

A Study on Sustainable use of Conventionally Formulated Biopesticide in Agricultural Fields of Darbaripur Village of Gurugram, Haryana, India

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Abstract—Food is one of the basic necessities of all living organisms. The food chain starts with the producers, which are mainly plants so a good crop yield is necessary to run a balanced food chain in ecosystem. One of the major enemies of plants, which reduce its yield are pests, which includes insects, fungi, weeds, viruses, nematodes, animals and birds. Nearly 10 000 species of insects, 50 000 species of fungi, 1800 species of weeds and 15 000 species of nematodes destroy food and fiber crop every year. The use of chemical pesticide was introduced to reduce the effect of these pests but they showed adverse effects on plants genetic make-up as well as environment. Thus the idea of using natural or bio pesticides come in picture as they are ecologically and environmentally accepted. In India, biopesticide represent around 3% of overall pesticide market in India and only 12 % of biopesticides have been registered (e.g. *Bacillus thuringiensis* var. *israelensis*, *Trichoderma viride*, *Bavaria bassiana* and neem based pesticides etc.) In this study we are trying to use cheap and easily available plant based materials to be used as biopesticide.

Keywords: Biopesticides, Sevin (Carbaryl) pesticide, Plant based biopesticides, Sustainability, Gurugram.

1. INTRODUCTION

India is basically an agricultural oriented country. Wheat, maize and rice are one of the major growing and consumed crops in India. A vast population of India is vegetarian and mostly dependent on fruits and vegetables like potato, tomato, brinjal, cauliflower, onion etc. As the land is very fertile in most parts of India, the growth of crops and vegetables are flourishing day by day. But there are some threats to these plants like the attack of pests, which not only damages the plant but also decreases its yield. In order to overcome this, farmers generally uses chemical pesticides, which work on nervous system of the pests and kills them [4]. But the disadvantage associated with chemical pesticides are genetic variation in plant populations, reduction of beneficial species, development of insect resistance, damage to the environment or water bodies, increase in toxic residue through food chain, poisoning of food and health problems such as cancer etc. [4]. So the scientists have proposed a novel idea of use of Bio pesticide.

1.1 Biopesticides

Bio pesticides are environmental-friendly pesticides. These are obtained from naturally obtaining and easily processed plants and microbes. In India Bt., neem based and *Trichoderma* etc. have already used by farmers as biopesticides. The most commonly used biopesticides are living organisms, which are pathogenic for pest of interest, for e.g., *Bacillus Thuringiensis*. The advantages of using biopesticides are they are environmental friendly non-toxic substance, biodegradable, used in small quantity and shows great results in Integrated Pest Management Programmes (IPM). The National Farmer Policy 2007 has intensely acclaimed the promotion of biopesticides for increasing agricultural production, sustaining the health of soil, farmers and environment [3; 6].

1.2 Use of Biopesticide in India

India has high prospective for use of bio pesticides. In 2005-06, consumption of bio pesticides in India stands at 1920 MT [3]. Biopesticides market in India represent only 2.89% (as on 2005) which could be increased by educating the farmers at the ground level [4; 5; 7].

There are various kinds of Biopesticides available in market like microbial biopesticides, plant based biopesticides, plant incorporated protectants and biochemical pesticides etc. Out of these microbial biopesticides are widely used biopesticides in IPM program (around 90%) as they are highly effective, species- specific and eco-friendly in nature [5]. But in this manuscript the objective of the study is to develop a new formulation of biopesticide using conventional methods and its field trial to evaluate the efficacy of bio pesticides over chemical pesticides.

2. STUDY AREA

Darbaripur, a village in sector 75 Gurugram, Haryana, India (Fig.1) was selected as study area. The village is spread over 34 acres of land and is mostly dependent on agriculture. The

population of village consists of 2000 people only. The soil type of village is sandy- loamy and the topsoil is about 0.30 m deep. Wheat, mustard and bajra are the major cultivable crops in that village. These crops and vegetables are often get affected by pests leading to the damage of crops and increased economic stability in the village.



