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## Efficacy of different insecticides against tobacco leaf eating caterpillar (*Spodoptera litura* Fab.) on soybean (*Glycine max* L)

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### Abstract

The experiment on, "Efficacy of different insecticides against tobacco leaf eating caterpillar (*Spodoptera litura* Fab.) on soybean (*Glycine max* L)." was undertaken at Agricultural farm of Krishi Vigyan Kendra, Dhule and College of Agriculture, Dhule during 2020 -2021. The experiment was planned out in Randomized Block Design with seven treatments and three replications. The variety used for study was JSS-335. Total seven treatments were used in present investigation consisting of insecticides viz., Lambda cyhalothrin 4.6% + Chlorantraniliprole 9.3% ZC @ 0.5 ml/l, Novaluron 5.25% + Emamectin benzoate 0.9% w/w SC @ 1.75ml/l, Lambda cyhalothrin 5% EC @ 0.05 ml/l, Chlorantraniliprole 18.50% SC @ 0.3 ml/l, @ 0.44 gm/l, Emamectin benzoate 5% SG, Spinetoram 11.7% SC @ 0.9ml/l and untreated control. As regards the efficacy of different insecticides, all the insecticides were significantly superior over untreated control in recording the lowest percentage of tobacco leaf eating caterpillar per cent infestation.

Average effect showed significantly, lowest incidence of tobacco leaf eating caterpillar was recorded 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 SC, the next best treatments were in order as Spinetoram 11.7% SC, Lambda cyhalothrin 5% EC and Emamectin benzoate 5% SG.

**Keywords:** Tobacco leaf eating caterpillar, soybean, infestation, insecticides

### Introduction

The soybean is believed to have originated from China. In India is grown commercially in Maharashtra, Madhya Pradesh, Andhra Pradesh, Karnataka, Rajasthan etc. In Maharashtra-Ahmednagar, Dhule, Jalgaon, Akola, Parbhani, Osmanabad, Latur, Hingoli, Nanded districts are under soybean cultivation. It is a rich source of vitamins, minerals, poly unsaturated fats specially Omega 6 and Omega 5 fatty acids and well balanced in essential amino acids.

It contains 40% protein, 20% oil, 17-19% carbohydrates, 5-6% crude fibre and 6-7% total minerals, protein has several health benefits including soy protein and its isoflavones which has beneficial role in obesity, reduces body weight and fat mass in addition to lowering plasma cholesterol, triglycerides. Soybean and soy foods may reduce the risk of a range of cardiovascular disease, stroke, coronary heart disease (CHD), some cancers as well as improving bone health.

SOPA said "Estimated total production of soybean crop for all India for the year 2021 is 119.98 lakh tons, which is higher by 14.337 lakh tons (13.71 per cent) as compared to last year". The production stood at 104.55 lakh tonnes last year, the production in Madhya Pradesh and Maharashtra stood at 41.8 lakh tonnes and 45.44 lakh tonnes last year. The estimated production of soybean Madhya Pradesh occupy first rank with 55.68 lakh tonnes followed by Maharashtra (43.84 lakh tonnes), Rajasthan (9.25 lakh tonnes), Karnataka (3.82 lakh tonnes), Telangana (3.48 lakh tonnes), Gujarat (2.23 lakh tonnes) and others (1.12 lakh tonnes).

So as to raise production the obstacles have to take in note are abiotic and biotic factors like insect-pests plays role into reduce the yield of crop. Since, soybean is recently introduced in Maharashtra state and getting good monetary returns, the area under this crop is increasing with a tremendous scope particularly in Vidarbha, South Maharashtra and Marathwada. Improved variety of soybean are JS-335, JS-80-21, JS-95-60, JS 93-05, JS 80-21, NRC 2 (Ahilya1), NRC 37, NRC-12, NRC-7 have been introduced in Indian states.

Due to severe attack of pests on soybean crop, there is no certainty of harvesting the crop in good condition. Therefore, it is necessary to manage the pests effectively. Whereas there are many methods of pest control like cultural, physical, mechanical, chemical, biological, and legal method, chemical one is the best, which gives quick results.

The selected insecticide molecules under this study were Lambda cyhalothrin 4.6% which included in class pyrethroid targets on nervous system as a sodium channel modulator, Chlorantraniliprole 9.3% ZC and 18.50% ZC categorised as non-neonicotinoid, Novaluron 5.25% SC under class benzoylurea insect growth regulator (IGR) targets the growth and development system acts as chitin synthesis inhibitor (CSI), Emamectin benzoate 5% SG under class avermectin targets on nervous system acts as chloride channel activator (CCA) (T. V. Prasad, 2020) and Spinetoram 11.7% SC is a semi synthetic pyrethroid. Considering the seriousness of the

pest infestation and damage to soybean crop, the present study was undertaken as entitled "Efficacy of different insecticides against tobacco leaf eating caterpillar (*Spodoptera litura* F) on soybean".

