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Bio-efficacy of some Insecticides against *Chrysodeixis acuta* Walk. and *Obereopsis brevis* Swed. Infesting Soybean

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Abstract: Six insecticides i.e. Indoxacarb 14.5 SC @ 0.3 L ha^{-1}, Indoxacarb 14.5 SC @ 0.15 L ha^{-1}, Diafenthiuron 50 WP @ 0.5 kg ha^{-1}, Profenophos 50 EC @ 1.25 L ha^{-1}, Lamdacyhalothrin 5 EC @ 0.3 L ha^{-1}, Emamectin benzoate 5 SG @ 0.18 kg ha^{-1} and Triazophos 40 EC @ 0.8 L ha^{-1} were evaluated for their efficacy against green semi-looper *Chrysodeixis acuta* (Noctuidae: Lepidoptera) and girdle beetle *Obereopsis brevis* (Lamiidae: Coleoptera) at Agricultural Research Station, Ummedganj, Kota (Rajasthan), during kharif 2005 and 2006. The treatment of Indoxacarb 14.5 SC @ 0.3 L ha^{-1} was most effective against green semi-looper, where only 0.08 larvae m^{-1} row length was recorded after 5 days of treatments followed by Diafenthiuron 50 WP @ 0.5 kg ha^{-1} (0.12 larvae m^{-1} row length), Profenophos 50 EC @ 1.25 L ha^{-1} (0.12 larvae m^{-1} row length), Triazophos 40 EC 0.8 L ha^{-1} (0.16 larvae m^{-1} row length), Lamdacyhalothrin 5 EC 0.3 L ha^{-1} (0.20 larvae m^{-1} row length). The treatment of Triazophos 40 EC @ 0.8 L ha^{-1} was most effective against girdle beetle, where only 0.74% infestation was recorded after 5 days of treatment followed by Lamdacyhalothrin 5 EC 0.3 L ha^{-1} (1.87%), Diafenthiuron 50 WP @ 0.5 kg ha^{-1} (1.90%), Indoxacarb 14.5 SC @ 0.3 L ha^{-1} (2.24%). Maximum seed yield was found in the treatment of Triazophos 40 EC 0.8 L ha^{-1} (1980 kg ha^{-1}) followed by Indoxacarb 14.5 SC 0.3 L ha^{-1} (1970 kg ha^{-1}) but were statistically *at par*. The maximum net return (Rs 3606 ha^{-1}) was found in the treatment of Triazophos 40 EC 0.8 L ha^{-1} followed by Indoxacarb 14.5 SC 0.3 L ha^{-1} (Rs 2646 ha^{-1}) and Lamdacyhalothrin 5 EC 0.3 L ha^{-1} (Rs. 2541 ha^{-1}).

Key words: Green semi-looper, girdle beetle, soybean, insecticide.

Soybean, *Glycine max* (Linn.) Merill, ranks first in the world for production of edible oil. India ranks third in world in respect of area and fifth in terms of production. The productivity of soybean in India is only 11.71 q ha^{-1}. Rajasthan ranks third in the country and occupies area of 0.66 M ha and the production is 0.46 M t with productivity of 691 kg ha^{-1}. Insect pests are one of the constraints for low productivity of soybean. The crop is reported to be attacked by 273 species of insects. About two dozen insect pests have been observed on crop in the region. Among them semi-loopers among defoliators and girdle beetle among borers are of economic significance and can cause severe damage and consequent reduction in yield (Sharma, 1999). The girdle beetle infests the plants both in early and late phase. As a result of early infestation of plants, 75% plants can die before maturity and lose 47.2 kg ha^{-1} grains at an average plant infestation of 8.7% (Gangrade and Singh, 1976). The control of these two pests through traditional insecticides particularly through Chlorpyriphos, Quinolphos, Monocrotophos, Endofulfan, etc. is well documented (Chaudhary and Patidar, 2007). Therefore, the present investigation was carried out to identify the potential novel and new insecticides, which could be utilized for the effective management of major insect pests in soybean crop.

