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Studies on bio-efficacy of different insecticides on management of stem fly *Melanagromyza sojae* on soybean

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Abstract
To study the effect of different insecticides via. were Chlorantraniliprole 18.5% SC @ 3 ml/10 L, Ethion 50% EC @ 35 ml/10 L, Flubendiamide 39.35% SC @ 3 ml/10 L, Beta Cyfluthrin 8.49% + imidacloprid 19.81% 300 OD @ 7 ml/10 L, Profenofos 50% EC @ 20 ml/10 L, Spinetoramm 11.70% SC @ 20 ml/10 L on incidence of stem fly, in soybean crop at experimental field of Anand Niketan College of Agriculture, Warora, Chandrapur (Maharashtra) during *Kharif* season 2021-22. The lowest plant infestation was recorded in Chlorantraniliprole 18.5% which was at par with profenofos 50% EC. Maximum plant infestation was observed in untreated check the highest seed yield was obtained in Chlorantraniliprole 18.5% SC (19.80 q/ha).

Keywords: Soybean, stem fly, chlorantraniliprole, Profenofos, Ethion

Introduction
Soybean (*Glycine max* L.) is one of the miracle 'Golden bean' of the 20th century. In India, Soybean was first time introduced as food in 1935 (Sharma *et al*. 2004) [20]. These were used in preparation of a large variety of fresh, fermented and dried food products, considered in dispensible in the diet of oriental people. Large quantities of soybeans were crushed to extract the oil for food and industrial purposes. Soybean possess a very high nutritional value on an average it contains 20 percent oil, 40 percent protein, vit A, B, C, D, E and K along with 0.69 percent phosphorus, 0.112 percent iron and 0.024 percent calcium. It has high calorific value releasing 420 calories from 100 g. Soybean protein provides all the nine essential amino acids. Nutritionally value of soya protein is virtually equivalent to that of milk and egg (Bishnoi *et al*. 2005) [12].

Edible soy proteins are one of the world's least expensive and high-quality protein source. Soybean is recognized as valuable food material. The values as per 100 g of edible soybean are protein (43.2 g), fat (19.5 g), calcium (240 mg), Iron (11.5 mg), Carbonate (426 mg), Thiamine (0.73 mg), Riboflavin (0.39 mg), Niacin (3.20 mg), and Energy (432 Cal). Commercial method of use of soy proteins are soy flour (less than 65% Protein), soy protein concentrate (65 to 89% protein) and soy protein isolate (90% or more protein) (Pandya *et al*. 1988) [13].

Soybean is originated in India from China in 1882, which is distributed among various countries of world. During 2019-20 in area under soybean cultivation Brazil rank first with 144.00 million tons and India occupy the fifth position in production with 11.20 million tons and productivity of soybean is 1126 kg ha-1. Its cultivation has been largely confined to Madhya Pradesh, Uttar Pradesh, Rajasthan and Maharashtra. In 2021-22, Maharashtra area under cultivation of soybean has been recorded as 46.01 lakh hectare with annual production of 36.29 lakh tons and annual productivity 1054 kg ha-^{1}. In Maharashtra, Vidarbha region has attained the highest production (1038 kg ha-^{1}) of soybean crop (Anonymous 2021).

Farmers are facing severe problem of Lepidopteran and other major pests on soybean. This crop is attacked by 88 insect pest species belonging to six different orders and mites. Most economic injury caused by 25 insects belong to order Lepidoptera and *Hemiptera*. Insect pests associated with crop are Aphid *Aphis gossypii*, *Aphis craccivora*, white fly *Bemisia tabaci*, Green semilooper *Diachrysia orichalcea*, Bihar hairy caterpillar *Spilosoma obliqua*, leaf roller *Bilobata subsecivella*, Girdle beetle *Obereopsis brevis*, stem fly *Melanagromyza sojae*, Tobacco leaf eating caterpillar *Spodoptera litura*, leaf miner *Aproaerema modicella*. (Singh and Singh *et al*. 1990) [14].