### Materials and Methods

The field experiment was conducted during Kharif season of 2020-2021 at farm of Krishi Vigyan Kendra, Dhule and College of Agriculture, Dhule. The variety used for study was 'JSS-335' with spacing 5 × 4 m.

### Method of Recording Observations of Tobacco leaf eating caterpillar

The population of tobacco leaf eating caterpillar was recorded. The average larval population per meter row length was recorded from randomly selected three locations of one meter row length, during early in the morning.

Treatment Details

Treatments	Name of Insecticides	Dosage / ha
		(G/ml per l).
T <sub>1</sub>	Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC	0.5
T <sub>2</sub>	Novaluron 5.25% + Emamectin benzoate 0.9% w/w SC	1.75
T <sub>3</sub>	Lambda cyhalothrin 5% EC	0.05
T <sub>4</sub>	Chlorantraniliprole 18.50% SC	0.3
T <sub>5</sub>	Emamectin benzoate 5% SG	0.44
T <sub>6</sub>	Spinetoram 11.7% SC	0.9
T <sub>7</sub>	Untreated control (water spray)	-

### Results and Discussion

To evaluate efficacy of insecticides on infestation of tobacco leaf eating caterpillar seven treatments were used with the untreated control. The result indicated that, all the insecticidal treatments were significantly superior over untreated control in recording lowest number of tobacco leaf eating caterpillar infestation.

The observations on average of tobacco leaf eating caterpillar infestation recorded at 3, 7 and 14 days after first and second spray revealed that, all the treatments were significantly superior over untreated control. The data revealed that all the treatments were significantly superior to the untreated control in checking the tobacco leaf eating caterpillar population at 3, 7 and 14 days after spray.

The data pertaining to effect of different chemical insecticides on the average population of tobacco caterpillar infesting soybean after two sprays are presented in Table 1 and depicted in Fig 1.

The data revealed that all the treatments were significantly superior to the untreated control in checking the tobacco leaf eating caterpillar population at 3, 7 and 14 days after spray. The result in respect of the trend of the efficacy of various chemical insecticides against tobacco leaf eating caterpillar are the same at 3, 7 and 14 days after spray.

The data recorded on third day after treatment application revealed that, all the treatments were significantly superior over untreated control. The average number of larvae/mrl ranged from 3.49 to 8.16 in the insecticidal treatments as against 11.16 in untreated control. The treatment with Chlorantraniliprole 18.5% SC @150 ml/ha was found significantly most effective against tobacco leaf eating caterpillar population (3.49/mrl) and Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC @ 250 ml/ha (5.49/mrl), Novaluron 5.25% + Emamectin benzoate 0.9% w/w SC @

875 ml/ha (5.49/mrl), Spinetoram 11.7% SC @ 450 ml/ha (5.88/mrl) shown significant effect and were at par. Thereafter, Emamectin benzoate 5% SG @ 220 g/ha (8.16 /mrl), Lambda cyhalothrin 5% EC @ 25 ml/ha (7.05/mrl).

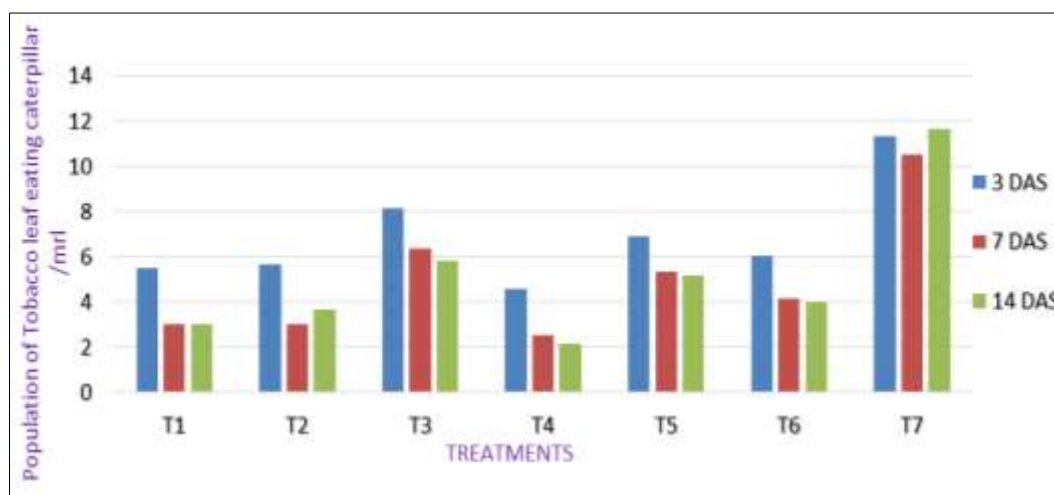
On seventh day after spray, all the treatments significantly reduced the tobacco leaf eating caterpillar population as compared to untreated control. The average number of larvae/mrl ranged from 1.99 to 8.16 in the insecticidal treatments as against 10.50 in untreated control. The Chlorantraniliprole 18.5% SC @ 150 ml/ha was found most effective treatment against tobacco leaf eating caterpillar and recorded minimum number of average tobacco leaf eating caterpillar population (1.99/mrl) and followed by Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC @ 250 ml/ha (2.99/mrl) which was at par with Novaluron 5.25% + Emamectin benzoate 0.9% w/w SC @ 875 ml/ha (3.00/mrl) and Spinetoram 11.7%SC @ 450 ml/ha (4.16/mrl), thereafter Lambda cyhalothrin 5% EC @ 25ml/ha (5.33/mrl), Emamectin benzoate 5% SG @ 220 g/ha (6.33/mrl).

