

Research Paper

## Efficacy of chemical and botanical insecticides against green semilooper, *Chrysodeixis acuta* (Walker) in soybean

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Received: 28 June 2024

Accepted: 11 September 2024

Handling Editor:

Dr. Anup Chandra, ICAR-Indian Institute of Pulses Research, Kanpur, India

### ABSTRACT

In the present study, new insecticides against green semilooper in soybean were evaluated in a variety JS-335. Treatments comprising eight insecticides including control were applied at 35 and 50 DAS and observations were taken on the 1<sup>st</sup>, 3<sup>rd</sup>, and 7<sup>th</sup> days after each spray. The results revealed that ampligo 150 ZC @ 200 ml/ha recorded the lowest cumulative mean larval population i.e 0.92 -1.24 larvae/mrl over the years. The next best treatment was emamectin benzoate 5 SG @ 15 g/ha with (1.03) and (1.34 larvae/mrl) during both the year respectively. Hence, two sprays at fifteen days intervals of ampligo 150 ZC (chlorantraniliprole 10% SC + lambda-cyhalothrin 5% CS) @ 200 ml/ha was effective against green semilooper as it showed the minimum incidence, highest yield (1915.5/ha) and highest benefit-cost ratio (4.63) in both the years.

**Key words:** Benefit cost ratio, Bio-efficacy, JS-335, Insecticide, Yield

### INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is one of the important oilseed crops of India belonging to the family Leguminosae. The multipurpose nature of soybean makes it valuable in the field of industrial formulations, the agriculture sector, and pharmaceuticals and thus it is a unique crop. The cultivation of soybeans has numerous challenges in Jharkhand and throughout India because the crop is highly susceptible to heavy infestation by insect-pest complexes at every stage of growth. The crop is infested by more than 275 insect pests throughout its growth stages from germination to maturity (Babu *et al.* 2017). Infestation of defoliators is becoming the most important production constraint, posing a threat to soybean. Green semilooper, *Chrysodeixis acuta* (Walker) (Noctuidae: Lepidoptera) is one of the serious leaf-eating insects of soybean which damages the crop at the vegetative and flowering stages and in severe cases, it causes dramatic yield loss. In the year 2009, in Mississippi, among soybean loopers, *Chrysodeixis acuta* infested 1.7 million acres of soybeans and caused a 19 percent total loss plus cost of control to producers (Musser and Catchot 2009). At the flowering stage of the crop, its larvae choose to eat the flowers rather than the leaves and farmers believe their plants are healthy because of healthy leaves on plants resulting in a significant loss in output. To control the pests below the point

of economic harm, farmers must use insecticides while managing insect pests. Because of the number of insecticides available in the market to manage soybean pests, it is necessary to identify the most effective chemical to manage the major insect pests of soybeans at a reasonable cost and also prevent pest resurgence. Keeping this in view, the present study was conducted to evaluate the efficacy of some newer and combination insecticides against this pest in soybean.

### MATERIALS AND METHODS

The field experiment was conducted at the Soybean Research Farm of Birsa Agricultural University during the *Kharif* season (2021 and 2022) on a soybean variety JS-335. The field experiment was laid out in a Randomized Block Design with eight treatments including control (water spray) and three replications with a plot size of 4m × 3m. Two foliar sprays with the respective insecticidal treatment(s) were applied at 35 and 50 days after sowing using a knap sack sprayer. For recording the larval population of green semilooper, five spots of one-meter row length (mrl) were selected randomly leaving border rows in each plot. Of these five spots, four spots were selected in the corner and one in the centre. From each spot, four plants were randomly selected for observation (Sharma *et al.* 2014). Four corners and the center of the plots were

selected for observation to cover the maximum possible distribution of the insects within the plot. Observations on pest incidence were recorded one day before treatment and after 1<sup>st</sup>, 3<sup>rd</sup>, and 7<sup>th</sup> days of the first and second spray, respectively.

Seed yield at harvesting was recorded for each treatment separately. Net return and benefit: cost ratio was also worked out by comparison of the cost of protective sprays and net return over the control.

The collected data was used for square root transformations before subjecting to analysis of variance (ANOVA) by using R- software. The grading was done with Duncan's Multiple Range Test (DMRT) using R- software (Gomez and Gomez 1984).

