Bio-efficacy of selected insecticides againstsoybean leaf folder, *Omiodesindicata* (Fabricius, 1775)(Lepidoptera: Crambidae)

Attention to authors: Maintain uniformity as per the journal-- Ton/tonnes/ hectare/ha; percent or % and altitude in meter or m asl -----. Asl means above sea level. Similarly follow the uniformity in writing larvae per meter row length.

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ABSTRACT

A study was conducted at the Agricultural Research Station (UAS, Dharwad), Sankeshwar, Karnataka during *Kharif*2022-23 to assess the effectiveness of selected insecticides against soybean leaf folder, *Omiodesindicata*. Among five treatments, lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 0.4 ml l^{-1} exhibited the lowest mean population of soybean leaf folder, *Omiodesindicata* (Fabricius) aton5th and 10th day after spray with 2.12 and 0.98 larval population per meter row length, respectively which was followed emamectin benzoate 5 % SG @ 0.3 g l^{-1} (3.03 and 1.83 larvae per meter row length). Lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC was found to be best effective treatment with the highest per cent reduction of larvae with 81.97%per cent followed by emamectin benzoate 5 SG (71.61 %).

KEYWORDS: Insecticides, Legume,Leaf folder, Soybean

1. INTRODUCTION

Soybean, scientifically known as *Glycine max* (L. Merrill) belongs to the (Fabaceae)family. It has been recognized as a remarkable crop and has been given various titles such as wonder crop and golden bean in the 20th century [1]. Soybean seeds contain an impressive composition of over 40 % protein and 20 % oil[2] with 6.4 % lysine, 19.5 % fat and 20.9 % carbohydrates [3].As it's having several nutrition values mentioned above, soyabean also contributes about 25 % global edible oil and 2/3rdof world's protein concentrates for livestock feeding, poultry, fish feed and soybean meal as human diet supplements for protein [4]. In addition to theabove,usesitsoil is also used in preparation of varnishes, paints, lubricants, antibiotics, adhesives *etc*.It is also abundant in mineral salts and essential amino acids, making it a promising crop for combating acute malnutrition [5].

Soybean is a significant oilseed crop in the rainfed agroecosystems of central and peninsular India. In worldwide, it Itis cultivated over a vast area of 132.26 million hectaresin the world. Total production is around 385.52 million ton and average productivity is about 2.88 metric tonnes per hectare. India is the fifth-largest producing country of soybean behind China, United States, Argentina and Brazil. In India, soybean is grown on 11.44 million hectares of land, yielding a total of 12.03 million tonnes with an average of 1051 kilograms per hectare. The prominent states in India for soybean production are Madhya Pradesh, Maharashtra, Rajasthan, Andhra Pradesh, Karnataka and Gujarat. In Karnataka, soybean is cultivated on 0.43 million hectares of land, resulting in an output of 0.44 million tonne and a productivity rate of 1005 kg ha^{-1} [6].

Globally, there are more than 380 species of insect pests that affectingthe soybean crop. In India, the number of species has increased from 10 to 12 in the 1970's to 270species, including mites, millipedes, vertebrates and snails. In Karnataka alone, 65 insect species have been found to infest soybean from its early stages to harvest[7]. Amongthemthese Soybean leaf webber, *Omiodesindicata* (Fab.) (Lepidoptera: Crambidae) is an emerging pest on leguminous plants, commonly known as bean leaf webworm moth, soybean leaf folder or roller, lablab leaf webber and soybean webworm. Other scientific names include, *Nacoleiaindicata*Dognin, *Lamprosemaindicata* (Fabricius), *Hedyleptaindicata* (Fabricius) and in 1900 it is renamed as *O. indicata* (Fabricius).

Leaf webbers, including *Omiodesindicata*, are major insect pests in both tropical and temperate regions of the world. *O. indicata* is distributed across various regions, *viz*., Africa, India, China, Japan, Hong Kong and New Guinea. It causes direct damage to the crops and it may occasionally become a serious pest on soybean, black gram, green gram, cowpea and it has been recently recorded in various regions of China and India but there is a lack of quantitative data regarding the impact of this pest on crops in these areas. The young leaves are spun together and larger leaves are rolled, starting from the tip. The larvae of *O. indicata* feed inside these rolled-up leaves [8]. Under severe infestations, the final-instar larvae can completely skeletonize the leaves.Recently, there has been a significant increase in the infestation of soybean leaf folders, causing concern to soybean farmers. due to the lack of information on how to effectively manage this pest. As a result, With the view to manage this pest, a research study was conducted to assess the effectiveness of certain insecticides in controlling the soybean leaf folder.