At fourteenth day after spray, all the treatments significantly reduced population of the tobacco leaf eating caterpillar as compared to untreated control. The average number of larvae/mrl were ranged from 2.16 to 5.83 in the insecticidal treatments as against 11.66 in untreated control. The Chlorantraniliprole 18.5% SC @ 150 ml/ha was found most effective treatment against tobacco leaf eating caterpillar and minimize tobacco leaf eating caterpillar population (2.16/mrl), followed by Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC @ 250 ml/ha (3.00/mrl) which was at par with Novaluron 5.25% + Emamectin benzoate 0.9% w/w SC @ 875 ml/ha (3.66/mrl) and Spinetoram 11.7%SC @ 450 ml/ha (3.99/mrl), thereafter Lambda cyhalothrin 5% EC @ 25 ml/ha (5.16 /mrl) was at par with Emamectin benzoate 5% SG @ 220 g/ha (5.83/mrl).

**Table 1:** Cumulative effect of different chemical insecticides on survival population of tobacco leaf eating caterpillar (*S. litura*) of soybean (average of two sprays)

Sr. No.	Treatment details	Dose formulated product g/ml/ha	Survival population of leaf eating caterpillar per meter row length at		
			3 DAS	7 DAS	14 DAS
T <sub>1</sub>	Lambda cyhalothrin 4.6% + Chlorantraniliprole 9.3% ZC	250 ml	5.49 (2.51)	2.99 (1.99)	3.00 (1.98)
T <sub>2</sub>	Novaluron 5.25% + Emamectin benzoate 0.9% w/w SC	875 ml	5.49 (2.52)	3.00 (1.98)	3.66 (2.14)
T <sub>3</sub>	Lambda cyhalothrin 5% EC	25 ml	7.05(2.82)	5.33 (2.50)	5.16 (2.44)
T <sub>4</sub>	Chlorantraniliprole 18.5% SC	150 ml	3.49 (2.21)	1.99 (1.72)	2.16 (1.74)
T <sub>5</sub>	Emamectin benzoate 5% SG	220 gm	8.16 (3.00)	6.33 (2.70)	5.83 (2.57)
T <sub>6</sub>	Spinetoram 11.7% SC	450 ml	5.88 (2.58)	4.16 (2.25)	3.99 (2.16)
T <sub>7</sub>	Untreated		11.33 (3.51)	10.50 (3.39)	11.66 (3.55)
	SE +		0.08	0.15	0.07
	CD at 5%		0.25	0.47	0.22

DAS- Days after spray, Figures in parentheses indicate  $V_{n+1}$  transformed value,

**Fig 1:** Survival population of tobacco leaf eating caterpillar per meter row length (Average of two sprays)

In the present finding's insecticides Chlorantraniliprole 18.5% SC @ 150 ml/ha was found most effective in minimizing the tobacco leaf eating caterpillar population and showed their superiority over the other insecticides.

The present finding agrees with the results of Raut *et al.*, (2014) [9], was reported that Chlorantraniliprole 18.5% SC were most effective in minimizing the *Spodoptera litura* larval population. Similar results are also reported by Gadhiya *et al.*, (2014) [13] and Patil *et al.*, (2014) [14], Patil *et al.*, (2015) [8], Prashant *et al.*, (2016) [15], Sharma *et al.*, (2017) [10] and Toshima *et al.*, (2017) [16], DG Chaudhari, (2020) [3].

In results of present findings among the treatments were found effective for controlling the tobacco leaf eating caterpillar population. The results of present findings are corroborated with findings of earlier researchers as Abdullah *et al.*, 2001 [17], Srivastava, 2007 [18], Harish *et al.*, and Chaudhary *et al.*, 2009 [5].

