Field efficacy of selected chemicals and biopesticide<u>s</u> against brinjal shoot and fruit borer(*Leucinodesorbonalis*) on <u>b</u>~~B~~rinjal (*Solanum melongena*)

Abstract –

A field experiment was carried out at the Central research farm of Sam Higginbottom University of Agriculture, Technology, and Sciences, located in Prayagraj, Uttar Pradesh~~ (Pin: 211007)~~, during the *<u>k</u>~~K~~harif* season of 2023-24. The experiment was designed following a randomized block design with three replications. It encompassed eight treatments: T_1- Neem oil 3%@ 30ml/lit, T_2- *Metarhizium anisopliae*<u>@ </u>2.5ml/lit,T_3– *B. thuringiensis* <u>@</u>2gm/lit, T_4- Spinosad 45SC @ 0.3 ml/lit, T_5–Em~~m~~amectin benzoate @ 0.4 gm/lit, T_6~~-Chlopyeifos~~ <u>Chlorpyrifos </u>20EC <u>@ </u>2.5ml/lit, T_7- Chlorantraniliprole 18.5SC @ 0.4ml/lit and T_8-untreated control. The objective was to assess the field efficacy of selected chemicals and biopesticides against*Leucinodesorbonalis*<u>(</u>Guenee<u>)</u> infestation on <u>b</u>~~B~~rinjal in Prayagraj. Two rounds of spraying were ~~conducted~~ <u>done</u>at 15~~-~~day<u>s</u> interval~~s~~. Data on shoot and fruit infestation ~~were~~ <u>was</u>recorded after each spraying and picking, including the percentage of shoot infestation. The results showed that the initial population of the pest before the spray exhibited a non-significant distribution.Following the spray, the findings demonstrated that T5– Em~~m~~amectin benzoate ~~at~~ <u>@</u>0.4 ml/<u>lit</u>~~L~~ exhibited significant effectiveness against shoot and fruit borer, comparable to T7–Chlorantraniliprole 18.5SC~~,~~<u>@ 0.4ml/lit </u>at 3, 7,and 14 days post-spraying. Following closely in efficacy were Spinosad 45SC and Chlorpyrifos 20EC.~~The highest cost benefit ratio was recorded T_5-Emmamectin benzoate @ 0.4 ml/L, followed by T_7-Chlorantraniliprole 18.5SC.~~ The highest cost-benefit ratio ~~were~~ <u>was</u>recorded<u> in</u>~~-~~ T_5–Em~~m~~amectin benzoate@2ml/~~L~~<u>lit</u> followed by T_7-Chlorantraniliprole 18.5SC<u>@ 0.4ml/lit.</u>i~~.e Emmamectin benzoate > Chlorantraniliprole > Spinosad > Chlopyrifos >*Metarhizium anisopliae* > Neem oil >*Bacillus thuringiensis* var. *krustaki* > Untreated control.~~

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Keywords:*Metarhizium anisopliae*, *Bacillus thuringiensis* var. *kurstaki*,*Leucinodesorbonalis*

~~1.~~ Introduction~~–~~

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Brinjal (*Solanum melongena* Linn.), with a chromosome count of 2n=24, stands as one of the most beloved vegetables, also recognized by names like eggplant, aubergine, or guinea squash. Belonging to the nightshade family Solanaceae, it holds the prestigious title of "King of the Vegetables". Renowned for its high yielding capabilities, brinjal can thrive year-round across a variety of agro-climatic conditions, particularly in tropical and sub-tropical regions. The Indian sub-continent serves as the center of origin for this esteemed vegetable(**Omprakash and Raju, 2014**).

