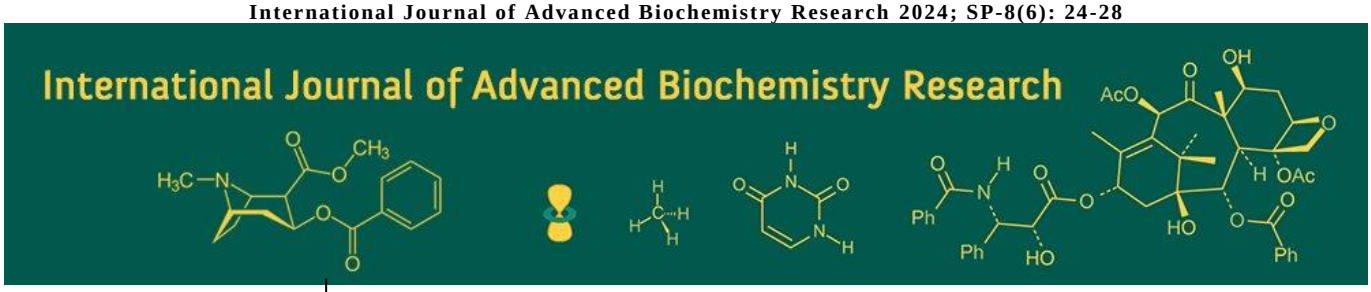

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Divya Yadav
M.Sc. Scholar, Department of Entomology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Usha Yadav
Assistant Professor, Department of Entomology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Divya Yadav
M.Sc. Scholar, Department of Entomology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Efficacy of different biopesticides and botanicals against the hadda beetle, *Henosepilachna vigintioctopunctata* (Fab.) on Brinjal

Divya Yadav and Usha Yadav

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Abstract
A field trail was conducted at the Central Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj during *Kharif* season 2023. The trail was laid out in Randomized Block Desion with three replications, eight treatments were evaluated against *Earias vittella viz*, T_1 Spinosad 240 EC @ 1.5ml/lit, T_2 Indoxacarb 14.5 SC @0.1ml/lit, T_3 emamectin benzoate 1.9 EC @2.0ml/lit, T_4 Garlic extract @50ml/lit, T_5 Neem seed kernel extract 5% @5 ml/lit, T_6 Karanja plant extract @50ml/lit, T_7 Tobacco leaf extract @ 100ml/lit T_8 - untreated control were evaluated against Hadda Beetle. The result showed that the treatments lowest larval population was recorded in T_6 Karanja plant extract (2.15, 1.55), and the treatments T_7 neem seed kernel extract 5% (3.063, 2.53) was least effective among all the treatments against Hadda Beetle. The plot treated with Karanja plant extract (T_6) showed highest yield (211.69 q/ha) and found to be most effective treatment and lowest effective Neem seed kernel extract 5% (T_5) 106.35 q/ha as compared to untreated control plot (74.06 q/ha).

Keywords: Botanicals, Brinjal, botanicals, efficacy, hadda beetle

Introduction
Vegetables play a vital role in providing essential protective nutrients like vitamins and minerals and are used as selective diets by everybody. Brinjal or eggplant (*Solanum melongena* Linn.) is one of the most important vegetable crops grown all over India. Brinjal is one of the most commonly grown vegetable crops of the country. It is originated in India and cultivated in the Subcontinent since last 4000 years (Dunlop, 2006) [7].

Nutritional value per 100 g of edible portion contains calories (24.0), sodium (3.0 mg), moisture content (92.7%), copper (0.12 mg), carbohydrates(4.0%), potassium (2.0 mg), protein (1.4 g), sulphur (44.0 mg), fat (0.3 g), chlorine (52.0 mg), fibre (1.3 g), vitamin A (124.0 I.U.), INTRODUCTION Page 2 oxalic acid (18.0 mg), folic acid (34.0 µg), calcium (18.0 mg), thiamine (0.04 mg), magnesium (15.0 mg), riboflavin (0.11 mg), phosphorus (47.0 mg), B-carotene (0.74 µg), iron (0.38 mg), vitamin C (12.0 mg), zinc (0.22 mg) and amino acids (0.22). It contains potassium, which maintains electrolyte balance in the body. Thus, help in neutralizing the effects of sodium in the entire human body and thus aiding in blood pressure control (Jat and Shrivastava, 2023) [13].