2. MATERIALS AND METHODS

The experiment was conducted at Agricultural Research Station located at Dharwad,Sankeshwar (Latitude: 16.14N; , Longitude: 74.30E and altitude: 698 m asl)meters(UAS,), duringKharif from June to October (2022).in soybean. Field experiment followed a Randomized Block Design with three replications and five treatments. Plots area wasof23.4 m^2 (6 m × 3.9 m) and spacing of30×10 cm was followed. The objective of the present study was to assess effectiveness of selected insecticides against soybean leaf folder.*Omiodesindicata* (Fabricius) in soybean (JS 335). The treatment includes emamectin benzoate 5 % SG @ 0.3 g l^{-1}, quinalphos 20 % EC @ 2 ml l^{-1}, lambda cyhalothrin 5 % EC @ 0.5 ml l^{-1}, lambda cyhalothrin 4.6 % + Chlorantraniliprole 9.3 % ZC @ 0.4 ml l^{-1}and an untreatedcontrol (Table 1).

Periodical observations were conducted to monitor the occurrence of soybean leaf folder per meter row length. Treatments were imposed when the pests crossed Economic Threshold Level

(ETL). Observations were recorded 24 hours before spray (pre-treatment) and at 5 and 10 days after spray (post-treatment). The mean data recorded during thefield trialexperiment was statistically analyzed [9]and thein RBD as perPer cent %reduction in treatments over control plots was estimated by using abbotts' formula given by[10].

$$\text{Population reduction over control (\%)} = \frac{\text{Population in untreated check - Population in treatment}}{\text{Population in untreated check}} \times 100$$

3. RESULTS AND DISCUSSION

At one day before spray, there was no appreciable significant difference between the treatments regarding the mean population of leaf folder larvaeand the mean population was ranged from 5.21 to 6.02 (larvae mrl^{-1}).Butthere was a substantial difference between the treatments aton five days afterthe spraying. The mean population of leaf folder larvae after five days afterof spraying varied from 2.12 to 8.23 (larvaemrl^{-1}) among different treatments. Out of different treatments imposed, the treatment lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC recorded the least population of 2.12 larvae per meter row length which was followed by emamectin benzoate 5 % SG (3.03 larvaemrl^{-1}), quinalphos 20 % EC (4.01 larvae mrl^{-1}) which is on par with lambda cyhalothrin 5 % EC (4.46 larvae mrl^{-1}).

A similar trend was noticed at ten days on the 10th day after spraying. The data (Table 2) showed that the mean population varied from 0.98 to 8.96 (larvaemrl^{-1}) among different treatments.Out of different treatments imposed, the treatment lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC recorded the least mean population of 0.98 larvae per meter row length which was followed by emamectin benzoate 5 % SG (1.85 larvae mrl^{-1}), quinalphos 20 % EC (2.69 larvae mrl^{-1}) which is on par with lambda cyhalothrin 5 % EC (2.93 larvae mrl^{-1}).

Among different treatments-imposed lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC was recorded as the best effective treatment by showing the highest per cent reduction of superior to other treatments with 81.97 % per centcontrol, followed by emamectin benzoate 5 % SG (71.61 %), quinalphos 20 % EC (61.02 %) which is on par with lambda cyhalothrin 5 % EC (57.01 %)over control. The results of the present investigation are supported by Divya et. al [11]revealed that lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC was effective treatment against *Antigastracatalaunalis* in sesamum by recording the lowest larval population (1.30 $plant^{-1}$) and lowest capsule damage (1.25 %) compared to all other treatments. Similarly, Swathi et al[12] reported that lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC @ 0.5 ml l^{-1} was found to be very effective by recording 75.91 per cent overall mean reduction in *Maruca vitrata* larval population with lowest pod damage (7.04 %) over control (60.58 %) and also recorded highest grain yield (8.31 qha^{-1}) followed by chlorantraniliprole 18.5 % SC at 0.0037 per cent and flubendiamide at 39.35 % SC 0.00787 per cent with 72.04 and 67.30 per cent overall reduction in mean larval population, respectively of *Maruca vitrata* over untreated control in black gram.Similarly, Jakhar et al[13] reported that two sprays of chlorantraniliprole 18.5 % SC @ 0.15 ml l^{-1} of water gave maximum control of *Maruca vitrata* (3.33 %) in pigeon pea with maximum grain yield (1817 kg ha^{-1}) followed by indoxacarb 15.8 EC @ 0.5 ml l^{-1} (pod borers damage of 3.83 % and grain yield 1758 kg ha^{-1}).

4. CONCLUSION

The combi product lambda cyhalothrin 4.6 % + chlorantraniliprole 9.3 % ZC was found effective in managing soybean leaf folder infestation potentially due to their complementary mode of action or synergistic effect and followed by emamectin benzoate 5 % SG.