## RESULTS AND DISCUSSION

The results presented in Table 1 showed that the pooled mean of the first and second spray of *Chrysodeixis acuta* larval population recorded during 2021 was lowest in treatment with ampligo 150 ZC (0.92 larvae/mrl) as it was the most effective treatment while emamectin benzoate 5 SG (1.03 larvae/mrl) and spinosad 45 SC (1.16 larvae/mrl) were found to be the next effective treatments and the remaining treatments, acetamiprid 20 SP and diafenthiuron 50 WP (1.31 larvae/mrl) were moderate in their efficacy whereas azadirachtin 1500 PPM (1.40 larvae/mrl) and thiamethoxam 25

WG (1.67 larvae/mrl) were least effective against *C. acuta*. The pooled mean obtained during second year of experiment showed similar results in Table 2 which indicated that ampligo 150 ZC recorded minimum larval population (1.24 larvae/mrl), while emamectin benzoate 5 SG (1.32 larvae/mrl) and spinosad 45 SC (1.43 larvae/mrl) were found to be the next effective treatments whereas azadirachtin 1500 PPM (1.66 larvae/mrl) and thiamethoxam 25 WG (1.84 larvae/mrl) were least effective against green semilooper.

The findings of the present investigation for ampligo are comparable with Kambrekar (2019) who investigated that a novel insecticide in the anthranilic diamide and a pyrethroid class, ampligo (chlorantraniliprole 9.3% w/w + lambda-cyhalothrin 4.6% w/w) demonstrates significant levels of toxicity to several lepidopteron insect pests worldwide. Applications of chlorantraniliprole 9.3%+ lambda-cyhalothrin 4.6% ZC @ 200 ml/ha recorded lowest population of semilooper with 0.67 and 0.97 larvae/mrl and reported that the same dosage of ampligo was also effective in reducing the various insect pest population in soybean viz., *Spodoptera litura* (Fab.), *Thysanoplusia orichalcea* (Fab.) and *Obereopsis brevis* (Swed.).

Matti and Deotale (2015) reported the least larval population (0.05/mrl) by using fenvalerate 20 EC @ 0.50 ml/l and found it to be superior

**Table 1.** Efficacy of chemical and botanical insecticides against green semilooper during *Kharif*, 2021

Treatments	Trade name	Dosage (gm or ml/ha)	Pre-treatment count	Mean larval population/mrl								Pooled mean
				Days after 1st spray application				Days after 2 <sup>nd</sup> spray application				
				1	3	7	Mean	1	3	7	Mean	
Chlorantraniliprole (10 %) + Lambda cyhalothrin (5%) ZC	Ampligo 150 ZC	200 ml	1.87 (1.46)	0.29 (0.89)a	0.29 (0.89)a	0.57 (1.03)a	0.38 (0.94)a	0.36 (0.93)a	0.27 (0.88)a	0.31 (0.9)a	0.31 (0.9)a	0.35 (0.92)a
Spinosad 45 SC	Spinosad	75 g	1.58 (1.44)	1.37 (1.37)bc	0.97 (1.21)bc	1.31 (1.35)abc	1.22 (1.31)bc	0.44 (0.97)ab	0.46 (0.98)a	0.49 (0.99)ab	0.46 (0.98)a	0.84 (1.16)abc
Azadirachtin 1500 PPM	Neem-baan	800 ml	2.15 (1.60)	1.88 (1.54)bc	1.82 (1.52)d	1.74 (1.5)abc	1.81 (1.52)cd	1.09 (1.26)bc	1.10 (1.26)ab	1.13 (1.28)c	1.11 (1.27)b	1.46 (1.40)cd
Diafenthiuron 50 WP	Eagle	400 g	1.95 (1.57)	1.69 (1.48)bc	1.44 (1.39)cd	1.79 (1.51)bc	1.64 (1.46)c	1.02 (1.23)abc	1.06 (1.25)ab	1.09 (1.26)c	1.06 (1.25)b	1.35 (1.31)bc
Emamectin benzoate 5 SG	Ematin	15 g	0.81 (1.14)	0.94 (1.2)ab	0.47 (0.98)ab	0.77 (1.13)ab	0.73 (1.11)ab	0.42 (0.96)ab	0.38 (0.94)a	0.41 (0.95)ab	0.40 (0.95)a	0.57 (1.03)ab
Thiamethoxam 25 WG	Evident	100 g	2.41 (1.69)	2.12 (1.62)c	1.49 (1.41)cd	4.63 (2.2)d	2.75 (1.79)e	1.76 (1.50)c	1.85 (1.53)b	2.00 (1.58)d	1.87 (1.54)c	2.31 (1.67)d
Acetamiprid 20% SP	Wapkil	20 g	2.40 (1.70)	1.83 (1.53)bc	1.31 (1.35)cd	1.61 (1.45)abc	1.58 (1.44)c	0.83 (1.15)ab	0.87 (1.17)ab	0.90 (1.18)bc	0.87 (1.17)b	1.23 (1.31)bc
Control	-	-	0.58 (1.04)	2.13 (1.6)bc	3.47 (1.96)e	2.20 (1.64)c	2.64 (1.76)de	3.14 (1.87)d	4.40 (2.16)c	5.80 (2.49)e	4.45 (2.22)d	3.55 (2.01)e
SEm±			(0.150)	(0.119)	(0.088)	(0.139)	(0.080)	(0.094)	(0.115)	(0.083)	(0.050)	(0.092)
CD (p=0.05)			NS	(0.361)	(0.269)	(0.421)	(0.244)	(0.285)	(0.351)	(0.253)	(0.153)	(0.281)
CV (%)			(18.530)	(14.470)	(11.50)	(16.319)	(9.871)	(13.222)	(15.782)	(10.89)	(6.840)	(11.887)