Materials and Methods

A field experiment was conducted at Warora Anandniketan college of agriculture, Dist. Chandrapur Maharashtra during *Kharif* 2021 on Soybean variety JS-9305. Chandrapur district comes under the tropical zone of the Maharastra, which is situated at 24º 31' and 88 º 15' longitudes in the north and east respectively, with an altitude of 306.6 m above the mean sea level (MSL). The average rain fall in the region varies between 900 mm to 1100 mm and the maximum and minimum temperature during *Kharif* 2021 season ranged between 34 to 38 C and 23 to 24 C respectively.

The experiment was laid out in Randomized Block Design with Seven treatments including control having three replications. The treatments were Chlorantraniliprole 18.5% SC @ 3 ml/10 L, Ethion 50% EC @ 35 ml/10 L, Flubendiamide 39.35% SC @ 3 ml/10 L, Beta Cyfluthrin 8.49% + imidacloprid 19.81% 300 OD @ 7 ml/10 L, Profenofos 50% EC @ 20 ml/10 L, Spinetoram 11.70% SC @ 20 ml/10 L along with control. All agronomic practices were followed as per recommendations. The quantity of insecticide per plot was calculated on the basis of active ingredients and standard dose. Before the application of insecticides each plot was bunded separately, and then insecticides were applied at 15 day after interval. Percent infestation of mentioned insect was recorded before spray of insecticides and on 3, 7 and 14 day after the treatment.

The data was analyzed as per the experimental design to test the significant of the treatment. Second spray of insecticide was done after 15 days of 1st treatment. Observations related to pest infestation and yields were also made. Pest infestation was recorded separately from each plot and observation for Stem fly (*Melanagromyza sojae*) five spots were selected from each plot of one meter row length and number of plants damaged due to stem fly was calculated and percent infestation was calculated. The data obtained were subjected to analysis of variance (ANOVA) after suitable transformation to find out the critical difference between the treatments (Gomez and Gomez, 1984) [3]. Yield data was recorded and lastly economics and ICBR were calculated for each treatment.

Results and Discussion

Efficacy of above mentioned six insecticides were evaluated against stem fly after three, seven & fourteen days of the insecticide spray

Stem fly (*Melanagromyza sojae*)

The efficacy of Six insecticides namely i.e. Chlorantraniliprole 18.5% SC @ 3 ml/10 L , Ethion 50% EC @ 35 ml/10 L, Flubendiamide 39.35% SC @ 3 ml/10 L, Beta Cyfluthrin 8.49% + imidacloprid 19.81% 300 OD @ 7 ml/10 L, Profenofos 50% EC @ 20 ml/10 L, Spinetoram 11.70% EC @ 20 ml/10 L were evaluated after three spray done on 30,45 and 60 DAG against girdle beetle (Table 1 and 2). The observation was recorded after one day, 3, 7 & 45th day of the insecticide spray. All insecticides were found effective against the pest but variation in the degree of pest control was observed. The post treatment effect, after one day, indicated a significant reduction in the infestation of insect in the insecticide treated plot than untreated control. The average number of pest varied from 5.55 to 6.25% in insecticide treated plot as against (9.12%) untreated control. A significance reduction in the pest population due to insecticide treatment was seen after 3rd and 7th day of the application with a record of 2.54 to 2.89% infestation respectively. However, the infestation in untreated control consequently, were found at 9.97%. Among the insecticides Chlorantraniliprole 18.5% SC @ 3 ml/10 L (0.80%) was found effective over all the treatments in reducing the stem fly infestation. This treatment was found at par with Profenofos 50% EC @ 20 ml/10 L (1.31%) and Ethion 50% EC @ 35 ml/10 L (1.62%). The next effective treatment was Flubendiamide 39.35% SC @ 3 ml/10 L (1.93%) which was at par with Beta cyfluthrin 8.49% + imidacloprid 19.81% 300 OD @ 7 ml/10 L (1.65%), Spinetoram 11.7% SC @ 9 ml/10 L (2.38%). Maximum infestation of stem fly was recorded in control (8.90%). The present findings are in conformity with the findings of Shabana *et al.* (2018) [19] who studied the evaluation of insecticides against insect pest of soybean and reported that most effective treatment against stem fly infestation was Chlorantraniliprole 18.5% SC.

