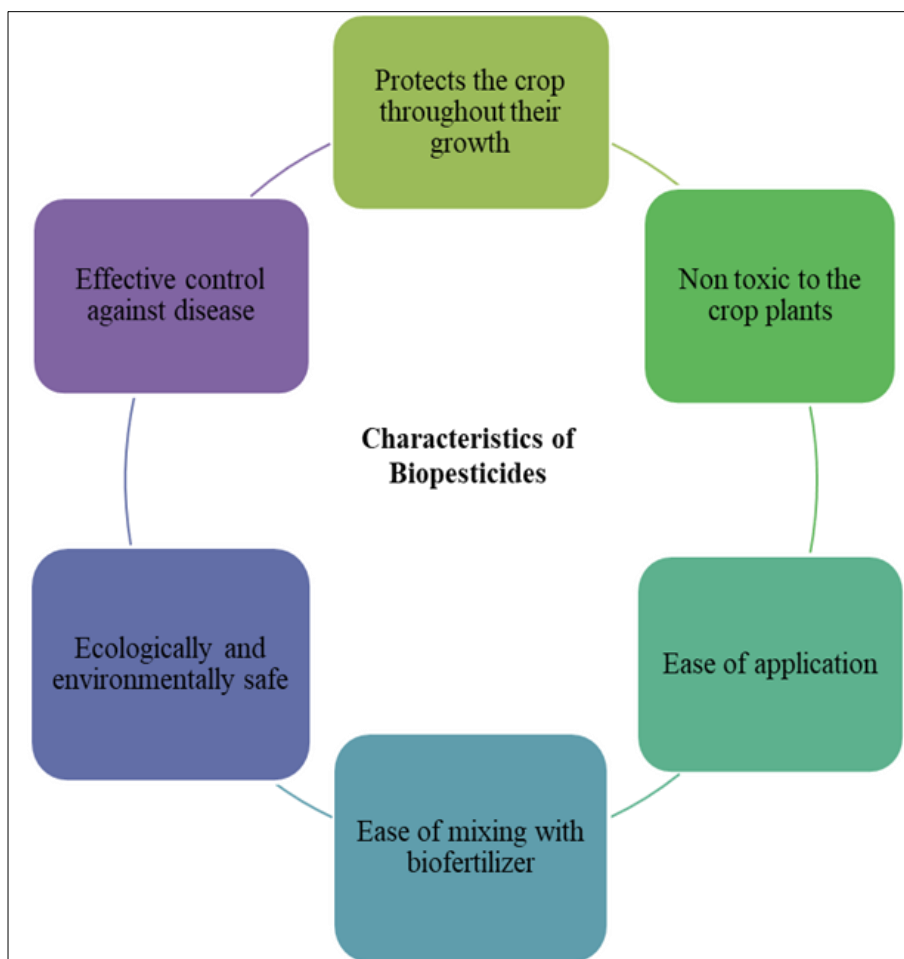


Fig 2: Characteristics of biopesticide

There are many factors affecting biopesticides should be considered Fig 1. Employing plant-based pesticides as an alternative to chemical ones, but it will take some time before this practice becomes particularly popular as processing them and making it accessible should be attained. Despite the usage of biocontrol agents having a number of benefits and being environmentally safe, there are several restrictions [7]. For the constituent substances to be effective under field circumstances, high doses are required. The environment in which plants are grown refers to the amount of active metabolites in plants.

The diversity of species and their types also influence the constituent active chemicals, which results in variations in how plants react to diseases. Additionally, there are no established preparation procedures or recommendations for efficacy testing, particularly in the field. Despite the outstanding results from in vitro studies, there are often discrepancies in the field because of the short shelf life and perhaps poor quality of the source. For a limited acreage, crop coverage and exposure time are crucial, and since application may be manual, this could prove costly. Data on chemistry, toxicology, packaging, and formulation are necessary for product registration but are occasionally difficult to come by. A novel pesticide product typically has a high production cost and several resource restrictions. It is challenging to engage in biopesticides since there is no readily accessible market. Natural products' shelf lives are influenced by a variety of variables, including moisture levels and temperatures, both of which can be challenging to regulate [8].

