Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(5): 339-342

Received: 13-07-2019
Accepted: 15-08-2019

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Bioefficacy of insecticides against predatory spider in soybean

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Abstract
Field experiments was conducted in *kharif* season during 2017 and 2018 to evaluate bio-efficacy of insecticides against spider in soybean. The pooled data of both the years indicated that there were highest population of spider recorded in control plot (0.97 spider/mrl), chlorantraniliprole 0.4 GR (0.92 spider/mrl) and thiamethoxam 30 FS (0.89 spider/mrl). The lowest population found in imidacloprid 48 FS (0.82 spider/mrl) and phorate 10 CG (0.85 spider/mrl) followed by fipronil 0.3GR (0.87 spider/mrl) and clothiniadin 50 WDG (0.88 spider/mrl). The pooled data of two years indicated that the maximum yield of soybean was recorded in chlorantraniliprole 0.4 GR (26.46 q/ha) followed by clothianidin 50 WDG (25.93 q/ha), fipronil 0.3 GR (25.22 q/ha) and thiamethoxam 30 FS (23.42 q/ha) at par with each other. whereas the lowest yield was found in control plot (18.02 q/ha) and phorate 10 CG (22.40 q/ha).

Keywords: Soybean, predatory, spider, bioefficacy, insecticide

1. Introduction
Soybean [*Glycine max* (L.) Merrill] is one of the most important leguminous crops belonging to family Leguminosae, sub-family Papilionoaceae. It is the world's largest source of animal protein feed and the second largest source of vegetable oil. It is considered as pulse crop but due to high oil content, now it is placed in oilseeds category. It originated from China [7]. The area, production and productivity of soybean in Maharashtra during *Kharif* 2017-18 was 36.39 lakh ha, 38.35 lakh MT and 1102 kg/ha, respectively, whereas in Marathwada it was 15.944 lakh ha, 16.318 lakh MT and 1050.37 kg/ha respectively [1] Many insecticides are used by the farmers on large scale for controlling these pests. their massive overuse and frequent misuse has created the problems that is development of insecticidal resistance, resurgence of secondary pest, elimination of natural enemies of insect pests, residual toxicity, hazards to human being, domestic animals, phytotoxicity and environmental pollution [4]. To overcome these problems, there was urgent need to use of effective insecticides on economic threshold level, environmentally safe and bio-intensive control measures such as newer insecticides with various modes of action.

In nature, bioagents that are predators and insect pathogen influence the population of the insect pests. Activity of these biocontrol agents is reduced due to indiscriminate use of chemical insecticides [2]. Foliar spray of insecticides in early crop stage is famous for causing serious pest resurgence in Asian rice production [9]. Foliar sprays of organophosphorus insecticides in early soybean growth are very common in Maharashtra. Hence present study was undertaken to evaluate effect of insecticide for seed treatments on diffrent stem pests and a natural enemy as a measure for replacement of foliar sprays.

2. Materials and Methods
The field experiments was conducted during *kharif* 2017 and 2018 at the farm of All India Coordinated Research Project on Soybean, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra). The trial was laid out in randomized block design having plot size 3.15 × 5 m and spacing of 45 × 5 cm. The soybean variety JS 335 was used. All the treatments were replicated thrice. The field efficacy of six insecticides *viz.*, Seed treatments with thiamethoxam 30 FS and imidacloprid 48 FS were given before sowing. Required quantity of soybean seed and insecticides were put in polythene bag and mixed thoroughly. The mixture was stirred and uniform coating of insecticides obtained. The treated seeds were spread on a paper and kept for drying, Soil application of phorate10 CG, fipronil 0.3 GR and chlorantraniliprole 0.4 GR were done at the time of sowing, Soil drenching of clothiniadin 50

WDG was done at the 7-10 (DAG) and evaluated along with untreated control. Observation of incidence of spider per mrl (meter row length) was recorded weekly from three places and mean was worked out. The data obtained on natural enemies in different treatments were averaged and subjected to analysis after square root transformation. The mean values after suitable transformation were subjected to statistical analysis to test significance for interpretation of the results using OPSTAT software [5].

