REVIEW ON BIOPESTICIDES: AN ENVIRONMENTAL FRIENDLY APPROACH

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ABSTRACT

Over the past 60 years, crop protection has relied heavily on synthetic chemical pesticides. The injudicious use of broad-spectrum chemical pesticides for improving agricultural productivity has caused numerous ill effects such as development of resistance in target pests, killing of beneficial organisms, leave harmful residues in food, feed and fodder, hazardous impact on human health. Increasing public concern about the potential adverse effects of synthetic agrochemicals prompts search for the technologies and products safer for the environment. Therefore, alternative eco-friendly pest management tactics are needed. Biopesticides are pest management agents based on living micro-organisms or natural products. They have proven potential for pest management and they are being used across the world. Biopesticides are formulations made from naturally occurring substances that control pests by non-toxic mechanisms and in an eco-friendly manner. The potential benefits to agriculture and public health programs through the use of biopesticides are considerable.

Key Words: Biopesticides; Botanicals

INTRODUCTION

Agriculture is adversely affected by destructive activities of numerous pests like bacteria, fungi, weeds and insects, leading reduced yields. Since 1960s, the most common method for pest control has been based on the intensive use of synthetic organic pesticides. These pesticides were first introduced in the 1940s with the use of dichloro-diphenyl-trichloroethane (DDT), followed by other organophosphate and carbamate pesticides (Nicholson, 2007). There up on crop production was increased by successful implementation of green revolution technology through the application of synthetic chemical pesticides in pest control program. But the over dependence on chemical pesticides and their indiscriminate use caused several detrimental effects on environment. Recognizing the detrimental effects of chemical pesticides such as pesticide resistance, pest resurgence, outbreak of secondary pests, pesticide residues in the produce, soil, air and water resulting in human health hazards and ecological imbalances (Al-Zaidi *et al.*, 2011), it is important to develop alternative methods. Hence, the need of the day is to produce maximum from the decreasing availability of natural resources without adversely affecting the environment. Therefore, alternative, environmentally safe methods are needed for pest management. As a result, bio-pesticides using eco-friendly, plant or microbial derived ingredients showing broad insecticidal effects with minimal damage to the environment have been increasingly developed. Biopesticides are generally less toxic than chemical pesticides, often target specific, cause minimal harm to birds, insects and mammals. In addition, even if used in an open field, they decompose quickly, thereby minimizing the risk of environmental pollution or residual toxicity.

Different biopesticides, such as viruses, microorganisms (bacteria, fungi, etc.), derived products, animal derived products (pheromones, hormones, insect-specific toxins, etc.), plant derived products or genetically modified organisms have been developed and used across the world. Interest in biopesticide is gaining importance because of its merits associated with environmental safety, target-specificity and efficacy in very small quantity, natural decomposition. Thus, biopesticides are one of the promising alternatives to manage environmental pollutions. They can replace some of the hazardous chemical pesticides. Though potential of biopesticide for promoting sustainable agriculture has been known for years, it has gained interest in view of the growing demands for safe and healthy organic food. Although use of agrochemicals is indispensable to meet the ever growing demands of food, feed and fodder. Increasing demands for residue-free crop produce, growing organic food market and easier registration than chemical pesticides are some of the key drivers of the biopesticide market. In India, some of the biopesticides like Bt, NPV, neem based pesticides, etc. have already been registered and are being practiced. (Suman Gupta and A. K. Dikshit)

Biopesticides may be broadly categorized into three major groups: 1) Microbial biopesticides 2) Biochemical and 3) Plant-Incorporated Protectants (PIPs)

(1) Microbial Pesticides: Microbial biopesticides are preperations containing living microorganisms (Bacteria, Fungi, Viruses or Protozoans) which are pathogenic for the pest of interest. Microbial pesticides can control many different kinds of pests these include biofungicides (*Trichoderma*), bioherbicides (*Phytopthora*) and bioinsecticides (*Bacillus thuringiensi* and *Baculovirus*). The most widely known microbial pesticides are varieties of the bacterium *Bacillus thuringiensis*, or Bt, which can control certain insects in cabbage, potatoes, and other crops. Bt produces a protein that is harmful to specific insect pests. Certain other microbial pesticides act by out-competing pest organisms. The widely used microbial pesticides are *Bacillus thuringenesis, Bacillus sphaericus, Psudomonas fluorescence* (Bacteria), *Trichoderma viride, Beauveria bassiana* (Fungi), Baculo virus and Nucleopolyhedrosis Virus.

(2) Biochemical pesticides: biochemical pesticides are naturally occurring substances from microorganisms, plants and animals that control pests by non-toxic mechanisms. Conventional pesticides, by contrast, are synthetic materials that usually kill or inactivate the pest. 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. Historically, many plant species have been explored well for human welfare by studying their insecticidal, repellent and antifeedant properties. In general, many plants contain wide spectrum of secondary metabolites such as phenols, flavonoids, terpenoids, quinones, tannins, alkaloids, saponins, coumarins and sterols which show vary in their efficacies against pest species. Plant biochemicals are collectively called Botanicals.

Quantitatively, the most important botanical is pyrethrum, followed by neem, rotenone and essential oils, typical used as insecticides (e.g. pyrethrum, rotenone, rape seed oil, quassia extract, neem oil, nicotine), repellents (e.g. citronella), fungicides (e.g. laminarine, fennel oil, lecithine), herbicides (e.g. pine oil), sprouting inhibitors (e.g. caravay seed oil) (Isman, 2006). Plants are capable of synthesizing an overwhelming variety of small organic molecules called secondary metabolites, usually with very complex and unique carbon skeleton structures (Sarker et al., 2005). The well-known example is azadrachtin which is isolated from the seed kernel of Azadirachta indica contributes for the development of more than 100 commercial products. the most important botanical is pyrethrum, followed by neem, rotenone and essential oils, typical used as insecticides (e.g. pyrethrum, rotenone, rape seed oil, quassia extract, neem oil, nicotine), repellents (e.g.citronella), fungicides (e.g. laminarine, fennel oil, lecithine), herbicides (e.g. pine oil), sprouting inhibitors (e.g. caravay seed oil) and adjuvants such as stickers and spreaders (e.g. pine oil) (Isman, 2006).

(3) Plant Incorporated Protectants: Plant incorporated protectants are produced by introducing a gene offering resistance to target pest into a crop plant. For example, the gene for Bt pesticidal protein, was introduced e into the genetic material of cotton plant. Such transgenic plant produces biodegradable protein with no harmful effect on animals and human beings, and thus curtails the use of hazardous pesticides.

DISCUSSION AND CONCLUSION

The growth of total world production of biopesticides is increasing at a rapid rate. India has a vast potential for biopesticides. However, its adoption by farmers in India needs education for maximizing gains. The stress on organic farming and on residue free commodities would certainly warrant increased adoption of biopesticides by the farmers. However, its adoption by farmers in India needs education for maximizing gains. In India, so far only 15 types of biopesticides have been registered under the Insecticide Act, 1968. Biopesticides represent only 5% of the overall pesticide market in India and is expected to exhibit an annual growth rate of about 3% in the coming years.

Training on production and quality control to manufacturers, and organizational training to extension workers and farmers to popularize biopesticides may be essential for better adoption of the technology. As environmental safety is a global concern, we need to create awareness among the farmers, manufacturers, government agencies, policy makers and the common men to switch-over to biopesticides for pest management requirements. Clearly, the public needs better information on their risks and benefits, especially in comparison with chemical pesticides and, hopefully, the negative social perception will decrease. Microbial pesticides need to be continuously monitored to ensure they do not become capable of harming non-target organisms, including humans.

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