Materials and Methods

Field experiments were conducted at experimental Farm of Agricultural Research Station, Ummedganj, Kota, during kharif 2005 and 2006 in randomized block design (RBD) having the soybean variety JS 335 and replicated thrice along with control. The crop was sown in the first week of July keeping 30 cm row-to-row and 10 cm plant-to-plant distance in 2.1 x 5.0 m plot. Six insecticides i.e., Indoxacarb 14.5 SC @ 0.3 L ha^{-1} and @ 0.15 L ha^{-1}, Diafenthiuron 50 WP @ 0.5 kg ha^{-1}, Profenophos 50 EC @ 1.25 L ha^{-1}, Lamdacyhalothrin 5 EC @ 0.3 L ha^{-1}, Emamectin benzoate 5 SG @ 0.18 kg ha^{-1} and Triazophos

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40 EC @ 0.8 L ha^{-1} were evaluated for their efficacy against green semi-looper and girdle beetle. Insecticides were sprayed at 40 days after sowing and 15 days after first spray in 2005, whereas only one spray was needed in 2006. The population of green semi-looper (*Chrysodeixis acuta* Walk.) was counted on random sample of per meter row length area by using "vertical beat sampling technique" after 5 days of imposing treatment, whereas girdle beetle (*Obereopsis brevis* Swed.) infestation was recorded from one meter earmarked row length by counting total and infested plants. Three such samples were taken plot-wise for both the test insects and mean was worked out. The number of larvae was transformed in square root values and per cent infestation were transformed angularly for statistical analysis. Seed yield was recorded from each replication after the harvest of the crop and subjected to the statistical analysis. Data for both the years were subjected for pooled analysis. Net return in term of Rs. and ICBR were also worked out by comparison of protective sprays and net gain over the control.

Results and Discussion

Green semi-looper (Chrysodeixis acuta Walk.)

The data recorded on green semi-looper population during kharif 2005 revealed that after 5 days of treatment, green semi-looper population varied from 0.08 to 0.42 larvae m^{-1} row length in different insecticidal treatments and 3.75 larvae m^{-1} row length was recorded in untreated control (Table 1). All the insecticidal treatments were found statistically at par with each other, but were significantly superior over untreated control. The treatment of Diafenthiuron 50 WP @ 0.5 kg ha^{-1} was found most effective against green semi-looper where only 0.08 larvae m^{-1} row length was recorded, and was followed by Indoxacarb 14.5 SC @ 0.3 L ha^{-1} (0.17 larvae m^{-1} row length).

During kharif 2006 the treatment of Indoxacarb 14.5 SC @ 0.3 L ha^{-1}, Profenophos 50 EC @ 1.25 L ha^{-1} and Lamdacyhalothrin 5 EC @ 0.3 L ha^{-1} were found most effective against green semi-looper where no larval population were observed after 5 days of treatment, while in untreated control 2.59 larvae m^{-1} row length was found (Table 1). In the rest of the treatments, green semi-looper population varied from 0.08 to 0.25 larvae m^{-1} row length.

Pooled data of kharif 2005 and 2006 presented in Table 1 indicated that after 5 days of treatments, green semi-looper population varied from 0.08 to 0.29 larvae m^{-1} row length in different insecticidal treatments and 3.16 larvae

Table 1. Effect of some insecticides on insect pests and seed yield of soybean

Treatments	Dose	Green semi-looper (mrl)			Girdle beetle (% infestation)			Seed yield (kg ha^{-1})		
		2005	2006	Pooled	2005	2006	Pooled	2005	2006	Pooled
Indoxacarb 14.5 SC	0.30 L ha^{-1}	0.17 (0.81)*	0.00 (0.71)*	0.08 (0.76)*	4.50 (12.08)**	0.00 (0.00)**	2.24 (6.04)**	2143	1809	1970
Indoxacarb 14.5 SC	0.15 L ha^{-1}	0.33 (0.91)	0.25 (0.86)	0.29 (0.89)	6.00 (13.95)	1.67 (5.26)	3.84 (9.61)	2029	1655	1837
Diafenthiuron 50 WP	0.50 kg ha^{-1}	0.08 (0.76)	0.17 (0.81)	0.12 (0.79)	3.00 (8.51)	0.83 (2.63)	1.90 (5.58)	2077	1738	1904
Profenophos 50 EC	1.25 L ha^{-1}	0.25 (0.86)	0.00 (0.71)	0.12 (0.79)	3.00 (8.54)	1.67 (5.26)	2.32 (6.90)	1981	1724	1847
Lamdacyhalothrin 5 EC	0.30 L ha^{-1}	0.42 (0.95)	0.00 (0.71)	0.20 (0.83)	3.75 (11.03)	0.00 (0.00)	1.87 (5.52)	1886	1821	1866
Emamectin benzoate 5 SG	0.18 kg ha^{-1}	0.33 (0.90)	0.17 (0.81)	0.25 (0.86)	5.25 (13.13)	0.83 (2.63)	3.04 (7.88)	2042	1738	1885
Triazophos 40 EC	0.80 L ha^{-1}	0.25 (0.86)	0.08 (0.76)	0.16 (0.81)	1.50 (4.94)	0.00 (0.00)	0.74 (2.50)	2143	1828	1980
Control	-	3.75 (2.05)	2.59 (1.76)	3.16 (1.91)	24.25 (29.47)	8.33 (16.09)	16.28 (22.72)	1785	1500	1637
S. Em. ±		(0.12)	(0.024)	(0.04)	(2.15)	(2.19)	(1.59)	(104.76)	(38.09)	(76.00)
C.D. (P=0.05)		(0.34)	(0.071)	(0.12)	(6.42)	(6.45)	(5.03)	(314.28)	(104.76)	(219.00)

* Figures in parentheses are square root (x+0.5) transformed value.

