INTERNATIONAL JOURNAL OF PLANT PROTECTION
VOLUME 10 | ISSUE 2 | OCTOBER, 2017 | 241-246

● e ISSN-0976-6855 | Visit us : *www.researchjournal.co.in*

IJPP

RESEARCH PAPER

DOI : 10.15740/HAS/IJPP/10.2/241-246

Evaluating the efficacy of novel insecticides against Bihar hairy caterpillar, *Spilosoma obliqua* walker (Lepidoptera: Arctiidae) in soybean crop

■ S. K. MISHRA*, VIKAS GUPTA AND R.K. SARAF

Dryland Horticulture Research and Training Centre, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Garhakota, SAGAR (M.P.) INDIA

ARITCLE INFO

Received : 24.06.2017
Revised : 04.08.2017
Accepted : 18.08.2017

KEY WORDS :
Efficacy, Novel insecticides, *Spilosoma obliqua*

ABSTRACT

A field experiment was conducted at JNKVV, DHRTC farm during 2014 and 2015 to evaluate the effectiveness of eleven insecticides including untreated check against bihar hairy caterpillar, *Spilosoma obliqua* Walker. 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 T_4 (Flubendiamide 480 SC) exhibited its superiority by registering the lowest larval population of 0.80 and 0.15 per meter row length during first and second spray, respectively. The overall order of effectiveness of these insecticides against *S. obliqua* was found to be Flubendiamide 480 SC > Indoxacarb 14.5 SC > Spinosad 45 SC > Thiodicarb 75 WP > Emmamectin benzoate 5 SG > Rynaxypyre 20 SC > Thiomethoxom 25% WG > Fipronil 5% SL > Imidacloprid 17.8 SL > 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 per cent with 11.72 per cent losses in seed yield in Indoxacarb 14.5 SC. Maximum yield loss 43.72 per cent was noticed in untreated crop against 11.72 to 37.79 per cent in different insecticidal treatments.

How to view point the article : Mishra, S.K., Gupta, Vikas and Saraf, R.K. (2017). Evaluating the efficacy of novel insecticides against Bihar hairy caterpillar, *Spilosoma obliqua* walker (Lepidoptera: Arctiidae) in soybean crop. *Internat. J. Plant Protec.*, **10**(2) : 241-246, **DOI : 10.15740/HAS/IJPP/10.2/241-246**.

***Corresponding author:**
mishradhrtc@gmail.com

INTRODUCTION

Soybean is a major oilseed crop of world grown in area of 103.29 million hectare with production of 251.47 million tones and productivity of 2430 kg/ha (Anonymous, 2012). 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 (Anonymous, 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 millipids, 10 vertebrates and 1 snail (Singh, 1999) and in India, 20 insect species have been recorded major pests infesting soybean crop (Singh and Singh, 1990).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*), green semilooper (*Plusia orichalcea* Fab.), Pod borer (*Helicoverpa armigera* Hub.) etc. The defoliators, *Spodoptera litura* (Fab.), *Thysanoplusia orichalcea* (Fab.), *Spilosoma obliqua* (Walk.) and *Helicoverpa armigera* (Hub.) feed on foliage, flower and pods causing significant yield loss. Defoliation often reaches population levels that significantly reduce the yield in soybean. Among the defoliator pest of soybean, the Bihar hairy caterpillar, *Spilosoma obliqua* is a voracious feeder which feeds gregariously on soybean leaves. In case of severe infestation, the entire crop is damaged badly thus, causing 40 per cent defoliation of leaf area. 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 and Wolfenbarger and Brewer, 1993). Keeping this in view, study were undertaken to test the effectiveness of some newer group of molecules against Bihar hairy caterpillar in soybean.

MATERIAL AND METHODS

The field experiment was laid out during the year 2014 and 2015 in a Randomized Block Design with three replication having plot size of 5 x 5 m at JNKVV, DHRTC Farm, Garhakota, district- Sagar (M.P.). The cultivar JS-335 were sown on 28th June 2014 and 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 (Table A). Observations on effect of insecticides on the larval population of leaf eating caterpillars were recorded a day before and after one, two, three and seven days of the sprays. The population of leaf eating caterpillar 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 :

Table A: Treatment details for the evaluation of newer insecticide molecules against *S.obliqua* in soybean

Treatments No.	Treatments 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

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

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

where,

A = Seed yield in best treatment

B = Seed yield in testing treatment.

