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BIOPESTICIDES – FOR FUTURE

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ABSTRACT

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INTRODUCTION

Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria and certain minerals. In commercial terms, biopesticides include microorganisms that control pests (microbial pesticides), naturally occurring substances that controlpests (biochemical pesticides), and pesticidal substances produced by plants containing added genetic material (plant incorporated protectants). Biopesticides are employed in agricultural use for the purposes of insect control, disease control, weed control, nematode control and plant physiology and productivity.Biopesticides are usually inherently less toxic than conventional pesticides. They provide growers with valuable tools by delivering solutions that are highly effective in managing pests, without creating negative impacts on the environment.They generally affect only the target pest and closely related organisms, in contrast to the broad-spectrum conventional pesticides that may affect organisms as different as birds, insects, and mammals. Overall, the biopesticides have very limited toxicity to birds, fish, bees and other wildlife thus helping in maintaining beneficial insect populations. Biopesticides often are effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides. When used as a component of Integrated Pest Man-

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agement (IPM) programs, biopesticides can greatly decrease the use of conventional pesticides, while crop yields remain high. To use biopesticides effectively, however, users need to know a great deal about managing pests. Biopesticides fall into three major classes:

1. Biochemical pesticides

These are naturally occurring substances that control pests by non-toxic mechanisms. Conventional pesticides are generally synthetic materials that directly kill or inactivate the pest. Biochemical pesticides include substances, such as insect sex pheromones that interfere with mating as well as various scented plant extracts that attract insect pests to traps.

2. Microbial pesticides

The active ingredient is a microorganism that either occurs naturally or is genetically engineered (e.g., a bacterium, fungus, virus or protozoa, nematodes, yeast). Microbial pesticides can control many different kinds of pests, although each separate active ingredient is relatively specific for its target pests. For example, there are fungi that control certain weeds, and other fungi that kill specific insects.The most widely used microbial pesticides are subspecies and strains of *Bacillus thuringiensis*, or Bt, NPV, *Trichodermaharzianum*.

3. Plant-Incorporated-Protectants are pesticidal substances that plants produce from genetic material that has been added to the plant. For example, scientists can take the gene for the Bt pesticidal protein, and introduce the gene into the plant's own genetic material. Then the plant, instead of the Bt bacterium, manufactures the substance that destroys the pest. The protein and its genetic material, but not the plant itself, are regulated by EPA.

Scope of Biopesticides

The striking feature of biopesticides is environment friendliness and easy biodegradability, thereby resulting in lower pesticide residues and largely avoiding pollution problems associated with chemical pesticides. Further, use of biopesticides as a component of Integrated Pest Management (IPM) programs can greatly decrease the use of conventional (chemical) pesticides, while achieving almost the same level of crop yield. However, effective use of biopesticides demands understanding of a great deal about managing pests especially by the end users.In terms of production and commercialization biopesticides have an edge over chemical pesticides like low research expenditure, faster rate of product development as well as flexible registration process.

Biopesticides in India

The global weighted average consumption level of biopesticides is approximately 1 kg/ ha. With the global organic farming area comprising about 24 million hectares, global biopesticide consumption is thus estimated at about 24 million kg. In India, they represent only 2.89% (as on 2005) of the overall pesticide market in India and expected to exhibit an annual growth rate of about 2.3% in the coming years (Thakore, 2006). Consumption of biopesticides has increased from 219 metric tons in 1996-97 to 683 metric tons in 2000-01, and about 85% of the biopesticides used are neem based products. However, consumption of chemical pesticides has significantly fallen from 56,114 MT to 43,584 MT during the same period.

In India, so far only 12 types of biopesticides have been registered under the Insecticide Act, 1968 (www.nicm.org.in/biopesticides/registered.htm). Neem based pesticides, *Bacillus thuringensis*, NPV and *Trichoderma* are the major biopesticides produced and used in India (http://coe.mse.ac.in/taxproj.asp). Whereas more than 190 synthetics are registered for use as chemical pesticides. Most of the biopesticides find use in public health, except a few that are used in agriculture. Besides, transgenic plants and beneficial organisms called bioagents arealso used for pest management in India.

Biopesticides Registered under Insecticides Act,

1. *Bacillus thuringiensis* var. israelensis
2. *Bacillus thuringiensis* var. kurstaki
3. *Bacillus thuringiensis* var. galleriae
4. *Bacillus sphaericus*
5. *Trichodermaviride*
6. *Trichodermaharzianum*
7. *Pseudomonas fluoresens*
8. Beauveriabassiana
9. NPV of Helicoverpaarmigera
10. NPV of Spodopteralitura
11. Neem based pesticides
12. Cymbopogan

Major biopesticides produced and used in India are briefly described below (http://coe.mse.ac.in/taxproj.asp).

Some success stories about successful utilization of biopesticides and biocontrol agents in Indian agri-

Table 1. Annual availability of biopesticides in India

Biopesticides/ Bioagents	Quantity/ annum (approx)
Neem 300 PPM	1,000,000 L
Neem 1500 PPM	250,000 L
Bacillus thuringiensis	50,000 kg
NPV (liquid)	500,000 Le
Beauveria	Meager
Pheromone traps	500,000 nos.
Lures	2 million
Trichogramma	1 million
Chrysoperla & other biocontrol insects	Meager
Trichoderma	500 T

Kalra &Khanuja, 2007

culture include (Kalra & Khanuja, 2007):

- Control of diamondback moths by *Bacillus thuringiensis.*
- Control of mango hoppers and mealy bugs and coffee pod borer by Beauveria.
- Control of Helicoverpaon cotton, pigeon-pea, and tomato by *Bacillus thuringiensis.*
- Control of white fly on cotton by neem products.
- Control of Helicoverpaon gram by N.P.V.
- Control of sugarcane borers by *Trichogramma.*
- Control of rots and wilts in various crops by *Trichoderma*-based products.
- Control of mites and scale insects in apple by tree spray oil (TSO)

Advantages of biopesticides

- Naturally occurring
- No Residue Issues: No MRL
- Safe to Human Beings: Non-toxic
- Highly effective under favorable conditions
- Safe to Predators & Parasites

Factors affecting growth of biopesticides

Some of the factors, which have restricted the growth of biopesticides, are:

- Low reliability because of low stability in effect
- Target specificity which distracts farmers
- Slow in action compared to synthetics
- Shorter shelf life
- Erratic availability of biopesticides in the market
- Already established and strong market of chemical pesticides
- Regulatory system favorable to chemical pesticides,
- The gradual disappearance of multiple or mixed cropping, which is known to keep away the magic bullet-chemical pesticide.

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