Biological Forum – An International Journal 15(10): 482-487(2023)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Population Dynamics and Management of Shoot and Fruit Borer (*Earias vittella* F.) on Okra with Newer Insecticides

Suman Shivani[1*], Badaya Ashok Kumar[2], Saxena Sakshi [1], Naveen[3] and Kumar Neeraj[3]
[1]Department of Entomology, College of Agriculture, Indore,
Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, 474002 (Madhya Pradesh), India.
[2]Principal Scientist, RVSKVV- Krishi Vigyan Kendra, Dewas, 455001 (Madhya Pradesh), India.
[3]Department of Entomology, College of Agriculture, Gwalior, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, 474002 (Madhya Pradesh), India.

(Corresponding author: Suman Shivani)*
(Received: 01 August 2023; Revised: 19 August 2023; Accepted: 24 September 2023; Published: 15 October 2023)
(Published by Research Trend)

ABSTRACT: The fluctuation in weather parameters can significantly influence pest populations in okra crops. Pests are affected by various weather-related factors, which can either promote or limit their population growth. So, the present investigation was carried out to study the population dynamics and management of shoot and fruit borer with newer insecticides in Okra. The population of shoot and fruit borers was first recorded during the 35th standard meteorological week (SMW) which attained its peak (20.25% fruit damage) during the 38th SMW. After that, a tendency towards a decline in the pest population was observed up to the harvest *i.e.*, 41st SMW. Shoot and fruit borer, *Earias vittella* Fabricius incidence correlated with weather parameters indicated that morning relative humidity showed a significant positive correlation (r = 0.89) whereas minimum temperature (r = -0.53) and wind velocity (r = -0.67) showed significant negative correlation. In the field experiment, all the insecticidal treatments recorded significantly less fruit damage as compared to the control. Among the newer insecticides, abamectin 1.9% EC @ 987 ml/ha treated plot was recorded with the least fruit damage (5.27%) and produced the highest fruit yield (68.33 q/ha). However, afidopyropen 50 g/l DC @ 600 ml/ha was found economical and most effective with the highest cost-benefit ratio (1:22.3) followed by tolfenpyrad 15% EC @ 1000 ml/h (1:15.1). This integrated approach can help reduce crop losses and ensure a more sustainable and profitable okra production system.

Keywords: Abamectin, afidopyropen, fruit infestation, novel insecticides, weather parameters.

INTRODUCTION

The most crucial element of our balanced diet is vegetables. These include vitamins, minerals, dietary fibre, and supplements. Okra [*Abelmoschus esculentus* (L.) Moench] is the most popular vegetable in the Malvaceae family and is also referred to as Bhindi in local languages. Okra is a green vegetable with excellent viscous juice. Vitamin K, vitamin C, B1, and B6 are all present in good amounts, as well as dietary fibre, magnesium, manganese, and potassium. The stems and roots serve to purify the sugarcane juice that is used to prepare gur or jaggery (Chauhan, 1972). India ranks second in vegetable production with around 187474 thousand MT, yet it ranks first in okra production. India has 528.4 thousand hectares under okra, with 6146 thousand MT produced, and a yield of 11.6 MT/hectare. Gujrat is growing the highest per unit yields followed by West Bengal. Among the okra fields in Madhya Pradesh, the area is 40.12 thousand ha, the production is 536.73 thousand MT, and the productivity is 13.38 MT/ha. (Anonymous, 2017). Leaf hopper, aphids, white flies, spider mites, and fruit borers are the main insect pests that are known to cause damage to okra in India which are important in okra (Singh *et al*. 2013). Among these, *Earias vittella* Fabricius (Lepidoptera: Noctuidae), the shoot and fruit borer, is regarded as a serious pest that seriously damages crops, producing more than 50% loss in cotton and 69% loss in Bhindi alone in certain parts of India. *E. vittella* alone may cause a net yield loss of up to 41.6 percent in Bhindi (Rai *et al*. 2010).