Globally, India is the second largest producer of vegetables with 199.88 million tonnes production during 2021-22 after China. Brinjal, *Solanum melongena* L., family Solanaceae. It is native to India in South Asia. It is also known as eggplant, aubergine or "King of vegetables". Eggplant is grown as a vegetable throughout the tropical, subtropical and warm temperate climate of the world. The area under brinjal cultivation in India is 0.74 million hectare with estimated annual production of 12.7 million tonnes with a productivity of 17.16 tonnes per hectare (MA & FW, 2022) [17].

Epilachna vigintioctopunctata is a serious pest of vegetables and can be easily identifies by 14 or 28 spots on its dorsal side with 7 pronotal spots. Hadda beetle can cause serious damage to Cucurbitaceous and Solanaceous crops (Khan *et al*., 2000) [13]. They are specialist feeders of various plant species of family Solanaceae but they vigorously start feeding within 5 minutes on tomato and brinjal and continually feeding to cause severe losses (Shinogi, 2005) [28].

Both the damaging stages, adults and grubs feed on the epidermal layer of the leaves, reducing the photosynthetic area and cause serious defoliation. The most damaging and voracious stages are 3rd and 4th instar grubs and may cause damage up to 80% in favorable conditions however it varies depending on the environmental conditions. The adults confine their damage to the upper side while grubs usually on the lower side of the leaves. The affected leaves of the plant become skeletonized, gradually dry and drop down. The larvae confine their attack to the lower surface while adult beetles usually feed on the upper surface of the leaves (Khan *et al*., 2000) [13].

Objective

1. Efficacy of new insecticides and botanicals against hadda beetle, *H. vigintioctopunctata* on brinjal.
2. To calculate the cost benefit ratio of the treated insecticides.

Materials and Methods

Field trails were conducted to study the "Comparative efficacy of biopesticides and certain chemicals against shoot and fruit borer (*Earias vittella*) on Okra [*Abelmoschus esculentus* (L.)]" at central research field, SHUATS, Prayagraj, U.P. during *Kharif* 2023-2024. The survey was laid out in RBD having seven treatments and control in three replications with the plot size $2m^2$. The Research was fulfilled on Brinjal variety Indam Supriya. Two spraying intervals were given at fifteen days interval using a hand sprayer during dawn or dusk hours to avoid photo oxidation of insecticedes. The treatments details are: T_1 Spinosad 240 EC @ 1.5ml/lit, T_2 Indoxacarb 14.5 SC @0.1ml/lit, T_3 emamectin benzoate 1.9 EC @2.0ml/lit, T_4 Garlic extract @50ml/lit, T_5 Neem seed kernel extract 5% @5 ml/lit, T_6 Karanja plant extract @50ml/lit, T_7 Tobacco leaf extract @ 100ml/lit, T_8 - untreated control.

Percent shoot Infestation

At each picking the total number of shoots and number of shoots infested of five selected plants from each treatment replication wise was recorded.

$$\% \text{ Shoot infestation} = \frac{\text{No. of shoot infested}}{\text{Total no. of shoot}} \times 100$$

Percent fruit Infestation

At each picking the total number of fruit and number of fruit infestation five selected plants from each treatment replication wise was recorded.

$$\text{Fruit infestation}\% = \frac{\text{No. of fruit infested}}{\text{Total no. of fruit}} \times 100$$

Cost Benefit Ratio

Gross return was calculated by multiplying total yield with the market price of the produce. Cost of cultivation and cost of treatment imposition deducted from the gross returns, to find out net returns and cost benefit ratio by following formula.

$$\text{B:C} = \frac{Gross\ return}{Total\ cost\ of\ production}$$

Results and Discussion

The present study entitled, "Efficacy of different biopesticides and botanicals against the Hadda beetle, *HenosEpilachna vigintioctopunctata* (Fab.) on Brinjal" was undertaken at the Central Research Farm, SHUATS, Prayagraj. The data so obtained through observation on various aspects were subjected to statistical analysis wherever necessary and the compiled mean data are tabulated in the following pages. Results, thus obtained are presented aspect wise here under.