In India, brinjal cultivation spans across approximately 0.743 million hectares of agricultural land, yielding a production of 12.77 million tonnes annually, with a productivity of nearly 17.17 MT/ha(**Anonymous, 2022**).The primary brinjal cultivating states in India include Bihar, Odisha, Karnataka, Andhra Pradesh, Maharashtra, West Bengal, Uttar Pradesh, and states with climatic conditions conducive to tropical and subtropical cultivation. In Karnataka, brinjal cultivation covers an area of 1.58 lakh hectares, contributing to a production of 402.5 MT, accounting for a 3.13% share, with a productivity of 25.4 MT/ha(**Anonymous, 2016**). Brinjal has been acknowledged in Ayurveda for its therapeutic potential in managing diabetes. Additionally, it is esteemed for its diverse medicinal properties, acting as a beneficial appetizer, aphrodisiac, cardiac tonic, laxative, and inflammation reliever. Moreover, it serves as an excellent remedy for liver-related health issues**(Lalita and Kashyp, 2020).**

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The year-round availability of brinjal exposes the crop to a spectrum of biotic and abiotic factors. Among these, insect pests emerge as crucial contributors to yield reduction, as they assail the crop from its nursery stage through harvesting. Brinjal faces attacks from approximately 142 species of insect pests, along with four species of mites and nematodes, across various regions worldwide**(Jat and Shrivastva, 2023).** Brinjal crops are susceptible to numerous insect pests, including aphids (*Aphis gossypi*i Glover), whiteflies (*Bemisiatabaci* Lind.), jassids (*Amrascabiguttulabiguttula* Ishida), spotted leaf beetles *(Epilachnavigintioctopunctata*Fab.), brinjal shoot and fruit borers (*Leucinodesorbonalis*Guenee), brinjal leaf beetles (*Psylliodesbali* Jacoby), and leaf folders (*Eublemma oleracea* Walk.)(**Patra et al.,2016**).

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Among these pests, the brinjal shoot and fruit borer, *Leucinodesorbonalis* (Guenée) (Lepidoptera: Crambidae), poses a significant and destructive threat to brinjal production. During the early stages of crop growth, adult female moths predominantly lay eggs on the lower side of young leaves near the midrib, occasionally on tender shoots. Upon hatching, young larvae bore into the young leaves near the midrib or tender shoots, sealing the opening with frass and feeding

Formatted: Space After: 0 pt, Line spacing: 1.5 lines within the shoot or midrib of the leaves. Drooping, wilting, or withering of shoots are typical symptoms of shoot damage during the early stages of crop growth. After fruit formation, larvae generally enter from the underside of the calyx, bud, or fruit, closing the entry hole with frass. Infestation in the buds results in flower drop. The holes observed on the fruits are actually exit holes of the larvae. Such infested fruits are partially unfit for human consumption and fetch lower prices in the market(**Shigaonkaret al.,2022**). This pest inflicts damage on brinjal crops, leading to yield losses ranging from 60-80 percent, or even causing complete damage if no control measures are implemented(**Thakare et al., 2021**).

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~~2.~~ MATERIALS AND METHODS –

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The investigation on the **''Field efficacy of selected chemicals and biopesticide against brinjal shoot and fruit borer (*Leucinodesorbonalis*Guenee) on Brinjal (*Solanum melongena* L.) at Prayagraj''**was conducted at the experimental field of Sam higginbottom university of agriculture, Technology and Sciences, Prayagraj, ~~-211007~~Uttarpradesh during the k~~K~~*harif* season of 2023-24.

The data were subsequently converted into percentages of infestation utilizing specific formulas.-

On Shoot:

Number basis The total number of shoots and the number of infested shoots from five selected plants in each treatment replication ~~were~~ wasrecorded**(Soulakheet al., 2021).**

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$$\%\text{Shootinfestation} = \frac{\text{No.ofshootsinfested}}{\text{Totalno.ofshoots}} \times 100$$

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On Fruit:

Number basis During each picking, the total number of fruits and the number of infested fruits from five selected plants in each treatment replication ~~were~~ wasrecorded (**Gowrish et al., 2015**).

$$\text{Fruitinfestation} = \frac{\text{No.offruitsinfested}}{\text{Totalno.offruits}} \times 100$$

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~~2.1~~Cost-Benefit Ratio (ICBR) and statistical analysis –

The Cost-Benefit Ratio was calculated by dividing the net monetary return (B) by the total additional cost incurred due to treatments (C). For statistical analysis, the percentage of fruit damage caused by borers was subjected to angular transformation using the ARCSIN method. The data were then analyzed using standard analysis of variance as suggested by **Panse and Sukhatame (1985)**.

