Integrated field management of *Henosepilachna vigintioctopunctata* (Fabr.) on potato using botanical and microbial pesticides

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ABSTRACT

Potato (*Solanum tuberosum* L.) is cultivated in India in a commercial scale and this crop is susceptible to various insect pests of which epilachna beetle (*Henosepilachna vigintioctopunctata* Fabr.) causes heavy damage. Studies were made to evaluate efficacy of extracts from plants such as *Pongamia pinnata* L. (Karanja) and *Nicotiana tabacum* L., botanical insecticide such as azadirachtin (1500 ppm), microbial insecticides like *Beauveria bassiana* Vuillemin against epilachna beetle infesting potato crop under field conditions of the sub-Himalayan region of north-east India during the rabi season. Methanol was used as solvent for extracting from fruits of *Pongamia* and water for leaves of *Nicotiana tabacum*. Cartap hydrochloride 50% SP was used as check. Three sprays at 10-day intervals were made, starting with the initiation of infestation. Total epilachna beetle numbers (both adult and grub) per plant were counted at 4 and 9 days after treatment (DAT). The data thus obtained were converted to the per cent reduction of the epilachna beetle population and analyzed statistically. Significant differences were found in the efficacy of different treatments in reducing the pest population and their persistence at different DAT. Cartap hydrochloride was found the most effective treatment for the controlling epilachna beetles, followed by botanical insecticide, azadirachtin. It was observed that botanical insecticide, azadirachtin and extracts of *Pongamia* at a concentration of 5 % gave satisfactory control, recording more than 50 % mortality. The azadirachtin was found very effective against the epilachna beetle, achieving more than 60% mortality at 4 days after spraying. Plant extracts, botanical insecticides and microbial insecticides are biopesticides having less or no hazardous effects on human health and the environment, and therefore, they can be incorporated in IPM programmes and organic farming.

Key words: Biopesticides, organic farming, potato, vegetable IPM

INTRODUCTION

Potato (*Solanum tuberosum* L.) is the forth most important food crop in the world after wheat, rice, and maize in terms of production. It contributes about 22 % of the total vegetables and about 40% of the root and tuber crops produced in the world (FAO, 2010). The crop is susceptible to various insect pests of which epilachna beetle (*Henosepilachna vigintioctopunctata* Fabr.) causes heavy damage. Epilachna beetles are important polyphagous defoliators often become one of the important limiting factors in successful cultivation of potato crop (Ratul and Misra, 1979). *Pongamia pinnata* L. is an indigenous plant of India. The oil of *Pongamia* repelled brown plant hopper (*Nilaparvata lugens* Stal.) and significantly reduced its ingestion and assimilation of food and both brown plant hopper and white back plant hopper (*Sogatella furcifera* Horv.) suffered heavy mortality (Lim and Bottrell, 1994). *Pongamia* cake was found effective in controlling the attack of ground beetles (*Mesomorphus villager* Blanch. and *Seleron latipes* Guer.) on tobacco. It also did not leave any of harmful residues in the soil. *Pongamia* cake water exterct was found to act as an antifeedant against *Spodoptera litura* in tobacco nurseries and in groundnut crop. Other pests which have been reported to be susceptible to powders or extracts of *Pongamia* are *Papilio demoleus* L., *Henosepilachna vigintioctopunctata* Fabr., *Amsacta moorei* Butl., *Chilo partellus* Swin. and *Leucopholis lepidophora* Blanch. (Dhaliwal and Arora, 2006).

Generally, the nicotine contain of the plant (*Nicotiana tabacum* L.) varies from 5-10 % in the leaves and trace amounts in the seeds (Thacker, 2002). Nicotine was found to be highly toxic to eggs and neonate larvae of *Helicoverpa armigera* Hub. and *Spodoptera litura* Fabr. and also effective against *Bemisia tabaci* Genn. (Dhaliwal and Arora, 2001). Applying tobacco (*Nicotina tabacum* L.) at the podding stage significantly reduced pod pest of cowpea (*Vigna unguiculata*) and *Callosobruchus maculates* infesting in storage. Use of synthetic and tobacco was more economically beneficial than using synthetics alone (Opolot *et al.*, 2006).