The incidence of Shoot and fruit borer, *E. vittella* F. (Lepidoptera: Noctuidae) typically happens during humid conditions after the rainfall. The underlying invasions take place in 3-4 weeks old crop. The Larvae make entry hole into growing flowers, fruits, shoots, and buds feed on them, and closes the hole with their excreta. The plants show a dwarf appearance bearing small curved and seedless fruits. Accordingly, the fruit becomes unsuitable for utilization. Pests can significantly reduce okra crop yields if left unchecked. Okra production in India was severely damaged by the infestation of this insect, which had a negative impact on the country's economy. By studying pest population dynamics, farmers can optimize their pest control efforts, leading to increased crop yields and economic returns. Pests, including shoot and fruit borers, can develop resistance to commonly used insecticides over time. Introducing newer insecticides with different modes of action can help delay the development of resistance, ensuring that these chemicals remain effective in the long term. Keeping this in mind, the current study was designed to investigate the impact of weather conditions on the okra shoot and fruit borer, *E. vittella,* as well as to assess the effectiveness of various newer insecticides against the pests in the okra crop.

MATERIALS AND METHOD

The present investigation was carried out during the *Kharif* season 2019 at the Research field of Sorghum, RVSKVV, College of Agriculture, Indore, Madhya Pradesh to study the population dynamics of Shoot and Fruit Borer (*E. vittella*) of Okra [*A. esculentus*] and its management with newer insecticides. An experiment was laid out in Randomized Block Design (RBD) maintaining proper spacing of 45 cm between rows and 30 cm between plants. The healthy seeds improved variety Nidhi 98 of okra was sown manually at 5 cm depth on 16th July 2019. The mean weekly meteorological data during the crop growth period were collected from, All India Co-ordinate Research Project for Dryland Agriculture, College of Agriculture, Indore (M.P.). The infestation of fruit borer, *E. vittella* was recorded from the initiation of pest and continued till the last picking. The number of fruits infested with fruit borer out of the total fruits was counted at each picking and converted into the per cent incidence of fruit borer. The various weather parameters such as maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rainfall, and wind velocity were correlated with per cent infestation by fruit borer.

The eight treatments including control namely T_1- afidopyropen 50 g/l DC @ 450 ml/ha, T_2- afidopyropen 50 g/l DC @ 600 ml/ha, T_3- afidopyropen 50 g/l DC @750 ml/ha, T_4- afidopyropen 50 g/I DC @ 1000 ml/ha, T_5- abamectin 1.9% EC @ 987 ml/ha, T_6- tolfenpyrad 15% EC @ 1000 ml/ha, T_7- spirotetramat 11.01% w/w + imidacloprid 11.01% w/w SC @ 500 ml/ha and T_8- control, were tested against shoot and fruit borer on okra. All of the treatments used in the study were applied as foliar sprays with a Knapsack sprayer to assess the effectiveness of more recent pesticides. All the treatments were applied thrice at fortnightly intervals starting from 30 days after sowing. After harvesting, infested and healthy fruits were weighted separately, according to Sujayanand *et al*. (2014), the percentage of fruit damage was calculated. Fruit yield was also recorded at each picking.

RESULTS AND DISCUSSION

The activity of shoot and fruit borer, *E. vittella* on okra was first recorded from 1st November 2018 during the 35th SMW *i.e.,* 27th August to 2nd September. The present results are somehow in conformity with the findings of Parijatha *et al.* (2018) who reported that the occurrence of shoot and fruit borer commenced from 36th SMW. Similarly, Rajput and Tayde (2017) also reported that the occurrence of shoot and fruit borer commenced from the 34th standard week. From Table 1 it is seen that the fruit borer infestation % increased sharply from 36th SMW *i.e.,* 3rd to 9th September, and reached its peak during 38th SMW *i.e.,* 17th to 23rd September.

Table 1: Population dynamics of shoot and fruit borer of okra and its correlation with weather parameters during Kharif 2019.

