

**Field efficacy and economics of selected biopesticides and chemicals against shoot and fruit borer, *Earias vittella* (Fabricius) on okra**

**ABSTRACT**

The field trial was conducted at Central Research Field, Department of Entomology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during kharif season 2023. The experiment was laid out in in Randomised Block Design (RBD) with eight treatments each replicated thrice using variety Kashi Chaman. The treatments viz., T<sub>1</sub> *Beauveria bassiana* 1.5% T<sub>2</sub> Spinosad 45%SC T<sub>3</sub> Neem seed kernel extract 10%WP T<sub>4</sub> Emamectin Benzoate 5SG T<sub>5</sub> Fipronil 5SC T<sub>6</sub> Chlorantraniliprole 18.5SC T<sub>7</sub> Azadirachtin 0.03%WSP 300PPM (5ml/lit) and along with untreated control T<sub>0</sub> against *Earias vittella* in okra. The data on percentage of shoot and fruit infestation of okra shoot and fruit borer first and second spray mean revealed that all treatments are significantly superior over control. Among all the treatments lowest per cent shoot and fruit, infestation was recorded in T<sub>6</sub> Chlorantraniliprole 18.5SC (8.46) (9.44),, T<sub>2</sub> Spinosad 45% SC (9.95) (10.44),, T<sub>4</sub> Emamectin benzoate 5%SG (11.83) (11.85),, T<sub>5</sub> Fipronil 5%SC (12.96) (12.91),, T<sub>3</sub> Neem seed kernel extract 10% WP (14.82) (13.27), T<sub>1</sub> *Beauveria bassiana* 1.5% (15.94) (14.62) and T<sub>7</sub> Azadirachtin 0.03%WSP 300PPM (5ml/lit) (16.97) (14.79) and is significantly superior over the control (23.78) (23.26). While The highest yield was recorded in T<sub>6</sub> Chlorantraniliprole 18.5SC (210.2q/ha), as well as B:C ratio (1:6.54), T<sub>2</sub> Spinosad 45%SC (195.7q/ha) (1:6.02),, T<sub>4</sub> Emamectin benzoate 5SG (163.4q/ha) (1:5.17), T<sub>5</sub> Fipronil 5SC(149.2q/ha) (1:4.69), T<sub>3</sub> Neem seed kernel extract10%WP (138.4q/ha) (1:4.42),, T<sub>1</sub> *Beauveria bassiana* 1.5% (131.7q/ha) (1:4.00), T<sub>7</sub> Azadirachtin 0.03%WSP 300PPM (5ml/lit) (120.2q/ha) (1:3.71), as compared to T<sub>0</sub> control (90.2q/ha) (1:2.96).

**Key words:** Cost benefit Ratio, chemicals *Earias vittella*,, okra shoot and fruit borer.

**INTRODUCTION**

“Okra (Lady finger or bhendi), *Abelmoschus esculentus* (L.) Moench is cultivated in India mainly for its immature fruits. Okra fruits have nutritious as well as dietary value. Though, it is mainly used as a fresh vegetable, it is also consumed as canned, dehydrated or frozen forms. Among vegetables, it occupies an important position and is grown extensively throughout

Okra fruits are an important source of vitamins, calcium, potassium and other minerals. In addition, mucilaginous extract of green stem of okra is used for clarifying sugarcane juice in a jaggery preparation” (Chauvan, 1972).

“The crop, however, is vulnerable to attack of important insect pests, among which fruit borer *Earias vittella* (Fabricius) is the most important pest causing direct damage to marketable fruits. It alone is reported to cause 57.1 per cent fruit infestation and 54.04 per cent net yield loss in okra” Chaudhary *et al.* (1989) “*Earias vittella* damage to okra crop is done by two ways. First, the terminal portion of growing shoots is bored by caterpillars, which move down by making tunnels inside. As a result, the shoot drop downward or dry up”[23-25]. “Second, the larvae enter the fruit by making holes, rendering them unfit for human consumption. According to an estimate this pest can cause 36-90% loss in fruit yield of okra” (Misra 2002).