** Figures in parentheses are angular transformed value.

m^{-1} row length was recorded in untreated control. The treatment of Indoxacarb 14.5 SC @ 0.3 L ha^{-1} was found most effective against green semi-looper where only 0.08 larvae m^{-1} row length was recorded followed by Diafenthiuron 50 WP @ 0.5 kg ha^{-1} (0.12 larvae m^{-1} row length), Profenophos 50 EC @ 1.25 L ha^{-1} (0.12 larvae m^{-1} row length), Triazophos 40 EC 0.8 L ha^{-1} (0.16 larvae m^{-1} row length), Lamdacyhalothrin 5 EC 0.3 L ha^{-1} (0.20 larvae m^{-1} row length), Emamectin benzoate 5 SG 0.18 kg ha^{-1} (0.25 larvae m^{-1} row length) and Indoxacarb 14.5 SC 0.15 L ha^{-1} (0.29 larvae m^{-1} row length). All the insecticidal treatments were found statistically superior over untreated control, while there was no significant difference among Indoxacarb 14.5 SC @ 0.3 L ha^{-1}, Diafenthiuron 50 WP @ 0.5 kg ha^{-1}, Profenophos 50 EC @ 1.25 L ha^{-1}, Triazophos 40 EC 0.8 L ha^{-1} and Lamdacyhalothrin 5 EC 0.3 L ha^{-1}.

Girdle beetle (Obereopsis brevis Swed.)

The data recorded during kharif 2005 revealed that after 5 days of treatments, girdle beetle infestation varied from 1.50 to 6.00% in different insecticidal treatments with 24.25% recorded in untreated control (Table 1). All the insecticidal treatments were found statistically *at par* with each other, but were significantly superior over untreated control. The treatment of Triazophos 40 EC 0.8 L ha^{-1} was found most effective against girdle beetle where only 1.50% infestation was recorded followed by Diafenthiuron 50 WP @ 0.5 kg ha^{-1} (3.0% infestation) and Profenophos 50 EC @ 1.25 L ha^{-1} (3.0% infestation). In rest of the treatments girdle beetle infestation was 3.75, 4.50, 5.25 and 6.00% in the treatment of Lamdacyhalothrin 5 EC @ 0.3 L ha^{-1}, Indoxacarb 14.5 SC @ 0.3 L ha^{-1}, Emamectin benzoate 5 SG @ 0.18 kg ha^{-1} and Indoxacarb 14.5 SC @ 0.15 L ha^{-1}, respectively.

During kharif 2006 (Table 1) all the insecticidal treatments were found statistically *at par* with each other, but superior over untreated control. The treatment of Indoxacarb 14.5 SC @ 0.3 L ha^{-1}, Triazophos 40 EC @ 0.8 L ha^{-1} and Lamdacyhalothrin 5 EC @ 0.3 L ha^{-1} were found most effective where no infestation of girdle beetle was found after 5 days of treatment, while in untreated control 8.33% infestation was recorded. In rest of the treatments, infestation of girdle beetle varied from 0.83 to 1.67%.

Pooled data of kharif 2005 and 2006 (Table 1) indicated that after 5 days of imposing treatments, infestation of girdle beetle varied from 0.74 to 3.84% in different insecticidal treatments and 16.28% in untreated control. The treatment of Triazophos 40 EC @ 0.8 L ha^{-1} found most effective where only 0.74% infestation was recorded followed by Lamdacyhalothrin 5 EC 0.3 L ha^{-1} (1.87%), Diafenthiuron 50 WP @ 0.5 kg ha^{-1} (1.90%), Indoxacarb 14.5 SC @ 0.3 L ha^{-1} (2.24%), Profenophos 50 EC @ 1.25 L ha^{-1} (2.32%), Emamectin benzoate 5 SG 0.18 kg ha^{-1} (3.04%) and Indoxacarb 14.5 SC 0.15 L ha^{-1} (3.84%). All the insecticidal treatments were found statistically superior over untreated control, while there was no significant difference among Triazophos 40 EC 0.8 L ha^{-1}, Lamdacyhalothrin 5 EC 0.3 L ha^{-1}, Diafenthiuron 50 WP @ 0.5 kg ha^{-1}, Indoxacarb 14.5 SC @ 0.3 L ha^{-1} and Profenophos 50 EC @ 1.25 L ha^{-1}.