\*Figures in parentheses are square root transformed values, means in the columns followed by the same alphabet do not differ significantly by DMRT (P=0.05), NS= non-significant

compared to other treatments. The next effective treatments were emamectin benzoate 5 SG @ 0.3 g/l (T6: 0.06/ml) and also in spinosad 45 SC @ 0.25 ml/l (T3: 0.07/ml). Biradar *et al.* (2023) recorded the significantly, lowest incidence of tobacco leaf-eating caterpillar in chlorantraniliprole 18.50% SC, followed by lambda-cyhalothrin 4.6% + chlorantraniliprole 9.3% ZC at par with novaluron 5.25% + emamectin benzoate 0.9% w/w. Rathod *et al.* (2020) reported that emamectin benzoate 5%

SG @ 200 gm/ha is most effective in controlling the incidence of major foliage feeders *viz.*, *S. litura* (0.72 larvae/ml), *C. acuta* (0.31 larvae/ml) and *S. obliqua* (0.72 larvae/ml) with cost-benefit ratio of (1:19.28) and registered highest grain yield (23.93 quintal/ha).

The incremental cost benefit ratio worked out for various treatments on the basis of pooled yield data of two years are presented in Table 3. Results

**Table 2.** Efficacy of chemical and botanical insecticides against green semilooper during *Kharif*, 2022

Treatments	Trade name	Dosage (gm or ml/ha)	Pre-treatment count	Mean larval population/ml								Pooled mean
				Days after 1st spray application				Days after 2 <sup>nd</sup> spray application				
				1	3	7	Mean	1	3	7	Mean	
Chlorantraniliprole (10 %) + Lambda cyhalothrin (5%) ZC	Ampligo 150 ZC	200 ml	4.53 (2.24)	1.19 (1.30)a	1.20 (1.30)a	1.43 (1.39)a	1.27 (1.33)a	0.84 (1.16)a	0.76 (1.12)a	0.75 (1.12)a	0.78 (1.13)a	1.03 (1.24)a
Spinosad 45 SC	Spinosad	75 g	4.27 (2.18)	2.16 (1.63)ab	2.23 (1.65)ab	1.87 (1.54)a	2.09 (1.61)b	1.06 (1.25)a	0.91 (1.19)a	0.96 (1.21)a	0.98 (1.22)a	1.53 (1.43)ab
Azadirachtin 1500 PPM	Neem-baan	800 ml	4.10 (2.14)	2.38 (1.70)ab	5.24 (2.35)c	2.27 (1.66)a	3.30 (1.94)c	1.36 (1.36)a	1.10 (1.26)a	1.15 (1.28)a	1.20 (1.31)a	2.25 (1.66)bc
Diafenthiuron 50 WP	Eagle	400 g	4.71 (2.28)	2.17 (1.63)ab	2.41 (1.71)b	2.15 (1.63)a	2.24 (1.66)b	1.13 (1.28)a	1.32 (1.35)a	1.10 (1.26)a	1.18 (1.30)a	1.71 (1.49)ab
Emamectin benzoate 5 SG	Ematin	15 g	4.23 (2.17)	1.50 (1.41)ab	1.57 (1.44)ab	1.73 (1.49)a	1.60 (1.45)ab	0.87 (1.17)a	0.86 (1.17)a	0.89 (1.18)a	0.87 (1.17)a	1.24 (1.32)a
Thiamethoxam 25 WG	Evident	100 g	3.77 (2.07)	4.58 (2.21)c	2.46 (1.72)b	2.27 (1.66)a	3.10 (1.89)c	1.56 (1.43)a	4.77 (2.24)b	1.61 (1.45)a	2.65 (1.77)b	2.87 (1.84)cd
Acetamiprid 20% SP	Wapkil	20 g	4.51 (2.24)	2.28 (1.67)ab	2.29 (1.67)ab	1.97 (1.57)a	2.18 (1.64)b	1.14 (1.28)a	1.04 (1.24)a	1.12 (1.27)a	1.10 (1.26)a	1.64 (1.46)ab
Control	-	-	4.61 (2.21)	2.73 (1.80)b	2.54 (1.74)b	4.87 (2.25)b	3.38 (1.96)c	4.83 (2.30)b	1.84 (1.53)a	5.40 (2.37)b	4.02 (2.13)c	3.70 (2.05)d
SEm (±)			(0.110)	(0.118)	(0.120)	(0.138)	(0.072)	(0.101)	(0.129)	(0.131)	(0.093)	(0.078)
CD (p=0.05)			NS	(0.358)	(0.365)	(0.419)	(0.221)	(0.308)	(0.391)	(0.398)	(0.283)	(0.236)
CV (%)			(9.390)	(12.269)	(12.302)	(14.527)	(7.500)	(12.592)	(16.128)	(16.33)	(11.522)	(8.687)

