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Evaluation of different insecticides against green semilooper, *Thysanoplusia orichalcea* (Fab.) in soybean ecosystem

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ABSTRACT

A field study was conducted during *Kharif* season 2014-15 to determine the efficacy of different insecticides against semilooper *Thysanoplusia orichalcea* (Fab.) in soybean ecosystem in the insectory premises of Agricultural Entomology Section, College of Agriculture Nagpur. Least cumulative average number larvae (0.05/mrl) was recorded in treatment of Fenvalerate 20 EC @ 0.50 ml/l (T_7) found to be superior compared to other treatments. The next effective treatments were emamectin benzoate 5 SG @ 0.3 g/l (T_6: 0.06/mrl) and also in Spinosad 45 SC @ 0.25 ml/l (T_3:0.07/mrl), Indoxacarb 15.8 EC @ 0.60 ml/l (T_5:0.08/mrl) found to be at par with T_6 and T_3. However, the treatment Neem Oil 2 per cent (T_2) recorded 0.78 larvae/mrl. Whereas, NSE @ 5 per cent (T_1:0.95/mrl) and *Beauveria bassiana* $1x10^8$ CFU @ 4 g/l (T_4:0.99/mrl) were found to be least effective in reducing larval population/mrl. Maximum mean larval population (1.48/mrl) was recorded in control (Water spray; T_8). Fenvalerate 20 EC @ 0.50 ml/l, Indoxacarb 15.8 EC @ 0.60 ml/l, Spinosad 45 SC @ 0.25 ml/l were found to be most effective treatments which recorded highest yield of 21.05 q/ha, 20.10 q/ha and 19.02 q/ha, respectively. From the seed production point of view Fenvalerate 20 EC @ 0.50 ml/l, Indoxacarb 15.8 EC @ 0.60 ml/l, Spinosad 45 SC @ 0.25 ml/l were most effective in recording highest yield.

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INTRODUCTION

Soybean (*Glycine max* L.) is one of the miracle 'Golden bean' of the 20th century. It is originated in China "Pen Tsao Kong Mu" (Material Medica) which is about 5000 year old. In India, soybean was first time introduced as food in 1935 (Sharma, 2004). Soybean possess a very high nutritional value, on an average it contains 20 per cent oil, 40 per cent protein, Vit A, B, C, D, E and K along with 0.69 per cent phosphorus, 0.112 per cent iron and 0.024 per cent calcium. Soybean protein provides all the nine essential amino acids. Edible soy protein one of the world's least expensive and high quality protein source. Soybean is recognised as valuable food material.

Soybean agro ecosystem is being adopted rapidly

by farmers of Vidarbha and it becomes second major *Kharif* crop. As a result, many oil industries are established to provide employment in the region. During 2013, national acreage under soybean cultivation was 120.327 lakh ha with an estimated yield of 1079 kg/ha and production of soybean during 2013 was 129.832 lakh MT in India. In Maharashtra area sown under soybean was 38.704 lakh ha and total production was 48.565 lakh ton, with total productivity of 12.55 q/ha during *Kharif* 2013. In Vidarbha during *Kharif* 2013 the area sown under soybean was cultivated on 20.93 lakh ha with total production of 26.62 lakh MT and productivity 11.55 q/ha (Anonymous, 2013).

Soybean semilooper, *Thysanoplusia orichalcea* (Fab.) is a major defoliator feeds on foliage causing significant yield loss (Singh and Singh, 1990). *Thysanoplusia orichalcea* damages the crop from August to September during *Kharif*. The infestation can result into 30 per cent underdeveloped pods and about 50 per cent yield loss. In case of heavy attack, the caterpillars are also found to feed on flowers and pods (Anonymous, 2007).

Indiscriminate use of chemical insecticides disturbs the natural balance of pest, leading to resurgence of pest, outbreak of secondary pests, and pollution in crop ecosystem from this angle, botanicals have become more attractive and are considered to provide an ecofriendly alternative (Dodia and Patel, 2008). Biopesticides and botanicals play an important role in insect pest management as they are best alternative to chemical insecticides against major defoliators on soybean. They are locally available, relatively cheap, biodegradable and easy to handle which enable to minimize input cost of management for major defoliators of soybean and keep balance of ecosystem.

MATERIAL AND METHODS

The present study entitled, "Seasonal incidence and management of major defoliators on soybean (*Glycine max* L.)" was conducted during *Kharif* season 2014-15 at Agricultural Entomology Section, College of Agriculture Nagpur. The crop was grown at a spacing of 30 x 5cm with three replications and total eight treatments with control in Randomized Block Design. Neem seed extract 5 per cent, Neem Oil 2 per cent, *Beauveria bassiana* 1 x 10^8 CFU @ 4 g/l, Spinosad 45 SC @ 0.25 ml/l, Indoxacarb 15.8 EC @ 0.60 ml/l, Emamectin benzoate 5 SG @ 0.3 g/l, Fenvalerate 20 EC @ 0.50 ml/l were used under field condition on soybean variety JS-335 used during the course of present investigation.