SMW	Dates	Weather parameters#						% Fruit infestation by shoot and fruit borer
		Temperature (ºC)		Relative humidity (%)		Rainfall (mm)	Wind Velocity (km/hr)	
		Maximum	Minimum	Morning	Evening			
30	23 - 29 July	29.1	24.0	80.6	79.7	8.19	1.96	0.00
31	30 July -5 Aug	26.2	22.4	83.5	80.6	11.40	2.22	0.00
32	6 - 12 Aug	26.8	22.9	82.2	80.9	17.96	1.02	0.00
33	13 - 19 Aug	26.6	22.3	80.8	82.2	11.00	2.21	0.00
34	20 - 26 Aug	27.7	22.3	85.3	76.7	11.00	1.63	0.00
35	27 Aug- 02 Sep	26.6	22.3	87.3	71.2	19.71	0.48	5.50
36	03 -09 Sep	27.1	23.0	90.9	75.0	13.14	0.18	8.15
37	10 - 16 Sep	25.4	21.4	91.7	79.7	28.29	1.38	15.5
38	17 - 23 Sep	29.0	22.1	91.9	77.8	4.57	0.34	20.25
39	24 - 30 Sep	28.7	21.5	90.6	75.1	10.86	0.23	17.00
40	01 - 07 Oct	29.4	20.4	90.5	68.7	16.29	0.32	13.25
41	08 - 14 Oct	29.5	20.1	90.2	67.6	5.86	0.10	10.49
Correlation coefficient (r) of population with maximum temperature								**0.31**
Correlation coefficient (r) of population with minimum temperature								**-0.53***
Coefficient of correlation (r) of population with morning relative humidity (%)								**0.89***
Coefficient of correlation (r) of population with evening relative humidity (%)								**-0.36**
Correlation coefficient (r) of population with total rainfall (mm)								**-0.11**
Correlation coefficient (r) of population with wind velocity (km/hr)								**-0.67***

***significant at 5% level of significance**

#**Source**: Meteorological Observatory, All India Co-ordinated Research Project for Dryland Agriculture, College of Agriculture, Indore (M.P.)

During this period maximum and minimum temperatures were 29ºC and 22.1ºC respectively, whereas, morning and evening relative humidity were 91.90 and 77.80 per cent respectively. Further, wind velocity and rainfall were 0.34 km/hr. and 4.57 mm respectively. After that, the incidence of the shoot and fruit borer declined during the 39th SMW *i.e.,* 24th to 30th September, and were available up to the 41st SMW *i.e.,* 08th to 14th October 2019. These observations are in close agreement with Singh *et al.* (2015) who observed that *Earias vittella* incidence started from the 34th SMW and peak population was observed in the 38th SMW. While Rajput and Tayde (2017) reported that the peak population of the shoot and fruit borer was observed on the 39th standard week Rawat *et al.* (2020) reported the population attained peak in the 37th SMW. The data on the correlation of shoot and fruit borer with weather factors are presented in Table 1 indicating that morning relative humidity showed a significant positive correlation with shoot and fruit borer infestation. Minimum temperature and wind velocity showed a significant negative correlation with the per cent fruit borer incidence. The present findings are in conformation with that of Akhila *et al.* (2019) who reported that the correlation between minimum temperature and shoot and fruit borer incidence indicated a negative significant relationship. While maximum temperature showed a non-significant positive correlation. On the other hand, there was a non-significant negative correlation between shoot and fruit borer infestation and evening relative humidity and rainfall. The present results are in alignment with the findings of Sharma *et al.* (2010) who reported that correlation with rainfall was found non-significantly and negatively correlated with the incidence of shoot and fruit borer. In line with Parijatha *et al.* (2018) who reported that the correlation between minimum temperature and wind velocity was negatively significant although, rainfall showed negatively non-significant where morning relative humidity showed a positive significant correlation with shoot and fruit borer. Regression studies have also been carried out to further assess the weather parameters that determine the infestation of shoot and fruit borer of okra. The association between the incidence of shoot and fruit borer and morning relative humidity, minimum temperature, and wind velocity are presented in Fig. 1, 2, and 3, respectively.

