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A comparative study between biopesticides and conventional pesticides

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Abstract- Conventional pesticides are synthetic chemicals (or agrochemicals). They generally work by directly killing or inactivating pests. Biopesticides, on the other hand, are naturally occurring bioactive organisms or substances. Biopesticides may directly kill harmful organisms, or they may work indirectly by interfering with the reproduction or simply repelling pests with substances they don't like. Most biopesticides do not provide a "quick kill", but rather suppress pests so that they can be managed over time. They also tend to decompose quickly and leave fewer residues on food and in the environment. Conventional Pesticides refers to synthetic substances as active ingredient while in biopesticides the active ingredient is derived from natural materials, such us, plants, fungi, entomopathogenic virus, nematodes, etc. Pesticides are chemical compounds that are used to kill pests.

Key words: Biopesticides, Conventional pesticides, chemical pesticides, agrochemical, bioactive

INTRODUCTION

A pesticide is a mixture of chemical or biological substances that are used to reduce, kill or protect against the ill effects of insects.[1] It is used extensively in the field of agriculture to save trees and plants. Fertilizers help in plant growth while insecticides act as a protection against pests. An insecticide is a substance or mixture of substances used to prevent, destroy, remove or reduce insect damage.[2] Pesticides are chemical substances (phosphamidon, lindane, fluoropyrifos, heptachlor, malathion, etc.) or organisms such as viruses, bacteria, weeds, insect-eating insects, fish, birds, and mammals.

In 1994, we established the Biopesticides and Pollution Prevention Division in the Office of Pesticide Programs to facilitate the registration of biopesticides.[3] Since biopesticides tend to pose fewer risks than conventional pesticides, Environment Protection Agency (EPA) generally requires much less data to register a biopesticide than to register a conventional pesticide. New biopesticides are often registered in less than a year, compared with an average of more than three years for conventional pesticides.[4]

While biopesticides require fewer data and are registered in less time than conventional pesticides, EPA always conducts rigorous reviews to ensure that registered pesticides will not harm people or the environment.[5] For EPA to be sure that a pesticide is safe, the Agency requires that registrants submit the results of a variety of studies and other information about the composition, toxicity, degradation, and other characteristics of the pesticide.

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CLASSIFICATION OF PESTICIDES

A. Conventional (chemical) Pesticides

Many pesticides are toxic to humans. The government has banned some insecticides while the use of others has been regulated.[6]

On Basis of Target Organisms:

(i) Fungicides- Fungicides are used to eliminate the effect of fungi in the soil and crop.

(ii) Weedicides - Weeds are generated in crops and water etc., the chemical or insecticide with which it is controlled is called weedicide.

(iii) Insecticides- Chemicals or animals used to control insects. They are called insecticides.

(iv) Nematicides- Nematodes are harmful. They are controlled by using nematicides.

(v) Rodenticides- Rodenticides are used to control the rodent class which includes rats and other rat species.

On Basis of Chemical Structure:

Under this, products made from chemicals are used. They also have side effects on Animals and Human beings, but still, they are used for pest control in large quantities.

These are of the following types:

I. Organochlorine: These are Organic Compounds that contain many atoms of Chlorine like D.D.T., BHC. Aldrine and Endosulphonol etc. come in this category. These fats are affectionate and interact with the fat tissue, due to which they are very harmful to human beings.

II. Organophosphate: These are organic esters of Phosphoric, Thiophosphoric, and Phosphoric Acid. It has more effect on the Liver System.

III. Carbonate: These are organic esters of organic acids, whose organic composition is similar to Acetyline Color and they are very much attracted by an enzyme called Esterase. They get absorbed in any part of the skin.

IV. Pyrithorides: It is obtained from the Pyrithin chemical extracted from an annual plant called Chrysenpius.

V. Trigene: These Pesticides are used to control Weeds from which Urea is obtained. It is used to control weeds in tea, tobacco, and cotton crops.

B. Biopesticides

Biopesticides are crop protection products derived from natural sources that are used to control pests, pathogens, and weeds by a variety of means.[5]

1. Biopesticides fall into three major classes:

(I) 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.[7] Biochemical pesticides include substances that interfere with mating, such as insect sex pheromones, as well as various scented plant extracts that attract insect pests to traps. Because it is sometimes difficult to determine whether a substance meets the criteria for classification as a biochemical pesticide, EPA has established a special committee to make such decisions.

(II) Microbial pesticides consist of a microorganism (e.g., a bacterium, fungus, virus, or protozoan) as the active ingredient.[8] Microbial pesticides can control many different kinds of pests, although each separate active ingredient is relatively specific for its target pest[s]. For example, some fungi 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. Each strain of this bacterium produces a different mix of proteins and specifically kills one or a few related species of insect larvae. While some Bt ingredients control moth larvae found on plants, other Bt ingredients 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.

