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RELATIVE EFFICACY OF DIFFERENT INSECTICIDES AGAINST LEAF FEEDERS ON SOYBEAN CROP (*GLYCINE MAX* L. MERRILL)

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ABSTRACT

Soybean is a fascinating crop with innumerable possibilities of not only improving agriculture but also supporting industries. In the present investigation, attempts were made to study the relative efficacy of different insecticides against leaf feeders during *kharif,* 2012 at Research cum Instructional Farm, Indira Gandhi Krishi Vishwa vidyalaya, Raipur, (C.G). It was found that Profenophos 50 EC @ 1250 ml/ha was most effective against caterpillar pests with 1.22 larvae per meter row and the grain yield was 15.450 q/ha with 13.14:1 benefit cost ratio. In Triazophos 40 EC @ 625 ml/ha (2.36 larvae / meter row) with 12.390 q/ha grain yield and 12.30:1 benefit cost ratio. It was followed by Profenophos 50 EC @ 1000 ml/ha (2.01 larvae per meter row) with 11.700 q/ha grain yield and 10.70:1 benefit cost ratio was least economical

INTRODUCTION

Leaf feeders are known to cause yield reduction in soybean. A number of insecticides are in use to manage these pests. Researchers in many parts of India have confirmed that different insecticide and chemicals are being adversely affected by major insect pests viz. girdle beetle, tobacco caterpillar, green semilooper, gram pod borer, jassids and white fly. Noctuid pest has been difficult to control because of varying degrees of resistance to many chemical insecticides (Brewer and Trumble 1989, 1994), Insecticides have widely been used for more than 50 years. Although the goal of insecticides application is to kill all target pests, however survivors are common as target species develop resistance to particular compounds (Armes *et al*., 1997; Byren and Toscano, 2001; Kranthi *et al*., 2002; Wei *et al*., 2004). Field evaluation of (Singh and Singh, 1988) eleven insecticides against larvae of grey semilooper, *Rivula* sp. revealed that 0.01 per cent fenvalerate and 0.025 per cent quinalphos kept the crop free from infestation for up to 15 days. The highest yield (1,704 kg/ha) was achieved with fenvalerate followed by quinalphos (1,679 kg/ha) followed by 0.036 per cent monocrotophos 1,628 kg/ha as against in untreated control 1,214 kg/ha). While evaluating the bioefficacy of cypermethrin, dichlorvos, endosulfan, profenophos, and quinalphos against *Spodoptera litura* infesting soybean *cv*. DS228 (Phule Kalyani), the treatment with profenophos 0.1% gave maximum protection up to 7 days after application with 6.5% foliage damage (Hole *et al*., 2009).

Spodoptera littoralis (Boisduval) (Lepidoptera: Noctuidae) is one of the most destructive pests of several crops such as cotton, Gossypium hirsutum L.; peanut, Arachis hypogaea L., soybean, Glycine max L., and vegetables in Africa, Asia, and Europe (Bayoumi *et al.,* 1998, El-Aswad *et al*., 2003). Patil *et al.,* 2014. Observed that the Insecticides used in experiment Chlorantraniliprole 18.5%SC@ 30 g.ai/ha, Methomyl 40 % SP @ 300g.ai/ha , Spinosad 45% SC @ 75 g.ai/ha , Indoxacarb 15.8% EC @ 30 g.ai/ha, Thiodicarb 75 % WP @7 50 g.ai/ha, Trizophous 40% E.C @ 25 g.ai/ha and Profenofos 50 % EC @500 g.ai/ha . In both years there were significant difference detected across the treatment when these seven foliar insecticides used for the control of soybean defoliators.

The soybean defoliators mainly include tobacco caterpillar *Sopdoptera litura* (Fabricius) and green semilooper, *Chrysodeixis acuta*. Immature stages (larva or caterpillar) of both tobacco caterpillar and green semilooper damages the crop at vegetative stage and in severe case, it completely defoliate the crop and dramatic yield loss. *S. litura* larvae even damages to soybean pods also (Chaturvedi *et al*.,1998, Mandal et al., 1998, Singh *et al*., 2000, Patil 2002 and Sastawa *et al*., 2004).

In field trials conducted by Kumar *et al*. (2010) to find out the efficacy of neem products in comparison to triazophos 40 EC (@ 1.5 ml per/l) against stem borer complex in soybean, triazophos proved to be most effective against stem borer. In this scenario, using new types of insecticides, originated from natural agents or products that disrupt the physiological processes of the target pest, could be useful as an alternative for the integrated management approach (Dhadialla *et al*. 1998, Thompson *et al*. 2000, Smagghe *et al*. 2003). In view of above, it was considered appropriate to evaluate the insecticides in vogue for their efficacy in management of leaf feeders.

