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Biopesticides - An environmentally friendly approach for desert locust control

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Introduction

Desert locust, *Schistocerca gregaria* (Forskål, 1775) is a migratory pest, always present somewhere in the deserts between Mauritania and India. Swarms of desert locusts are threatening large areas of pastures and crops, overwhelming several countries across multiple agro-climatic zones ranging from Africa, the Middle East to Asia (Despland, 2005). The management of the locusts is still mainly based on the control of gregarious adults and hoppers with synthetic chemical insecticides. Because they work quickly, chemical pesticides remain a key tool in extreme cases like the current large-scale infestations. Generally, in Pakistan, Malathion and Lamdacyhalothrin are used for locust control; they are broad spectrum and used above the recommended dose rate, which may pose a risk to human health and the environment. It is not an easy task to keep the adverse environmental effects of locust control to a minimum. These chemicals will remain in the ecosystem for long time and that is a disaster on local ecosystems. Concern about the environmental and human health effects of the large quantities of these insecticides has sparked renewed interest in the use of biological control options. Moreover, continuing favourable conditions can lead to rapid population increase mean that it make sense to change our focus to disrupt the breeding cycle using an effective ecological tool that farmers and governments can use in any environment. Biopesticides offer a reliable, less harmful alternative for controlling locust outbreaks before they reach crisis

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levels and, when locust numbers are high, they offer a solution for treating outbreaks in environmentally sensitive areas and fragile ecosystems ensuring locusts are treated wherever they are found as part of an effective integrated pest management program (Dakhel et al., 2019; Zhang et al., 2019).

What are Biopesticides?

As the name suggests, biopesticides repurpose nature's own tools and use them against pests. One popular set of bio tools are microbes including entomopathogenic bacteria, nematodes, fungi and viruses. One of the approaches that have been researched was the use of entomopathogenic fungi, the most promising of which belong to the genus *Metarhizium*. *Metarhizium acridum* based formulations i.e. Green Muscle, Novacrid, Green Guard and similar products are very effective for the control of locusts that can kill 90 percent of hopper populations within 10-15 days. Oil formulations of *Metarhizium* have been successfully used in Australia, Africa, Brazil and China against locusts. China applies biopesticides on more than 100,000 hectares annually against locusts and insect pests of different crops (Zhang et al., 2019), while FAO has successfully used *Metarhizium* biopesticide against locust in Somalia. *Metarhizium* biopesticides generally consist of *Metarhizium* spores in an oil formulation and when sprayed on locust infestations, some of the spores land on the locusts themselves, but a much greater infection results because of the behaviour of the locusts. Most of the spores land on the vegetation and, because locusts are voracious eaters of vegetation, they pick up many spores as they move through and consume vegetation. The spores attach to the surfaces of the locust body and penetrate into the locust's body where the *Metarhizium* grows and kills the insect over a number of days. The rate of growth of the *Metarhizium* fungus very much depends on the ambient temperature. During the heat of summer, locusts are killed within about 10 days or even less: while it is too hot in the middle of the day for the growth of the fungus, temperatures are ideal for fungal growth during the night and morning (Arthurs and Thomas, 2001; Fargues et al., 1997). At the milder temperatures of spring, development takes longer two weeks or so, as temperatures are mainly favourable from mid-morning until late afternoon.

Benefits of using biopesticides

Biopesticides have a number of advantages over chemical insecticides: they are much safer to apply and do not lead to chemical residues being present in agricultural products and the environment. Their host specificity means harmful side effects on beneficial organisms are avoided resulting in much reduced effects on biodiversity in ecosystems (Githae and Kuri, 2021). Unlike chemical insecticides, resistance is unlikely to develop against biopesticides because of their biological mode of action. They can be applied in nature reserves, national parks, wetlands and other areas with water bodies. Moreover, as a component of an integrated

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pest management (IPM) programs, biopesticides can contribute greatly to ensuring locusts are treated wherever they are found (Lomer, 1999).

Conclusion and future prospects

Biopesticides cover only 4.0% of the global pesticide market but they could play a significant role in integrated locust management strategies. Despite several challenges, we believe that the microbial pesticide market in Pakistan has a bright future as there are increasing standards for the environment and human health both nationally and internationally that means widespread chemical pesticide use will face increasing scrutiny. Although biopesticide research in Pakistan is at a relatively early stage, it is evolving rapidly with increasing focus on demonstrating its efficacy and value in environmentally sensitive areas, analysis of suitable application techniques, identifying effective indigenous isolates, and improving formulation and manufacturing technologies that reduce costs and enhance the shelf life of the products. The registration process for biopesticides needs to be evolved and legislation should be addressed for the patenting process for microbial products as part of adopting international standards for the development and application of biopesticides in Pakistan.

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