Biopesticide: The future of agriculture?

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Abstract:

This article explores the potential of biopesticides as the future of agriculture. Biopesticides, which are derived from natural sources such as plants, fungi, and bacteria, have been gaining attention as a safer and more sustainable alternative to traditional chemical pesticides. The article discusses the advantages and limitations of biopesticides, and examines the current state of research and development in the field. The conclusion highlights the potential of biopesticides to revolutionize the agricultural industry and calls for further investment in research and development.

Keyword: Biopesticides, Agriculture, Sustainability, Natural sources, Chemical pesticides, Research and development.

Introduction

Global Agriculture Situation, The problem that is needed is the ability that will reduce production capacity and lower capabilities, the environment and natural resources in a very broad sense in creating quality and quality of Human Resources in a special sense. The phenomenon that is stored is something new. The measurement orientation to the field developed by the International Food Policy Research Institute (IFPRI), namely the formulation of the Global Hunger Index (GHI) can be used as an instrument to see, etc. To reach the state GHI level, it should be developed countries first showed that, based on the GHI that unites nutritional aspects, children who are less than five years old who experience dry (throwing away), stunting or high dryness rates are not present which can achieve the same status as developed countries. The fact shows that 14 developing countries achieved GHI values < 5.0 in 2017.

Globalization that takes place in a very fast process has formed patterns of food consumption in developing countries including patterns that develop in developed countries. The developed countries here are Western countries such as Western Europe and the United States. Improvement efforts by using GHI advanced status process of food consumption patterns in developing countries. The standard GHI achievement that applies in countries needs to be

improved as a goal to overcome with open methods or policies, in accordance with conditions, and potential in each developing country. (Agus Pakpahan (2018).

Agricultural expansion contributes greatly to food security. It also helps to alleviate poverty. It also serves as a driver of overall economic growth in much of the developing world. However, the agrarian sector's success has not been distributed evenly across regions and countries, and it is unclear whether this success can be sustained, let alone extended to those who have fallen behind. Many of the developing world's least developed nations, particularly in Sub-Saharan Africa and in marginal manufacturing environment, continue to have low or stagnant agricultural productivity, rising food deficits, and high levels of hunger and poverty.

The global population is expected to reach 9 to 10 billion people by 2050. The majority of the growth is expected to occur in poor developing countries, where the income elasticity of food demand remains high. By 2050, population growth combined with moderately high income growth could result in a 70% increase in demand for food and other agricultural products. (Mette Wik, Prabhu Pingali, and Sumiter Broca (2018).

Indonesian Agriculture Situation, In 2000 several country distributions were developed in the Moderate GHI group, Seriously, and Hazards are relatively consistent, each with 31 countries, 26 countries, and 28 countries. In 2017, most developing countries are in the Serious GHI group (44 countries). The increasing number of members in the Serious Hunger group is positive from the shift with the Dangerous GHI in 2000 to Serious GHI in 2017. The position of Indonesia, already mentioned, in 2000 and 2017 was in the same group namely Serious hunger. Of the 31 developing countries, Turkey and Ukraine are countries that are able to issue from countries with the GHI group in 2000 successfully become countries classified as GHI <5.0 (developed countries). GDP from Agriculture in Indonesia fell to 82332 IDR in the fourth quarter of 2018 from 84110 Billion Rupiah in the second quarter 2018. GDP of indonesian Agriculture averaged 69008.14 Billion Rupiah from 2010 to 2018, pick up all-time highs of 88067.70 Billion Rupiah in the first quarter 2017 and recorded a low of 37,282.5 billion Rupiah in the fourth quarter of 2012.

What is “Biopesticide”?

Biopesticides are “living organisms (plants, microscopic animals such as nematodes, and microorganisms, including bacteria, viruses, and fungi) or natural products derived from these organisms, that are used to suppress pest populations” (Biocon, 2006).