Effect on grain yield

Table 2 revealed that all treatments produced significantly higher yield than untreated control (8.56 q/ha). Treatment Chlorantraniliprole 18.5% SC @ 3 ml/10 L produce highest yield 19.80 q/ha at par with Profenofos 50% EC @ 20 ml/10 L, Spinetoram 11.70% SC @ 9 ML/10 L and Flubendiamide 39.35% SC @ 3 ml/10 L recorded yield 18.91q/ha, 17.75 q/ha, 16.25 q/ha. The next effective treatment was Ethion 50% EC @ 35 ml/10 L recorded yield 15.13 q/ha at par with Beta Cyfluthrin 8.49% + imidacloprid 19.81% 300 OD 7 ml/10 L produce 14.24 q/ha respectively. Minimum yield was recorded in untreated control 8.43 q/ha.

Present investigating of the research work are similar with the earlier finding of Ilyas *et al.* (2015) [15], Ahirwar *et al.* (2016) [1], Chaudary *et al*, (2020) [16], who reported that maximum yield of soybean obtained in Chlorantraniliprole 18.5% SC. The next finding result similar with the scientist Kujur *et al*. (2011) [17] who reported the maximum yield of soybean obtained in Profenofos 50% EC.

Cost benefit ratio

Table 3, revealed that the treatment Profenofos 50% EC @ 20 ml/10 Lfound to be most economical treatment with ICBR of (1:11.66) and net profit of Rs 49324/ha followed by Ethion 50% EC @ 35 ml/10 L (1:10.35), Chlorantranilipole 18.5% EC @ 3 ml/10 L (1:7.20), Beta Cyfluthrin 8.49% + imidacloprid 19.81% 300 OD 7 ml/10 L (1:6.73), Flubendiamide 39.35% SC @ 3 ml/10 L (1:2.33) and Spinetoram 11.7% SC @ 9 ml/10 L (1:1.45). Present investigation of the research work is collaborated with the earlier finding of Sapekar *et.al* (2020) [21] reported that highest ICBR rank obtained in lambda cyhalothrin 4.9 CS followed by Profenofos 50% EC. The next finding results similar with the scientist VK Bhamare *et al.* (2020) [18], Patil (2014) [9] reported the highest ICBR rank in Chlorantraniliprole 18.5% SC.

Table 1: Efficacy of different treatments against percent infestation of Girdle beetle in the field of soybean

