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Evaluation of indoxacarb 14.5% SC for the management of lepidopteron pests in soybean

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Abstract

The present study was conducted to evaluate the efficacy of different doses of Indoxacarb 14.5% SC along with other insecticides for the management of *Spodoptera litura*, *Helicoverpa armigera* and other lepidopteron pests infesting soybean. Results of the field experiments revealed that among the treatments evaluated, Indoxacarb 14.5% SC @ 500 ml/ha and 400 ml/ha were proved superior by recording lowest larval population of lepidopteron pests and recorded highest grain yield.

Keywords: Indoxacarb 14.5% SC, *Spodoptera litura*, *Helicoverpa armigera*, soybean

1. Introduction

Soybean (*Glycine max* (L.) Merrill) is a unique crop with high nutritional value, providing 40% protein and 20% edible oil, besides minerals and vitamins. Soybean protein is rich in amino acids like lysine, methionine and cystine. Soybean ranks first among the oilseeds in the world as well as in India. In India it is grown in 10.27 million hectares with production of 11.0 million tonnes and an average yield of 1,071 kg/ ha^[1]. Soybean accounts more than 0.22 million hectares area with production of 0.23 million tonnes in Karnataka. In India, soybean productivity is lower than world average due to biotic as well as abiotic factors. Among the biotic factors, insect pests are of economically important.

Soybean is reported to be attacked by 273 species of insects^[10] and in India 20 insect pest species have been recorded infesting soybean crop^[11]. Some common insect pest complex infesting soybean crops are green semilooper, tobacco leaf eating caterpillar, white fly, girdle beetle etc.,^[12]. The defoliators [*Spodoptera litura* (Fab.), *Thysanoplusia orichalcea* (Fab.), *Spilarctia obliqua* (Walk.)] and *Helicoverpa armigera* (Hubner) are feeding on foliage, flower and pods causing significant yield loss^[11]. Taking in to consideration the seriousness of the pest infestation and damage to soybean crop, the present study was undertaken to manage the pest with the help of chemical insecticides.

2. Materials and Methods

The field experiments were conducted for two consecutive years during kharif 2014-15 and 2015-16 at Agricultural Research Station Bidar. The experiment was laid out in Randomized block design with seven treatments replicated thrice [as detailed in Table1]. Soybean var. JS 335 was sown at 45cm ×10cm spacing and all the recommended package of practices was followed to raise the crop, except plants protection measures. First spray was done at initiation of pest infestation in all the experimental plots and subsequent sprays were given at fifteen days intervals.

Observations on incidence of *Helicoverpa armigera*, *Spodoptera litura* and other lepidopteron pests were recorded at one day before spray, 3 and 7 days after each spray at three randomly selected spots of one meter row length in each plot, leaving border rows. The seed yield was recorded plot wise at the time of harvest and converted in to hectare basis.

The data thus collected was subjected to analysis of variance after making necessary transformation.

3. Results and Discussion

The pooled results of first and second season revealed that of larval population of *S. litura* at one day before imposing the treatment ranged from 1.97 to 2.30 larvae per mrl (Table 1) which were on par with each other.

Three days after imposing the treatments, indoxacarb 14.5% SC @ 500 ml/ha recorded significantly least larval population (1.10 larvae/ mrl) which was on par with indoxacarb 14.5% SC @ 400 ml/ha with 1.27 larvae/ mrl. These two treatments were followed by indoxacarb 15.8% EC @ 333 ml/ha and indoxacarb 14.5% SC @ 333 ml/ha with 1.50 and 1.53 larvae/ mrl respectively. However, highest population was recorded in untreated control (2.63 larvae/ mrl). Further, at seven days after the first spray, indoxacarb 14.5% SC @ 500 ml/ha recorded significantly least larval population (0.54 larvae/ mrl) which was followed by indoxacarb 14.5% SC @ 400 ml/ha and indoxacarb 15.8% EC @ 333 ml/ha with 0.74 and 0.78 larvae/ mrl respectively. These two treatments were followed by indoxacarb 14.5% SC @ 333 ml/ha (1.14 larvae/ mrl), indoxacarb 14.5% SC @ 200 ml/ha (1.47 larvae/ mrl), triazophos 40% EC @ 625 ml/ ha (1.74 larvae/ mrl). However, highest population was recorded in untreated control (3.10 larvae/ mrl) (Table 1). During second spray, similar trend of results were observed as that of first spray at 3rd and 7th day after second spray.