The differentiation between pesticide and biopesticide

1. **Biopesticide,** Bio-pesticides are key elements of incorporating insect management (IPM) programs and are receiving much practical attention as a means to reduce the fill of artificial chemicals being used. Heavy use of synthetic chemicals for pest control started from the 1940s. Till then we were using natural insecticides namely Rotenone from the roots of Derris plant, and Pyrethrum from the flower heads of a species of chrysanthemum. After twenty years, it was found that the level of synthetic pesticides was building and was not biodegradable and their harmful effects started coming out. There is a need to create bio-pesticides which are effective, eco-friendly and do not leave any harmful effect on the environment.
2. **Gardening,** Gardening is the foundation of the Native Indian economic climate. Up to 70% of the population is directly or indirectly involved in town industry. Growing Native Indian populations necessitate adequate town produce. Gardening and agricultural vegetation are vulnerable to unwanted pest infestations in the form of bugs, infection, harmful bacteria or viruses, or fresh mushrooms, and control of these has become necessary to keep failures to a minimum. Biopesticides are pesticides derived from natural materials such as animals, plants, bacteria, and minerals. Fungi such as *Beauveria sp*., bacteria such as *Bacillus sp*., Neem extract, and pheromones are examples of these. (Shilpi Sharma and Promila Malik, 2012).

3. **Pesticide,** Pesticides are natural or synthetic agents used to eliminate unwanted animals, plants, or pests. While the term pesticide is now frequently associated with synthetic chemical compounds, synthetic cides have only recently been used. Since ancient times, natural compounds or extracts have been used as pesticides. Salt, sulfur stone, tobacco extract, red chili, and other early pesticides are examples. The Napoleonic army was said to have used crushed chrysanthemums to control fleas, with limited success. Petroleum oils, heavy metals, and arsenic were freely used to control unwanted pests and weeds until the 1940s, when they were mostly replaced by organic synthetic pesticides, the most well-known of which was DDT.

   Because long-term pesticides contain a diverse range of substances, an explanation of pesticide taxonomy and nomenclature is warranted. Pesticides can be classified according to their target pest or according to their chemical identity. The classification based on the target pest is most likely the most well-known. Insecticides, for example, are pesticides that target insects, whereas herbicides target plants. There are many more examples (acaricide targets, nematicides targets, nematode targets, etc.), but for the purposes of this report, it is important to note that 11 of the 12 cases that OSAGWI is concerned about involve insecticides and/or acaricides. DEET, number twelve, is also intended to repel insects and fleas, but it is distinct

in that it is a repellent rather than an insecticide. To avoid confusion, the term pesticide is used as a substitute for subclassified alternatives in this report.
(https://www.rand.org/content/dam/rand/pubs/monograph_reports/MR1018z8/MR1018.8.ch2.pdf.)

Types of Biopesticides consist of:

Bio-pesticides can classify into three major classes below:

1. Microbial pesticides comprise microorganism (e.g., Bacterium, fungus, virus or protozoan) which is an active ingredient. Microbial pesticides can arrange many kinds of pests diversity, although each separate active part is relatively specific for its target pests. An example: some fungi can supervise particular sable and other fungi that can kill certain insects.
2. Biochemical pesticides are a naturally happening matter that arranges pest by non-toxic manner. Traditional pesticide, conversely, is generally synthetics material that straight kills or deactivate the pest. The substances that include in a biochemical pesticide are insect sex pheromones, which interfere with mating, as well as different types of scented plant essences that pull insect pests to traps. Because it is occasionally hard to determine a matter meets the criteria for methods as a biochemical pesticide, the conscientious authority would establish a specific committee to arrange the decision.
3. Plant-Incorporated-Protectants (PIPs) are a pesticidal matter that crops produce from genetic material that has added to the crop. For example, scientists can take the gene for the B.t. Pesticide protein, and introduce the gene into the plant's genetic material. Then the crop, instead of the B.t. The substance bacterium companies who destroy the pest. (Suman Gupta and A. K. Dikshit, (2010).

Advantages

When using bio-pesticide to plantation that will provide benefit to living things, first, which are biodegradable and eco friendly to the environment. It will not cause pollution and offer good nutrient to the soil as well as crop. This condition will be good for the substance which in the soil. Second, utilize bio-pesticide will preserve pollinators and plant friendly insects such as bees, butterflies, and ladybugs. Where this insects are useful from the growth of the plantation. Third, usage of bio-pesticide will kill pests through their lifecycle in different ways, not like others which targeted by egg, larval, or adult. Fourth, in using bio-pesticide will impact to the pest because they don’t have ability to develop resistance differently when using synthetic pesticide because sometimes bugs have ability to develop tolerance to certain matter (Marc Sporleder, Lawrence A. Lacey, 2013). Fifth, market of the product become increases because

awareness from the people to healthy lifestyle who want to consume organic product (Biocon, 2006).