### Conclusion

In efficacy studies of different insecticides against tobacco leaf eating caterpillar on soybean, the findings are as; The treatments with Chlorantraniliprole 18.5 SC @ 150 ml /ha, Chlorantraniliprole 9.3% +Lambda cyhalothrin 4.6% ZC @ 250 ml/ha, Novaluron + Emamectin benzoate 5 SG @ 875 ml/ha, were found significantly superior for the control of tobacco leaf eating caterpillar, among them Chlorantraniliprole 18.5 SC @ 150 ml /hahad highest BC

ratio (3.85) followed by Chlorantraniliprole 9.3% +Lambda cyhalothrin 4.6% ZC @ 250 ml/ha (3.09), Novaluron 5.25% + Emamectin benzoate 0.9% w/w SC @ 875 ml/ha (3.05), Lambda cyhalothrin 5% EC @ 25 ml/ha (2.73), Emamectin benzoate 5% SG @ 220 g/ha (2.77) and Spinetoram 11.7% SC @ 450 ml/ha (2.61).

The monetary return (Rs. 1,35,160/-) and net income (Rs. 1,00,060/-) were found maximum treatment with Chlorantraniliprole 18.5% SC @ 150 ml /ha. It was followed by Chlorantraniliprole 9.3% +Lambda cyhalothrin 4.6% ZC 250 ml/ha (Rs. 1,06,020/- and Rs. 71,808/-), Novaluron 5.25% + Emamectin benzoate 0.9% w/w @875 ml/ha (Rs. 1,04,160/- and Rs. 70,097.5/-), Spinetoram 11.7%SC @ 450ml/ha (Rs. 1,01,060/- and Rs. 94,760/-), Emamectin benzoate 5% SG @ 220 g/ha (Rs.89,900/- and Rs. 57,482.5/-) and Lambda cyhalothrin 5% EC @ 25 ml/ha (Rs.93,620/- and Rs. 59,420/-).

All these treatments provide better yield and higher Incremental Cost Benefit Ratio. The highest (6.24) ICBR was found in Spinetoram 11.7% SC @ 450 ml/ha. It was followed by Chlorantraniliprole 18.5% SC @ 150 ml /ha (5.66), Chlorantraniliprole 9.3% +Lambda cyhalothrin 4.6% ZC @ 250 ml/ha (5.53), Emamectin benzoate 5% SG @ 220 g/ha (5.53), Novaluron 5.25% + Emamectin benzoate 0.9% w/w SC @ 875 ml/ha (5.23) and Lambda cyhalothrin 5% EC @ 25 ml/ha (5.50).

**Table 2:** Economics of the different treatments

Sr. No.	Treatments	Dose formulated product g/ml/ha	Yield q/ha	Additional yield over control q/ha	Additional Income over control (Rs.)	Cost of cultivation + Cost of insecticide (Rs.)	Monetary return (Rs.)	Net Income	B:Cratio	ICBR	Rank
T <sub>1</sub>	Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC	250 ml	17.10	6.85	42,470	34,212.5	1,06,020	71,808	3.09	5.53	3
T <sub>2</sub>	Novaluron 5.25% + Emamectin benzoate 0.9% w/w SC	875 ml	16.80	6.55	40,610	34,062.5	1,04,160	70,097.5	3.05	5.50	4
T <sub>3</sub>	Lambda cyhalothrin 5% EC	25 ml	14.50	4.85	26,350	32,417.5	89,900	57,482.5	2.73	5.53	3
T <sub>4</sub>	Chlorantraniliprole 18.5% SC	150 ml	21.80	11.55	71,610	35,100	1,35,160	1,00,060	3.85	5.66	2
T <sub>5</sub>	Emamectin benzoate 5% SG	220 gm	15.10	4.25	30,070	34,200	93,620	59,420	2.77	5.23	5
T <sub>6</sub>	Spinetoram 11.7% SC	450 ml	16.30	6.05	37,510	38,700	1,01,060	94,760	2.61	6.24	1
T <sub>7</sub>	Untreated control	--	10.25	--	--	32,400	63,550	40,550	1.60	--	

**Total cost of cultivation except insecticide control: Rs. 32,400/-**

Cost of insecticides (Rs.):

1. Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC: Rs. 1812.5/250ml
2. Novaluron 5.25% + Emamectin benzoate 0.9% w/w SC: Rs. 1662.5/875ml
3. Lambda cyhalothrin 5% SC: Rs. 17.5/25 ml
4. Chlorantraniliprole 18.5% SC: Rs. 2700/150 ml
5. Emamectin benzoate 5% SG: Rs. 1800/220 gm
6. Spinetoram 11.7% SC: Rs. 6300/450 ml
7. Price of soybean grains: Rs. 6,200/ql.

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