The initial larval population of *H. armigera*, a day before imposing the treatment ranged from 1.77 to 1.97 larvae/ mrl which were on par with each other. At three days after imposing the treatments, indoxacarb 14.5% SC @ 500 ml/ha recorded significantly least larval population of 0.96 larvae/ mrl which was followed by indoxacarb 14.5% SC @ 400 ml/ha and indoxacarb 15.8% EC @ 333 ml/ha with 1.15 larvae/ mrl and 1.30 larvae/ mrl respectively. These two treatments were followed by indoxacarb 15.8% EC @ 333 ml/ha (1.35 larvae/ mrl), indoxacarb 14.5% SC @ 200 ml/ha (1.35 larvae/ mrl) and triazophos 40% EC @ 625 ml/ ha (1.55 larvae/ mrl). However, highest population was recorded in untreated control (1.93 larvae/ mrl). At seven days after the first spray, indoxacarb 14.5% SC @ 500 ml/ha and 400 ml/ha recorded significantly least larval population of 0.65 larvae/ mrl and 0.85 larvae/mrl respectively. These two treatments were followed by indoxacarb 15.8% EC @ 333 ml/ha (1.10 larvae/ mrl), indoxacarb 14.5% SC @ 333 ml/ha (1.20 larvae/ mrl) and indoxacarb 14.5% SC @ 200 ml/ha (1.24 larvae/ mrl). However, highest population was recorded in untreated control (2.20 larvae/ mrl) (Table 2). During second spray, similar trend of results were observed with respect to *H. armigera* larval population as that of first spray at 3rd and 7th day after second spray.

A day before imposing the treatments, initial larval population of other lepidopteron pests like, semiloopers, hairy caterpillars and other lepidopteron pests ranged from 2.04 to 2.30 larvae/ mrl which were on par with each other. Three

days after spray indoxacarb 14.5% SC @ 500 ml/ha recorded significantly least larval population of 0.88 larvae/ mrl which was followed by indoxacarb 14.5% SC @ 400 ml/ha and indoxacarb 15.8% SC @ 333 ml/ha with 1.17 larvae/ mrl and 1.70 larvae/ mrl respectively. These two treatments were followed by indoxacarb 15.8% EC @ 333 ml/ha (1.74 larvae/ mrl), indoxacarb 14.5% SC @ 200 ml/ha (1.88 larvae/ mrl) and Triazophos 40% EC @ 625 ml/ ha (1.96 larvae/ mrl). However, highest population was recorded in untreated control (2.24 larvae/ mrl). Seven days after the first spray, larval population of lepidopteron pests followed same trend as that of three days after imposing the treatments. During second spray, similar trend of results were observed with respect to larval population of other lepidopterons as that of first spray at 3rd and 7th day after second spray.

3.1 Yield

Over the two years maximum seed yield was recorded in the treatments indoxacarb 14.5% SC @ 500 ml /ha and 400 ml/ha with seed yield of 14.87 q/ha and 13.71 q/ha respectively. These two treatments were followed by indoxacarb 15.8% EC @ 333 ml/ha (12.37 q/ha), indoxacarb 14.5% SC @ 333 ml/ha (11.06 q/ha), indoxacarb 14.5% SC @ 200 ml/ha (9.34 q/ha) and triazophos 40% EC @ 625 ml/ ha (8.41 q/ha). However, lowest seed yield was recorded in untreated control (6.58 q/ha) (Table 3).