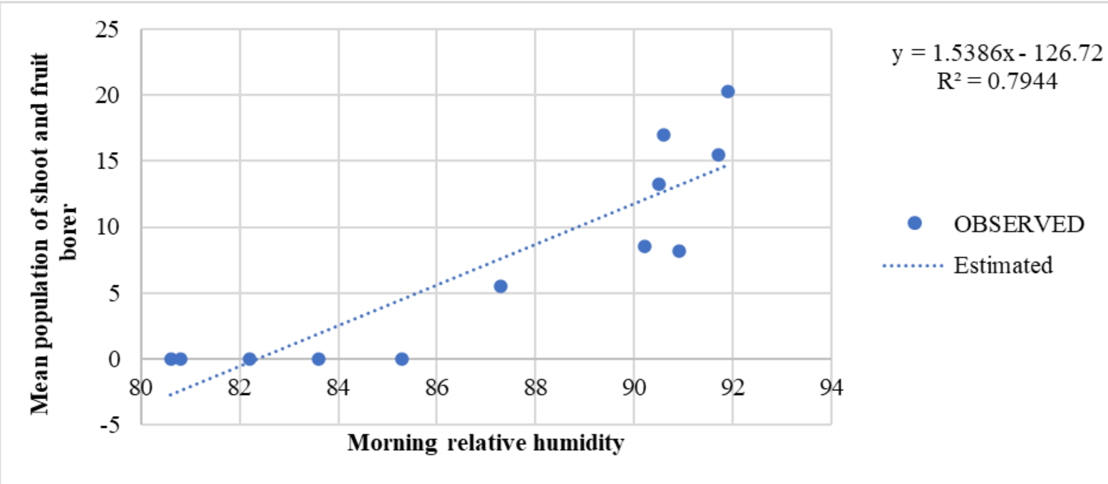

Fig. 1. Regression of morning relative humidity on *Earias vittella* infesting okra.

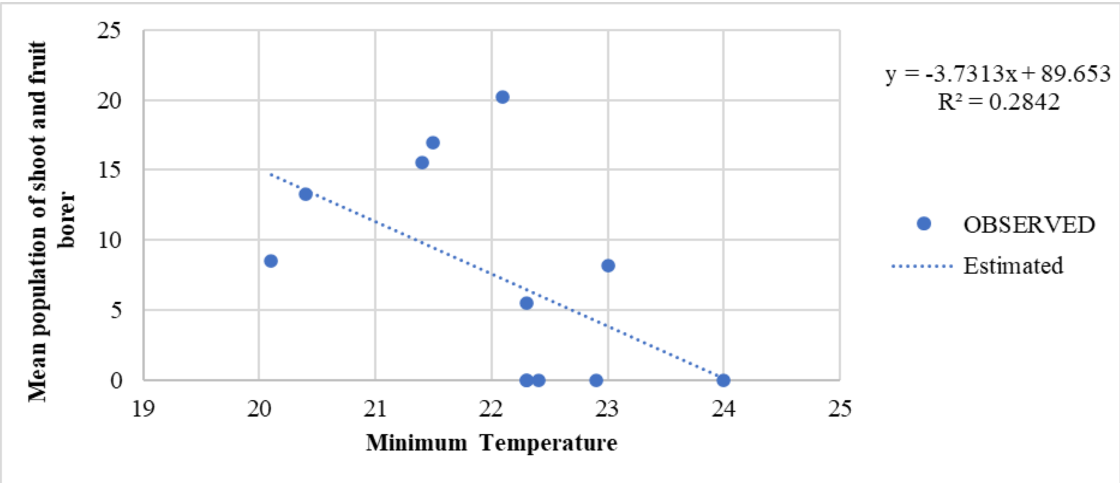

Fig. 2. Regression of minimum temperature on *Earias vittella* infesting okra.