“The crop is grown throughout India, Andhra Pradesh is the leading okra producing state which has production of around 884.2 thousand tons from an area of 78.90 thousand ha, with a productivity of 15 tons / ha. It is followed by west Bengal (862.1 thousand tonnes from 74.00 thousand with 11.70 tons / ha productivity. In Uttar Pradesh area, production and productivity of okra is 48.6 thousand ha, 176.26 thousand tones, 8 tons/ha respectively”. (NHB 2021-22).

“The productivity of okra is low due to many factors in which the attack of shoot and fruit borer, *E. vittella* and *Earias insulana* (Boisduval), Aphid (*A. gossypii*) and Jassid, *A. biguttula* are most serious pests of okra and cause 45.00-57.10% damage to fruits. The sucking pest complex of okra consisting of aphids, leaf hoppers, whiteflies, thrips and mites causes 17.46% yield loss and failure to control them in initial stages was reported to cause 54.04% yield loss” (Chaudhary *et al.* (1989) and Anitha *et al.* (2008).

## **Objectives:**

1. To Evaluate Field efficacy of selected biopesticides and chemicals against shoot and fruit borer, *Earias vittella* (Fabricius) on okra.

2. To Calculate Cost Benefit ratio [C:B ratio].

## Materials and methods

The experiment will be conducted during kharif season 2023 at Central Research Field (CRF), SHUATS, Prayagraj, Uttar Pradesh, India, in a randomized block design with eight treatments replicated three times using variety Kashi Chaman in a plot size of (2m×1m) at a spacing of (45×30cm) with a recommended package of practices excluding plant protection. The soil of the experimental site is well drained and medium high.

In this experiment eight treatments are used consisting application T<sub>1</sub> *Beauveria bassiana* 1.0% WP (10gm/lit) T<sub>2</sub> Spinosad 45%SC (0.35ml/lit) T<sub>3</sub> Neem seed kernel extract 10%WP (50gm/lit) T<sub>4</sub> Emamectin Benzoate 5SG (0.3gm/lit) T<sub>5</sub> Fipronil 5SC (2ml/lit) T<sub>6</sub> Chlorantraniliprole 18.5SC (0.25ml/lit) T<sub>7</sub> Azadirachtin 0.03%WSP 300PPM (5ml/lit) and treatment of untreated control were tested against okra shoot and fruit borer.

As the ETL 5%shoot infestation and 10% fruit infestation crossed per plant crossed and application of the two sprays of insecticidal treatments were applied at 15 days interval.

The shoot and fruit infestation was recorded from randomly selected plants in every plot and infestation per 5 plants was noted. After that mean of three replications was calculated for each treatment and the same was done with the untreated plot. The shoot infestation of *Earias vittella* was recorded before 1 day before of first spraying and on 7<sup>th</sup> day and 14<sup>th</sup> day after insecticidal application. The fruit infestation of *Earias vittella* was recorded before 1 day before of second spraying and on 7<sup>th</sup> day and 14<sup>th</sup> day after insecticidal application. Healthy okra fruits are picked and their weight from each treatment was expressed as marketable yield in quintal per hectare. Ultimately, the cost benefit ratio was calculated on the basis of prevailing market price of yield, insecticides and spraying cost.

## Data Analysis

### Percent Shoot Infestation:

$$\% \text{ Shoot Infestation} = \frac{\text{Number of infested shoots}}{\text{Number of total shoots}} \times 100$$

### Percent Fruit Infestation:

$$\% \text{ Fruit Infestation} = \frac{\text{Number of infested fruits}}{\text{Number of total fruits}} \times 100$$

(Kalva Rani *et al.*, 2022)

## Economics:

### Cost benefit ratio:

$$C: B \text{ Ratio} = \frac{\text{Gross returns}}{\text{Total cost incurred}}$$

(Choudhury. A.R *et al.*, 2021)