These are only applicable at a specific developmental stage of target organisms, are frequently slow acting and disintegrate in the hot air and sunlight rapidly, microbial have short residual toxicity, so require regular applications, to be efficacious they need relatively high rates and rigorous coverage, manufacturing costs of biopesticides and natural euphoria are factors that affect the cost of controlling mixed population [9-11].

Commercial exploitation of Biopesticides

Globally, the usage of biopesticides is rising by about 10% annually. However, by replacing them with natural pesticides and lowering the over-reliance on chemical pesticides, these pesticides will significantly contribute to their global market consumption, which are expected to rise further in the future.

In the EU, biopesticides are evaluated in accordance with the same regulations as synthetic active chemicals, which need the addition of numerous new clauses to the existing legislation and make the registration of potential biopesticide products easier. The EU is thought to have fewer active biopesticide ingredients registered than the USA, India, Brazil, or China. By the early 2050s, it is anticipated that use of biopesticides will be comparable to that of synthetic pesticides, but there are significant uncertainties surrounding the rates of uptake, particularly in regions like southern Asia, which account for the majority of the versatility in such projection [12].

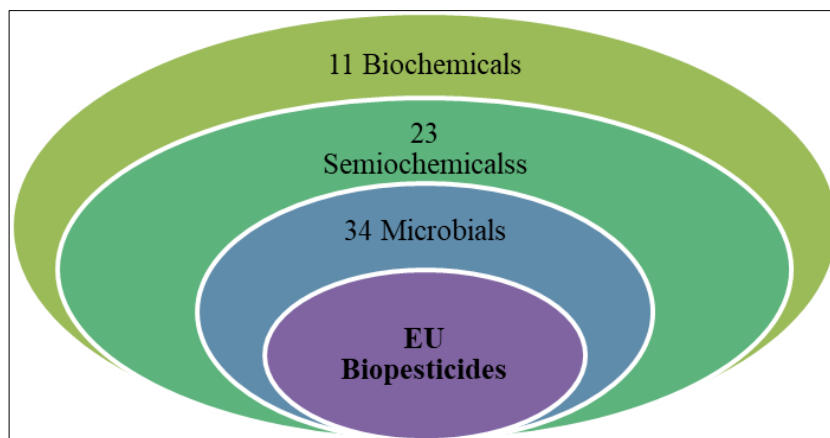


Fig 3: EU biopesticides

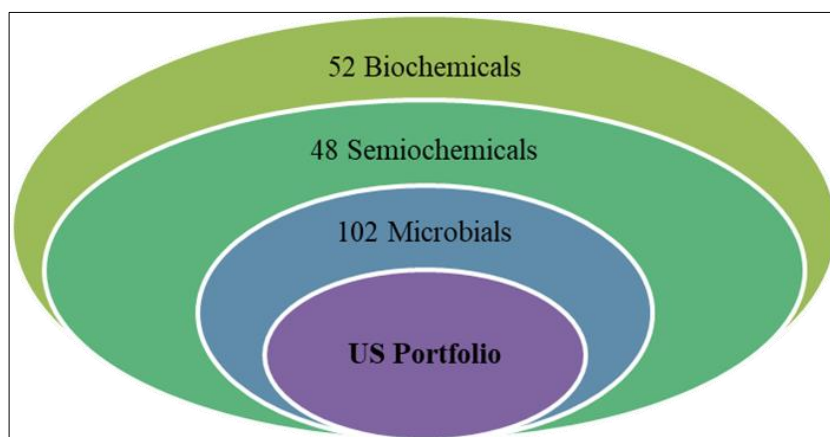


Fig 4: US Portfolio

Worldwide, a total of 1400 developed biopesticides formulations being sold. 68 biopesticide active products got registered under EU and then no. of 202 in USA depicted in Fig. 3 & 4. Chemical pesticides remains as a vital part in crop protection when they were at appropriate use, gives excellent control with minimized adverse effects. Usage of chemical pesticides should be within an IPM framework, to minimize the resistance property in target pest population [13].