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Net returns
BCR=-----------------------------
Costoftreatment

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Where,

BCR=Benefit Cost Ratio

3. Results andDiscussions-

3.1 To study the field efficacy of selected chemicals and biopesticide against brinjal shoot and fruit borer (*Leucinodesorbonalis*Guenee), Infesting brinjal

The data concerning the percentage of infestation by shoot and fruit borers after the first and second spray indicated that all chemical treatments exhibited significant superiority over the control. Among all treatments, the lowest percentage of infestation by shoot and fruit borers was observed in Emmamectin benzoate (T_5 - 7.94), followed by Chlorantraniliprole (T_7 - 8.93), Spinosad (T_4 - 10.12), Chlorpyrifos (T_6 - 10.82), *Metarhizium anisopliae* (T_2 - 11.57), Neem oil (T_1 - 12.46), *Bacillus thuringiensis* var.*Kurstaki* (T_3 - 11.57), and the control (T_0 - 26.90).A comprehensive analysis revealed that all the biopesticides were effective, with the following decreasing order of efficacy: Emmamectin benzoate > Chlorantraniliprole 18.5SC > Spinosad 45SC > Chlorpyrifos 20EC >*Metarhizium anisopliae*> Neem oil 3% >*Bacillus thuringiensis* var. *Kurstaki*. Their significant impact on reducing shoot infestation was evident when compared against the untreated control. These findings align closely with previous studies conducted by **Mane and Kumar (2020),Verma *etal*.,(2021)** and**Shyamrao*etal*.,(2018)** which also highlighted the superiority of Emmamectin benzoate in reducing the population of shoot and fruit borers.

Table.1 Fieldefficacyofselectedchemicalsandbio-pesticidesagainst*Leucinodesorbonalis*(Guenee)onbrinjal.:(1st and 2nd spray).

Treatments		Dose (gm/ ml/~~L~~lity)	% Shootinfestation~~/5plants~~									Overall mean	Yield (q/ha)	B:C Ratio
			1DBS	**3DAS**	**7DAS**	**14DAS**	**Mean**	**3DAS**	**7DAS**	**14DAS**	**Mean**			
T_1	Neemoil~~@~~3 %	30ml	20.94	15.69	13.75	14.21	14.55	12.05	9.05	10.04	10.38	12.46	72.3	1:3.2
T_2	*Metarhizium anisopliae*	2.5ml	20.38	14.88	13.24	13.76	13.96	10.72	7.89	8.95	9.18	11.57	75	1:5.0
T_3	*Bacillus thuringiensis*var.*kurstaki*	2gm	21.29	16.35	14.37	15.24	15.32	13.50	10.01	10.79	11.43	13.37	69.5	1:4.7
T_4	Spinosad45SC	0.3ml	21.35	13.55	11.82	12.56	12.64	9.15	6.61	7.01	7.60	10.12	85.12	1:5.3
T_5	E~~m~~mamectin benzoate5%	0.4gm	21.75	11.21	8.98	9.73	9.97	7.01	5.14	5.59	5.91	7.94	90	1:6.0
T_6	Chlorpyrifos 20EC	2.5ml	21.13	14.28	12.76	13.13	13.39	9.81	7.38	7.61	8.26	10.82	79.4	1:5.3
T_7	Chlorantraniliprole18.5SC	0.4ml	20.60	12.74	10.79	11.34	11.62	7.51	5.45	5.77	6.24	8.93	87.5	1:5.5
T_0	Control~~s~~	-	21.58	24.19	25.51	26.02	25.24	27.69	28.30	29.73	28.57	26.90	44	1:3.1
F-test			**NS**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	-	-
S. E(d)(±)			-	0.50	0.38	0.78	0.99	0.50	0.39	0.70	0.71	1.17	-	-
CD (5%)			-	1.29	0.78	1.42	1.14	1.07	0.77	0.85	1.41	2.42	-	-