The results of the present study reveals that, indoxacarb 14.5% SC @ 500 ml/ha and 400 ml/ha can be used on Soybean crop for the management of the *Spodoptera litura*, *Helicoverpa armigera* and lepidopteron pests, as these two treatments recorded lowest pest population and highest seed yield of soybean. These findings are in accordance with the findings where indoxacarb 14.5% SC was found most effective in managing *S. litura* and found next best treatment after flubendiamide 480 SC in soybean [7] and there are reports where, Indoxacarb and spinosad were proved potential insecticides against soybean defoliators [5, 6].

Further, novel insecticides indoxacarb and novaluron can manage *Helicoverpa* up to 95.83 per cent and 87.12 per cent respectively [13]. The 2nd instar larvae of *Spodoptera littoralis* are more susceptible to indoxacarb than 4th instar [3]. The evaluated results of the LC50 and LC90 values of indoxacarb against *Spodoptera exigua* which were 2.510 and 38.828 mg a.i. /l respectively [9]. The indoxacarb proved to be very effective in managing *H. armigera* and *S. litura* [2, 8, 11]. Novel insecticides like indoxacarb being target specific to lepidopteran pest could not affect the natural enemies [4].

Table 1: Bio-efficacy of Indoxacarb 14.5% SC against *Spodoptera litura* on soybean during kharif, 2014 and 2015 (Pooled)

Treatments	Dosage	No. of larvae/ mrl					
		I st - Spray			II nd - Spray		
		1 DBS	3 DAS	7 DAS	1 DBS	3 DAS	7 DAS
T1- Indoxacarb 14.5% SC	200 ml/ha	2.24	1.77	1.47	1.60	1.23	0.94
		(1.80)	(1.66)	(1.57)	(1.61)	(0.04)	(1.39)
T2- Indoxacarb 14.5% SC	333 ml/ha	2.04	1.53	1.14	1.33	1.00	0.67
		(1.74)	(1.59)	(1.46)	(1.53)	(1.42)	(1.29)
T3- Indoxacarb 14.5% SC	400 ml/ha	2.10	1.27	0.74	0.87	0.53	0.30
		(1.76)	(1.51)	(1.32)	(1.37)	(1.24)	(1.14)
T4- Indoxacarb 14.5% SC	500 ml/ha	1.97	1.10	0.54	0.67	0.37	0.20
		(1.72)	(1.45)	(1.24)	(1.29)	(1.17)	(1.10)
T5- Indoxacarb 15.8% EC	333 ml/ha	2.17	1.50	0.78	1.10	0.84	0.63
		(1.77)	(1.58)	(1.33)	(1.45)	(1.36)	(1.28)
T6- Triazophos 40% EC	625 ml/ha	2.30	2.00	1.74	2.00	1.54	1.14
		(1.82)	(1.73)	(1.65)	(1.73)	(1.59)	(1.46)

T7- UTC	-	2.30	2.63	3.10	3.87	4.03	4.14
		(1.80)	(1.90)	(2.02)	(2.20)	(2.24)	(2.26)
SEm±		0.07	0.08	0.08	0.08	0.06	0.06
CD(0.05)		NS	0.24	0.24	0.23	0.17	0.19

DBS: Day Before Spraying; DAS: Days after Spray; Figures in the parentheses are square root transformed values $\sqrt{(x+1)}$

Table 2: Bio-efficacy of Indoxacarb 14.5% SC against *Helicoverpa armigera* on soybean during kharif, 2014 and 2015 (Pooled)