3. Results and Discussion

Effect of insecticides on spider during *kharif* 2017, 2018 and pooled. All treatments showed non-significant. The data are presented in Table 1. and graphically represented in Figs.1 and 2.

During *kharif* 2017 at 30 DAS, there was maximum population of spider observed in chlorantraniliprole 0.4 GR (0.41 spider/mrl) and fipronil 0.3GR (0.37 spider/mrl) followed by clothiniadin 50 WDG (0.36 spider/mrl) and control (0.36 spider/mrl). The lowest population were recorded in thiamethoxam 30 FS (0.19 spider/mrl), imidacloprid 48 FS (0.30 spider/mrl) and phorate 10 CG (0.35 spider/mrl).

At 45 DAS, there was highest population found in fipronil 0.3GR (1.16 spider/mrl) and control plot (1.16 spider/mrl) followed by phorate 10 CG (1.10 spider/mrl) and thiamethoxam 30 FS (1.05 spider/mrl). The lowest population were recorded in imidacloprid 48 FS (0.77 spider/mrl), chlorantraniliprole 0.4 GR (0.99 spider/mrl) and clothiniadin 50 WDG (0.99 spider/mrl).

At 60 DAS, thiamethoxam 30 FS (1.83 spider/mrl), phorate 10 CG (1.66 spider/mrl) and clothiniadin 50 WDG (1.66 spider/mrl) recorded highest spider among all treatments. The harmful treatments were imidacloprid 48 FS (1.55 spider/mrl) and fipronil 0.3GR (1.55 spider/mrl) except control plot.

At 75 DAS, there was lowest population observed in fipronil 0.3GR (0.38 spider/mrl) as compared to thiamethoxam 30 FS (0.55 spider/mrl) and phorate 10 CG (0.55 spider/mrl) followed by imidacloprid 48 FS (0.60 spider/mrl) and clothiniadin 50 WDG (0.60 spider/mrl). The control plot and chlorantraniliprole 0.4 GR (0.66 spider/mrl) were recorded maximum population of spider.

At 90 DAS, there was maximum population found in chlorantraniliprole 0.4 GR (0.34 spider/mrl) and control plot followed by clothiniadin 50 WDG (0.28 spider/mrl). The lowest population found in phorate 10 CG (0.11 spider/mrl) followed by thiamethoxam 30 FS (0.18 spider/mrl), imidacloprid 48 FS (0.22 spider/mrl) and fipronil 0.3GR (0.22 spider/mrl).

Mean, control plot (0.82 spider/mrl) and chlorantraniliprole 0.4 GR (0.80 spider/mrl) recorded highest spider among all treatments. The harmful treatments were imidacloprid 48 FS (0.68 spider/mrl), phorate 10 CG (0.73 spider/mrl) and fipronil 0.3GR (0.73 spider/mrl) followed by thiamethoxam 30 FS (0.76 spider/mrl).

During *kharif* 2018 at 30 DAS, there was highest population of spider recorded in control and chlorantraniliprole 0.4 GR (0.44 spider/mrl) followed by fipronil 0.3GR (0.37 spider/mrl) and phorate 10 CG (0.39 spider/mrl). The lowest population were recorded in thiamethoxam 30 FS (0.22 spider/mrl), imidacloprid 48 FS (0.26 spider/mrl) and clothiniadin 50 WDG (0.26 spider/mrl).

At 45 DAS, there were highest population observed in control plot (1.16 spider/mrl), phorate 10 CG (1.16 spider/mrl) and fipronil 0.3GR (1.10 spider/mrl). The harmful treatments was imidacloprid 48 FS (0.88 spider/mrl) followed by chlorantraniliprole 0.4 GR (0.99 spider/mrl) and clothiniadin 50 WDG and thiamethoxam 30 FS (1.05 spider/mrl).

At 60 DAS, fipronil 0.3GR (1.66 spider/mrl), thiamethoxam 30 FS (1.66 spider/mrl) and control plot (1.66 spider/mrl) recorded highest spider among all treatment. These were followed by clothiniadin 50 WDG (1.55 spider/mrl), chlorantraniliprole 0.4 GR and phorate 10 CG. The toxic treatment was imidacloprid 48 FS (1.49 spider/mrl).