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under the following heads:

Efficacy of insecticides against *S. obliqua* :

The results pertaining to the efficacy of insecticides on *S. obliqua* larval population on a day before and at 1,2,3 and 7 days after spraying are given in (Table 1 and 2) The pooled results of first spray (Table 1) indicates that the larval population ranged from 2.18 to 2.66 larvae per meter row length (mrl) before application of

Table 1 : Pooled mean efficacy of newer insecticides against *S. obliqua* 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	2.66(1.77)	1.28(1.33)	1.13(1.27)	0.98(1.21)	0.94(1.20)	1.08(1.25)
Indoxacarb 14.5 SC	0.5ml/l	2.57(1.75)	1.01(1.22)	0.06(0.74)	0.71(1.10)	0.67(1.08)	0.61(1.05)
Thiodicarb 75WP	0.75g/l	2.34(1.68)	1.23(1.31)	1.08(1.25)	0.94(1.20)	0.89(1.17)	1.03(1.23)
Fiubendiamide 480 SC	0.2g/l	2.45(1.71)	0.80(1.14)	0.65(1.07)	0.50(1.00)	0.46(0.97)	0.60(1.04)
Fipronil 5% SL	1ml/l	2.50(1.73)	1.58(1.44)	1.43(1.38)	1.24(1.31)	1.20(1.30)	1.36(1.36)
Imidacloprid 17.8 SL	0.25ml/l	2.34(1.68)	1.61(1.45)	1.46(1.40)	1.31(1.34)	1.27(1.33)	1.41(1.38)
Rynaxypyre 20 SC	0.2ml/l	2.22(1.64)	1.30(1.34)	1.15(1.28)	1.00(1.22)	0.96(1.20)	1.10(1.26)
Spinosad 45 SC	0.2ml/l	2.18(1.63)	1.05(1.24)	0.90(1.18)	0.76(1.12)	0.71(1.10)	0.85(1.16)
Thiomethoxom 25% WG	0.5g/l	2.35(1.68)	1.61(1.45)	1.46(1.40)	1.36(1.34)	1.33(1.35)	1.44(1.39)
Chloropyriphos 20 EC	2ml/l	2.59(1.75)	1.97(1.57)	1.82(1.52)	1.67(1.47)	1.62(1.45)	1.77(1.50)
Untreated check	-	2.56(1.74)	2.56(1.74)	2.60(1.76)	2.63(1.76)	2.58(1.75)	2.59(1.75)
C.D. (P=0.05)		NS	0.044	0.039	0.164	0.052	
S.E.±		0.16	0.015	0.013	0.059	0.018	

NS= Non-significant, DBS= Day before spray, DAS = Day after spray, mrl = Metre row length

*Average mean of three replications , Figure in parentheses are $\sqrt{x+0.5}$ transformed values

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

Treatments	Dosage	1 DBS No. of larvae / mrl	After second spray No. of larvae / mrl				
			1 DAS	2 DAS	3 DAS	7 DAS	Mean
Emmamectin benzoate 5SG	0.2g/l	1.08 (1.25)	0.60 (1.04)	0.50 (1.00)	0.48 (0.98)	0.36 (0.92)	0.48 (0.98)
Indoxacarb 14.5 SC	0.5ml/l	0.78 (1.13)	0.36 (0.92)	0.33 (0.91)	0.29 (0.88)	0.20 (0.83)	0.29 (0.88)
Thiodicarb 75WP	0.75g/l	1.03 (1.23)	0.55 (1.02)	0.45 (0.97)	0.44 (0.96)	0.38 (0.93)	0.45 (0.97)
Fiubendiamide 480 SC	0.2g/l	0.63 (1.06)	0.25 (0.86)	0.17 (0.81)	0.10 (0.77)	0.08 (0.76)	0.15 (0.80)
Fipronil 5% SL	1ml/l	1.26 (1.32)	0.94 (1.20)	0.86 (1.16)	0.72 (1.10)	0.65 (1.07)	0.79 (1.12)
Imidacloprid 17.8 SL	0.25ml/l	1.35 (1.36)	1.00 (1.22)	0.97 (1.21)	0.86 (1.16)	0.73 (1.10)	0.89 (1.17)
Rynaxypyre 20 SC	0.2ml/l	0.99 (1.22)	0.65 (1.07)	0.60 (1.04)	0.54 (1.01)	0.45 (0.97)	0.56 (1.02)
Spinosad 45 SC	0.2ml/l	0.81 (1.14)	0.39 (0.94)	0.34 (0.91)	0.31 (0.90)	0.27 (0.87)	0.32 (0.90)
Thiomethoxom 25% WG	0.5g/l	1.34 (1.35)	0.91 (1.18)	0.88 (1.17)	0.81 (1.14)	0.66 (1.07)	0.81 (1.14)
Chloropyriphos 20 EC	2ml/l	1.67 (1.47)	1.04 (1.24)	0.95 (1.20)	0.87 (1.17)	0.80 (1.14)	0.91 (1.18)
Untreated check	-	2.32 (1.67)	2.37 (1.69)	2.41 (1.70)	2.45 (1.71)	2.64 (1.77)	2.46 (1.72)
C.D. (P= 0.05)		NS	0.062	0.032	0.296	0.046	
S.E.±		0.03	0.021	0.011	0.10	0.015	