CONSENT Not applicable

ETHICAL APPROVAL Not applicable

REFERENCES

1. Netam HK, Gupta R, Soni S. Seasonal Incidence of insect pests and their biocontrol agents on soybean. Journal of Agriculture and Veterinary Sciences. 2013;2(2):07-11.
2. Agarwal DK, Billore S D, Sharma A N. Soybean: Introduction, improvement and utilization in India problems and prospects. Agricultural Research. 2013;2:293–300.
3. YadavSK, AgniothriM, BishtRS. Seasonal incidence of insect pests of Blackgram, *Vigna mungo* (Linn.) and its correlation with abiotic factors.Agricultural Science and Digest. 2015; 35(2):146-148.
4. AlexanderMV. Soybean production in Virginia experimentation division. Virginia Polytechnic Institute and State University.1974; 44.
5. Pande AD, Umbarkar AS, Deshmukh MR, Kubde KJ. Quality and nutrient uptake as influenced by diverse nitrogen management in vertisols. The Pharma Innovation Journal. 2023; 12(1), 2211-2213.
6. Anonymous. Annual report (2021-22), AICRP on soybean, IISR, Indore, India. 2022;1-57.
7. Singh OP. Perspective and prospects of insect pest control in India with reference to sustainable environment in India. Paper presented in: Proceedings of world soybean conference- *VI,* August 4-7, 1999, Chicago, Illionois, U.S.A, 1999; 638-640.
8. Chien CC, Chou LY, Chiu SC. Biology and natural enemies of *Hedyleptaindicata*in Taiwan. *Journal of Agricultural Research of China*. 1984; 33(2): 181-189.
9. Gomez KA, GomezAA. Statisticalprocedureforagricultural research.JohnWiley&Sons Publishers,NewYork. 1984: 4-6.
10. Abbott WS. A method for computing the effectiveness of an insecticide. Journal of Economic Entomology. 1925; 18: 265-267.

11. Divya P, Dhurua S, Chalam MSV, Rao SG. Evaluation of insecticides against leaf webber and capsule borer (*Antigastracatalaunalis* Dup.) in sesamum. Journal of Experimental Zoology India. 2022; 25 (1): 62-78.
12. Swathi K, Ramu PS, Dhurua S, Suresh M. Field evaluation of newer insecticides against spotted pod borer [*Maruca vitrata* (Geyer)], on blackgram (*Vigna mungo* L.) in North Coastal Andhra Pradesh. International Research Journal of Pure and Applied Chemistry.2019; 18(2): 1-9.
13. Jakhar BL, Kumar S, Ravindrababu Y. Efficacy of different newer insecticides against legume pod borer, *Maruca vitrata* (Geyer) on pigeonpea. Research on Crops. 2016; 17(1): 134-136.

Table 1. Treatment details delete table -1 No need at all

Tr.No.	Treatments	Rec. Dose (g ml $^{-1}$)
T_1	Emamectin benzoate 5 % SG	0.3 g
T_2	Quinalphos 20 % EC	2 ml
T_3	Lambda cyhalothrin 5 % EC	0.5 ml
T_4	Lambda cyhalothrin 4.6 % + Chlorantraniliprole 9.3 % ZC	0.4 ml
T_5	Control	-

Table 2. Efficacy of selected insecticides against soybean leaf folder (*Omiodesindicata*)

Tr.No.	Treatments	No. of larvae mrl^{-1}				
		1 DBS	5 DAS	10 DAS	Mean	ROC (%)
T_1	Emamectin benzoate 5 % SG @ 0.3 g l^{-1}	5.33 (2.31)	3.03 (1.74)^{b}	1.85 (1.36)^{b}	2.44 (1.56)^{b}	71.61
T_2	Quinalphos 20 % EC @ 2 ml l^{-1}	5.82 (2.41)	4.01 (2.00)^{c}	2.69 (1.64)^{c}	3.35 (1.83)^{c}	61.02
T_3	Lambda cyhalothrin 5 % EC @ 0.5 ml l^{-1}	5.96 (2.42)	4.46 (2.11)^{c}	2.93 (1.71)^{c}	3.70 (1.92)^{c}	57.01
T_4	Lambda cyhalothrin 4.6 % + Chlorantraniliprole 9.3 % ZC @ 0.4 ml l^{-1}	5.98 (2.44)	2.12 (1.46)^{a}	0.98 (0.99)^{a}	1.55 (1.24)^{a}	81.97
T_5	Control	6.02 (2.45)	8.23 (2.87)^{d}	8.96 (2.99)^{d}	8.60 (2.92)^{d}	-
	S.Em ±	NS	0.05	0.06	0.06	-
	C.D. (p = 0.05)		0.15	0.17	0.16	-
	C.V. (%)	9.98	8.99	9.56	8.32	-

Note: - Figures in parentheses are √x + 0.5 transformed values; Means in the columns followed by the same alphabet do not differ significantly by DMRT (p =0.05); DBS-Day before spray; DAS-Days after spray; ROC- Reduction over control; mrl- meter row length.

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