## Result and discussion

The data on the percent infestation of shoot and fruit borer on okra 7th and 14th day after first spray and second spray revealed that all the chemicals and biopesticides treatments were significantly superior over control. “Among the selected treatments, Chlorantraniliprole 18.5SC was found effective in controlling the shoot and fruit borer population which can be recommended for management of shoot and fruit borer on okra”. [26] The values obtained in the first and second spray are 8.46% and 9.44% respectively. The results were similar to the findings reported by **Patra *et al.* (2016)** who reported that Chlorantraniliprole 18.5SC was most effective treatment. The next effective treatment was in Spinosad 45% SC which the values obtained in first and second spray are 9.95% and 10.44 respectively. These findings were support by **Yadav *et al.* (2017)**, **Mane *et al.* (2010)** and **Naidu *et al.* (2019)**.

The efficacy of Emamectin benzoate 5%SG in first and second spray are 11.83% and 11.85% respectively. These results are similar to the findings of **Bangar *et al.* (2012)** and **Dash *et al.* (2020)**. Fipronil 5SC was found to be next effective treatment and the values obtained in the first and second spary are 12.96% and 12.91% respectively. These findings were similar and supported by **Rakshith *et al.* (2017)** and **Singh *et al.* (2017)**. This was followed by the next best treatment which is Neem seed kernel extract 10% WP in which the efficacy values obtained 14.82% and 13.27% respectively which was supported by **HB Mulani *et al.* (2021)** This was followed by next effective treatment *Beauveria bassiana* 1.5% 15.94%and 14.62% respectively which was supported by **Sarkar *et al.* (2015)** and Azadirachtin 0.03%WSP 300PPM 16.97% and 14.79%. These findings are supported by **Nayak *et al.* (2012)** and **Ramesh *et al.* (2012)** These are found to be least effective than all the treatments and is significantly superior over the control (23.78) (23.26).

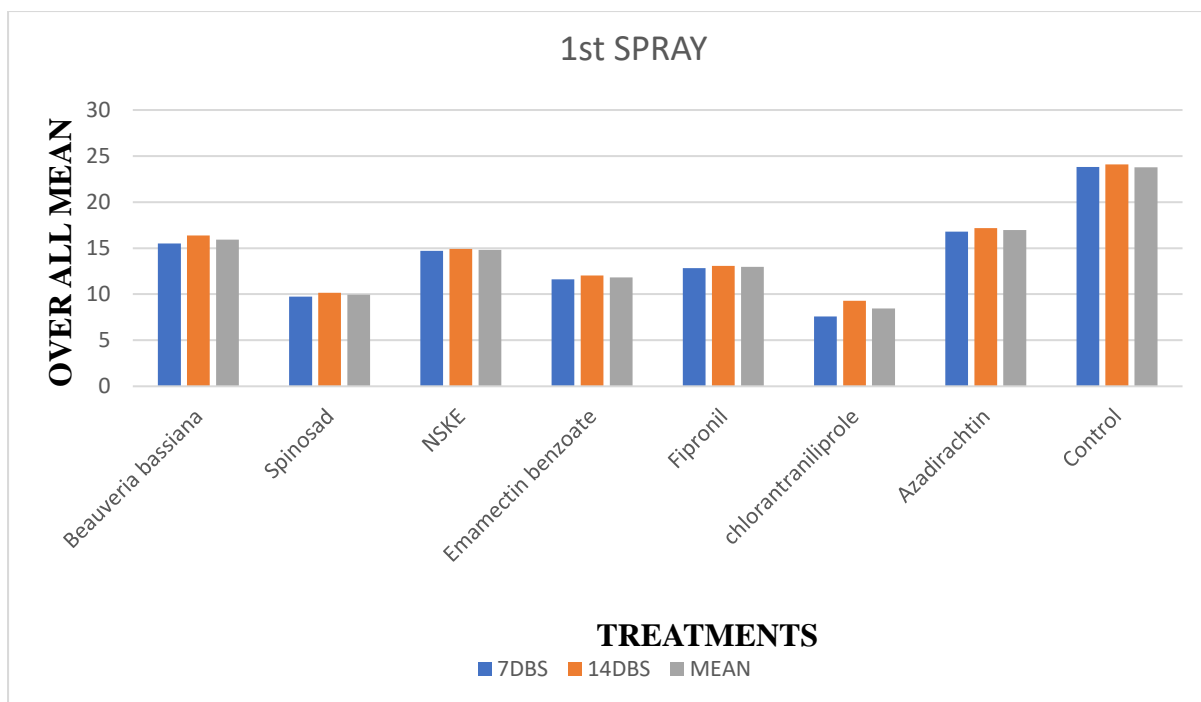
The yield among the treatments was significant. The highest yield was recorded in T<sub>6</sub> Chlorantraniliprole 18.5SC (210.2q/ha), T<sub>2</sub> Spinosad 45%SC (195.7q/ha), T<sub>4</sub> Emamectin benzoate 5SG (163.4q/ha), T<sub>5</sub> Fipronil 5SC(149.2q/ha), T<sub>3</sub> Neem seed kernel extract10%WP