Fig.1: Map of study area



Fig. 2: Wheat plant before application of Biopesticide

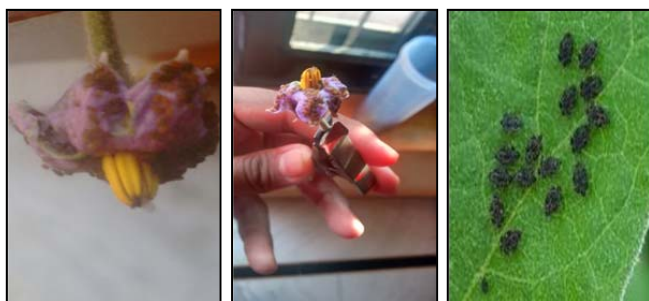


Fig. 3: Brinjal plant before application of Biopesticide



Fig. 4: Potato plant before application of Biopesticide

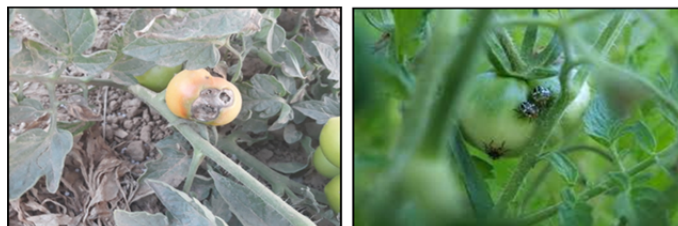


Fig. 5: Tomato plant before application of Biopesticide

Some bugs and worms can be picked and squeezed by hand, while aphids can be blown off a plant. Sufficient sunlight and plants spacing can also reduce the population of pests in agricultural fields. But in order to completely overcome the pests related problems farmers generally use chemical pesticides to kill insects like BHC (Benzenehexachloride), DDT (Dichlorodiphenyltrichloroethane), super sulphate, malathion etc. The export of crops having pesticide residue has affected in the most recent years. Chemical pesticides are good in killing pests but their prolonged exposures may link to the immune suppression, hormone disruption, diminished intelligence, reproductive abnormalities and cancer [1]. So it has generated the idea of developing a new formulation of biopesticides using conventional method from easily available and cheap natural pest killer plant products.

3. MATERIALS AND METHODS

3.1. Plants and their associated pests

Among plants wheat (crop) and brinjal, potato and tomato (vegetables) were selected for the study. (Table 1) represents the selected plants and their associated pests used in the study. Wheat is generally affected by cereal leaf beetle and cereal aphids (Fig.2), brinjal by shoot and fruit borer and stem borer (Fig.3), potato by Colorado potato beetle, wire worms, aphids and potato leaf hopper (Fig.4) and tomato by hornworm (the larval stage of the five-spotted Hawk moth) (Fig.5).

Table 1: Plants and their associated pests

Sl. No.	Plants selected for study	Pests associated with these plants
1	Wheat	<ul style="list-style-type: none"> Wheat is generally affected by cereal leaf beetle and cereal aphids
4	Brinjal	<ul style="list-style-type: none"> Brinjal by shoot and fruit borer and stem
2	Potato	<ul style="list-style-type: none"> Colorado potato beetle, wire worms, aphids, scales and potato leafhopper, potato cutworm.
3	Tomato	<ul style="list-style-type: none"> Tomato by hornworm (the larval stage of the five-spotted Hawk moth), horn worm

3.2 Materials used for pesticide formation

In chemical pesticide “Sevin (Carbaryl) insecticide” was selected for the study, as it is widely used synthetic pesticide by farmers containing the active ingredient carbaryl, which kills pests by disrupting their nervous system. In case of blank, plants were grown in field without the application of any chemical or biological pesticides. Using our traditional knowledge of medicinal effects of plants on pests, we have proposed a combination of materials consisting of (onion, neem leaves, acda leaves, garlic and chili) (Table 2) having pesticide properties. The composition was name as “Naturaside” (insecticide made up of natural materials). The commercial value of material was proposed as INR 320.66-780.89 per acre of land if it gets successfully registered for commercial use.

Table 2: Materials used for Biopesticide formulation and their pesticide properties

Sl. No.	Biopesticide Formulation		
	Materials used	Quantity of materials used (kg)	Pesticide properties of materials
1	Onion	2-3	<ul style="list-style-type: none"> Non host plant Kills moth at larvae stage by disrupting developmental process Repel bugs on plants as they contain strong sulfur compound without harming the plant
2	Neem leaves	3-4	<ul style="list-style-type: none"> Powerful natural insecticide Disrupts life cycle of insects

			at all stages <ul style="list-style-type: none"> Kills a variety of sucking insects, aphids, , fruit and stem borer
3	Acda plant leaves	3-4	<ul style="list-style-type: none"> Acts as natural poison to pests and kills them at larvae stage
5	Garlic	0.5-1	<ul style="list-style-type: none"> Garlic kills bacterial leaf blight and Helminthosporium leaf spot Acts as insect and bird repellents Lethal to moth larvae Allicin compound in garlic has antibiotic, anti-fungal and anti-bacterial properties
6	Chili (red and green)	0.5-1	<ul style="list-style-type: none"> Natural home-made natural insect repellent for pests Used to repel mammals as they contain capsaicin that creates burning, peppery effects Acidity of chili damages soft skin of moths

3.2 Methodology

The experimental set up was designed in the agricultural fields of house no 68 of Darbaripur village. A plot of 20 acre of land was used as study area. 4 plots were selected to grow crops and vegetables for the study. Each plot was divided into three parts. In the first part of plots, chemical pesticide (Sevin) was sprayed and the second plot, formulated biopesticide (Naturaside) was sprayed and the third plot was used as control in which neither chemical pesticide nor biopesticide was used as spray.