Biopesticide and Sustainable Agriculture

Synthetic pesticides have been used to manage pests from the middle of the 19th century until the present. The world population is expected to increase by 34% from 6.8 billion people today to 9.1 billion people in 2050, according to the most recent assessment of the UN demographic forecasts. It is a huge task to feed this growing population, especially given how quickly land productivity is dropping. Agrochemical residue pollution is growing and depleting the natural resource base. To feed the world's expanding population, the production system must be sustainable. Sustainable agriculture systems are ones that are economically feasible, meet society's demand for healthy food, and do so while preserving or improving the environment's quality for coming generations. While retaining vigor and dynamism in agricultural expansion for satiating fundamental human needs and protecting natural resources, it is environmentally friendly. It strives to produce food that is healthy for human consumption and nutrient-dense. Biopesticides are a very safe option for pest control in sustainable agriculture because all of the ingredients are natural or biological [14-15].

Biopesticides are suitable in Integrated Pest Management (IPM), helps to reduce the use of chemical pesticides in management of pests. Biopesticides, also used for decontamination of agricultural soils via introducing the important microbial species [16].

Pesticides and Environmental Safety

Less harm to the environment and to human health is caused by biopesticides. The most frequently employed biopesticides are live things that are pathogenic to the target pest. Biofungicides (*Trichoderma*), bioherbicides (*Phytophthora*), and bioinsecticides are some of them (*Bacillus thuringiensis*). There are a few other plant items that can currently serve as a significant source of biopesticides. Protectants that are naturally created when plants undergo genetic change are included in plant-incorporated protectants. Examples of this include integrating the Bt gene, lectines, chitinase, protease inhibitors, etc. into the plant genome so that the transgenic plant produces its own chemical that kills the targeted pest. The use of biopesticides has significant promise for improving agricultural and public health initiatives [17].

Scenario of Biopesticide

There is a wide range of options in terms of supplies for natural biological control organisms as well as natural plant-based insecticides because of its great biodiversity. The widely diverse indigenous tribes in different countries traditional knowledge base may hold important hints for the development of more advanced and efficient biopesticide. The emphasis on residue-free products and organic farming would undoubtedly encourage the use of biopesticides more frequently. The availability of high-quality goods at

reasonable rates, the strengthening of supply chain management, and concrete evidence of the effectiveness of biopesticides in reducing crop damage are other factors that influence increased acceptance. Priority should be given to biological pest control method development and research, as well as education of the general public and agriculturalists in particular regarding the handling and application of such control measures. All of this will result in a general comprehension of the advantages of biopesticides as a green substitute. IPM, INM, ICM, and GAP are needed today, nonetheless, and by putting them into practice, one may ensure their quality of life and health [18].

Future prospects

The utilization of several microorganisms as biopesticides needs further study. It is important to create new product formulations. In the biopesticides sector, a public-private approach is necessary. Supply chain management needs to be strong [18].

Safety criteria should be imposed on use of conventional chemical pesticides which results in very few products on the market. It creates an opportunity for biopesticide companies to make over, but there will be major challenges too. The development of biopesticides depends on exploiting knowledge about the genome data of pests and their natural enemies specific to pest.

Further research is very much needed to develop a biopesticides formulation. Development of stable products particularly in open fields results in effectiveness in crop pest management. Hence the Research should be oriented to provide a biopesticides with stability and durability [19-20] Biopesticides is a tool, to develop rational use and cost effectiveness. There should be a significant progress in developing formulations, but much work to be done regarding the use of biopesticides. The improved techniques and multidisciplinary research are made to provide good, safe, effective and inexpensive products for plant protection.