(138.4q/ha), T<sub>1</sub> *Beauveria bassiana* 1.5% (131.7q/ha), T<sub>7</sub> Azadirachtin 0.15%EC (120.2q/ha), as compared to T<sub>0</sub> control (90.2q/ha). which was supported by **Bansode *et al.*, (2015)** **Naidu *et al.* (2019)**, **Nayak *et al.* (2012)**. **Bansode *et al.* (2015)**. and **Dash *et al.* (2020)**.

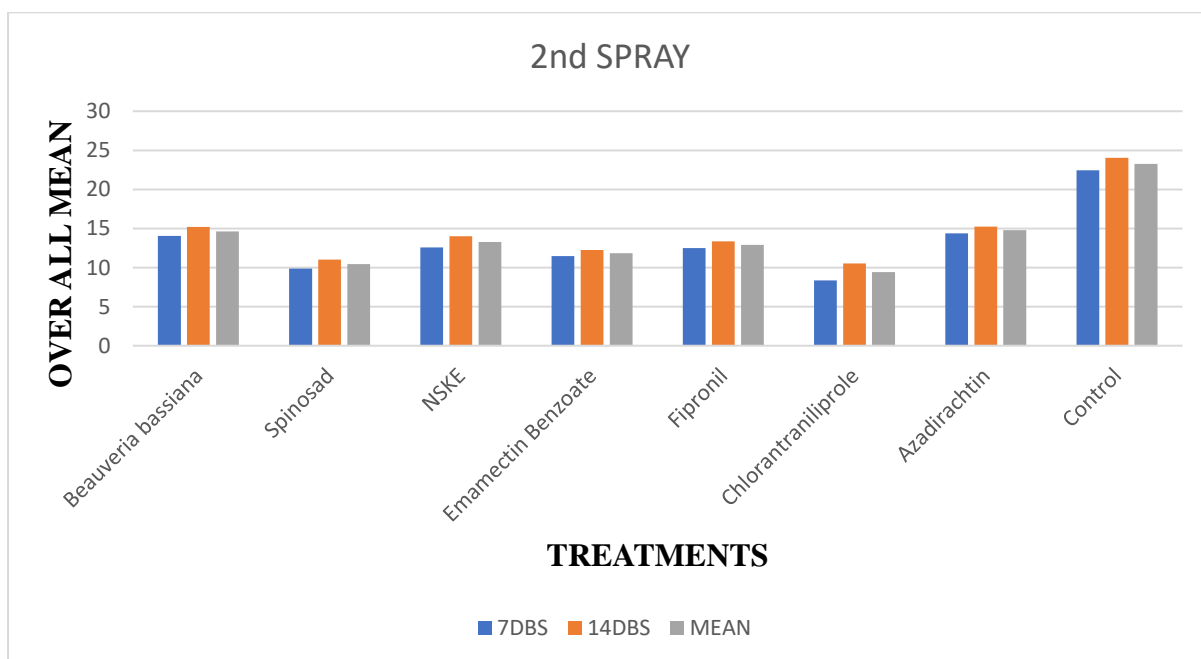
When the benefit cost ratio was worked out, interesting results was achieved. Among the treatment studied the best and most economical treatment was T<sub>6</sub> Chlorantraniliprole 18.5SC (1:6.54), followed by T<sub>2</sub> Spinosad 45%SC (1:6.02), T<sub>4</sub> Emamectin benzoate 5SG (1:5.17), T<sub>5</sub> Fipronil 5SC(1:4.69), T<sub>3</sub> Neem seed kernel extract10%WP (1:4.42), T<sub>1</sub> *Beauveria bassiana* 1.5% (1:4.00), T<sub>7</sub> Azadirachtin 0.03%WSP 300PPM (1:3.71), as compared to T<sub>0</sub> control (1:2.96). These findings were similar and supported by **Srivastava *et al.* (2014)**, **Chandravanshi *et al.* (2019)**, **Surendra Kumar *et al.* (2017)** **Rakshith *et al.* (2017)** and **Singh *et al.* (2017)**.