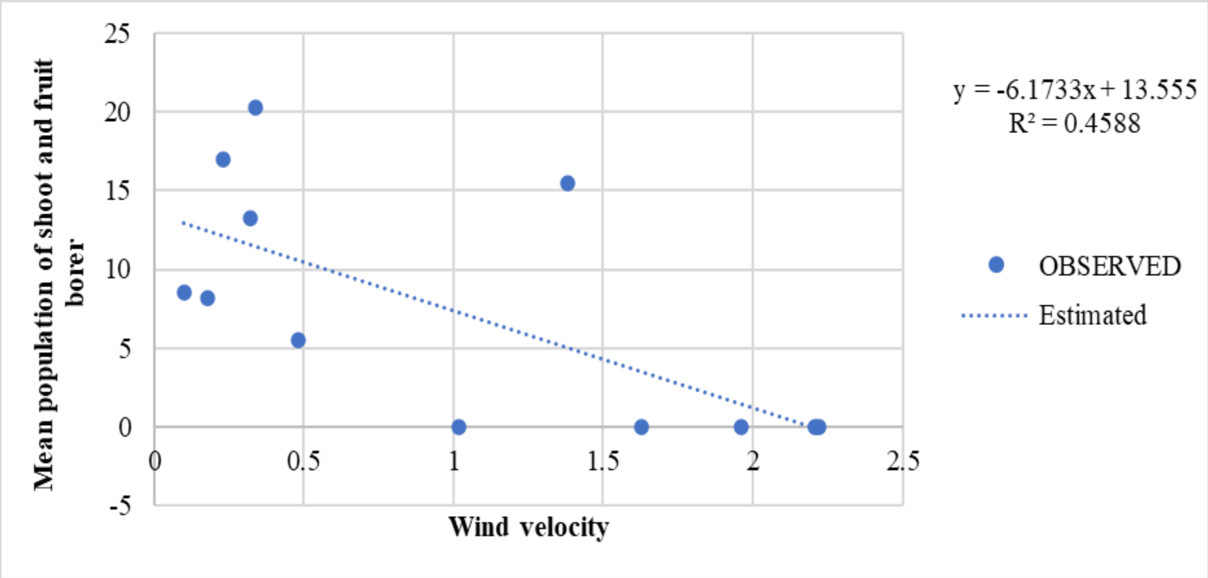

Fig. 3. Regression of wind velocity on *Earias vittella* infesting okra.

Based on overall mean fruit damage and cumulative healthy marketable fruit yield, all the insecticidal treatments recorded significantly less fruit damage and higher fruit yield as compared to control as data given in Table 2 and Table 3 respectively. Among the treatments, abamectin 1.90% EC @ 987 ml/ha treated plot was recorded with minimum fruit damage and maximum fruit yield. Next effective treatment with less fruit damage and higher fruit yield were recorded as tolfenpyrad 15% EC @ 1000 ml/ha followed by afidopyropen 50 g/l DC @ 600 ml/ha, afidopyropen 50 g/l DC @ 750 ml/ha, afidopyropen 50 g/l DC @ 1000 ml/ha and afidopyropen 50 g/l DC @ 450 ml/ha. However, spirotetramat 11.01% w/w + imidacloprid 11.01% w/w SC @ 500 ml/ha was found at least effective treatment with maximum fruit damage and minimum fruit yield but significantly superior to the control. All the treatments were found significantly superior to the control. In line with the findings of Ajanta *et al.* (2008) who reported that abamectin was significantly effective in suppressing *Earias vittella* over control and found maximum yield. While Javed and Majeed (2018) likewise observed that abamectin 1.9% EC caused the greatest reduction in okra borers. Contrary to Jalgaonkar (2019) who reported that tolfenpyrad 15% EC was recorded as minimum fruit borer per cent infestation and found at par with all other treatments except untreated check.

According to the data presented in Table 3, abamectin 1.9% EC @ 987 ml/ha recorded the highest net profit per hectare as compared with other treatments which were followed by tolfenpyrad 15% EC @ 1000 ml/h and the lowest net profit per hectare was observed in treatment spirotetramat 11.01% w/w + imidacloprid 11.01% w/w SC @ 500 ml/ha. However, the highest cost-benefit ratio per hectare was registered in afidopyropen 50 g/l @ 600 ml/ha which was followed by tolfenpyrad 15% EC @ 1000 ml/human the lowest cost-benefit ratio was recorded in spirotetramat 11.01% w/w + imidacloprid 11.01% w/w @ 500 ml/ha.