Treatments	Dosage	No. of larvae/ mrl					
		I st - Spray			II nd - Spray		
		1 DBS	3 DAS	7 DAS	1 DBS	3 DAS	7 DAS
T1- Indoxacarb 14.5% SC	200 ml/ha	1.84	1.48	1.24	1.54	1.20	0.98
		(1.68)	(1.58)	(1.49)	(1.59)	(1.48)	(1.41)
T2- Indoxacarb 14.5% SC	333 ml/ha	1.84	1.35	1.20	1.37	1.07	0.83
		(1.68)	(1.53)	(1.49)	(1.54)	(1.44)	(1.36)
T3- Indoxacarb 14.5% SC	400 ml/ha	1.90	1.15	0.85	1.17	0.83	0.61
		(1.70)	(1.47)	(1.36)	(1.47)	(1.36)	(1.26)
T4- Indoxacarb 14.5% SC	500 ml/ha	1.97	0.96	0.65	0.99	0.53	0.32
		(1.72)	(1.40)	(1.29)	(1.41)	(1.24)	(1.15)
T5- Indoxacarb 15.8% EC	333 ml/ha	1.93	1.30	1.10	1.30	0.90	0.77
		(1.71)	(1.52)	(1.45)	(1.52)	(1.38)	(1.33)
T6- Triazophos 40% EC	625 ml/ha	1.77	1.55	1.44	1.74	1.30	1.14
		(1.66)	(1.59)	(1.56)	(1.65)	(1.52)	(1.46)
T7- UTC	-	1.87	1.93	2.20	2.65	2.75	2.98
		(1.68)	(1.71)	(1.78)	(1.90)	(1.93)	(1.99)
SEm±		0.07	0.04	0.06	0.06	0.05	0.06
CD(0.05)		NS	0.12	0.20	0.18	0.18	0.18

DBS: Day Before Spraying; DAS: Days after Spray; Figures in the parentheses are square root transformed values $\sqrt{(x+1)}$

Table 3: Bio-efficacy of Indoxacarb 14.5% SC against other lepidopterous pests occurring on soybean and soybean grain yield during kharif, 2014 and 2015 (Pooled)

Treatments	Dosage	No. of larvae/ mrl						Yield (q/ha)
		I st - Spray			II nd - Spray			
		1 DBS	3 DAS	7 DAS	1 DBS	3 DAS	7 DAS	
T1- Indoxacarb 14.5% SC	200 ml/ha	2.24	1.88	1.65	1.86	1.55	1.10	9.34
		(1.79)	(1.70)	(1.63)	(1.69)	(1.60)	(1.45)	
T2- Indoxacarb 14.5% SC	333 ml/ha	2.17	1.70	1.54	1.65	1.20	1.03	11.06
		(1.78)	(1.64)	(1.59)	(1.63)	(1.49)	(1.43)	
T3- Indoxacarb 14.5% SC	400 ml/ha	2.30	1.17	1.00	1.36	0.87	0.67	13.71
		(1.82)	(1.48)	(1.42)	(1.54)	(1.37)	(1.29)	
T4- Indoxacarb 14.5% SC	500 ml/ha	2.30	0.88	0.63	1.17	0.57	0.29	14.87
		(1.82)	(1.37)	(1.28)	(1.47)	(1.25)	(1.13)	
T5- Indoxacarb 15.8% EC	333 ml/ha	2.04	1.74	1.43	1.60	1.14	1.00	12.37
		(1.74)	(1.65)	(1.56)	(1.61)	(1.46)	(1.42)	
T6- Triazophos 40% EC	625 ml/ha	2.17	1.96	1.77	1.95	1.60	1.44	8.41
		(1.78)	(1.72)	(1.66)	(1.72)	(1.61)	(1.56)	
T7- UTC	-	2.04	2.24	2.47	2.70	2.80	2.97	6.58
		(1.73)	(1.79)	(1.85)	(1.92)	(1.94)	(1.99)	
SEm±		0.06	0.06	0.07	0.07	0.06	0.07	0.46
CD(0.05)		NS	0.19	0.22	0.19	0.19	0.22	1.39

DBS: Day Before Spraying; DAS: Days after Spray; Figures in the parentheses are square root transformed values $\sqrt{(x+1)}$

4. Conclusion

Indoxacarb 14.5% SC @ 500 ml/ha and 400 ml/ha can be used on Soybean crop for the management of the *Spodoptera litura*, *Helicoverpa armigera* and lepidopteron pests, as these two treatments recorded lowest pest population and highest seed yield of soybean.

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