**Table 1 Field Efficacy of selected biopesticides and chemicals against shoot and fruit borer, *Earias vittella* (Fabricius) on okra and Yeild and C:B ratio**

T.No	Treatments	Per cent shoot and fruit infestation of <i>Earias.vittella</i> /5Plants								Yield (q/ha)	C:B Ratio
		1 <sup>st</sup> Spray				2 <sup>nd</sup> Spray					
		1DBS	7 DAS	14 DAS	Mean	1 DBS	7 DAS	14 DAS	Mean		
T <sub>1</sub>	<i>Beauveria bassiana</i> 1.0%	18.44	15.51	16.38	15.94	18.49	14.05	15.19	14.62	131.1	1:4.00
T <sub>2</sub>	Spinosad 45%SC	16.93	9.73	10.17	9.95	17.74	9.86	11.02	10.44	195.7	1:6.02
T <sub>3</sub>	Neem seed kernel extract 10%WP	15.57	14.72	14.93	14.82	18.10	12.56	13.99	13.27	138.4	1:4.42
T <sub>4</sub>	Emamectin benzoate 5%SG	17.41	11.63	12.03	11.83	18.95	11.45	12.26	11.85	163.4	1:5.17
T <sub>5</sub>	Fipronil 5%SC	17.26	12.84	13.08	12.96	17.09	12.48	13.34	12.91	149.2	1:4.69
T <sub>6</sub>	Chlorantraniliprole 18.5SC	16.67	7.59	9.30	8.46	18.92	8.37	10.52	9.44	210.2	1:6.54
T <sub>7</sub>	Azadirachtin 0.03% WSP 300PPM	19.09	16.78	17.16	16.97	18.58	14.37	15.22	14.79	120.2	1:3.71
T <sub>8</sub>	Control	17.95	23.80	24.11	23.78	19.81	22.46	24.06	23.26	90.2	1:2.96
	F- test	NS	S	S	S	NS	S	S	S		
	S. Ed. (±)	1.725	0.686	0.715	0.074	2.257	0.436	0.629	0.051		
	C. D. (P = 0.05)	-	2.11	2.16	0.93	-	1.68	2.02	1.16	-	-



**Fig.1. Assessment of biopesticides and chemicals against okra shoot and fruit borer *Earias vittella* in okra first spray.**



**Fig.2. Assessment of biopesticides and chemicals against okra shoot and fruit borer *Earias vittella* in okra second spray**

## CONCLUSION

From the above discussion it was found that, spraying of insecticides significantly reduced the shoot and fruit borer percent infestation in okra. The present findings conclude that the new generation insecticides like T<sub>6</sub> Chlorantraniliprole 18.5SC(0.25ml/lit), followed by T<sub>2</sub> Spinosad 45%SC(0.35ml/lit), T<sub>4</sub> Emamectin benzoate 5SG(0.3gm/lit). T<sub>5</sub> Fipronil 5SC(2ml/lit), T<sub>3</sub> Neem seed kernel extract10%WP(50gm/lit) , T<sub>1</sub> *Beauveria bassiana* 1.5%SG(10gm/lit), T<sub>7</sub> Azadirachtin 0.03%WSP 300PPM (5mg/lit) treatment of untreated control plant T<sub>0</sub> were found effective against shoot and fruit borer of okra *Earias vittella*.