Table 2: Efficacy of newer insecticides against shoot and fruit borer on okra during *Kharif* 2019.

Treatments	Mean % Fruit damage by shoot and fruit borer**
T_1- Afidopyropen 50 g/l DC @ 450ml/ha	11.62 (19.90)*
T_2- Afidopyropen 50 g/l DC @ 600 ml/ha	8.20 (16.57)
T_3- Afidopyropen 50 g/l DC @ 750 ml/ha	9.67 (18.08)
T_4- Afidopyropen 50 g/l DC @ 1000 ml/ha	11.15 (19.49)
T_5- Abamectin 1.9% EC @ 987 ml/ha	5.27 (13.21)
T_6- Tolfenpyrad 15% EC@ 1000 ml/ha	6.73 (15.02)
T_7- Spirotetramat 11.01% W/W + Imidacloprid 11.01% W/W SC@ 500 ml/ha	13.08 (21.18)
T_8- Control	16.30 (23.80)
SEm±	**0.44**
CD at 5%	**1.34**

*Figures in parentheses are arc sine transformed values; **Mean of 6 pickings

Table 3: Economics of different insecticides on fruit yield of okra during Kharif 2019.

Treatments	Fruit yield q/ha	Increase in yield over control	Cost of Treatments	Cost increased yield over control @ Rs. 2000/- per Quintal	Net profit (Rs./ha)	Cost benefit ratio
T_1- Afidopyropen 50 g/l DC @ 450 ml/ha	35.50	15.17	2031	30340	28309	1:13.9
T_2- Afidopyropen 50 g/l DC @ 600 ml/ha	48.90	28.57	2442	57140	54698	1:22.3
T_3- Afidopyropen 50 g/l DC @ 750 ml/ha	42.83	22.50	2970	45000	42030	1:14.1
T_4- Afidopyropen 50 g/l DC @ 1000 ml/ha	41.50	21.17	4125	42340	38215	1:9.26
T_5- Abamectin 1.9% EC @ 987 ml/ha	68.33	48.00	8026	96000	87974 H	1:10.9
T_6- Tolfenpyrad 15% EC@ 1000 ml/ha	52.67	32.34	4000	64680	60680	1:15.1
T_7- Spirotetramat 11.01% W/W + Imidacloprid 11.01% W/W SC@ 500 ml/ha	28.33	8.00	2200	16000	13800	1:6.27
T_8- Control	20.33	-	-			

CONCLUSION

From the present investigation, it can be concluded that the incidence of *E. vitella* was first recorded during the 35th SMW and available up to the 41st SMW. The population of pests started increasing sharply from the 36th SMW and reached its peak during the 38th SMW. Correlation studies revealed that morning relative humidity showed a significant positive correlation while minimum temperature and wind velocity showed a significant negative correlation with shoot and fruit borer damage. Also, the overall superiority of afidopyropen 50 g/l @ 600 ml/ha was recorded among all the treatments due to the highest economic return marked the effect on reduction of pest damage. Although the highest net fruit yield was recorded in abamectin 1.9% EC @ 987 ml/ha due to the highest cost of treatment, economically this treatment is not considered as most effective treatment. The next effective treatment in higher fruit and economic return was recorded as tolfenpyrad 15% EC@ 1000 ml/ha. Hence, for sustainable Okra production, it is necessary to replace old-generation insecticides with safer and novel chemistry compounds with a distinct and unique mode of action.

FUTURE SCOPE

This study is crucial for effective pest management and sustainable agricultural practices.

Acknowledgement. The authors are grateful to Late Dr. Ravindra Kumar Choudhary, Head of the Department of Entomology for his support and guidance, and Dean, College of Agriculture, Indore for providing the necessary facilities to carry out the research work.
Conflict of interest. None.