*Figures in parentheses are arc sin transformation values, DAS -days after spray

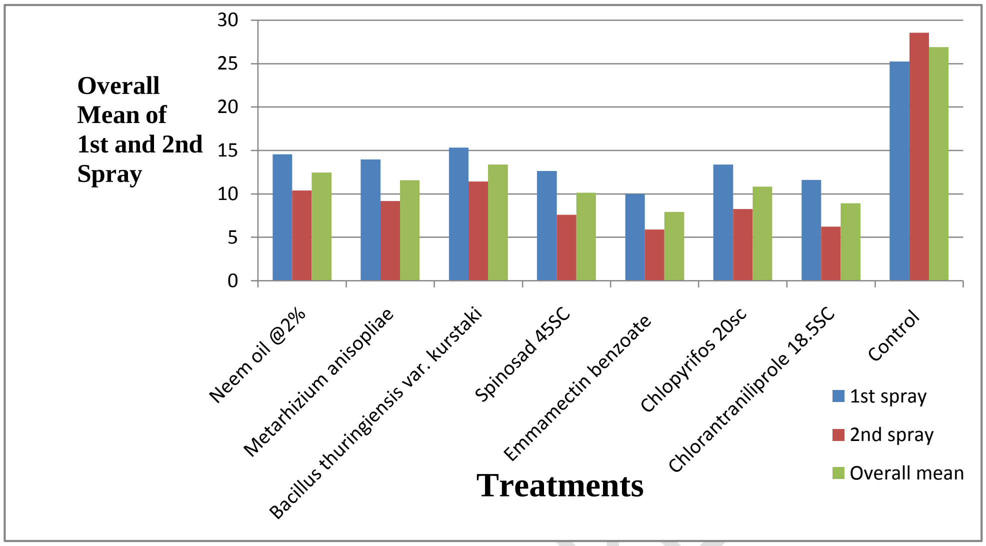

Fig 1- Overall mean of brinjal shoot and fruit borer infestation at the 1st and 2nd spray

~~3.2.~~ Yield~~-~~

The data revealed that the highest grain yield of 90 q/ha was attained with Em~~m~~amectin benzoate (T_7), followed by Chlorantraniliprole 18.5 SC (T_7) with 87.5 q/ha, Spinosad 45SC (T_4) with 85.12 q/ha, Chlorpyrifos 20EC (T_6) with 79.4 q/ha, *Metarhizium anisopliae* (T_2) with 75 q/ha, Neem oil 3% (T_1) with 72.3 q/ha, and *Bacillus thuringiensis* var.*kurstaki* (T_3) with 69.5 q/ha. The untreated control plot (T_0) recorded the lowest yield of 44 q/ha.

In this study, Em~~m~~amectin benzoate (T_5) exhibited the most promising results among all treatments, followed by Chlorantraniliprole (T_7), in reducing crop infestation. Spinosad 45SC (T_4), Chlorpyrifos 20EC (T_6), *Metarhizium anisopliae* (T_2), and Neem oil 3% (T_1) also demonstrated effectiveness against the Brinjal shoot and fruit borer [*Leucinodesorbonalis*(Guenee)].

~~3.3.~~ Cost Benefit Ratio –

The analysis of the Cost-Benefit Ratio for all treatments revealed that the highest monetary return was achieved with Em~~m~~amectin benzoate (T_5) (1:6.0), followed by Chlorantraniliprole 18.5SC (T_7) (1:5.5), Spinosad 45SC (T_4) (1:5.3), Chlorpyrifos 20EC (T_6) (1:5.3), *Metarhizium* *anisopliae* (T_2) (1:5.0), Neem oil 3% (T_1) (1:3.2), and *Bacillus thuringiensis* var.*kurstaki*(T_3) (1:5.0). The lowest monetary return was observed with the control (T_0) (1:3.1).

~~4.~~ Conclusion-

The data on the percent infestation of shoot and fruit borer after first and second spray revealed that all the chemical treatments were significantly superior over control. Among all the treatments lowest percent infestation of shoot and fruit borer was recorded in Em~~m~~amectin benzoate(7.94) with highest yield 90q/ha~~e~~ and cost benefit ratio ~~recorded~~ (1:6.0).The highest infestation recorded in untreated control(26.90) with lowest cost benefit ratio (1:3.1).

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