Further, it was observed that the cost benefit ratio was also high with T<sub>6</sub> Chlorantraniliprole 18.5SC and T<sub>2</sub> Spinosad 45%SC. Hence, it is suggested that the effective insecticides may be alternated in harmony with the existing Intergrated pest management programmes in order to avoid the problems associated with insecticidal resistance, pest resurgence etc.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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## REFERENCES

- 1. Abdur Razzak Choudhury M.D., M.D. Fuad Mondal, Ahasan Ullah Khan (2021)** Evaluation of Biological Approaches for Controlling Shoot and Fruit Borer (*Earias vitella* F.) of Okra Grown in Peri-Urban Area in Bangladesh *Horticulturae* 7,7.
- 2. Anitha, K. R. and Nandihali, B. S. (2008).** Seasonal incidence of sucking pests in okra ecosystem. *Karnataka Journal of Agricultural Science*, **21**: 137-38.
- 3. Bangar, Nilam R. And Patel, J.J. (2012).** Evaluation Of Various Synthetic Insecticides Against *Earias Vittella* Fabricius Infesting Okra. *Agres – An International E-Journal*, **3**(1): 367-375.
- 4. Bansode, A. G., Patil, C. S. and Jadhav, S. S. (2015).** Efficacy Of Insecticides Against Shoot and Fruit Borer, *Earias vittella* F. Infesting Okra. *Pest Management In Horticultural Ecosystems*, **21**(1): 106-109.
- 5. Chandravanshi, D.K., Tomar, R.K.S., Awasthi, A.K., and Kerketta, A. (2019).** Field efficacy of different insecticides and bio-pesticides against okra shoot and fruit borer. *Journal of Pharmacognosy and Phytochemistry*, **8**(1): 2623-2625.
- 6. Chaudhary, H. R. and Daderch, L. N. (1989).** Incidence of insects attacking okra and the avoidable losses caused by them. *Annals of Arid zone*, **28**: 305-07.
- 7. Chauvan, D.V.S. (1972).** Vegetable production in India (3rd Edn.), Published by Ram Prasad sons, Agra.