REFERENCES

Ajanta, B., Raghuraman, M., Singh, B. and Gupta, G.P. (2008). Impact of abamectin on bollworm complex in cotton. *Indian Journal of Entomology*, *70*(3), 259-263.

Akhila, N., Kumari, A. D., Nayak, M. H. and Vijaya, D. (2019). Population dynamics of pest in okra Cv. Arka Anamika in relation to weather parameters. *International Journal* of *Pure* & Applied *Bioscience*, *7*(1), 405-411.

Anonymous 2017. Horticulture statistics at a glance 2017.

Chauhan, D. V. S. (1972). Quoted by Bose T K, Som M G, and Kabir J, 1993. Vegetable Crops, Naya Prakash, Calcutta-6, pp. 711.

Jalgaonkar, V. N. (2019). Management of major arthropod pests of summer okra. Ph.D. Thesis, RARS, Karjat, Dr. BSKKV Dapoli, Ratnagiri, Maharashtra.

Javed, M. and Majeed, M. Z. (2018). Field efficacy of Selected Synthetic and Botanical Insecticides against Lepidopterous Borers, *Earias vitella* and *Helicoverpa armigera* (Lepidoptera: Noctuidae), on Okra (*Abelmoschus esculentus* (L.) Moench). *Pakistan Journal of Zoology*, *50*(6), 2019-2028.

Parijatha, V. N., Thakur, S. and Chandrappa, B. P. (2018). Population Dynamics of Shoot and Fruit Borer *Earias vitella* of Okra *Abelmoschus esculentus* (L.) Moench during *Kharif. International Journal* of *Current Microbiology* and *Applied* Sciences, *7*(9), 1358- 1361.

Rai, A. B., Swamy, T. M. S., Kodandaram, M. H. and Jaideep, H. (2010). Integrated Pest Management of Vegetable Crops: Potential and Prospects. *In: Souvenir of National Symposium on Conservation Horticulture* held at Dehradun, Uttarakhand from 21-23 March, 2010, pp. 246-261.

Rajput, G. S. and Tayde A. (2017). Population dynamics and comparative efficacy of certain novel insecticides, botanicals and bioagents, against shoot and fruit borer (*Earias vitella* F.) of okra [*Abelmoschus esculentus* (L.) Moench]. *Journal of Entomology and Zoology Studies*, *5*(4), 1667-1670.

Rawat, N., Karnatak, A. K. and Srivastava, R. M. (2020). Population dynamics of major sucking insect pests of Okra in agro-climatic condition of Pantnagar. *Journal of Entomology and Zoology Studies*, *8*(1), 540-545.

Sharma, R. P., Swaminathan, R. and Bhati, K. K. (2010). Seasonal incidence of fruit and shoot borer of okra along with climatic factors in Udaipur region of India. *Asian Journal of Agricultural Research*, *4*(4), 232-236.

Singh, H. P., Bajad, V. V. and Chamroy, T. (2015). Seasonal incidence and field efficacy of insecticides against Shoot and Fruit borer, *Earias vittella* (Fab.) on okra (*Abelmoschus esculentus*). *Plant Archives*, *15*(1), 389-392.

Singh, Y., Jha, A., Verma, S., Mishra, V. K. and Singh, S. S. (2013). Population dynamics of sucking insect pests and its natural enemies on okra agro-ecosystem in Chitrakoot region. *African Journal of. Agricultural Research*, *8*, 3814-9.

Sujayanand, G. K. S., Sharma, R. K. and Shankarganesh, K. (2014). Impact of intercrops and border crops on pest incidence in okra. *Indian Journal* of *Horticulture*, *73*(2), 219-223.

How to cite this article: Suman Shivani, Badaya Ashok Kumar, Saxena Sakshi, Naveen and Kumar Neeraj (2023). Population Dynamics and Management of Shoot and Fruit Borer (*Earias vittella* F.) on Okra with Newer Insecticides. *Biological Forum – An International Journal*, *15*(10): 482-487.