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FIELD EVALUATION OF SOME NEWER INSECTICIDES AGAINST *SPODOPTERA LITURA* IN SOYBEAN

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Abstract

A Field experiment was conducted at JNKVV, DHRTC farm during 2014 & 2015 to evaluate the effectiveness of eleven insecticides including untreated check against tobacco caterpillar, *Spodoptera litura* Fab.. All the insecticides were capable of keeping the population of larvae at the minimum level and significant differences were noted among the treatments at 1, 2, 3 and 7 days after first and second spray of insecticides compared to untreated check. The treatment $\mathbf{T_4}$ (Flubendiamide 480 SC) exhibited its superiority by registering the lowest larval population of 0.90 and 0.20 per meter row length during first and second spray, respectively. The overall order of effectiveness of these insecticides against *S.litura* was found to be Flubendiamide 480 SC > Indoxacarb 14.5 Sc > Spinosad 45 SC > Thiodicarb 75 WP > Emmamectin benzoate 5 SG > Rynaxypyre 20 Sc > Fipronil 5% SL > Imidacloprid 17.8 SL > Thiomethoxom 25% WG > Chloropyriphos 20 EC. The highest seed yield of 16.88 q/ha. was obtained in the plots treated with Flubendiamide 480 SC. The next effective treatments was Indoxacarb 14.5 SC followed by Spinosad 45 SC recorded 14.90 and 14.77 q/ha. The protection efficiency was higher being 88.27 percent with 11.72 percent losses in seed yield in Indoxacarb 14.5 SC. Maximum yield loss 43.72 percent was noticed in untreated crop against 11.72 to 37.79 percent in different insecticidal treatments.

Key words : Bioefficacy, novel insecticides, *Spodoptera litura.*

Introduction

India is one of the major oilseeds producing country in the world and these are the second largest agricultural commodity in India after cereals occupying 13-14% of gross cropped area (Sreekanth *et al*., 2013). In the world it is cultivated mainly in USA, China, Brazil, Argentina and India. In India, it is grown over an area of 10.02 million hectares with production of 11.64 million tones and productivity of 1161 kg/ha (Annon., 2014-15). The average productivity of Soybean crop is quite low due to a number of abiotic and biotic stresses, e.g. non-adoption of improved technology and cultivation in marginal lands having low fertility. In addition, the insect-pests and diseases also cause heavy damage to the yield potential of soybean crop. About 380 species of insects have been reported on soybean crop from many parts of the world. In India, soybean is reported to be attacked by 273 species of insects, 1 mite, 2 millipedes, 10 vertebrates and 1 snail (Singh, 1999) The soybean crop is damaged at various stages of plant growth by a number of insect-pests *viz*., jassid (*Amrasca biguttula* Ishida), white fly (*Bemisia tabaci* Genn.), girdle beetle (*Oberia brevis* S.), bihar hairy caterpillar (*Spilosoma obliqua* Walk.) tobacco caterpillar (*Spodoptera litura* Fab.), green semilooper (*Plusia orichalcea* Fab.), Pod borer (*Helicoverpa armigera* Hub.) etc. The defoliators, *Spodoptera litura*, *Thysanoplusia orichalcea*, *Spilosoma obliqua* and *Helicoverpa armigera* feed on foliage, flower and pods causing significant yield loss. Defoliation often reaches population levels that significantly reduce the yield in soybean. Among the different defoliators, tobacco caterpillar (*Spodoptera litura)* is a serious and devastating polyphagous pest. Larvae feeds on the foliage results in complete defoliation and in case of severe infestation, complete devastation of soybean crop occurs. This pest has been reported to attack over 112 cultivated plant species of which 60 are from India and distributed in much of Asia, including tropical, subtropical and temperate areas and Oceania (Venette *et al.*, 2003). Yield losses in soybean are directly associated with higher larval densities and increased

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defoliation (GeonHwi *et al*., 2006). Chemical control strategies remain the main tool in the suppression of soybean defoliators. In the past, defoliators were controlled using broad spectrum insecticides such as organochlorines, organophosphates, synthetic pyrethroids and carbamates. Overuse and reliance on these insecticides led to many documented cases of resistance of virtually all classes of insecticides (Brewer *et al*., 1990 & Wolfenbanger & Brewer, 1993). Keeping this in view, study were undertaken to test the bioefficacy of some newer insecticides against tobacco caterpillar in soybean.