The data on mean population of hadda beetle (3rd, 7th and 14 DAS) of second spray revealed that all the treatments were significantly superior over control. Among all the treatments, the plot treated with Spinosad 240 EC (2.150) recorded least larval population as compared to the remaining. It was followed by Emamectin benzoate 1.9EC (2.287) and it was at par with Indoxacarb 14.5 SC (2.530), Neem seed kernal extract 5% (2.687) and Karanja plant Extract (2.840). It was followed by Garlic extract (2.930), and Tobacco leaf extract (3.063). Control plot T_8 (5.530) infestation.

The data on mean population of hadda beetle (3rd, 7th and 14 DAS) of second spray revealed that all the treatments were significantly superior over control. Among all the treatments, the plot treated with Spinosad 240 EC (1.55) recorded least larval population as compared to the remaining. It was followed by Emamectin benzoate 1.9EC (1.683) and it was at par with Indoxacarb 14.5 SC (1.84), Neem seed kernal extract 5% (1.907) and Karanja plant Extract (2.06). It was followed by Garlic extract (2.283), and Tobacco leaf extract (2.53). Control plot T_8 (6.217) infestation.

The data showed that the highest grain yield of 211.69q/ha was registered in Spinosad 240 EC (T_6) these findings are similar with, which was followed by Emamectin benzoate 1.9EC (T_7) 180.74q/ha and these findings are similar. The next treatment is Indoxacarb 14.5 SC (T_2) 174.58q/ha these findings are supported by Kodandaram *et al*., 2014 [15], the next best treatment is Neem seed kernal extract 5% (T_3) 166.61 q/ha and are similar, the next best treatment is Karanja plant Extract (T_4) 150.75 q/ha and these findings are very close to Murugesan and Murugesh, 2008 [21], the next best treatment is Garlic extract (T_1) 145.49 q/ha these findings are similar to Mahato and Misra, 2018, the next best treatment is Tobacco leaf extract (T_5) 106.35 q/ha and these are supported as compared to control (T_8) 74.06 q/ha.

The analysis of Cost benefit ratio of all treatment was also carried out which revealed that the best and economical treatment was T_6 Spinosad 240 EC (1:12.78) and was found significantly superior over the rest of the treatments and these findings are similar to Jat and Shrisvastva, 2023 [13]. Which was followed by T_7 Emamectin benzoate 1.9 EC (1:11.58) and these findings are similar to Stanley *et al*., 2007 [30], T_2 Indoxacarb 14.5 SC (1:11.21), T_3 Neem seed kernal extract 5% (1:10.42) and these findings are similar to Jat and Shrisvastva, 2023 [13],T_1 Garlic extract (1:8.06) and these findings are similar, T_4 Karanja plant extract (1:6.48) T_5 Tobacco leaf extract (1:3.15) and these findings are similar over the control plot T_8 (1:3.01).

Table 1: Efficacy of different biopesticides and botanicals against the hadda beetle after first spray.

Treatments		Larval Population				
		1 DBS	After Spray			
			3 DAS	7 DAS	14 DAS	Mean
T_1	Garlic Extract	5.33	3.07^{de}	3.00^{d}	2.73^{d}	2.93^{bc}
T_2	Indoxacarb 14.5 SC	5.13	2.80^{cd}	2.47^{d}	2.33^{cd}	2.53^{e}
T_3	Neem seed Kernal extract 5%	5.33	2.93^{c}	2.60^{c}	2.53^{bc}	2.68^{de}
T_4	Karanja plant extract	5.00	3.00^{b}	2.87^{b}	2.67^{b}	2.84^{bc}
T_5	Tobacco leaf extract	5.00	3.20^{f}	3.13^{e}	2.87^{e}	3.06^{b}
T_6	Spinosad 240 EC	5.00	2.53^{e}	2.07^{e}	1.87^{e}	2.15^{f}
T_7	Emamectin benzoate 1.9 EC	5.13	2.73^{a}	2.13^{a}	2.00^{a}	2.28^{f}
T_8	Control	5.20	5.47^{bc}	5.47^{bc}	5.40^{bc}	5.38^{a}
Overall Mean		5.16	3.23	2.96	2.81	3.01
F- test		NS	S	S	S	S
S. Ed. (±)		0.13	0.87	1.01	1.03	0.99
C. D. (P = 0.05)		-	0.18	0.23	0.19	0.26

