JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

BIO PESTICIDE: ROLE IN SAFE CROP CULTURE

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ABSTRACT : Now a days , use of natural products was overtaken by synthetic chemicals due to their efficacy, reliability and quick knock down effect. However, synthetic pesticides have become a health hazards for humans and environment due to their toxicity and pollution. Biopesticides are derivatives of plants, microorganisms and insects. Bio pesticides are potential alternatives to synthetic pesticides. Sources of bio pesticides are readily available, easily biodegradable, exhibit various modes of action, are less expensive and have low toxicity to humans and non-target organisms. Many Bio pesticides for e.g. Neem , pyrethrum, cotton and tobacco a have already been used commercially for long time. Bio pesticides are however faced with challenges of formulation, registration, commercialization, acceptance and adoption. This paper describes several aspects of bio pesticide -what is bio pesticides , types of bio pesticides , microorganisms as a source of bio pesticides , Production, Formulation and Commercialization of Bio pesticides , limitations etc.

KEY WORDS : Bio pesticides , microorganisms, synthetic pesticide .

Introduction:

Pest problem is one of the major constraints for achieving higher production in agriculture crops. India loses about 30% of its crops due to pests and diseases each year. The damage due to these is estimated to be Rs.60,000 crores annually. The use of pesticides in crop protection has certainly contributed for minimising yield losses. The pesticides, which are needed to be applied carefully, only when the threshold limits of the pest population is exceeded. However, quite often the indiscriminate and unscientific use of pesticides has led to many problems, such as pests developing resistance, resurgence of once minor pest into a major problem besides environmental and food safety hazards.

The problem of Insect-pest is acute in case of all the crops and especially so in case of commercial crops. The use of insecticides and pesticides have increased manifolds during the past 3 – 4 decades with the introduction of intensive cropping. The average consumption of pesticides in India is about 570 gms per ha. As compared to developed countries like Japan, Thailand and Germany where the consumption rate is 11 kg, 17 kg and 3 kg per ha, respectively. Though the average quantum of pesticides usage in India is low, the damage caused due to their indiscriminate usage and poor quality maintenance is alarming. Interms of value, much of the pesticide application is accounted for by a few crops. For example, cotton, paddy and vegetable crops account for 80% of the value of pesticides applied in India.

Pesticides or chemicals are meant to control harmful pests such as insects, nematodes, diseases, weeds etc. However, excessive use of pesticides not only leave residues in soil, water and air but also have adverse effects on the non target organisms such as pollinators, parasitoids, predators and wild animals. This has adversely affected the ecological balance resulting in pest resurgence, development of resistance in the pest species and environmental pollution. Development of pest resurgence and resistance has resulted in high cost of production and low income especially to cotton farmers in AP, Maharashtra.

In view of the several disadvantages associated with the unscientific use of pesticides in agriculture, there is an urgent need for minimising the use of chemical pesticides in the management of insect pests. Growing public concern over potential health hazards of synthetic pesticides and also steep increase in cost of cultivation/low profit making by farmers has led to the exploration of eco-friendly pest management tactics such as Integrated Pest Management (IPM). IPM aims at suppressing the pest species by combining more than one method of pest control in a harmonious way with least emphasis on the use of insecticides. In simple terms “IPM is the right combination of cultural, biological and chemical measures which provides the most effective, environmentally sound and socially acceptable methods of managing diseases, pests and weeds”. The major components of IPM are prevention, observation and intervention. The IPM seems to be the only answer to counter some of the major pests of crops, which have become unmanageable in recent years. The success of IPM largely depends upon conservation of naturally occuring bio control agents.

Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. For example, canola oil and baking soda have pesticidal applications and are considered biopesticides. Biopesticide is a biological substance or organism that damages, kills, or repels organisms seens as pests. They are obtained from organisms including plants, bacteria and other microbes, fungi, nematodes, etc. Plants and microorganisms are the major sources of biopesticides due to the high components of bioactive compounds and antimicrobial agents . Different plant families have varied antimicrobial bioactive compounds which include oil components such as α- and β-phillandrene, limonene, camphor, linalool, β-caryophyellene and linalyl acetate depending on the plant family . Microbial biopesticides include bacteria species such as Pseudomonas, Bacillus, Xanthomonas, Rahnella and Serratia or fungi such as Trichoderma, Verticillium and Beauveria species . Biopesticides exhibit different modes of action against pathogens such as hyperparasitism,

competition, lysis and predation . Species of Pseudomonas and Bacillus have been used as biofertilizers with reports showing increase in plant growth, yield and phosphorous and zinc content in fruits and soils . Natural enemies including predators, pathogens and some insects are also used as biopesticides in management of insect pests. Compost teas are filtrates of compost extracts and are similarly used as biopesticides .

This paper discusses the current status of knowledge on biopesticides including their sources, production, formulation, commercialization, role in sustainable agriculture and their limitations , current scenario of Biopesticides in Rajasthan.

What is bio pesticides .

Biopesticides are pesticides derived from natural materials, including animals, plants, fungi and microbes.

A pesticide made from biological sources, that is from toxins which occur naturally . naturally occurring biological agents used to kill pests by causing specific biological effects rather than by inducing chemical poisoning.

The U.S. Environmental Protection Agency states that biopesticides "are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals".

Furthermore, the EEA defines a biopesticide as a pesticide in which "the active ingredient is a virus, fungus, or bacteria, or a natural product derived from a plant source. A biopesticide's mechanism of action is based on specific biological effects and not on chemical poisons."

Some biopesticides are targeted in their activity, often working on a small number of species. However, users need more knowledge to use biopesticides effectively. This is because they are often most effectively used as part of an Integrated Pest Management approach.

Types of bio pesticides

Biopesticides are classified into three main categories: biochemical, microbials and plant-incorporated protectants.

Bio pesticides can be classified into three categories:

1. Biochemicals : Biochemicals are derived from naturally occurring substances such as plant extracts. This includes insect repellants, insect attractants and repellants, pheromones, and non-pest management class—plant growth regulators. 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. Examples

Azadirachtin (broad-spectrum insecticide).

Capsaicin (compound from chili peppers) (broad-spectrum insecticide, nematicide and fungicide).

Clove, rosemary and peppermint oil (broad-spectrum fungicide).

2. Microbial : Microbials are products containing micro-organisms or their fermentation by-products. Microbial pesticides can control many different kinds of pests, although each separate active ingredient is relatively specific for its target pest 8. For example, there are fungi that control certain weeds and other fungi that kill specific insects. The most widely known microbial pesticides are varieties of the bacterium Bacillus thuringiensis, or Bt, which can control certain insects in cabbage, potato, and other crops. Bt produces a protein that is harmful to specific insect pest. Certain other microbial pesticides act by out-competing pest organisms. Microbial pesticides need to be continuously monitored to ensure that they do not become capable of harming non-target organisms, including humans.

Examples

The bacterium Bacillus thuringiensis for use against caterpillars.

The fungus Beauveria bassiana for use against whiteflies, aphids and thrips.

3. Plant-incorporated protectants : Plant-incorporated protectants are pesticidal substances produced by plants as a results of genetic manipulation. There are no plant-incorporated protectant compounds registered for use in greenhouses. Plant-Incorporated-Protectants (PIPs) 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.

Advantages of using biopesticides?

Biopesticides are usually inherently less toxic than conventional pesticides.Biopesticides generally affect only the target pest and closely related organisms, in contrast to broad spectrum, conventional pesticides that may affect organisms as different as birds, insects, and mammals.They 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.

- Biopesticides are usually inherently less toxic than conventional pesticides.
- Biopesticides generally affect only the target pest and closely related organisms, in contrast to 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.

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.

Despite the potential benefits of using biopesticides, their usage has not been as popular as expected for the following reasons:

- Expenses associated with creating, testing, and obtaining regulatory approval for new biological agents contribute to the high cost of pesticide manufacture.
- Due to regional and climatic changes in humidity, temperature, soil conditions, etc., there is limited field effectiveness.
- Farmers are hesitant about biopesticides because of their high specificity, which means that they only work against specific pathogens and pests.
- Multiple biological agents are used in biopesticides to manage a variety of insects and pests in the field. These treatments are difficult to use, expensive, and inconvenient, and they are not suitable for many pests and pathogens.
- Because biopesticides are sensitive to changes in temperature and humidity, they have a short shelf life.

