Biopesticides: An Ecofriendly Approach for Pest Management

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Abstract- *The current pest management strategy relies heavily on synthetic chemical pesticides which cause adverse effects on the soil quality, soil fertility, beneficial organisms, pesticide content in food, environmental pollution. One more problem arising is the development of resistance of pests to chemical pesticides. For that one of the promising alternatives has been used of biopesticides. Biopesticides are certain types of pesticides derived from such natural materials as animal, plants, bacteria and certain minerals. The potential benefits of biopesticides in agriculture and public health is considerable. Their usage reduces the risk of exposure to chemicals, causes less harm to soil & beneficial fauna, biodegradable, gives better quality food. Currently in India, biopesticides like Bt, Trichoderma, neem based biopesticides, NPV have already in practice.*

Keywords- Biopesticides, pest control, biodegradable, Bt.

I. INTRODUCTION

Entry of chemical pesticides into food chain and their bioaccumulation triggers several unforeseen consequences. Chemical pesticides are responsible for extensive pollution of the environment, a serious health hazard due to the presence of their residues in food, development of resistance in targeted insect pest populations, a decrease in biodiversity, and outbreaks of secondary pests that are normally controlled by natural enemies, biopesticides, in contrast, are inherently less toxic to humans and the environment, do not leave harmful residues, and are usually more specific to target pests. Biopesticides are pest management agents based on living micro-organisms or natural products.

Microbial biopesticides offer many advantages, such as high levels of specificity combined with lower developmental and registration costs than those for conventional pesticides (Chandler et al., 2008). Biopesticides are made from naturally occurring substances that controls pests by non-toxic mechanisms and in ecofriendly manner. They are generally less toxic than chemical pesticides, often target-specific, have little or no residual effects and have acceptability for use in organic farming.

Types of Biopesticides: There are three types of biopesticides:

1. Microbial pesticides: Microbial biopesticides represent an important option for the management of plant diseases. The United States Environmental Protection Agency (EPA) defines biopesticides as, "certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals." The bacteria that are used as biopesticides can be dividedinto four categories: crystalliferous spore formers (such as Bacillus thuringiensis); obligate pathogens (such as Bacillus popilliae); potential pathogens (such as Serratia marcesens);and facultative pathogens (such as Pseudomonas aeruginosa).Out of these four, the spore formers have been most widely adopted for commercial use because of their safety and effectiveness. One of the most widely used microbial pesticides is Bacillus thuringiensis. The bacterium produces crystalline proteins and specifically kills one or a few related insect species. Binding of the Bt crystalline protein to insect gut receptor determines the target insect species. Bacillus thuringiensis (Bt), which produces a protein crystal (the Bt δ-endotoxin) during bacterial spore formation that is capable of causing lysis of gut cells when consumed by susceptible insects (Gill SS., 1992). The δ-endotoxin is host specific and can cause host death within 48 h (Bond R. P. M. et. al., 1971 and Siegel JP., 2001). It does not harm vertebrates and is safe to people, beneficial organisms and the environment (Lacey L. A., Siegel J. P. 2000). Bt sprays are a growing tactic for pest management on fruit and vegetable crops where their high level of selectivity and safety are considered desirable, and where resistance to synthetic chemical insecticides is a problem (Van Driesche R. et. al., 2008).

To date, over one hundred B. thuringiensis-based bioinsecticides have been developed, which are mostly used against lepidopteran, dipteran and coleopteran larvae. In addition, the genes that code for the insecticidal crystal proteins have been successfully transferred into different crops plants, which has led to significant economic benefits (Shilpi Sharma, 2012). Subspeciesof B. thuringiensis that are used as biopesticides include B.thuringiensis tenebrionis(targeting Colorado potato beetle and elm leaf beetle larvae), B. thuringiensis kurstaki (targeting a variety of caterpillars), B. thuringiensis israelensis (targeting mosquito, black fly and fungus gnat larvae) and B. thuringiensis aizawai (targeting wax moth larvaeand various caterpillars, especially the diamond back moth caterpillar). These bacteria are mass-produced through either solid or liquid fermentation (Opender Koul, 2011). One more strain B. sphaericus were isolated in the mid-1960s from mosquitoes, blackflies and grasshoppers (Berry C et. al., 1991). These bacteria producean intracellular protein toxin and a parasporal crystalline toxin at the time of sporulation (De Barjac H et. al., 1985).