At 75 DAS there was lowest population found in phorate 10 CG (0.77 spider/mrl) followed by thiamethoxam 30 FS (0.82 spider/mrl), Fipronil 0.3GR (0.87 spider/mrl) and imidacloprid 48 FS as compared to chlorantraniliprole 0.4 GR, clothiniadin 50 WDG and control plot

At 90 DAS, there was maximum population found in thiamethoxam 30 FS (1.40 spider/mrl) followed by imidacloprid 48 FS (1.36 spider/mrl), fipronil 0.3GR (1.36 spider/mrl) and chlorantraniliprole 0.4 GR. the harmful insecticides were phorate 10 CG (0.99 spider/mrl) and fipronil 0.3GR (1.10 spider/mrl) followed by clothiniadin 50 WDG.

Mean, imidacloprid 48 FS (0.96 spider/mrl), phorate 10 CG (0.98 spider/mrl) recorded lowest spider followed by fipronil 0.3GR, clothiniadin 50 WDG thiamethoxam 30 FS (1.03 spider/mrl) and chlorantraniliprole 0.4 GR (1.05 spider/mrl). The highest spider found in control (1.12 spider/mrl).

The pooled data of 2017 and 2018 indicated that there were highest population of spider recorded in control plot (0.97 spider/mrl), chlorantraniliprole 0.4 GR (0.92 spider/mrl) and thiamethoxam 30 FS (0.89 spider/mrl). The lowest population found in imidacloprid 48 FS (0.82 spider/mrl) and phorate 10 CG (0.85 spider/mrl) followed by fipronil 0.3GR (0.87 spider/mrl) and clothiniadin 50 WDG (0.88 spider/mrl).

Suri *et al.* reported that maximum population of natural enemies was recorded in fipronil 0.6% GR and fipronil 0.3% GR [6]. Shrivastava *et al*. recorded that highest population of spider in seed treated with thiamethoxam and imidacloprid [8].

The pooled data of two year Table 2. indicated that the maximum yield of soybean was recorded in treatment chlorantraniliprole 0.4 GR (26.46 q/ha) followed by clothianidin 50 WDG (25.93 q/ha), fipronil 0.3 GR (25.22 q/ha) and thiamethoxam 30 FS (23.42 q/ha) at par with each other. The lowest yield was noticed in control plot (18.02 q/ha), phorate 10 CG (22.40 q/ha) except imidacloprid 48 FS (23.06 q/ha). Chaudhary *et al*. recorded that highest cane yield and natural enemies in chlorantraniliprole 0.4 GR followed by fipronil 0.3GR and flubendaimide 39.35 SC [3].

4. Conclusion

This can be concluded that the soil application of chlorantraniliprole 0.4 GR @ 10 kg /ha or fipronil 0.3 GR @ 25 kg /ha at sowing can recommend for use which are safer to natural enemy and maximum yield in soybean.

Table 1: Bioefficacy of insecticides against spider on soybean (Pooled data of 2017 & 2018)