Disadvantages

The usage processes from bio-pesticide cannot directly use by any farmer but needed farmer with good or enough knowledge to manage the particular plant. And also limited scope to commercial use bio-pesticide because it is more often developed by research institution than traditional pesticide industry. The last point is declining the shelf life from the product because the chemical contains in the bio-pesticide is lower than other (Marc Sporleder, Lawrence A. Lacey, 2013).

The uses of Bio-pesticide in Indonesia

Indonesian farmers have long been using biopesticides before they know synthetic pesticides. Because publications are limited, there are no reports about that. So far in agriculture, some Indonesian farmers have used organic agricultural products which include biopesticides, farmers still use compost or hummus and vegetables or biological pesticides. But in general, not all of the farmers use this because lack of knowledge of proper farming methods is a challenge in developing organic agriculture in Indonesia to get high quality in natural products (Surono, 2007).

One of the main tasks in agricultural development is to find farming methods that can be practiced effectively by farmers who have the only low ability and want to learn to develop better skills. The government needs to increase supervision and to counsel the use of pesticides to users. The method of prospective biopesticides but until now this is still in place because of several factors yet appropriately done. The farmers because lack knowledge of controlling pests or diseases with vegetable pesticides, farmers usually mix some plants extracts that are useful in inhibiting the development or killing of pests or diseases. Their effectiveness is generally unknown, and are rarely used singly, for example, srikaya seed extract only Farmers can mix 3-4 kinds of vegetable ingredients, even up to six types. A pesticide may be intended to be able to kill or inhibit various types of pests or diseases at once. Besides that, this method might work because of my limited knowledge of farmers about the effectiveness of each vegetable extract. Farmers rarely use control of pests or diseases biodiversity, so its efficacy is unknown. Only certain groups have pure isolates, then multiplied themselves by farmers, in this case, vulnerable to contamination, so the effectiveness is doubtful (Pretty and Bharucha, 2015).

It is an example about a farming area in Indonesia which they are farmer using already using the biopesticide, this Mojogedang is a sub-district that develops organic farming and has produced its biopesticides, and besides that, the Mojogedang sub-district is also one of the villages that are traditionalized as an ecological village. A biopesticide is an important innovation to support the development of organic agriculture. It is stated that of all pesticides produced worldwide today, 75% are used in developing countries.

In reality on the still shows that until now the farmers have not escaped from pesticides in farming activities, as are the farmers in Mojogedang who have not been able to avoid from chemical pesticides in their farming activities. Farmers in sub-district Mojogedang themselves use a type of plant-based biopesticide, which is a type of pesticide that uses ingredients derived from plants. Farmers widely used vegetable pesticide because the components can easily be obtained from the surrounding, among others: mahogany fruit, Gadung, Mimba leaves, drip drops to control plant pests or diseases (Tudi et al, 2021).

Awareness to Use Biopesticide

Most vegetable farmers in Indonesia uses synthetic pesticides to prevent pests and attacks plant disease (Ameriana, 2008), On the other hand, consumers began to realize the importance of resources healthy food and safe from residue pesticide. This influenced several factors such as motivation, risk, and consumer knowledge. That motivation meant here is higher consumer interest in consuming types certain foods, will be more top consumer concern for quality vegetable products. In developing bio insecticides there are 10 factors which is a consideration, namely the availability of materials standard, the effectiveness of vegetable ingredients that meet the requirements application technology, vegetable pesticide industry, distribution,transportation, and packaging, human resources,institutions, contributions to IPM, competitiveness, social,culture, and economy. Development of biopesticides should lead to three aspects, namely technology, institutional, and agribusiness (Octasari et al, 2019).

Resource factor humans can be overcome by training farmers or farmer groups to have skills multiply biopesticides. Institutional factors must come from the government. If institutional factors already built, then other factors will follow it. The government should be able to give container for developing biopesticide business together with other programs (such as the IPM program that is already running) by farmers with assistance (van den Berg et al, 2020).