Among plants wheat (crop) and brinjal, potato and tomato (vegetables) were selected for the experiment. An extensive study was done on the kind of pests that affects these plants by visiting the fields having appreciable yields of these plants. A composition of plant-based biopesticide was prepared at home using conventional methods and was stored at room temperature. The experiment was conducted in a randomized complete block design. For use in field experiments, pesticides were blended in distilled water and filtered into a beaker. Each filtrate was diluted with water to obtain a volume of 5 litres and transferred into a hand sprayer. Three to five drops each of paraffin oil and liquid soap were added to ensure the uniform mixture to permit the extract to stick onto the leaves of selected plants.

The field experiment was done for three months and the growth pattern and the effect of bio-pesticide was analyzed during these period of time. The results were observed and evaluated based on the growth pattern of plants on application of Pesticides.

4. RESULTS AND DISCUSSION

4.1. Growth pattern in plant after application of pesticides

The growth pattern in plants was observed after spraying pesticides on them (an interval of 15 days) from 0 days to 90 days. In case of wheat plant, growth pattern was found to be best in case of Nuraside (30 cm to 90 cm) followed by chemical Sevin and blank. The same effect was observed in case of vegetables (brinjal, potato and tomato). (Table 3; Fig.10). Nuraside was found to be more effective and environmental friendly to plants, animals and humans than Sevin and blank. Further the effectiveness of Nuraside as a biopesticide was also observed.

Table 3: Result of growth pattern in selected crop and vegetables on application of Pesticides

Selected Plants		Applicati on of pesticide s on selected plants	Growth pattern of Biopesticides on plants observed in months in (cm)			
			0 mont h	1 mont h	2 mont hs	3 mont hs
Crop	Whea t	Sevin (Carbryl) insecticide	30	35	38	50
		Nuraside	30	55	70	90
		Blank	30	35	40	40
Vegetab les	Brinja l	Sevin (Carbryl) insecticide	3	20	24	25
		Nuraside	3	20	25	30
		Blank	3	8	10	11
	Potat o	Sevin (Carbryl) insecticide	6	15	18	20
		Nuraside	6	20	35	40
		Blank	6	8	10	11
	Toma to	Sevin (Carbryl) insecticide	3	18	24	25
		Nuraside	3	29	40	50
		Blank	3	7	13	15

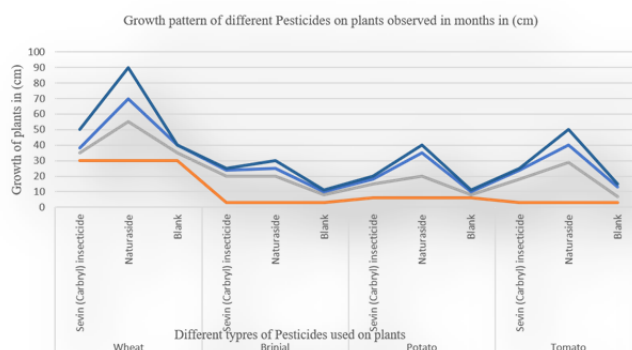


Fig. 10: Growth pattern of different pesticides on plants observed in months in (cm)

4.2 Effectiveness of Nuraside on selected plants

The effectiveness of pesticides on application of Nuraside was observed from 0 days to 90 days. After completion of 90 days of pesticide spray, it was observed that all the selected plants were devoid of their associated pests (Fig. 6, Fig. 7, Fig.8, and Fig. 9).



Fig.6. Wheat plant after application of Biopesticide



Fig. 7. Brinjal plant after application of Biopesticide



Fig.8. Potato plant after application of Biopesticide



Fig. 9: Tomato plant after application of Biopesticide

4.3 Cost comparison of formulated and already available pesticides in market

As the Naturaside is made up of easily available natural materials and the proposed price of the product for commercial use is INR 320.66-780.89 per acre of land, which is quite cheaper than Sevin, Bt. And Neem oil (Table 4).

Table 4: Study of cost analysis of pesticides [2]

Sl. No.	Name of Pesticides	Cost of pesticides per acre (INR)
1	Sevin (Carbaryl) insecticide	776.77- 10,439
2	Naturaside	320.66-780.89
3	Neem oil	670.44 – 5,363
4	Bt.	579.66-2,319

Thus Naturaside can be used as a natural, eco-friendly and economically accepted biopesticide.

5. CONCLUSION

Biopesticides enhances protection of crop losses and enhances quality of food. It also helps in the improvement and protection of plants yield and vector disease control. To have a sustainable growth of country economic, environmental and social system has to go hand in hand. In case of India sustainable development mainly depends on its agriculture and forests resources. In this manuscript we have discussed about the loss in plant yield due to pests associated with them. Naturaside, a combination of natural plant based compounds was formulated and its effectiveness was tested in field on selected plants. Based on the experimental results on growth pattern and potentiality of pesticides on selected plants, Naturaside was found to be better in comparison to Sevin (chemical pesticide). Some further research work should be done to evaluate and enhance the quality of formulated Naturaside. Also proper training plan should be designed for educating farmers and agriculturist on handling and use of natural plant based pesticides.

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