NS= Non-significant, DBS= Day before spray, DAS = Day after spray, mrl = Metre row length

*Average mean of three replications , Figure in parentheses are $\sqrt{x+0.5}$ transformed values

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 0.80 to 1.97 larvae per mrl among the treatments as against 2.56 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 0.80 per mrl found most effective and significantly superior over all other treatments. The next effective treatment was T_2 followed by T_8 recorded 1.01 and 1.05 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 1.23, 1.28, 1.30, 1.58, 1.61, 1.61 and 1.97 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 2) revealed that the larval population of *S. oblique* on a day before imposing the insecticides ranged from 0.63 to 1.47 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 0.15 to 0.91 larvae per mrl among the treatments as against 2.46 larvae per mrl. The treatment T_4 exhibited its superiority by registering the lowest larval population of 0.15 per mrl and the highest larval population of 0.91 was recorded in treatment of T_{10}. The overall order of effectiveness of these insecticides against *S.obliqua* was found to be Flubendiamide 480 SC > Indoxacarb 14.5 Sc > Spinosad 45 SC > Thiodicarb 75 WP > Emmamectin benzoate 5 SG > Rynaxypyre 20 Sc > Thiomethoxom 25% WG > Fipronil 5% SL > Imidacloprid 17.8 SL > 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 and Rajashri, 2006) Flubendiamide application showed better performance in reducing 80.63 per cent fruit infestation by *Leucinodes*

Table 3 : Pooled mean of effect of newer insecticides on the yield of soybean of *Kharif* 2014 and 2015

Treatment details	Formulation	Dosages	*Mean yield (q/ha.)	Increased yield over control (q/ha.)	Protection efficiency (%)	Yield loss (%)
Emmamectin benzoate	5 SG	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	75 WP	0.2g/l	13.45	3.95	79.68	20.31
Flubendiamide	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
Thiamethoxam	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
C.D. (P=0.05)			0.63			
S.E.±			0.20			

*Average of three replications

orbonalis and produced the higher fruit yield in brinjal (Abdul *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 reported Indoxacarb and spinosad were potential insecticides against soybean defoliators. Nair *et al*. (2007) and Kodandaram *et al*. (2012) studied the effectiveness of different insecticides against the bihar hairy caterpillar and found that indoxacarb was highly toxic under laboratory condition. Muthusamy *et al.* (2011) showed that imidacloprid was less toxic to hairy caterpillar.

Effect of insecticides on the yield of soybean :

Perusal of the pooled data of soybean seed yield presented in Table 3 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 3). The protection efficiency was higher being 88.27, 87.50, 79.68, 76.42 and 75.00 per cent with 11.72, 12.50, 20.31, 23.57 and 25.00 per cent losses in seed yield in Indoxacarb 14.5 SC, Spinosad 45 SC, Thiodicarb 75 WP, Emmamectin benzoate 5 SG and Rynaxypyre 20 SC treated crop, respectively. Maximum yield loss 43.72 per cent was noticed in untreated crop against 11.72 to 37.79 per cent 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.

REFERENCES

Abdul, Latif M., Mahbubar, Rahman M., Zinnatul, Alam M. and Muffazal, Hussain M. (2009). Evaluation of Flubendiamide as an IPM component for the management of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. *Munis Ent. Zool*., **4** : 257-267.

Ameta, O. P. and Bunker, G. K. (2007). Efficacy of NNI0001 (Flubendiamide) 480 SC against diamond back moth, *Plutella xylostella* L. in cabbage and its effects on natural enemies under field condition. *Pestol.*, **31**(6): 21-24.