Sankari and Narayanasamy (2007) reported that FA (Flyash based herbal pesticides) + neem seed kernel (10%) dust is very effective against epilachna beetle on brinjal recorded 57.62% mortality in grub and 57.81% mortality in adult. Jeyrajan and Babu (1990) reported that neem 1000 ppm was the best antifeedent for the fourth instar larvae of epilachna beetle. Feeding of brinjal leaves treated with 0.05% neem oil resulted prologation of pre-oviposition period of female coccinellid, *Henosepilachna sparsa* (Mishra *et al.*, 1989). It was further reported that females fed leaves treated with concentrated neem oil had a shorter oviposition period, a reduced number of egg laying days, a smaller number of egg masses/female and a smaller number of eggs/female. Anam *et al.* (2006) reported that adult emergence was greatly reduced in neem treated larvae of *Epilachna dodecastigma*. In addition the neem oil also reduced the fruit consumption of the beetle by acting as feeding deterrent.

Menses *et al.* (1980) reported based on a field application that *Beauveria bassiana* strain 32 (isolated originally from *Leptinotarsa decemlineata* in France) killed 66.3-95.8% adult rice pest, *Lissorhoptrus brevirostris* (Suffr.) within 4 days of application. Srivastava and Tandon (1980) reported that the *B. bassiana* caused 100% mortality in 4 days when the larvae of mango pest *Orthaga euadrusalis* (Walk.) were allowed to crawl over the fungus and in 6 days when they were sprayed.

The objective of this study was to determine the efficacy of the plant extracts of *Pongamia pinnata* and tobacco leaf, botanical insecticide azadirachtin and microbial pesticide *Beauveria bassiana* against epilachna beetle infesting potato.

MATERIAL AND METHODS

Study period and location

This two year (2007-2008 and 2008-2009) study during rabi season was conducted at the Instructional Farm of U.B.K.V. (State Agricultural University) at Pundibari, Coochbehar, West Bengal, India. The experimental area is situated in the sub-himalayan region of northeast India which is known as terai zone of West Bengal State. This terai zone is situated between 25^{o} 57' and 27^{o} N latitude and 88^{o} 25' E and 89^{o} 54' E longitude.

Cultivation practices

The potato variety Kufri jyoti was grown during the rabi (late December) season in both years under recommended fertilizer levels (150: 125: 125 kg NPK/ha) and cultural practices in 4 m x 5 m plots at a spacing of 60 cm x 10 cm The treatments were replicated three times in a Randomized Block Design (RBD).

Treatments

One microbial insecticide, *Beauveria bassiana* (Bals.) Vuillemin (commercial formulation available in India in the name of Biorin 10^{7} conidia /ml) @ 1.0 mL/L; two botanical extracts [*Pongamia pinnata* fruit extract @ 1.0% and 5.0% and *Nicotiana tabacum* leaf extract @ 5.0% and 10.0 %] and a neem insecticide (Azadirachtin- commercial formulation available in India in the name nemactin) 1500 ppm @ 2.5 ml/L were evaluated and compared with the ability of Cartap Hydrochloride 50 % SP, usual insecticides used in India @ 1g/L to control epilachna beetle along with no treatment was used.

The *Pongamia* fruits were extracted in methanol as follows: After washing with water, the fruits were chopped and dried. The dried fruit materials were powdered in a grinder. The powder (50 g) samples were transferred separately to a conical flask (500 mL) and dipped in 250 mL methanol. The material was allowed to stand for 72 hrs at room temperature with occasional stirring. After 72 hrs the extract was filtered through Whatman 42 filter paper and residues were washed twice with methanol.