Tr. No.	Treatments	Dose (g a.i /ha)	Spider/mrl												
			2017						2018						
			30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	Mean	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	Mean	Pooled Mean
T-1	Thiamethoxam 30 FS	225	0.19 (1.09)	1.05 (1.43)	1.83 (1.68)	0.55 (1.24)	0.18 (1.10)	0.76 (1.32)	0.22 (1.10)	1.05 (1.39)	1.66 (1.62)	0.82 (1.35)	1.40 (1.54)	1.03 (1.42)	0.89 (1.38)
T-2	Imidacloprid 48 FS	75	0.30 (1.13)	0.77 (1.33)	1.55 (1.58)	0.60 (1.26)	0.22 (1.12)	0.68 (1.29)	0.26 (1.12)	0.88 (1.37)	1.49 (1.57)	0.88 (1.37)	1.36 (1.53)	0.96 (1.40)	0.82 (1.35)
T-3	Phorate 10 CG	1500	0.35 (1.16)	1.10 (1.44)	1.66 (1.62)	0.55 (1.24)	0.11 (1.06)	0.73 (1.31)	0.39 (1.18)	1.16 (1.46)	1.55 (1.58)	0.77 (1.32)	0.99 (1.41)	0.98 (1.41)	0.85 (1.36)
T-4	Fipronil 0.3 GR	50	0.37 (1.17)	1.16 (1.46)	1.55 (1.58)	0.38 (1.17)	0.22 (1.12)	0.73 (1.31)	0.37 (1.17)	1.10 (1.44)	1.66 (1.62)	0.87 (1.36)	1.10 (1.44)	1.02 (1.42)	0.87 (1.37)
T-5	Chlorantraniliprole 0.4 GR	40	0.41 (1.18)	0.99 (1.41)	1.60 (1.59)	0.66 (1.28)	0.34 (1.15)	0.80 (1.34)	0.44 (1.20)	0.99 (1.41)	1.55 (11.58)	0.94 (1.39)	1.36 (1.53)	1.05 (1.43)	0.92 (1.39)
T-6	Clothiniadin 50 WDG	125	0.36 (1.16)	0.99 (1.41)	1.66 (1.62)	0.60 (1.26)	0.28 (1.13)	0.75 (1.32)	0.26 (1.12)	0.99 (1.41)	1.55 (1.58)	1.10 (1.44)	1.21 (1.47)	1.02 (1.42)	0.88 (1.37)
T-7	Control	-	0.36 (1.16)	1.16 (1.46)	1.60 (1.59)	0.66 (1.28)	0.34 (1.15)	0.82 (1.35)	0.44 (1.20)	1.16 (1.46)	1.66 (11.62)	0.99 (1.41)	1.36 (1.53)	1.12 (1.45)	0.97 (1.40)
	SE±		0.03	0.03	0.06	0.03	0.02	0.03	0.02	0.07	0.03	0.03	0.02	0.03	0.03
	C.D at 5%		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

* Figures in parentheses are square root transformed values. NS: Non significant mrl : meter row length

Table 2: Average grain yield of soybean

Sr. No	Treatments	Dose (g a.i. /ha)	Grain yield of soybean q/ha		
			Kharif 2017	*Kharif* 2018	Pooled
T-1	Thiamethoxam 30 FS	225	23.66	23.18	23.42
T-2	Imidacloprid 48 FS	75	23.24	22.89	23.06
T-3	Phorate 10 CG	1500	22.87	21.93	22.40
T-4	Fipronil 0.3 GR	50	25.55	24.90	25.22
T-5	Chlorantraniliprole 0.4 GR	40	26.78	26.15	26.46
T-6	Clothiniadin 50 WDG	125	26.05	25.82	25.93
T-7	Control	_	18.25	17.79	18.02
	SE±		0.80	0.65	0.72
	C.D at 5%		2.50	2.05	2.27