Materials and Method

The field experiment was laid out during the year 2014 & 2015 in a Randomized Block Design with three replication having plot size of 5 × 5 m at JNKVV, DHRTC Farm, Garhakota, District- Sagar (M.P.). The cultivar JS-335 were sown on 28th June 2014 & 30th June, 2015 with all the recommended packages of practices were followed in establishing plants except insect pest management. Different treatment comprising of eleven insecticides including untreated check were applied with the help of manually operated hand knapsack sprayer. Observations on effect of insecticides on the larval population of *Spodoptera litura* were recorded a day before and after one, two, three and seven days of the sprays. The population of *S. litura* were recorded at three randomly selected spots of one meter row length in each treatment leaving border rows. Larval count was made by shaking the plant gently over a white cloth placed between rows. The yield of soybean was recorded after harvesting of the crop and analysed statistically. Protection efficiency and yield losses for each treatment were calculated with the given formula :

$$\text{Protection efficiency (\%)} = \frac{B}{A} \times 100$$

$$\text{Yield loss (\%)} = \frac{A - B}{A}$$

Where,

A = Seed yield in best treatment

B = Seed yield in testing treatment

Results and Discussion

Efficacy of insecticides against *S. litura*:

The results pertaining to the efficacy of insecticides on *S. litura* larval population on a day before and at 1, 2, 3 and 7 days after spraying are given in (table-2 and 3). The pooled results of first spray (table-2) indicates that the larval population ranged from 2.97 to 3.26 larvae per meter row length (mrl) before application of insecticides and there was no significant differences exists among the treatments. It is evident that all the insecticides were capable of keeping the population of larvae at the minimum level and significant differences were noted among the treatments at 1, 2, 3 and 7 days after application of insecticides compared to untreated check. At one day after spray, the larval population varied from 1.30 to 2.47 larvae per mrl among the treatments as against 3.00 larvae per mrl in untreated check. However, all the treatments significantly registered less number of larvae compared to untreated check. The treatment T_4 recorded minimum larval population 1.30 per mrl found most effective and significantly superior over all other treatments. The next effective treatment was T_2 followed by T_8 recorded 1.53 and 1.55 larvae per mrl, respectively. Both treatments were significantly superior over other treatments except treatment T_4. The treatments T_3, T_1, T_7, T_5, T_6, T_9 and T_{10} were next in order of efficacy which recorded the larval population of 1.73, 1.78, 1.80, 2.08, 2.11, 2.11 and 2.47 per meter row length, respectively. The trend for these insecticides for 2, 3 and 7 days was more or less similar to those of one days interval.

The pooled results of second spray (table-3) revealed that the larval population of *S. litura* on a day before imposing the insecticides ranged from 0.76 to 2.98 larvae per meter row length (mrl) and there was no significant differences exists among the treatments at one, two, three and seven day after spray, all the insecticidal treatments were found significantly superior over untreated check. The overall mean larval population per mrl ranged from 0.20 to 0.84 larvae per mrl among the treatments as

Table 1: Treatment details for the bio efficacy of newer insecticide against *S. litura* in soybean.

Treatment No.	Treatment Details	Formulation	Dosages
T_1	Emmamectin benzoate	5 SG	0.5g/l
T_2	Indoxacarb	14.5 SC	0.25 ml/l
T_3	Thiodicarb	75 WP	0.2g/l
T_4	Flubendiamide	480 SC	0.5 ml/l
T_5	Fipronil	5% SL	0.2ml/l
T_6	Imidacloprid	17.8 SL	2ml/l
T_7	Rynaxypyre	20 SC	0.25g/l
T_8	Spinosad	45 SC	1ml/l
T_9	Thiamethoxam	25% WG	2 g/l
T_{10}	Chloropyriphos	20 EC	0.2 ml/l
T_{11}	Untreated Check	-	0.75 g/l

Table 2 : Pooled mean bio efficacy of newer insecticides against *S. litura* during *Kharif* 2014 and 2015 after I spray.