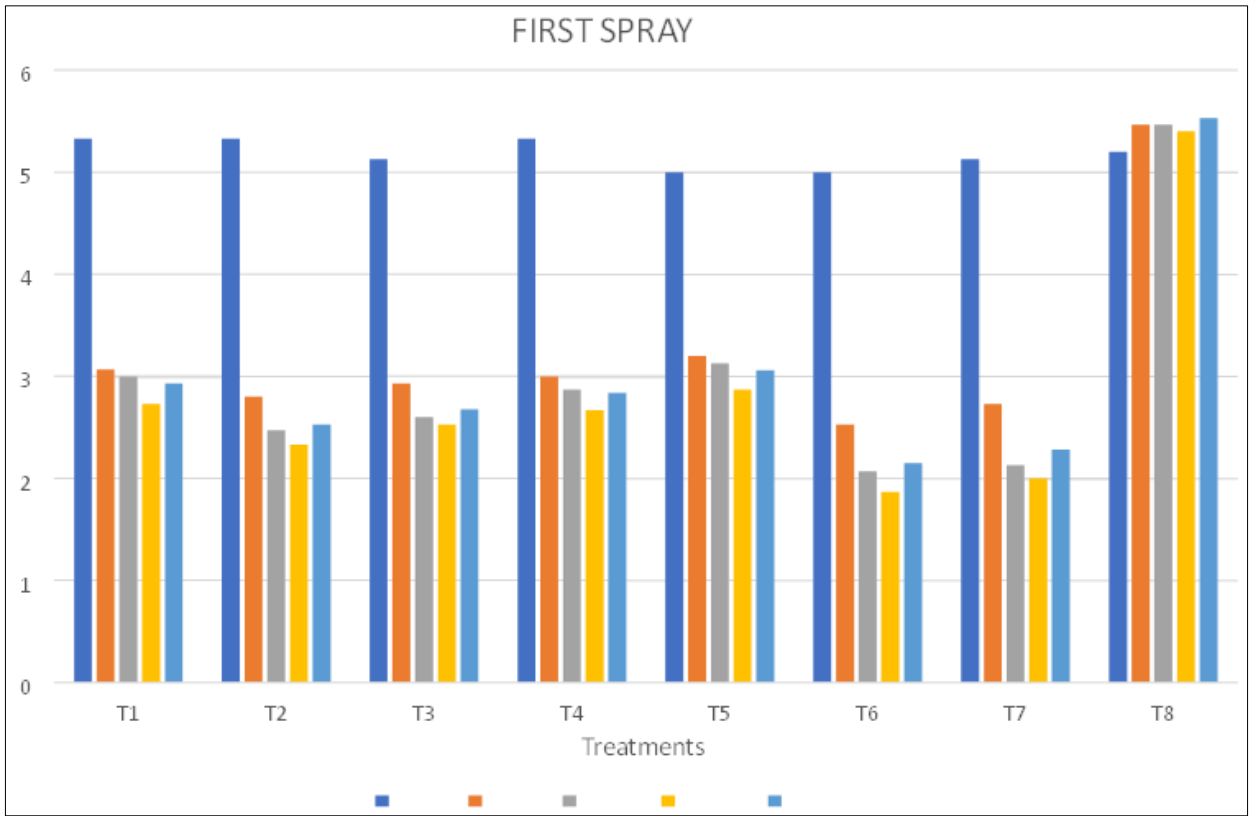

Fig 1: Efficacy of different biopesticides and botanicals against the Hadda beetle after first spray.

Table 2: Efficacy of different biopesticides and botanicals against the Hadda beetle after second spray.

Treatments		Larval Population				
		1 DBS	AFTER SPRAY			
			3 DAS	7 DAS	14 DAS	Mean
T_1	Garlic Extract	2.73^{d}	2.90^{e}	2.27^{de}	1.67^{de}	2.28^{cd}
T_2	Indoxacarb 14.5 SC	2.33^{cd}	2.40^{de}	1.87^{de}	1.27^{d}	1.85^{cd}
T_3	Neem seed kernal extract 5%	2.53^{bc}	2.50^{d}	1.93^{cd}	1.33^{cd}	1.92^{bcd}
T_4	Karanja plant extract	2.67^{b}	2.70^{b}	2.07^{b}	1.47^{b}	2.08^{b}
T_5	Tobacco leaf extract	2.87^{e}	3.30^{f}	2.33^{f}	1.93^{e}	2.52^{d}
T_6	Spinosad 240 EC	1.87^{e}	2.10^{ef}	1.53^{ef}	1.07^{e}	1.57^{d}
T_7	Emamectin benzoate 1.9 EC	2.00^{a}	2.30^{a}	1.73^{a}	1.13^{a}	1.72^{a}
T_8	Control	5.40^{bc}	5.90^{c}	6.27^{bc}	6.53^{c}	6.23^{bc}
Overall Mean		3.01	3.02	2.53	2.11	2.55
F- test		S	S	S	S	S
S. Ed. (±)		0.99	1.14	1.44	1.71	1.43
C. D. (P = 0.05)		0.19	0.19	0.24	0.24	0.80