Microbial biopesticides used against plant pathogens include Trichoderma harzianum, which is an antagonist of Rhizoctonia, Pythium, Fusarium and other soil-borne pathogens (Harman G. E. 2005). Coniothyrium minitans is a mycoparasite applied against Sclerotinia sclerotiorum, an important disease of many agricultural and horticultural crops (Whipps J. M. et. al., 2008). Microbial antagonists, including yeasts, filamentous fungi and bacteria, are also used as control agents of post-harvest diseases, mainly against Botrytis and Penicillium in fruits and vegetables (Spadaro D. et.al., 2004). The viruses used forinsect control are the DNA-containing baculoviruses(BVs), Nucleopolyhedrosis viruses (NPVs), granuloviruses (GVs), acoviruses,iridoviruses, parvoviruses, polydna-viruses, and poxviruses and the RNA-containing reoviruses, cytoplasmic polyhedrosis viruses, nodaviruses,picrona-like viruses and tetraviruses (Opender Koul, 2011). Another group of microorganisms that cancontrolpests is the entomopathogenic nematodes, which control weevils, gnats, white grubs and various species of the Sesiidae family (Klein MG. 1990; Shapiro-Ilan DI et. al., 2002; Grewal PS et. al., 2005 and Williams RN et. al., 2005). Commonly used nematodes in pest management belong to the genera Steinernema and Heterorhabditis, which attack the hosts as infective juveniles (IJs) (Kaya HK. Et. al., 1993 and . Koppenhofer AM et. al., 2002).

2. Plant-Incorporated-Protectants(PIPs): Plant-incorporated protectants (PIPs) are plants that have had genes inserted causing the plants to produce a pesticide inside its own tissues. When plants are genetically modified to produce pesticides in this manner, they are regulated as pesticides by the Environmental Protection Agency (EPA). When plant genes are modified to make the plants tolerate certain herbicides, they are not regulated as pesticides. This is possible because botanists add special pesticide proteins and strategically alter the genetic material of the plants. As a result, the plants are able to manufacture their own proteins and pesticides when needed.PIPs typically macromolecular in nature. First-generation insecticidal PIPs were Cry proteins expressed in GM crops containing transgenes from the soil bacterium Bacillus thuringiensis; next-generation double-stranded ribonucleic acid (dsRNA) PIPs have been recently approved. Like conventional synthetic pesticides, the use of either Cry protein or dsRNA PIPs results in their release to receiving environments (Parker KM and Sander M. 2017). The production of transgenic plants that express insecticidal δ-endotoxins derived from the soil bacterium Bacillus thuringiensis (Bt plants) were first commercialized in the US in 1996. The expression of these toxins confers protection against insect crop destruction (Shelton A.M at. al., 2000)

3. Biochemical pesticides: Biochemical pesticides are naturally occurring substances that control pests by non-toxic mechanisms. Biochemical pesticides include substances that interfere with growth or mating such as plant growth regulators, or substances that repel or attract pests, such as pheromones(Suman Gupta, A. K. Dikshit., 2010). Four groups are in commercial use: pyrethrum, rotenone, neem oil, and various essential oils are naturally occurring substances that control (or monitor in the case of pheromones) pests and microbial diseases. Some essential oils work as repellents, and their mode of action would be as a fragrance." (Steinwand, 2008). In practical terms, a non-toxic mode of action typically means that there is a delay between contact with the substance and death (Mandula, 2008). Some examples of non-toxic modes of action include suffocation or starvation. Biochemical pesticides typically fall into distinct biologically functional classes, including semichemicals, plant extracts, natural plant growth regulators, and natural insect growth regulators. There are almost 122 biochemical pesticide active ingredients registered with the EPA, which include 18 floral attractants, 20 plant growth regulators, 6 insect growth regulators, 19 repellents, and 36 pheromones (Steinwand, 2008).

Advantages to the use of insect pheromones include their high species specificity and relatively low toxicity. Sex pheromones tend to be specific to a particular species or even strain of insect, making them one of the most targeted pest management strategies and a disadvantage of insect pheromones is that they often must be used in combination with other pest management strategies to achieve the efficacy desired. Some botanical extracts such as floral essences attract insects to traps. Products made from plant extracts and oils can be regulated as biopesticides or conventional pesticides depending on their mode of action and level of toxicity.

Insect growth regulators are chemical compounds that alter the growth and development of insects. Thus, they are specific to the control of insect pests. For example Neem materials can affect insects, mites, nematodes, fungi, bacteria, and even some viruses. Despite being derived from natural and renewable sources, the use of Neem products raises some concerns due to its relatively broad-spectrum activity (Karen Peabody O'Brien et. al., 2009).

Advantages of Biopesticides:

Biopesticides sre host specific. It have ability to multiply in the target cells. Biopesticides are non toxic residue. Biopesticides does not have any of cross resistance. There are different conventional technique or methods can be used for its applications. Biopesticides gives permanent control of pest or long persisting effect. It is idealy suited for integration with most other plant protection measures used in IPM programme. Fungicidal and biofungicidal seed treatments are used to control soil borne fungal pathogens that cause seed rots, damping-off, root rot and seedling blights. Biopesticides does not cause any environment pollution and hence ecofriendly.

II. CONCLUSION

The use of biopesticides has emerged as promising alternative to chemical pesticides. Biopesticides have a precious role to play in the future of the Intrgreated Pest Mangement stratagies. As it is observed that there are different varieties of biopesticidse are available in the market which can increase the crop yield without any harmful effects on soil fertility, soil texture and normal flora of soil. So there is need to make general awareness for the use of such different kinds of biopesticides for better yield.

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