Treatments	Dosage	1 DBS No. of larvae/ mrl	After first spray *No. of larvae / mrl				
			1 DAS	2 DAS	3 DAS	7 DAS	Mean
Emmamectin benzoate 5SG	0.2g/l	3.06 (1.88)	1.78 (1.50)	1.43 (1.38)	1.22 (1.31)	0.98 (1.21)	1.35 (1.36)
Indoxacarb 14.5 SC	0.5ml/l	3.12 (1.90)	1.53 (1.42)	1.06 (1.24)	0.85 (1.16)	0.79 (1.13)	1.05 (1.24)
Thiodicarb 75WP	0.75g/l	2.97 (1.86)	1.73 (1.49)	1.38 (1.37)	1.17 (1.29)	0.92 (1.19)	1.30 (1.34)
Fiubendiamide 480 SC	0.2g/l	3.21 (1.92)	1.30 (1.34)	0.95 (1.20)	0.71 (1.10)	0.65 (1.07)	0.90 (1.18)
Fipronil 5% SL	1ml/l	3.09 (1.89)	2.08 (1.60)	1.45 (1.39)	1.29 (1.33)	1.13 (1.27)	1.48 (1.40)
Imidacloprid 17.8 SL	0.25ml/l	3.15 (1.91)	2.11 (1.61)	1.76 (1.50)	1.48 (1.40)	1.22 (1.31)	1.64 (1.46)
Rynaxypyre 20 SC	0.2ml/l	3.26 (1.93)	1.80 (1.51)	1.43 (1.38)	1.26 (1.32)	1.07 (1.25)	1.39 (1.37)
Spinosad 45 SC	0.2ml/l	3.08 (1.89)	1.55 (1.43)	1.20 (1.30)	0.93 (1.19)	0.84 (1.15)	1.13 (1.27)
Thiomethoxom 25% WG	0.5g/l	3.17 (1.91)	2.11 (1.61)	1.76 (1.50)	1.51 (1.41)	1.29 (1.33)	1.66 (1.46)
Chloropyriphos 20 EC	2ml/l	3.17 (1.91)	2.47 (1.72)	2.12 (1.61)	1.79 (1.51)	1.37 (1.36)	1.93 (1.55)
Untreated Check	-	2.95 (1.85)	3.00 (1.87)	3.06 (1.88)	3.08 (1.89)	3.09 (1.89)	3.05 (1.88)
CD (p=0.05)		NS	0.018	0.010	0.009	0.012	
SEm±		0.004	0.006	0.003	0.003	0.004	

NS= non significant, DBS= day before spray, DAS = day after spray, mrl = metre row length
*Average mean of three replications, Figure in parentheses are +0.5 transformed values

against 3.01 larvae per mrl. The treatment T_4 exhibited its superiority by registering the lowest larval population of 0.20 per mrl and the highest larval population of 0.84 was recorded in treatment of T_{10}. The overall order of effectiveness of these insecticides against *S.litura* was found to be Flubendiamide 480 SC > Indoxacarb 14.5 Sc > Spinosad 45 SC > Thiodicarb 75 WP > Emmamectin benzoate 5 SG > Rynaxypyre 20 Sc > Fipronil 5% SL > Imidacloprid 17.8 SL > Thiomethoxom 25% WG > Chloropyriphos 20 EC. The reviews pertaining to efficacy of flubendiamide 480 SC 0.2 ml/l in soybean are lacking as it is new molecule. However, its superiority in managing the pests in various other crops has been well documented. The newer molecule flubendiamide 20 WG @ 50 g a.i./ha was found superior in reducing the incidence of fruit borers in chilli with highest yield (Tatagar *et al*., 2009). Flubendiamide 20 WG @ 35 g a.i./ha was the most effective in reducing the incidence of rice stem borer, *Scirphophaga incertulas* (Walker) and leaf folder *Cnaphalocrosis medinalis* (Guen.) and recorded the higher yield (Mallikarjunappa *et al*., 2008). Flubendiamide 20 WG was found highly effective against, *H. armigera* on cotton (Lakshminarayana *et al*., 2006) Flubendiamide application showed better performance in reducing 80.63 per cent fruit infestation by *Leucinodes orbonalis* and produced the higher fruit yield in brinjal (Abdul Latif *et al*., 2009). Flubendiamide 480 SC @ 50 ml /ha caused significantly higher reduction of diamond back moth damage in cabbage (Ameta and Bunker, 2007). Tohnishi *et al*. 2005 reported the strong activity of flubendiamide 480 SC against lepidopteran insect pests and its severity towards non target organisms. The present results corroborate with that of Harish (2008) who noticed Emamectin benzoate and spinosad were found effective against leaf defoliators. Baldwin *et al*. (2011) reported that thiodicarb were effective against soybean loopers in Louisiana. The results of the present investigation supported by the finding of Knight *et al.* (2000) who

Table 3 : Pooled mean bio efficacy of newer insecticides against *S. litura* during *Kharif* 2014 and 2015 after II spray.