Seed yield

Yield data (Table 1) revealed that the treatment of Triazophos 40 EC 0.8 L ha^{-1} was found statistically superior over control with maximum pooled seed yield (1980 kg ha^{-1}) followed by Indoxacarb 14.5 SC 0.3 L ha^{-1} (1970 kg ha^{-1}), Diafenthiuron 50 WP 0.5 kg ha^{-1} (1904 kg ha^{-1}), Emamectin benzoate 5 SG 0.18 kg ha^{-1} (1885 kg ha^{-1}), Lamdacyhalothrin 5 EC 0.3 L ha^{-1} (1866 kg ha^{-1}), Profenophos 50 EC 1.25 L ha^{-1} (1847 kg ha^{-1}) and Indoxacarb 14.5 SC 0.15 L ha^{-1} (1837 kg ha^{-1}) while 1637 kg ha^{-1} in untreated check.

Economic evaluation

Data presented in Table 2 revealed that highest additional yield over control, avoidable yield loss and additional return was recorded in the treatment of Triazophos 40 EC 0.8 L ha^{-1} followed by Indoxacarb 14.5 SC 0.3 L ha^{-1}, Diafenthiuron 50 WP 0.5 kg ha^{-1}, Emamectin benzoate 5 SG 0.18 kg ha^{-1} and Lamdacyhalothrin 5 EC 0.3 L ha^{-1}. The maximum net return (Rs. 3606 ha^{-1}) was found in the treatment of Triazophos 40 EC 0.8 L ha^{-1} followed by Indoxacarb 14.5 SC 0.3 L ha^{-1} (Rs. 2646 ha^{-1}) and Lamdacyhalothrin 5 EC 0.3 L ha^{-1} (Rs. 2541 ha^{-1}), however, highest Increamental Cost Benefit ratio (12.27) was observed from the aplication of Lamdacyhalothrin 5 EC 0.3 L ha^{-1} followed by Triazophos 40 EC 0.8 L ha^{-1} (7.07).

Table 2. Economics and incremental cost benefit ratio of insecticides in soybean

Treatments	Dose	Additional yield over control (q ha^{-1})	Avoidable yield loss (%)	Additional return (Rs.)	Cost of insecticide (Rs.)	Net return (Rs.)	ICBR
Indoxacarb 14.5 SC	0.30 L ha^{-1}	3.33	16.90	3996	1350	2646	1.96
Indoxacarb 14.5 SC	0.15 L ha^{-1}	2.00	10.88	2400	675	1725	2.55
Diafenthiuron 50 WP	0.50 kg ha^{-1}	2.67	14.45	3204	1950	1254	0.64
Profenophos 50 EC	1.25 L ha^{-1}	2.10	11.25	2520	750	1770	2.36
Lamdacyhalothrin 5 EC	0.30 L ha^{-1}	2.29	12.27	2748	207	2541	12.27
Emamectin benzoate 5 SG	0.18 kg ha^{-1}	2.48	13.15	2976	2362	614	0.25
Triazophos 40 EC	0.80 L ha^{-1}	3.43	17.32	4116	510	3606	7.07
Control	-						

Soybean = Rs. 1200 q^{-1}, Indoxacarb = Rs. 3000 L^{-1}, Diafenthiuron= Rs. 2600 kg^{-1}, Profenophos = Rs. 400 L^{-1}, Lamdacyhalothrin = Rs. 460 L^{-1}, Emamectin benzoate = Rs. 875/100 g and Triazophos = Rs. 425 L^{-1}.

It is inferred that on the basis of criteria considered (i.e. green semi-looper population m^{-1} row length, per cent infestation of girdle beetle, seed yield and economics) for evaluation of insecticide, the treatment of Indoxacarb 14.5 SC 0.3 L ha^{-1}, Lamdacyhalothrin 5 EC 0.3 L ha^{-1} and Triazophos 40 EC 0.8 L ha^{-1} were found most effective where low green semi-looper population m^{-1} row length, low per cent infestation of girdle beetle, high seed yield and more net return (Rs. ha^{-1}) was recorded. The present findings are well accordance with the findings of Chaudhary and Bajpai (2007) was reported the effectiveness of Triazophos. Kumar and Ram (2002) also observed comparatively higher yield with two spray of chemical insecticide against insect pests in soybean crop. It is also inferred from present study that Indoxacarb is most effective against green semi-looper (*Chrysodeixis acuta* Walk.) though it is costly while Triazophos is more effective against girdle beetle (*Obereopsis brevis* Swed.).Where as Lamdacyhalothrin remained overall most cost effective against target pests applied at initiation of infestation on crop.

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