Benefits of using biopesticides are environmentally friendly because of its compounds contained in it is easily shed in nature. Biopesticides do not cause resistance or resurgence so that it does not cause rastas new to disease-causing microorganisms. Compounds in biopesticides are

not toxic in humans so that it does not disturb health users (farmers) and consumers. Biopesticides have the opportunity to be developed in Indonesia because there are various plants and microorganisms which can be used as raw material (Taufik et al, 2020).

Conclusion

Biopesticides have an opportunity to be developed in Indonesia because there are various plants and microorganisms which can be used as raw material, biopesticides are available from time to time to planting of vegetable-producing plants up to being raw material must be continuously carried out, or mass breeding of a predator, fungus entomopathogen.

Biopesticides effectively suppress growth and the development of plant pests and diseases, good at laboratory and field level, but not based on control thresholds such as inorganic pesticides. It will not cause pollution and offer good nutrient to the soil as well as crop. This condition will be good for the substance which in the soil and utilize bio-pesticide will preserve pollinators and plant friendly insects such as bees, butterflies, and ladybugs. Where this insects are useful from the growth of the plantation. Development of biopesticides requires support from various parties so that it can be used and benefit farmers as users and free from pollution originating from chemical pesticides.

References

1. Agus Pakpahan, (2018) Shift in Global Hunger Index 2000-2017:Implications to Agricultural Policy, Food and Quality of Indonesian Human Resources.
2. Mette Wik, Prabhu Pingali, and Sumiter Broca (2018), Global Agricultural Performance: Past Trends and Future Prospects.
3. Suman Gupta and A. K. Dikshit, (2010) Bio-pesticides: An ecofriendly approach for pest control.
4. Shilpi Sharma and Promila Malik, (2012), Bio-pestcides: Types and Applications, International Journal Of Advances In Pharmacy, Biology And Chemistry
5. https://www.rand.org/content/dam/rand/pubs/monograph_reports/MR1018z8/MR1018.8.ch2.pdf.
6. Marc Sporleder, Lawrence A. Lacey, 2013. Insect Pests of Potato.
7. Biocon, 2006. The biopesticide market for global agriculture use.
8. Ameriana, M. 2008. “Perilaku Petani Sayuran dalam Menggunakan Pestisida Kima”. Jurnal Hortikultura 18(1):95-106
9. Surono, J.I. (2007) Country case study of Indonesia. Powerpoint document presented at the Regional Conference on Organic Agriculture in Asia, Thailand.

10. http://pangan.litbang.pertanian.go.id/files/08-iptek11022016Sumartini.pdf
11. https://eprints.uns.ac.id/4064/1/169933001201211261.pdf
12. https://media.neliti.com/media/publications/41641-none-9cb12573.pdf
13. Pretty, J., & Bharucha, Z. P. (2015). Integrated Pest Management for Sustainable Intensification of Agriculture in Asia and Africa. Insects 2015, Vol. 6, Pages 152-182, 6(1), 152–182. https://doi.org/10.3390/INSECTS6010152
14. Tudi, M., Ruan, H. D., Wang, L., Lyu, J., Sadler, R., Connell, D., Chu, C., & Phung, D. T. (2021). Agriculture Development, Pesticide Application and Its Impact on the Environment. International Journal of Environmental Research and Public Health 2021, Vol. 18, Page 1112, 18(3), 1112. https://doi.org/10.3390/IJERPH18031112
15. Octasari, A. P., Afandhi, A., & Soemarno, S. (2019). Priority Analysis of The Integrated Pest Management (IPM) Implementation on Vegetable Cropping in Bumiaji Subdistrict, Batu City, East Java. Indonesian Journal of Environment and Sustainable Development, 10(2), 2087–3522. https://doi.org/10.21776/UB.JPAL.2019.010.02.07
16. Taufik, M., Cahyadi, B., Tarigan, E. D. br, & Razali, M. (2020). Biopesticide for overcoming caterpillar pests on cabbage plant (Brassica oleracea L). Journal of Saintech Transfer, 3(1), 43–51. https://doi.org/10.32734/jst.v3i1.3946
17. Taufik, M., Cahyadi, B., Tarigan, E. D. br, & Razali, M. (2020). Biopesticide for overcoming caterpillar pests on cabbage plant (Brassica oleracea L). Journal of Saintech Transfer, 3(1), 43–51. https://doi.org/10.32734/JST.V3I1.3946