Treatments	Dosage	1 DBS No. of larvae/ mrl	After first spray *No. of larvae / mrl 1 DAS	2 DAS	3 DAS	7 DAS	Mean
Emmamectin benzoate 5SG	0.2g/l	1.04 (1.24)	0.86 (1.16)	0.69 (1.09)	0.33 (0.91)	0.20 (0.83)	0.52 (1.00)
Indoxacarb 14.5 SC	0.5ml/l	0.98 (1.21)	0.57 (1.03)	0.50 (1.00)	0.22 (0.84)	0.09 (0.76)	0.34 (0.91)
Thiodicarb 75WP	0.75g/l	1.09 (1.26)	0.79 (1.13)	0.63 (1.06)	0.30 (0.89)	0.18 (0.82)	0.47 (0.98)
Fiubendiamide 480 SC	0.2g/l	0.76 (1.12)	0.36 (0.92)	0.31 (0.90)	0.12 (0.78)	0.04 (0.73)	0.20 (0.83)
Fipronil 5% SL	1ml/l	1.19 (1.30)	1.03 (1.23)	0.90 (1.18)	0.48 (0.98)	0.27 (0.87)	0.67 (1.08)
Imidacloprid 17.8 SL	0.25ml/l	1.28 (1.33)	1.07 (1.25)	0.93 (1.19)	0.51 (1.00)	0.30 (0.89)	0.70 (1.09)
Rynaxypyre 20 SC	0.2ml/l	1.11 (1.26)	0.98 (1.21)	0.82 (1.14)	0.36 (0.92)	0.22 (0.84)	0.59 (1.04)
Spinosad 45 SC	0.2ml/l	0.98 (1.21)	0.61 (1.05)	0.55 (1.02)	0.25 (0.86)	0.13 (0.79)	0.38 (0.93)
Thiomethoxom 25% WG	0.5g/l	1.36 (1.36)	1.14 (1.28)	1.04 (1.24)	0.74 (1.11)	0.34 (0.91)	0.81 (1.14)
Chloropyriphos 20 EC	2ml/l	1.41 (1.38)	1.17 (1.29)	1.05 (1.24)	0.76 (1.12)	0.39 (0.94)	0.84 (1.15)
Untreated Check	-	2.98 (1.86)	3.00 (1.87)	3.00 (1.87)	3.02 (1.87)	3.04 (1.88)	3.01 (1.87)
CD (p= 0.05)		NS	0.017	0.019	0.012	0.024	
SEm±		0.050	0.006	0.006	0.004	0.008	

NS= non significant, DBS= day before spray, DAS = day after spray, mrl = metre row length
*Average mean of three replications, Figure in parentheses are +0.5 transformed values

Table 4: Pooled mean of effect of newer insecticides on the yield of soybean of *Kharif* 2014 and 2015.

Treatments Details	Dosage	*Mean yield (q/ha.)	Increased yield over control (q/ha.)	Protection efficiency (%)	Yield loss (%)
Emmamectin benzoate 5SG	0.5g/l	12.90	3.40	76.42	23.57
Indoxacarb 14.5 SC	0.25 ml/l	14.90	5.40	88.27	11.72
Thiodicarb 75WP	0.2g/l	13.45	3.95	79.68	20.31
Fiubendiamide 480 SC	0.5 ml/l	16.88	7.38	100	0
Fipronil 5% SL	0.2ml/l	11.20	1.70	66.35	33.64
Imidacloprid 17.8 SL	2ml/l	10.85	1.35	64.27	35.72
Rynaxypyre 20 SC	0.25g/l	12.66	3.16	75.00	25.00
Spinosad 45 SC	1ml/l	14.77	5.27	87.50	12.50
Thiomethoxom 25% WG	2 g/l	11.45	1.95	67.83	32.16
Chloropyriphos 20 EC	0.2 ml/l	10.50	1.00	62.20	37.79
Untreated Check	0.75 g/l	9.50	-	56.27	43.72
CD at 5 %	**0.63**				
SEm±	**0.20**				

*Average of three replications

reported Indoxacarb and spinosad were potential insecticides against soybean defoliators.

Effect of insecticides on the yield of soybean:

Perusal of the pooled data of soybean seed yield presented in table-4 revealed that all the insecticidal treatments performed significantly better than control. The highest seed yield of 16.88 q/ha. was obtained in the plots treated with Flubendiamide 480 SC. The next effective treatments was Indoxacarb 14.5 SC followed by Spinosad 45 SC recorded 14.90 and 14.77 q/ha. The yield obtained in both these treatments were significantly superior over other treatments but lower than those of Flubendiamide

480 SC. The minimum seed yield of 10.50 q/ha was obtained in the treatment of chloropyriphos 20 EC in comparison to 9.50 q/ha in control. As the treatments of Flubendiamide 480 SC reduced maximum larval population with higher seed yield, the protection efficiency as well extent of losses in different treatments was calculated against the treatments (table-4). The protection efficiency was higher being 88.27, 87.50, 79.68, 76.42 and 75.00 percent with 11.72, 12.50, 20.31, 23.57 and 25.00 percent losses in seed yield in Indoxacarb 14.5 SC, Spinosad 45 SC, Thiodicarb 75 WP, Emamectin benzoate 5 SG and Rynaxypyre 20 SC treated crop, respectively. Maximum yield loss 43.72 percent was noticed in untreated crop against 11.72 to 37.79 percent in different insecticidal treatments. The maximum increase (7.38 q/ha) in the yield over control was found in the treatment of Flubendiamide 480 SC. The next group of insecticides in relation to increase in yield comprised of Indoxacarb 14.5 SC followed by Spinosad 45 SC recorded 5.40 and 5.27, respectively.

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