- 8.Dash, L., Ramalakshmi, V. and Padhy, D. (2020).**Bio-efficacy of emamectin benzoate 5% SG against shoot and fruit borer *Earias vittella* (Fabricius) on okra.“ *The Pharma Innovation Journal*, **9**(12):144-146.
- 9.H.B. Mulani., Bantewad, SD. and Jayewar, NE. (2021).** Biointensive management of Okra shoot and fruit borer *Earias vittella* *The Pharma Innovation Journal* 2021; 10(8): 681-690
- 10.Kalva Rani. and Ashwani Kumar (2022)** Field efficacy of different chemicals against shoot and fruit borer [*Earias vittella* (Fabricius)] of okra [*Abelmoschus esculentus* (L.) Moench] *The Pharma Innovation Journal*; 11(4): 1603-1607.
- 11.Mane, S. A., Waghmare, and U. M., Yadav G. A. (2010).** Bio-efficacy and economics of some newer insecticides against fruit borer (*Earias Vittella* Fabricius) of Okra, *Health and environmental Reasearch online*, 34(5): 39-42
- 12.Misra, H. P. (2002).** Field evaluation of some newer insecticides against aphid (*Aphis gossypii*) and jassid (*Amrasca biguttula biguttula*) on okra. *Indian Journal of Entomology*, **64**: 80-84.
- 13.Naidu, G. and Kumar, A. (2019).**Field efficacy of certain insecticides against shoot and fruit borer (*Earias vittella* Fab.) on rainy season okra in Prayagraj (U.P).“ *Journal of Entomology and Zoology Studies*, **7**(6): 1211-1213.
- 14.Nayak U. S., Baral K., Mandal P., and Chatterjee S., (2012).** Seasonal Variation in the larval Population of Brinjal Shoot and Fruit Borer *Leucinodes orbonalis* (Guenee.) with Respect to Different Ecological Parameters. *International Journal of Bio-Resource and Stress Management*,
- 15.National Horticultural Board (N.H.B)**
- 16.Patra S., Mondal S., Samanta A. And Chatterjee M. L. (2007).** Bioefficacy of some new insecticides against the okra shoot and fruit borer, *Earias vittella* (F.), *Pest Management and Economic Zoology*, **15**(1): 53-56.
- 17.Rakshith, K.A. and Kumar A. (2017).** „Field Efficacy of Selected Insecticides and Neem Products against Shoot and Fruit Borer [*Earias vittella* (Fabricius)] on Okra [*Abelmoschus esculentus* (L.) Moench]’. *International Journal of Current Microbiology and Applied Science*, **6**(8): 122-128.

- 18.Ramesh, S. M. (2012).** Bioefficacy of *Beauveria bassiana* 3% as against *Earias vittella* and *P. fluorescens* 0.5% WP against powdery mildew of okra (Doctoral thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra).
- 19.Sarkar, S., Patra, S and Samanta, A. (2015).** Evaluation of bio-pesticides against red cotton bug and fruit borer of okra. *The Bioscan*, 10(2), 601-604.
- 20.Srivastava N., Srivastava, A. K., Alok M., Gupta P., Singh, S. K. (2014).** Efficacy Of Selected Insecticides and Neem Oil Against Shoot and Fruit Borer (*Earias vittella* fab.) on okra (*Abelmoschus esculentus* L.). *International journal of pharmacy and life sciences (Ijpls)*,5(12): 4096-4099.
- 21.Singh G. P. Yadav, Ramkewal, Singh R. S. and Vikrant (2017).** Effect Of Certain Eco-Friendly Insecticides on *Earias Vittella* (Major Insect) Of Okra Crop In Central Region Of Uttar Pradesh, India. *Plant Archives*,17(1):135-140.
- 22.Surendra Kumar Yadav, K.C. Kumawat. (2017).** Bioefficacy of Newer and Biorational Insecticides against Shoot and Fruit Borer, *Earias spp.* on Okra. *Int.J.Curr.Microbiol.App.Sci* (2017) 6(7): 1035-1044.
23. Dipak, and Ashwani Kumar. 2024. "Comparative Efficacy of Selected Insecticides Against *Helicoverpa Armigera* (Hubner) on Cowpea, *Vigna Unguiculata* (L.) in Prayagraj, U.P., India". *Journal of Experimental Agriculture International* 46 (6):570-74. <https://doi.org/10.9734/jeai/2024/v46i62510>.
24. Roopwan, Yadav U, Madhu B. Efficacy of Biopesticides for the Management of Rice Yellow Stem Borer *Scirpophaga incertulas* (Walker) in Rice at Prayagraj, U.P, India. *Int. J. Plant Soil Sci.* [Internet]. 2023 Jul. 25 [cited 2024 May 28];35(18):888-93. Available from: <https://journalijpss.com/index.php/IJPSS/article/view/3354>
25. Malinga LN, Laing MD. Efficacy of three biopesticides against cotton pests under field conditions in South Africa. *Crop Protection*. 2021 Jul 1;145:105578.

26. Madhuri K, Kumar A. To study the field efficacy of certain chemicals and neem oil against shoot and fruit borer *Earias vittella* (Fabricius) on okra. *The Pharma Innovation Journal*. 2022;11(4):1575-8.