There is a need to evaluate insecticides comparatively safer to natural enemies. Initiative should be taken to develop non-insecticidal modules against the management of major insect-pests of soybean crop. Suitable integrated insect pest management strategies are needed to be worked out. Current study was aimed to evaluate the comparative efficacy of insecticides, different doses of Profenophos 50 EC, DDVP 76% EC, Quinalphos 25 EC and Triazophos 40 EC.

MATERIALS AND METHODS

A field experiment for evaluating the bio-efficacy of Profenophos along with Quinalphos, Dichlorvos and Triazophos as standard checks against major lepidopteran pests, namely tobacco caterpillar (*Spodoptera litura*), green semilooper (*Chrysodeixis acuta*) and gram pod borer (*Helicoverpa armigera)* on soybean crop was carried out in *kharif,* 2012. The experiment was laid out in randomized block design with seven treatments including untreated control replicated four times. This soybean (*var.* JS 335) crop sown on 10thJuly, 2012 was raised following the recommended package of practices. The insecticides under study sprayed two times between 15 days intervals when economic thresh-hold level is come. Mean population (No/m row length) of larvae was recorded one day before spraying of insecticides in randomly selected three places in each plot. The post-treatment counts were taken after 1, 3, 7 and 10 days of spraying of insecticides. The data on seed yield was recorded and utilized to work out avoidable loss and increase in yield due to treatment. The experiments were laid out in Randomized Block Design. The data obtained were transformed using square root transformation, by the formula ($\sqrt{X + 0.5}$). This transformed data was then analyzed by the method of analysis of variance as described by Gomez and Gomez (1984). The "F" test was used at 5 per cent level of significance. Critical difference (CD) values were analyzed at 5 per cent level of significance.

Determination of avoidable losses

(Kujur, 2011) Avoidable losses are the losses which can be recovered by timely management of insect-pests. It is expressed in per cent and is determined as follows:

$$\text{Avoidable loss (\%)} = \frac{\text{Actual increase in yield over control}}{\text{Yield of individual treatment plot}} \times 100$$

Where,

Actual increase in yield over control = (Yield of individual treated plot – Yield of untreated control plot).

$$\text{\% increase in yield due to treatment} = \frac{\text{Actual increase in yield over control}}{\text{Yield of unterated plot}} \times 100$$

Economic analysis of different chemical insecticides (Benefit Cost Ratio)

For benefit cost analysis, record of costs incurred in each treatment and that of control were maintained. It is to be noted here that expenses incurred referred to those only on pest management *i.e.* cost of insecticides and labour charges for insecticide spraying. The price of the harvested yield of each treatment and that of control were also calculated at market rate. Thereafter, Benefit cost ratio (B: C ratio) was calculated by the estimation of different pest management cost by adjusting with the control condition *i.e.*

$$\text{B: C ratio} = \frac{\text{Adjusted net return (Rs/ha)}}{\text{Cost of pest management (Rs/ha)}}$$

Where,

Adjusted net return (Rs/ha) = [Net return from individual treated plot (Rs/ha) – Net return from untreated control plot (Rs/ha)]

Cost of pest management (Rs/ha) = Cost of insecticide + Labour charges per hectare.

RESULTS AND DISCUSSION

An experiment for evaluating the bio-efficacy of Profenophos along with Quinalphos, Dichlorvos and Triazophos as standard checks against major leaf feeders pests *viz.* tobacco caterpillar, *Spodoptera litura*, green semilooper, *Chrysodeixis acuta* and gram pod borer, *Helicoverpa armigera* on soybean crop. The average larval population per meter row length was recorded (Table 1.1). Grain yield was recorded from each plot separately and converted into q/ha and presented in Table 1.2.

The mean larval population during the first spraying, Profenophos 50 EC @ 1250 ml/ha recorded least larval count of 1.49 larvae per meter row followed by Profenophos 50 EC @ 1000 ml/ha and Quinalphos 25 EC @ 3000 ml/ ha with 2.23 and 2.35 larvae per meter row, respectively. Other treatments recorded the pest count in the range of 2.43 to 4.77 larvae per meter row.

The mean larval population during second spray revealed that Profenophos 50 EC @ 1250 ml/ha recorded least larval count of 0.95 larvae per meter row. It was followed by Quinalphos 25 EC @ 3000 ml/ ha and Profenophos 50 EC @ 1000 ml/ ha with 1.76 and 1.80 larvae per meter row, respectively. Other treatments recorded the pest count in the range of 1.83 to 3.82 larvae per meter row.