Tobacco (*Nicotiana tabacum)* is cultivated in a large scale in the locality where experiment has been done. The tobacco leaves were extracted in water as follows. After washing with water the leaves were dried and powdered in a grinder. The powdered sample (100 g) were transferred to a container and dipped in 1 L water. The material was allowed to stand for 72 hrs at room temperature with occasional stirring. After 72 hrs the extract was filtered through Whatman 42 filter paper and added 15 mL liquid soap.

Data recording

Three sprays at 10 day intervals were made, starting with the initiation of infestation. Population density of grubs and adults were taken before each insecticides spraying as pre-count of the pests. Beetle population densities were recorded 4 and 9 days after each spraying by counting grub and adult on each plant from five randomly selected plants per replication. The results were expressed as epilachna beetle population suppression (%) compared to densities recorded on the control treatment. The potato was harvested when they attained maturity and reached marketable size. The yield of marketable produce was calculated in different years separately on the basis of tuber yield per plot and converted to quintal per hectare.

RESULTS AND DISCUSSION

The different treatments and their persistence at different days after application varied significantly in their suppression of epilachna beetle populations (Table 1). Among the seven treatments, cartap hydrochloride provided the best suppression of populations than botanical insecticide azadicachtin. Among the biopesticides, azadicachtin was the most effective than *Pongiamia* fruit extract at the higher concentration. From overall observation it was revealed that botanical insecticide azadirachtin and extracts of *Pongamia* gave better result, recording more than 60 % and 50% epilachna beetle suppression respectively. The least effective treatments were the *tobacco* leaf extract at the lower concentration and *Pongamia* fruit extracts at lower concentration. The microbial pesticide *B. bassiana* provided only 39.56 % suppression of the epilachna beetle population.

Four days after spraying, cartap hydrochloride was the most effective against the pest than botanical insecticide azadirachtin. *Pongamia* fruit extract at higher concentration provide better results against the pest. Similarly, the ability of Cartap Hydrochloride to suppress epilachna beetle populations extended to nine days after spraying. At nine days after spraying, among the biopesticides, azadirachtin, the botanical insecticide was found very effective against the epilachna beetle followed by the *Pongamia* at the higher concentration.

Yield was directly related to the efficacy of the insecticides. The highest yield was obtained from plots treated with Cartap Hydrochloride, closely followed by azadirachtin and *Pongamia* (Table 1). There was no significant difference in yield among these two treatments. In general, the botanical insecticide azadirachtin and fruit extract of *Pongamia* (the higher concentration) gave satisfactory epilachna beetle suppression. Based on their moderate to high efficacy levels, as well as low toxicity to natural enemies and minimum impact on human health, we conclude that botanical insecticides and plant extracts (both bio-pesticide) can be incorporated in future IPM programme and organic farming in potato cultivation.

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Table 1. Overall efficacy of plant extracts and microbial insecticides against *Epilachna beetle*, and the tuber yield of potato

Treatment	Dose (ml or g/L)	Pretreatment count(grubs & adults/plant)	Overall efficacy (% reduction) Days after treatment			Tuber yield(q/ha)
			4	9	Mean	
T_1=Karanja plant extract (1%)	10 ml	6.75	29.12	26.21	27.66	218.23
T_2=Karanja plant extract (5%)	50 ml	7.05	53.50	51.65	52.57	222.15
T_3=Tobacco leaf extract (5%)	50 m l	8.21	24.34	22.53	23.43	216.44
T_4=Tobacco leaf extract (10%)	100 ml	6.05	34.72	32.26	33.49	217.11
T_5=Azadirachtin (1500 ppm)	2.5 ml	7.25	62.91	57.69	60.30	223.22
T_6=*Beauveria bassiana* (10^7 conidia /ml)	1 ml	7.95	27.28	30.45	28.86	217.33
T_7= Cartap hydrochloride (50%SP)	1 g	9.00	64.64	64.42	64.53	225.12
T_8=Untreated check(control)	-	8.01	0.00	0.00	0.00	215.31
SEm (±)	-	-	1.70	1.50	-	2.19
CD (p=0.05)	-	NS	5.14	4.56	-	6.62

Figures in parentheses are angular transformed values, NS = Not significant

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