(III) Plant-Incorporated-Protectants (PIPs) are pesticide substances that plants produce from genetic material that has been added to the plant.[9] For example, scientists can take the gene for the Bt pesticidal protein and introduce the gene into the plant's 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.

Crop plants and groundwater are also contaminated due to the excessive use of pesticides. These use also cause severe toxicity and their use for a long period also affects the biological system of animals.[8] Pesticides are generally known to have carcinogenic, cancer-causing, tart-genic, tumor-causing, and cysts-producing effects. Their unregulated use reduces the diversity of natural enemies of pests.

2. A Highly Targeted Approach to Crop Protection

One of the main differences between bioactive crop protection products and conventional agrochemicals is selectivity. Conventional agrochemicals tend to be broad-spectrum products that impact many different kinds of organisms.[10] These products allow farmers to control numerous pests with one agrochemical, but can also negatively impact other non-harmful species in the environment.

Biopesticides tend to be highly targeted to specific pests. Because they are so targeted, they are generally considered to be more environmentally friendly than synthetic agrochemicals.[11] For example, *Bacillus thuringiensis* (Bt), a bacterium commonly used as a microbial pesticide, comes in many different strains and subspecies, each of which kills one specific insect or a few closely related insect species.[12] The protein each strain of Bt produces is highly specific to the target insect species and harmless to other organisms (including humans and animals).

3. BIOPESTICIDES VS CONVENTIONAL PESTICIDES

Biological pesticides, also known as biopesticides, biological controls or biocontrols, are organisms used to manage pests or diseases and is most notably used in agriculture.[13] Biopesticides are typically natural predators, parasitoids, fungi or nematodes which feed on a target pest, and use natural relationships in the food chain. Growers who use biologicals see the following benefits:

(I) Effect on non-target species

Biological control products typically target a narrow range of pests or diseases while non-target organisms, such as birds, bees, fish, humans and beneficial soil organisms, remain unaffected.[14]

(II) Pollution

Since biological controls are naturally occurring organisms, at the end of their life they completely biodegrade and leave no harmful residues on the crop or in the environment.[15] This feature helps promote the safety and wellbeing of people who work on farms and the environment.

(III) Cost

Biological control, as a part of IPM, works to achieve sustainable management of pests and diseases, keeping the pressure well below economically damaging levels. Pests and diseases do not develop resistance to biological controls.[16] Since the rate of application will only change with pest or disease pressure, farmers can accurately predict input costs.

(IV) Pest resistance

Records have shown that pests tend to become resistance to conventional pesticides thus proving that it is not a long term solution, something that never happens with the use of organic pesticides.[13]

(V) Market

As the ordinary consumer became aware of the dangers posed by synthetic chemicals, demand for farm products that have undergone organic treatments rose.[17] This makes the use of these chemicals a potential risk as there's a glaring possibility of incurring huge losses due to the consumer shunning your product.

4. BIOPESTICIDES REPLACED CONVENTIONAL PESTICIDES

Biopesticides offer a lot of advantages, but they aren't a panacea. Because they are not commonly used and have very specific application requirements, growers need the training to use biopesticides effectively.[18] Since they are highly targeted, growers will need different products to control different kinds of pests and pathogens. And biologicals aren't available for all kinds of pests—in some cases, a synthetic agrochemical is the only option.

Other challenges with biopesticides involve maintaining microbial viability during storage and compatibility with chemical pesticides.[19] Advances in the formulation are extending storage shelf-life and compatibility of mixed products. Also, innovations in delivery are providing new opportunities for biopesticide application.

- Biopesticides are usually inherently less toxic than conventional pesticides.
- Biopesticides 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.
- Biopesticides often are effective in very small quantities and often decompose quickly, resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides.
- When used as a component of Integrated Pest Management (IPM) programs, biopesticides can greatly reduce the use of conventional pesticides, while crop yields remain high.

To use biopesticides effectively (and safely), however, users need to know a great deal about managing pests and must carefully follow all label directions.[20,21]

CONCLUSION

Conventional pesticides are synthetic chemicals (or agrochemicals). They generally work by directly killing or inactivating pests. Biopesticides, on the other hand, are naturally occurring bioactive organisms or substances. Biopesticides may directly kill harmful organisms, or they may work indirectly by interfering with the reproduction or simply repelling pests with substances they don't like. Most biopesticides do not provide a "quick kill", but rather suppress pests so that they can be managed over time. They also tend to decompose quickly and leave fewer residues on food and in the environment.

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