Yield recorded at harvest was subjected to statistical and economical analysis after converting the data from kg/plot to q/ha (Table 1.2, 1.3 and 1.4). It revealed that Profenophos 50 EC when applied twice @ 1250 ml/ha was most effective with 15.450 q/ha yield. The treatment showed 8.25 q/ha actual increase in yield over untreated control which accounted for 114.58 per cent increase in yield due to treatment with 53.39 per cent avoidable losses. This treatment was at par with Triazophos 40 EC @ 625 ml/ha with 12.390 q/ha yield but significantly varied from DDVP 76% EC @ 375 ml/ha and Profenophos 50 EC with 9.100 and 11.700 q/ha yield respectively. Profenophos 50 EC @ 750 ml/ha was least effective with minimum 9.850 q/ha grain yield. It was at par with untreated control.

Thus, based on overall seasonal mean, Profenophos 50 EC @ 1250 ml/ha was found to most effective and economical against caterpillar pests (1.22 larvae per meter row) with maximum grain yield of 15.450 q/ha and 13.14:1 benefit cost ratio. It was followed by Triazophos 40 EC @ 625 ml/ha (2.36 larvae per meter row) with 12.390 q/ha grain yield and 12.30:1 benefit cost ratio. Profenophos 50 EC @ 1000 ml/ha with 8.06:1 benefit cost ratio was recorded least economical.

The results are in conformity with the findings of Hole *et al*. (2009) who observed that Profenophos 0.1% was most effective against *Spodoptera litura* infesting soybean in controlling larval population and thereby increasing the grain yield.

Kujur, J. (2011) observed that Profenophos 50 EC @ 1250 ml/ha was found to most effective and economical against caterpillar pests (0.74 larvae per meter row) with maximum grain yield of 13.75 q/ha and 6.59:1 benefit cost ratio. It was followed by Triazophos 40 EC @ 625 ml/ha (0.97 larvae per meter row) with 9.63 q/ha grain yield and 4.43:1 benefit cost ratio. Profenophos 50 EC @ 1000 ml/ha with 2.10:1 benefit cost ratio was recorded least economical.

Purwar and Yadav (2003) and Choudhary and Bajpai (2007) reported the effectiveness of Triazophos spray against caterpillar pests which resulted in lowest larval population in their experiments. In the present investigation also, Triazophos 40 EC @ 625 ml/ha proved to be effective against caterpillar pests; next to the best treatment *i.e.* Profenophos 50 EC @ 1250 mL/ha.

Kumar *et al*. (2010) conducted field trials during *kharif* to find out the efficacy of neem products in comparison to Triazophos 40 EC @ 1.5 ml/lit., against stem borer complex in soybean. Triazophos proved to be most effective against stem borer.

Netam (2010) reported Flubendiamide 480 SC was evaluated for bio-efficacy against lepidopteran pests, *S. litura* and *C. acuta*. Flubendiamide 480 SC when applied at the rate of 90 g. a.i./ha was most effective with minimum 1.62 larvae/m row and maximum grain yield of 25.47 q/ha. It was followed by the same insecticide applied @ 72 g.a.i./ha and Triazophos 40 EC with 3.00 and 3.06 larvae per meter row and 23.57 and 21.54 q/ha grain yield. Flubendiamide 480 SC@ 90 g.a.i/ha despite being most effective against the lepido pterous pests was also most economical with 34.82 percent avoidable losses and 1.53:1 benefit cost ratio.

Sinha (2009) evaluated that efficacy of different doses of Flubendiamide 480 SC log with Quinalphos and Triazophos as standard checks against major lepidopterous pests viz. *S. litura*, *C. acuta* and *H.armigera* on soybean crops. Flubendiamide 480 SC when applied twice @ 90 g a.i./ha was most effective with 19.40 q/ha yield. There was 8.15 q/ha increase in yield over control which account for 72.4 percent increase in yield with 42.0 percent avoidable losses. Quinalphos 25 EC when applied twice @ 250 g a.i./ha was most economical with 9.12:1 Benefit cost ratio.

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Table 1.1: Relative Efficacy of insecticide against leaf feeders of soybean.