\*Figures in parentheses are square root transformed values, means in the columns followed by the same alphabet do not differ significantly by DMRT (P=0.05), NS= non-significant

**Table 3.** Economics and benefit cost ratio of different treatments in soybean during *Kharif* 2021 and 2022

Treatments	Trade name	Seed yield (kg/ha)		Mean seed yield (kg/ha)	Increase in yield over control (kg/ha)	Per cent increase in yield over control (%)	Value of increased yield over control (Rs)	Total cost/ Expenditure involved (Rs)	Net profit (Rs/ha)	B:C ratio
		2021	2022							
		Chlorantraniliprole (10%) + Lambda cyhalothrin (5%) ZC	Ampligo 150 ZC							
Spinosad 45 SC	Spinosad	1765	1735	1750	181	11.54	7783	1686	6097	3.616
Azadirachtin 1500 PPM	Neem-baan	1662	1597	1629.5	60.5	3.86	2601.5	2070	531.5	0.257
Diafenthiuron 50 WP	Eagle	1671	1653	1662	93	5.93	3999	1982	2017	1.018
Emamectin benzoate 5 SG	Ematin	1863	1805	1834	265	16.89	11395	2385	9010	3.778
Thiametaoxam 25 WG	Evident	1782	1689	1735.5	166.5	10.61	7159.5	1850	5309.5	2.870
Acetamiprid 20% SP	Wapkil	1692	1676	1684	115	7.33	4945	1694	3251	1.919
Control	-	1585	1553	1569	-	-	-	-	-	-
SEm±		51.22	50.531	51.874						
CD (p=0.05)		155.36	153.27	157.345						
CV (%)		5.143	5.178	5.261						

Cost of soybean = Rs. 43/kg or Rs. 4300/q; No. of labour/spray= 2; Total cost of plant protection = Cost of labour + Cost of insecticide + sprayer hiring charges (Rs. 50/spray) + Miscellaneous charges (Rs100); Total labours (4) + rent of sprayer twice + Miscellaneous expenditure = 1550

revealed that highest net returns were obtained with ampligo 150 ZC (Rs. 12,253) having the highest benefit cost ratio (4.63) followed by the application of emamectin benzoate 5 SG (Rs. 9,010) with B:C ratio 3.77. The lowest net returns were obtained with the application of azadirachtin 1500 PPM (Rs. 531.5/ha) (Table 3). Bhumika *et al.* (2022) reported that maximum yield (3002 kg/ha) was obtained from chlorantraniliprole 10 + lambda cyhalothrin 5 and 43.77 per cent increase yield over control and a high net realization (Rs. 59,410/ha) in soybean.

## CONCLUSION

Two sprays of the combination insecticide ampligo 150 ZC (chlorantraniliprole 10% SC + lambda cyhalothrin 5% CS) @ 200 ml/ha was effective against green semilooper as it showed the minimum incidence in both the year, and highest yield (1915.5/h). Also it recorded the highest benefit cost ratio (4.63). In ampligo 150 ZC, one component i.e. chlorantraniliprole is a systemic insecticide which is effective for leaf eating insects as well as sucking pest and also it has longer duration effect. However, it is effective for early instars larva or small larva. While other component i.e. lambda cyhalothrin is a contact insecticide and effective for later instars or big larva. The next best insecticides found against green semilooper were emamectin benzoate 5 SG and spinosad 45 SC which are of biological origin.

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