It is heartening to observe the growing awareness among the farmers and policy makers about ecologically sustainable methods of pest management. More and more farmers are coming to realize the short-term benefits and long-term positive effects of the use of bioagents and other ecologically safe methods to tackle pests. The present article 'Biopesticides' is of much relevance in this context.

'Biopesticides' are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. These include for example; fungi such as Beauveria sp., bacteria such as Bacillus sp., neem extract and pheromones. Similarly Canola oil and baking soda have pesticide applications and are considered as biopesticides. The use of these materials is widespread with applications to goliage, turf, soil, or other environments of the target insect pests. In a much simpler way we can say that these are pest management tools that are based on beneficial microorganisms (bacteria, viruses, fungi and protozoa), beneficial nematodes or other safe, biologically based active ingredients. Benefits of biopesticides include effective control of insects, plant diseases and weeds, as well as human and environmental safety. Biopesticides also play an important role in providing pest management tools in areas where pesticide resistance, niche markets and environmental concerns limit the use of chemical pesticide products.

Biopesticides in general-
(a) have a narrow target range and a very specific mode of action.
(b) are slow acting.
(c) have relatively critical application times.
(d) suppress, rather than eliminate, a pest population.
(e) have limited field persistence and a short shelf life.
(f) are safer to humans and the environment than conventional pesticide.
(g) present no residue problems.

Advantages of Using Biopesticides

25 million cases of acute occupational pesticide poisoning in developing countries are being reported each year (WHO, 1990). 14% of all known occupational injuries and 10% of all fatal injuries are caused by pesticides (ILO,1996). Obsolete pesticides are being stored in developing countries-20,000 tonnes in Africa alone. Pesticide residues in agricultural commodities are being the issue of major concern besides their harmful effect
upon human life, wild life and other flora and fauna. Equally worrying thing is about development of resistance in pest to pesticides. The only solution of all these is use of 'Biopesticide' that can reduce pesticide risks, as-

(a) Biopesticides are best alternatives to conventional pesticides and usually inherently less toxic than conventional pesticides.

(b) Biopesticides generally affect only the target pest and closely related organisms, in contrast to broad spectrum, conventional pesticides that may affect organisms as rent as birds, insects, and mammals.

(c) 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.

(d) When used as a fundamental component of Integrated Pest Management(IPM) programs, biopesticides can greatly decrease the use of conventional pesticides, while crop yields remain high.

(e) Amenable to small-scale, local production in developing countries and products available in small,niche markets that are typically unaddressed by large agrochemical companies.

Types of Biopesticides

Biopesticides fall into three major classes:

(1) Microbial pesticides consist of a naturally occurring or genetically controlled microorganism (e.g., a bacterium, fungus, virus or protozoan) as the active ingredient. These pesticides can control many different kinds of pests, although each separate active ingredient is relatively specific for its target pest(s). For example, there are fungi that control certain weeds, and other fungi that kill specific insects. They suppress pest by-

(a) Producing a toxin specific to the pest.

(b) Causing a disease.

(c) Preventing establishment of other microorganisms through competition or

(d) Other modes of action.

An example of a most widely used microbial pesticide is subspecies and strains of Bacillus thuringiensis, or "Bt". It is a naturally occurring soil bacterium that is toxic to the larvae of several species of insects but not toxic to untargeted organisms. Bt can be applied to plant foliage or incorporated into the genetic material of crops and as discovered, it is toxic to the caterpillars(larvae) of moths and butterflies. These also can be used in controlling mosquitoes and black flies. Several strains of Bt have been developed and now strains are available that control fly larvae. While some Bt's control moth larvae found on plants, other Bt's are specific for larvae of flies and mosquitoes. The target insect species are determined by whether the particular Bt produces a protein that can bind to a larval gut receptor, thereby causing the insect larvae to starve.

(2) Plant-Incorporated-Protectant (PIPs) is pesticide substances that plants produce from genetic material that has been added to the plant. For example, scientists can take the gene for the Bt pesticide 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.

(3) Biochemical pesticides are naturally occurring substances that control pests by non-toxic mechanisms. Conventional pesticides, by contrast, 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. Man-made pheromones are used to disrupt insect mating by creating confusion during the search for mates, or can be used to attract male insects to traps. Pheromones are often used to detect or monitor insect populations, or in some cases, to control them.

Farmers in their traditional wisdom have identified and used a variety of plant products and extracts for pest control, especially in storage. As many as 2121 plant species are reported to possess pest management properties, 1005 species of plants exhibiting insecticide properties, 384 with antifeedant properties, 297 with repellant properties, 27 with attractant properties and 31 with growth inhabiting properties have been identified. The most commonly used plants are neem (Azadirachta indica), pongamia (Pongamia glabra) and mahua (madhuca indica). 2-5 % neem or mahua seed kernel extract has been found effective against rice cutworm, tobacco caterpillar, rice green leafhopper, and several species of aphids and mites. The efficacy of vegetable oils in preventing infestation of stored product pests such as bruchids, rice and maize weevils has been well documented. Root extracts of Tagetes or Asparagus as nematicide and Chenopodium and Bougainvillea as antivirus have also been reported.

**Potential of Biopesticide**

The efficacy of many of the biopesticide can equal that of conventional chemical pesticides. However, the mode of action will be different. With many of the biopesticides, the time from exposure to morbidity and death of the target insect may be 2 to 10 days. Understanding the fundamental differences in the mode of action of biopesticide vs. traditional pesticides is important since the use patterns of a biopesticide may be different from traditional pesticides to control a particular pest species.

It is important to be careful when using any pesticide, even organic or natural or biopesticide. Even if this product is considered to be organic in origin, it is still a pesticide. Just because a product is thought to be organic, or natural, does not mean that it is not toxic. Some organic pesticides are as toxic, or even more toxic, than many synthetic chemical pesticides. Organic pesticides have specific modes of action, just as do synthetic pesticides have specific modes of action, just as do synthetic pesticides. While some organic pesticides may be nontoxic or are only slightly toxic to people, they may be very toxic to other animals. For instance, the organic pesticide ryania is very toxic to fish. Also, some organic pesticides may be toxic to beneficial insects, such as honeybees, if they are combined with other materials, such as combining pyrethrins with rotenone. The use of an Integrated Pest Management Program(IPM) is important to insure success.

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