Conclusion

The development of the biopesticides must be strategic, all-encompassing, and forward-looking undertaking. Commercial biopesticides should be affordable, storage stability, simple handling and effective control against pests. It is necessary to identify new sources of biopesticides, an ecologically friendly technique to replace, or at least augment, the current chemical-based pesticides. The emphasis on residue-free products and organic farming would undoubtedly encourage the use of biopesticides – an ecofriendly perspective.

Acknowledgments

I acknowledge my thanks to the Management, V. V. Institute of Pharmaceutical Sciences.

Reference

1. Kumar J, Ramlal A, Dharmendra M. An Overview of Some Biopesticides and Their Importance in Plant Protection for Commercial Acceptance. *Plants*. 2021;10(1185):2-15.
2. Slavica G, Brankica T. Biopesticide Formulations, Possibility of Application and Future Trends. *Pestic. Phytomed.* (Belgrade). 2013;28(2):97-102.

3. Kachhawa D. Microorganisms as a biopesticides. *Journal of Entomology and Zoology Studies*. 2017;5(3):468-473.
4. Misra HP. Role of Botanicals, Biopesticides and Bioagents in Integrated Pest Management. *Odisha Review*. 2014, 62-67.
5. Shilpi S, Malik P. Biopesticides: Types and Applications. *International journal of advances in pharmacy, biology and chemistry*. 2012;1(4):508-515.
6. Prakash N, Kumari B, Shipra K. Biopesticides: Introduction and its Prospects. *International Journal of Current Microbiology and Applied Sciences*, 2019;8(2):2960-2964.
7. Suman G, Dikshit AK. Biopesticides: An ecofriendly approach for pest control. *Journal of Biopesticide*, 2010;3(1):186-188.
8. Vaishali K. Biopesticides. *International Journal of Environmental Research and Development*. 2014;4(2):191-196.
9. Rishap D, Narayan Singh D. Biopesticides: A Key to Sustainable Agriculture. *International Journal of Pure Applied Biosciences*. 2019;7(3):391-396.
10. Tijjani A, Bashir, Mohammed KA. Biopesticides for Pests Control: A Review. *Journal of Biopesticides and Agriculture*. 2016;3(1):6-13.
11. Geraldin MWL, James WM. Biopesticides and Their Role in Sustainable Agricultural Production. *Journal of Biosciences and Medicines*. 2018;6:7-41.
12. David C, Alastair SB, Mark Tatchell G. The development, regulation and use of biopesticides for integrated pest management. *Philosophical Transactions of Royal Society B*. 2011;366:1987-1998.
13. Vikas G, Nikhil S, Omkar G. Biopesticides – for future. *Jr. of Industrial Pollution Control*. 2014;30(2):203-205.
14. Luke B, Roger KD, Bateman ML. Assessment of potential biopesticide options for managing fall armyworm (*Spodoptera frugiperda*) in Africa. *J Appl Entomol*. 2018;142:805-819.
15. Jaba Jagdish E, Sajeesh PK, Vinod U. Nuclear Polyhedrosis Virus (NPV), A Potential Biopesticide: A Review. *Research Journal of Agriculture and Forestry Sciences*. 2013;1(8):30-33.
16. Vinod Kumar. A review on efficacy of biopesticides to control the agricultural insect's pest. *International Journal of Agricultural Science Research*. 2015;4(9):168-179.
17. Sucharita K. Review on biopesticides: an environmental friendly approach. *Journal of Chemical and Pharmaceutical Sciences*. 2014;3:141-142.
18. James NS, Joel C, Stephen OD, Aaron DG. Biopesticides: State of the Art and Future Opportunities. *Journal of Agricultural and Food Chemistry*. 2014;62:11613-11619.
19. Sengottayan Senthil-Nathan. A Review of Biopesticides and Their Mode of Action against Insect Pests. *Environmental Sustainability*. Springer publications, 2015, 49-63.
20. Vimalanathan S, Arnason JT, Hudson JB. Anti-inflammatory activities of Echinacea extracts do not correlate with traditional marker components. *Pharm Biol*. 2009;47(5):430-435.