Examples

A well-known example of a biopesticide is the bacteria Bacillus thuringiensis, which may infect Lepidoptera, Coleoptera, and Diptera. The B. thuringiensis toxin (Bt toxin) has been directly integrated into plants through genetic engineering. Its producers assert that it is less harmful to the environment than synthetic pesticides and has little impact on other living things. It is questionable if Bt toxin should be used.

Another biopesticide used is Pyrethrin.

Several other types of bio-insecticides and bio-pesticide are:

- Cow Urine
- Fermented curd water
- Neem -cow urine extract
- Mixed leaves extract
- Chilli –garlic extract

Introduction

Importance of Bio-pesticides

In nature every ecosystem exists in a balance. Growth and multiplication of each organism depends on the food-chain, its predetors, parasites, etc. In biological control system, these interrelations are exploited. The natural enemy of a pest, disease or weed is selected, its biology is studied for mass multiplication and utilize the same to check the target pest. They are also specific in their action and perish once their feed (i.e. the pest) is exhausted. Thus they are based on natural principles, do not leave any residue, safe and economical.

Among the alternatives, biological control of pests is one of the important means for checking pest problems in almost all agro-ecological situations.

Bio pesticides are living organisms which can intervene the life cycle of insect pests in such a way that the crop damage is minimized. The agents employed as biopesticides, include parasites, predetors and disease causing fungi, bacteria and viruses, which are the natural enemies of pests. Further, they complement and supplement other methods of pest control. Utilisation of naturally occurring parasites, predators and pathogens for pest control is a classical biological control. On the other hand, these bio agents can be conserved, preserved and multiplied under Laboratory condition for field release. Once these bio-agents are introduced in the field to build their population considerably, they are capable of bringing down the targeted pest' population below economic threshold level (ETL). However, the crux lies in their mass production and application at the appropriate time.

Major advantages of bio pesticides

Bio-pesticides are preferred over chemical pesticides for the following reasons:

- No harmful residues;
- Target specific and safe to beneficial organisms like pollinators, predetors, parasites etc.;
- Growth of natural enemies of pests is not affected, thus reducing the pesticide application;
- Environmental friendly;
- Cost effective;
- Important component of IPM as 1st line and 2nd line of defence, chemicals being the last resort.

Status of bio pesticide use in India

Last decade has witnessed a tremendous breakthrough in this aspect, especially on standardization of production techniques of Trichoderma, Gliocladium, Paecilomyces, Pseudomonas, Trichogramma, NPV and Bacillus to use them against many insect pests and diseases.

There are a number of instances where bio control agents have been successfully employed in India. Some examples of these are given below :

Growth of lantana weed was controlled by using the bug Telonemia scrupulosa

Sugarcane pyrilla has been successfully controlled in a number of States by the introduction of its natural enemy Epiricania melanoleuca and Tetrastictus pyrillae.

Trichogramma, which feeds on the eggs of sugarcane borers, has been used against the borers in the states of Tamil Nadu, Rajasthan, UP, Bihar and Haryana.

Similarly Trichogramma, Bracon, Chelonus and Chrysopa spp. are being used for the control of cotton bollworms. Trichogramma has also been used against rice stem borer and leaf folder.

The sugarcane scale insect has been controlled with the help of predatory coccinellid beetles in UP, West Bengal, Gujarat and Karnataka.

The popularity of biopesticides has increased in recent years, as extensive and systematic research has greatly enhanced their effectiveness. Also, techniques for the mass production, storage, transport and application of biopesticides have been improved in recent years.

Production

These biopesticides can be produced on a small or large scale. Small scale production is particularly suitable to village or community level cooperatives, which can produce and distribute these for local use. As the production technology of some of these agents (particularly Trichogramma) is relatively simple, the local farmers/SHGs can be trained to undertake the production. Medium and large scale production can be undertaken by firms, sugar mills cooperatives engaged in the manufacture and distribution of agro-chemicals. Foe example, fertilizer companies, which already possess sufficient in-house technological expertise and marketing resources, are ideally suited for producing biopesticides on a large scale. Similarly, seed companies are particularly well placed for undertaking the production and marketing of Trichoderma.