Anonymous (2012). Director's report and summary tables of experiments of AICRP on soybean, NRCS, Indore.

Anonymous (2014-15). *Director's report and summary tables of experiments 2014- 15*, All India Coordinated Research Project on Soybean, ICAR-Directorate of Soybean Research, Indore, India, pp. 329.

Brewer, M.J., Trumble, J.T., Alvarado-Rodriguez, B. and Chaney, W.E. (1990). Beet army worm (Lepidoptera : Noctuidae) adult and larval susceptibility to three insecticides in managed habits and relationship to laboratory selection for resistance *J. Eco. Entoy*., **83** (6) : 813-814.

Harish, G. (2008). Studies on incidence and management of defoliator pests of soybean M.Sc. (Ag.) Thesis, University of Agricultural Sciences Dharwad, M.S. (India) pp. 65.

Knight, K. H., Brier, H. and Desborough, P. (2000). The efficacy of new insecticides and dipel for soybean looper control in soybean and effects on beneficial insects and arthropods. In proceedings of 11th Australian soybean conference, Ballina Australia. pp. 62-71.

Kodandaram, M.H., Rai, A.B. and Halder, J. (2012). Toxicological investigation on the newer biorational and plant origin insecticides against major insect pests of vegetables. IIVR Annual Report 2011-12, Indian Institute of Vegetable Research, Baranasi. pp. 77- 79.

Lakshminarayana, S. and Rajashri, M. (2006). Flubendiamide 20% WG a new molecule for the management of American bollworm, *Helicoverpa armigera* on cotton. *Pestol.*, **30**: 16-18.

Mallikarjunappa, S., Kendappa, G. N. and Ganesh Bhat, U. (2008). Flubendiamide 20% WG-A novel insecticide for the control of rice stemborer, *Scirphophaga incertulas* and leaf

folder *Cnaphalocrosis medinalis*, In: *Coleman memorial National Symp. on Plant Protec*., 4-6,December, University of Agricultural Sciences, GKVK, Bangalore (KARNATAKA) INDIA.

Muthusamy, R., Karthi, S. and Shivakumar, M.S. (2011). Baseline susceptibility of five classes of insecticides on Bihar hairy caterpillar, *Spilosoma obliqua* (Walk.) (Lepidoptera: Arctiidae). *Resistant Pest Management Newsletter*, **21**(1): 11-13.

Nair, N., Sekh, K., Debnath, M., Chakraborty, S. and Somchoudhury, A.K. (2007). Relative toxicity of some chemicals to Bihar hairy caterpillar, *Spilarctia obliqua* Walker (Arctiidae, Lepidoptera). *J. Crop & Weed*., **3**(1): 1- 2.

Singh, O. P. and Singh, K. J. (1990). Insect pests of soybean and their management. *Indian Farm.*, **39**(10): 9-14.

Singh, O. P. (1999). Perspective and prospects of insect pest control in India with reference to sustainable environment in India: Proceedings of world soybean conference VI August 4-7, 1999, Chicago, Illionois U.S.A. pp. 638-640.

Tatagar, M.H., Mohankumar, H.D., Shivaprasad, M. and Mesta, R.K.(2009). Bio-efficacy of flubendiamide 20 WG against chilli fruit borers, *Helicoverpa armigera* (Hub.) and *Spodoptera litura* (Fb.). *Karnataka J. Agric. Sci*., **22** (3-Spl. Issue): 579-581.

Tohnishi, M. H., Nakao, T., Furuya, A., Seo, H., Kodama, K., Tsubata, S., Fujioka, H., Kodama, T., Hirooka and Nishimatsu, T. (2005). Flubendiamide a novel insecticide highly active against lepidopterous insect pests. *J. Pestic. Sci*.,**30**: 354-360.

Wolfenbarger, D.A. and Brewer, M.J. (1993). Toxicity of selected pesticides to field collected beet armyworm populations. In : *Proceedings, 46th Beltwide cotton insect research and control conference*. National Cotton Council, Memphis, TN. p. 1174.

■ WEBLIOGRAPHY

Baldwin, J., Davis, J. and Leonard, B. R. (2011). Control of Soybean insect pests LSU Ag Center Pub. *http:// www.lsuagcenter.com/NR/ rdonlyres/906FB494-4396-4949-A825-D416DD0 8B17D/56550/ pub2211soybeaninsects.pdf.*