Treatments		Dose (ml/ha)	Mean population of larvae/ m row							Over all seasonal mean					
			I Spray PT Ob.* Day	1 Days	3 days	7 days	10	Mean Day	II Spray PT Ob.* days	1 days	3 days	7	10	Mean	
T1	Profenophos 50 EC	750	2.50(1.73)	2.35 ab(1.69)	2.15 ab(1.62)	2.25bc(1.66)	3.00 abc(1.87)	2.43	4.00(2.12)	2.45 b(1.71)	2.30 b(1.67)	2.12 b(1.59	2.22 bc(1.65)	2.27	2.35
T2	Profenophos 50 EC	1000	2.25(1.66)	1.95 ab(1.56)	2.07 ab(1.60)	2.15 bc(1.62)	2.75 abc(1.80)	2.23	2.85(1.83)	2.10 ab(1.61)	1.85 ab(1.53)	1.76 b(1.47)	1.50 b(1.41)	1.80	2.01
T3	Profenophos 50 EC	1250	2.75(1.80)	1.52 a(1.42)	1.35 a(1.36)	1.22 a(1.31)	1.87 a(1.54)	1.49	2.30(1.67)	1.65 a(1.46)	1.17 a(1.29)	0.62 a(1.06)	0.37 a(0.93)	0.95	1.22
T4	DDVP 76% EC	375	2.50(1.73)	1.45 ab(1.71)	3.00 b(1.87)	2.80 c(1.81)	3.30 bc(1.95)	2.63	3.65(2.04)	2.05 ab(1.59)	1.89 ab(1.54)	2.42 bc(1.71)	0.95 cd(1.85)	1.83	2.23
T5	Quinalphos 25 EC	1000	2.75(1.80)	2.67 b(1.78)	2.00 ab(1.58)	2.00 bc(1.58)	2.74 ab(1.72)	2.35	2.50(1.73)	2.05 ab(1.59)	1.75 ab(1.50)	1.72 b(1.49)	1.52 b(1.42)	1.76	2.05
T6	Triazophos 40 EC	625	2.50(1.73)	2.35 ab(1.69)	2.55 b(1.74)	1.77 ab(1.51)	2.36 ab(1.69)	2.55	2.90(1.84)	2.62 b(1.76)	2.16 b(1.63)	1.95 b(1.56)	2.00 bc(1.58)	2.18	2.36
T7	Untreated control	-	2.75(1.80)	4.75 c(2.29)	5.75 c(2.50)	4.25 d(2.18)	4.34 c(2.20)	4.77	4.40(2.21)	4.27 c(2.18)	3.75 c(2.06)	3.52 c(2.00)	3.74 d(2.06)	3.82	4.29
C. D. at 5%			NS	0.32	0.34	0.26	0.40	-	NS	0.23	0.30	0.35	0.39	-	-

PT Ob.: Pretreatment Observation; Figures in parenthesis are √x+0.5 transformed values. In a column, means followed by a common letter are not significantly different at 5 per cent level.

Table 1.2: Efficacy of Insecticide against leaf feeders pests and Grain yield

S.NO.	Treatments	Dose (ml/ ha)	Over all seasonal mean of leaf feedersPests	Grain yield (Q / ha)
T 1	Profenophos 50 EC	750	2.35	9.850
T2	Profenophos 50 EC	1000	2.01	11.700
T 3	Profenophos 50 EC	1250	1.22	15.450
T4	DDVP 76% EC	375	2.23	9.100
T 5	Quinolphos 25 EC	3000	2.05	11.350
T6	Triazophos 40 EC	625	2.36	12.390
T 7	Untreated control	-	4.29	7.200

Table 1.3: Assessment of Avoidable losses due to leaf feeders pests on soybean crop treated with different insecticides.

S. No.	Treatments	Dose (ml/ha)	Yield (q/ha)	Actual increase in yield over control(q/ha)	% increase in yield due to treatment	Avoidable losses(%)
T1	Profenophos 50 EC	750	9.850	2.65	36.80	26.90
T2	Profenophos 50 EC	1000	11.700	4.5	62.5	38.46
T3	Profenophos 50 EC	1250	15.450	8.25	114.58	53.39
T4	DDVP 76% EC	375	9.100	1.9	26.38	20.87
T5	Quinalphos 25 EC	3000	11.350	4.15	57.64	36.56
T6	Triazophos 40 EC	625	12.390	5.19	72.08	41.88
T7	Untreated control	-	7.200	-	-	-

Table 1.4: Economics of different chemical insecticides for the management of leaf feeders pests of soybean.

S. No	Treatments	Dose (ml/ha)	No. of sprays	Cost of pest management (Rs./ha)	Yield (q/ha)	Gross return (Rs./ha)	Net return (Rs./ha)	Adjusted net return(Rs./ha)	B:C ratio
T1	Profenophos 50 EC	750	2	1230	9.850	29,550	28,320	6,720	5.46:1
T2	Profenophos 50 EC	1000	2	1490	11.700	35,100	33,610	12,010	8.06:1
T3	Profenophos 50 EC	1250	2	1750	15.450	46,350	44,600	23,000	13.14:1
T4	DDVP 76% EC	375	2	900	9.100	27,300	26,400	4,800	5.33:1
T5	Quinalphos 25 EC	3000	2	1330	11.350	34,050	32,720	11,120	8.36:1
T6	Triazophos 40 EC	625	2	1170	12.390	37,170	36,000	14,400	12.30:1
T7	Untreated control	-	-	-	7.200	21,600	21,600	-	-

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