Essential characteristics of effective biocontrol agents

- Speed/Mobility to prevent pathogen to develop resistant structures.
- Longevity, enough to protect plant during its vulnerable period, whatever that may be
- Environmental tolerance, to sustain activity under different soil and climatic conditions.
- Mode of Action, varies from pathogen to pathogen, physical contact, chemical nature of killing component.
- While using natural enemies, it is important to have fast growing biocontrol organism in the fields which can eventually make the conditions unfavourable for the pathogens proliferation

General precautions to be followed while maintaining host cultures

In production units, keep the host culture in a separate room and the virus production and storage facility should be located in a different facility.

In the NPV production units, inspite of best care, 100% larvae are not infected, the larvae which do not turn inactive after 4 – 5 days and keep consuming the normal diet should be culled out regularly from the NPV production unit.

Utmost care should be taken to prevent the break in the chain of the production system. This could be achieved only if highly dedicated and disciplined workers are engaged for such production units.

Strict hygiene should be maintained in different facilities. The equipments used should be either heat sterilised or sterilised using steam or chemicals. The work place should be thoroughly disinfected with sodium hypo chlorite solution.

The host culture should be initiated from a batch of healthy adults.

Microbial infection could be avoided if good insect husbandry practices are followed. If infection is detected, the culture or infected part should be destroyed immediately. Besides hygienic conditions, optimum temperature (24o C- 26o C) and humidy (65 – 70%) should also be maintained.

The texture and quality of the natural/semisynthetic diet should be good.

Entry to host culture unit after visiting virus production unit should be avoided

Organic Farming

In order to promote organic farming in horticulture crops, in view of the increasing demand for food produced by organic methods, 50 percent of the cost, maximum Rs. 10,000/- per hectare per beneficiary, in the ratio of 40:30:30 is payable in three years up to a maximum area of 4 hectares. . (Rs. 4000/- in the first year and Rs. 3000/- in the second and third year) The program is linked to the certification of organic farming. For the

certification of organic produce, a grant of Rs. 5.00 lakh is payable for a cluster of 50 hectares, which is Rs. 1.50 lakh in the first year, Rs. 1.50 lakh in the second year and Rs. 2.00 lakh in the third year.

Farmer Selection:

1. The farmer should have his own land (at least one hectare), livestock, water and availability of organic matter.
2. The farmer should agree to take crop production by organic method in the selected field for three consecutive years.
3. Farmer should agree to join the certification body for organic farming certification.
4. The farmer should agree to take all the crops of the crop cycle in the field selected for organic farming on the basis of organic farming practices.
5. In the program of organic farming, priority should be given to farmers associated with organic villages and organic farming.

The indicative inputs that can be used in organic farming are as follows: -

Vermicompost/Compost/Manure, Green manure, Biofertilizer, Neem cake, Gypsum, Neem based preparations, BT/NPV, Bio agents, Trichoderma, Mulching (from natural source), Rock phosphate, Pheromone traps, Prakash Posh, Algal Preparations (Blue Green Algae), Lime Sulphur, Plant Based Repellents, Vegetable and Animal Oils, Biodynamic Preparations, Copper Salts etc.

Conclusion :

Use of synthetic chemicals has raised numerous concerns due to their negative effects on the environmental, human health, natural enemies and ecosystem balance. Some of the active ingredients of synthetic pesticides have been found to be carcinogenic thus posing a threat to human life. Biopesticides offer better alternative to synthetic pesticides due to their low toxicity, biodegradability and low persistence in the environment. Despite the many challenges facing the adoption of biopesticides, they still remain suitable alternatives to conventional pesticides. Although, researchers have conducted studies on effectiveness of natural plant protection products with significant results being from in vitro experiments.

The use of organic fertilizers is beneficial to remove the increasing side effects of chemical fertilizers on human health, but awareness campaign and more research on organic fertilizers is needed to spread its information to the common farmer.

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