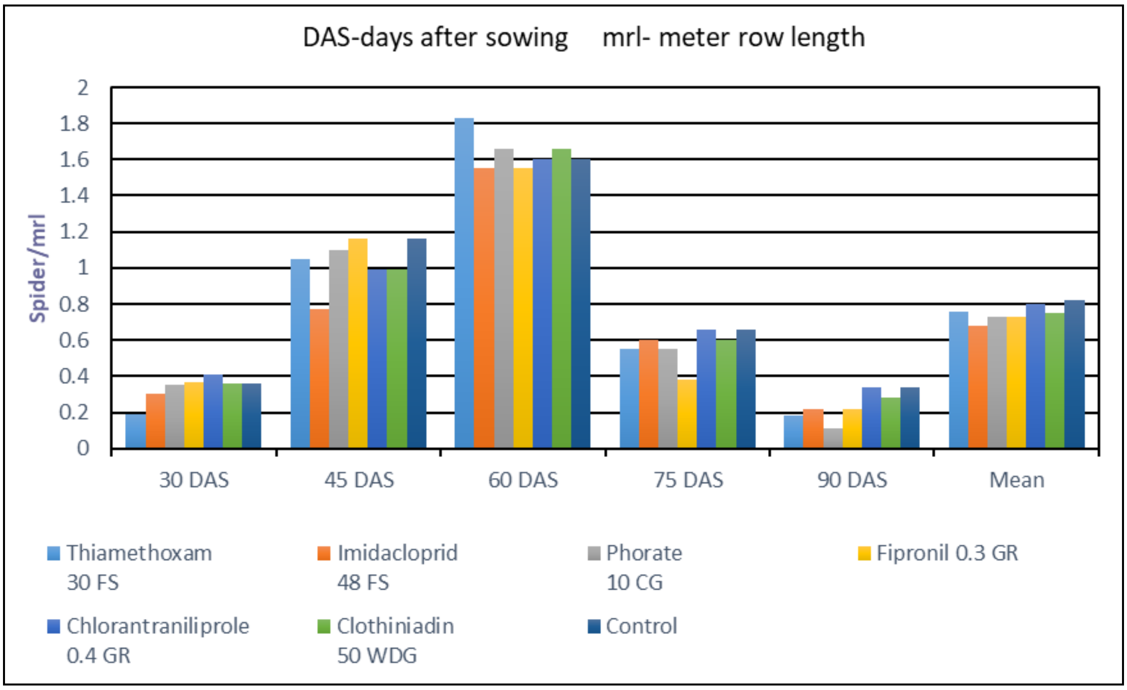

Fig 1: Bioefficacy of insecticides against predatory spider during 2017

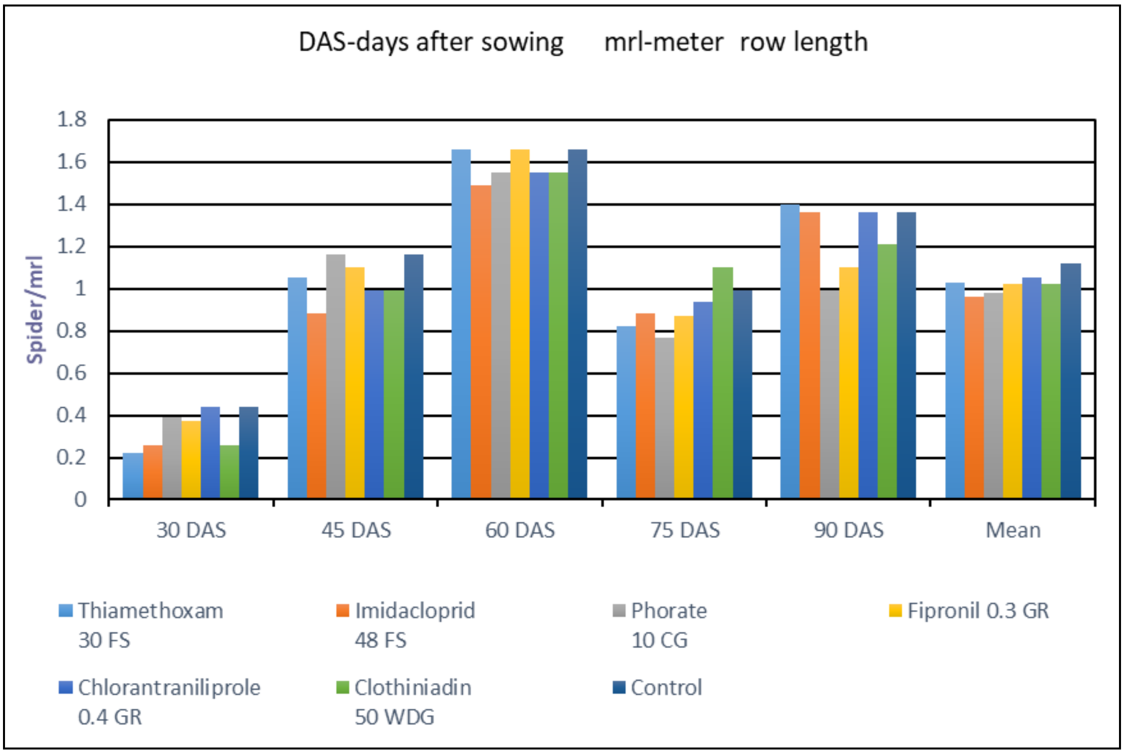

Fig 2: Bioefficacy of insecticides against predatory spider during 2018

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