Sr. No	Treatments	Percent infestation of stem fly										
		First Spray				Second Spray			Third Spray			
		1 DBS	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS	Mean
T_1	Chlorantraniliprole 15.5% SC @ 3 mL/10 L	5.55 (2.34)	1.06 (1.22)	1.42 (1.38)	1.96 (1.55)	0.71 (1.10)	0.64 (1.06)	0.51 (1.00)	0.42 (0.96)	0.30 (0.88)	0.20 (0.83)	0.80 (1.14)
T_2	Ethion 50% EC @ 35 ml/10 L	5.80 (2.39)	2.22 (1.63)	2.88 (1.82)	3.33 (1.94)	1.80 (1.42)	1.52 (1.40)	0.91 (1.18)	0.80 (1.14)	0.66 (1.07)	0.40 (0.95)	1.62 (1.45)
T_3	Flubendiamide 39.35% SC @ 3 ml/10 L	5.51 (2.33)	2.76 (1.79)	2.90 (1.83)	3.46 (1.97)	1.87 (1.53)	1.73 (1.49)	1.61 (1.43)	1.11 (1.27)	1.05 (1.24)	0.93 (1.19)	1.93 (1.56)
T_4	Beta cyfluthrin 8.49% + imidacloprid 19.81% 300 OD @ 7 ml/10 L	5.79 (2.37)	3.32 (1.94)	3.55 (1.99)	4.14 (2.15)	2.01 (1.58)	1.88 (1.54)	1.70 (1.47)	1.20 (1.28)	1.13 (1.26)	0.98 (1.20)	2.22 (1.65)
T_5	Profenofos 50% EC @ 20 ml/10 L	5.49 (2.32)	2.16 (1.50)	2.42 (1.69)	2.89 (1.83)	1.09 (1.24)	0.95 (1.19)	0.78 (1.12)	0.66 (1.07)	0.53 (1.01)	0.33 (0.90)	1.31 (1.35)
T_6	Spinetoram 11.70% SC @ 9 ml/10 L	4.30 (2.04)	3.54 (2.00)	3.78 (2.06)	4.23 (2.16)	2.26 (1.66)	2.00 (1.58)	1.79 (1.49)	1.33 (1.33)	1.25 (1.30)	1.10 (1.26)	2.38 (1.70)
T_7	Untreated Control	4.71 (2.13)	6.52 (2.54)	7.71 (2.86)	8.44 (2.99)	9.68 (3.19)	9.98 (3.23)	9.74 (3.20)	9.56 (3.16)	9.53 (3.16)	9.23 (3.11)	8.90 (3.07)
	F' Test	NS	Sig	Sig	Sig							
	SE (m)±	0.22	0.11	0.14	0.16	0.10	0.11	0.10	0.10	0.10	0.10	0.11
	CD at 5%	0.67	0.36	0.50	0.50	0.33	0.34	0.34	0.30	0.30	0.30	0.33
	CV%	16.72	11.21	13.55	13.55	11.31	11.82	13.29	11.89	11.89	12.21	12.18

Table 2: Effect of insecticides on Yield of Soybean, *Kharif* 2021-2022

Tr. No.	Treatments	Av. Yield (Kg/Plot)	Av. Yield (q/ha)
T_1	Chlorantraniliprole 18.5% SC @ 3 ml/10 L	4.45	19.80
T_2	Ethion 50% EC @ 35 ml/10 L	3.40	15.13
T_3	Flubendiamide 39.35% SC @ 3 ml/10 L	3.64	16.25
T_4	Beta Cyfluthrin 8.49% + imidacloprid 19.81% 300 OD @ 7 ml/10 L	3.20	14.24
T_5	Profenofos 50% EC @ 20 ml/10 L	4.25	18.91
T_6	Spinetoram 11.70% SC @ 9 ml/10 L	3.99	17.75
T_7	Untreated Control	1.88	8.43
	'F' Test	Sig	Sig
	SE(m)±	0.11	0.12
	CD at 5%	0.35	0.40
	CV%	10.26	11.21

Table 3: Incremental cost benefits ratio of various treatments in soybean

Tr. No.	Treatments	Qty. of insecticides req./ha	Cost of treatment (Rs /ha)		Total cost (A)	Yield (q/ha)	Increased yield over control (q/ha)	Value of increase yield @ 5110 (Rs./ha) (B)	Increment benefit (C) = (B-A)	ICBR (C/A)	Rank
			Cost of insecticides for 3 spray	Labour + sprayer charges							
T_1	Chlorantraniliprole 18.5% SC	150	5549	1530	7079	19.80	11.37	58101	51022	1:7.20	3
T_2	Ethion 50% EC	500	1485	1530	3015	15.13	6.70	34237	31222	1:10.35	2
T_3	Flubendiamide 39.35% SC	150	10440	1530	11970	16.25	7.82	39960	27990	1:2.33	5
T_4	Beta Cyfluthrin 8.49% + imidacloprid 19.81% 300 OD	350	2310	1530	3840	14.24	5.81	29689	25849	1:6.73	4
T_5	Profenofos 50% EC	1000	2700	1530	4230	18.91	10.48	53552	49324	1:11.66	1
T_6	Spinetoram 11.70% SC	450	16200	1530	17730	16.94	8.51	43486	25756	1:1.45	6
T_7	Untreated control	-	-	-	-	8.43	-	-	-	-	7

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