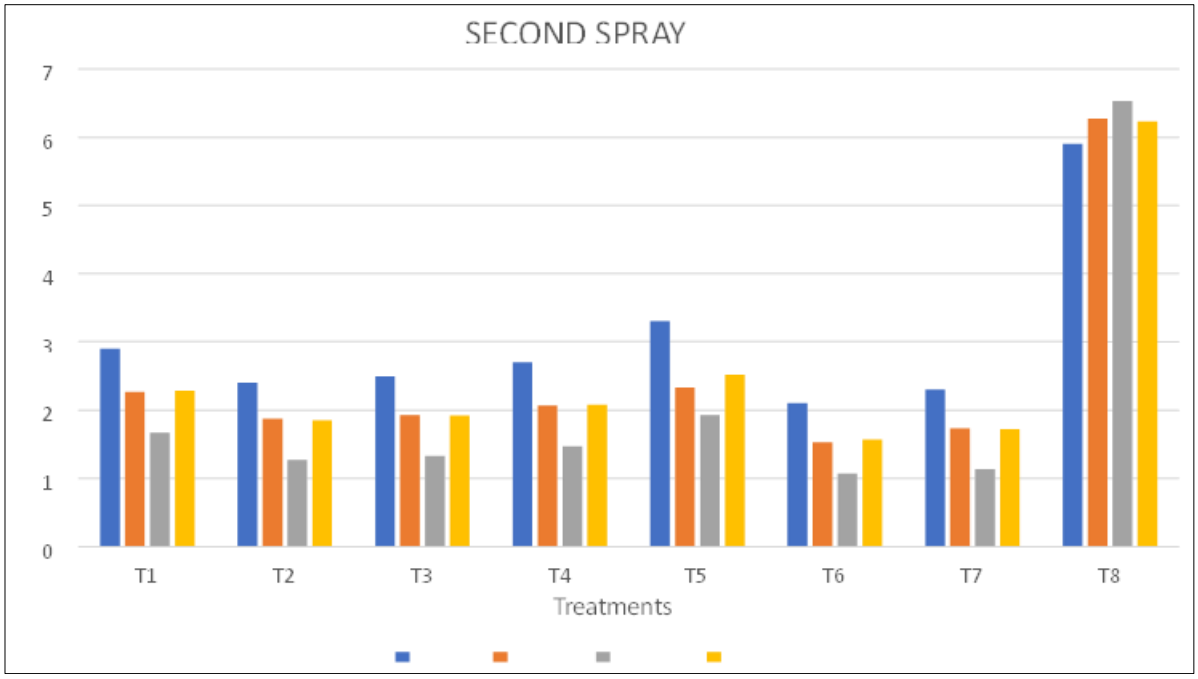

Fig 2: Efficacy of different biopesticides and botanicals against the Hadda beetle after second spray.

Conclusion

From the critical analysis of the present findings, it can be concluded Spinosad 240 EC (T_6) was found to be most effective against brinjal hadda beetle and produces maximum yield followed by, Emamectin benzoate 1.9 EC (T_7), Indoxacarb 14.5 SC (T_2), Neem seed kernal extract 5% (T_3), Karanja plant extract (T_4), Garlic extract (T_1), Tobacco leaf extract (T_5) was found significantly superior over control. And the highest Cost-Benefit ratio was recorded in Spinosad 240 EC, followed by Emamectin benzoate 1.9 EC, Indoxacarb 14.5 SC, Neem seed kernal extract 5%, Karanja plant extract, Garlic extract and Tobacco leaf extract over the control plot. However, Neem seed kernel extract 5% found to be least effective in managing brinjal hadda beetle as an effective tool under chemical control. Hence, it is suggested that effective insecticides may be alternated along with biopesticides with existing Integrated pest management programs to avoid the problems associated with insecticidal resistance, pest resurgences etc.

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