The spraying of treatments was done with the help of knapsack sprayer and obtained uniform coverage of insecticide in each plot. First spray was given 30 days after emergence (DAE), second spray 45 DAE and third spray at 60 DAE. All the recommended were adopted for raising the crop. The observation on mean number larvae per meter row length was taken at five randomly selected spots in the plot in meter row length and recorded at seven days after germination till the harvest of the crop and eight treatments consisting of Neem seed kernel extract @ 5 per cent, neem oil @ 2 per cent, Spinosad 45 SC @ 0.25%, *Beauveria bassiana* 1×10^8 CFU @ 4g/l, Indoxcarb 15.8 EC @ 0.60 ml/l, Emamectin benzoate 5 SG @ 0.3g/l, Fenvalerate 20 EC @ 0.50ml/l, Control (Water spray) were evaluated for their efficacy against defoliators on soybean *i.e.* tobacco leaf eating caterpillar and green semilooper. The average population of major pests on soybean was observed at 7 and 14 days after each spray application. The pre counting of larvae per one meter row length (mrl) was taken one day before spraying of chemicals on infestation of both larvae of semilooper.

The field data collected during the course of experimentation was subjected to statistical analysis after appropriate transformation for interpretation of results. Randomized Block Design was used in order to test the level significance among the various treatments as per Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The data on cumulative mean number of larvae of semilooper/mrl recorded at 7 DAT is presented in Table 1. The result was found statistically significant. However, numerically minimum cumulative average number of semilooper larvae (0.07/mrl) was recorded in treatment of Fenvalerate 20 EC @ 0.50 ml/l (T_7) and found superior compared to other treatments. The next effective treatments were of Spinosad 45 SC @ 0.25 ml/l (T_3:0.09/mrl), Emamectin benzoate 5 SG @ 0.3 g/l (T_6:0.11/mrl) Indoxacarb 15.8 EC @ 0.60 ml/l (T_5:0.12/mrl) which were of found to be at par with above mentioned treatment. However the treatments of Neem Oil @ 2 per cent (T_2) recorded 0.66 semilooper larvae/

mrl. Whereas, NSE @ 5% (T_1:0.78/mrl) and *Beauveria bassiana* 1x10^8 CFU @ 4 g/l (T_4:0.87/mrl) and these treatments were found to be least effective in reducing larval population/mrl. Maximum mean larval population (1.3/mrl) was recorded in control (Water spray; T_8).

The results are in comparision with Mascarenhas and Boethel (2000) who found the diagnostic concentration (concentration that kill 90-95% of susceptible individuals) of emamectin benzoate at 5 ppm and spinosad at 60 ppm against soybean looper, *P. includens*. Hall *et al*. (2000) who observed that, thiodicarb at 0.125, 0.25, 0.375 and 0.5 lb a.i./acre and spinosad at 0.0012 and 0.025 lb a.i./acre caused highest mortality of soybean looper (*P. includens*) larvae when fed with treated foliage of cotton. Baruah and Chauhan (1997) reported the bioeffectiveness of cypermethrin 10 per cent EC, 0.006 per cent 45 g a.i./ha, fenvalerate 20 per cent EC, 0.008 per cent (60 g a.i./ha), deltamethrin

Table 1: Efficacy of different treatments on number of semilooper larvae in soybean ecosystem

Treatments	7 DAT				14 DAT			
	30 DAS	45 DAS	60 DAS	Mean	30 DAS	45 DAS	60 DAS	Mean
T_1-NSE @ 5%	0.53b	0.80b	1.02b	0.78	0.67b	1.00b	1.17b	0.95
	(1.01)	(1.14)	(1.23)	(1.13)	(1.08)	(1.22)	(1.29)	(1.20)
T_2-Neem oil @ 2%	0.47b	0.73b	0.77b	0.66	0.60b	0.83b	0.92b	0.78
	(0.98)	(1.11)	(1.13)	(1.08)	(1.05)	(1.20)	(1.15)	(1.13)
T_3-Spinosad 45 SC @ 0.25 ml/l	0.20c	0.06c	0.03c	0.09	0.16c	0.04c	0.00c	0.07
	(0.84)	(0.75)	(0.73)	(0.77)	(0.81)	(0.73)	(0.71)	(0.75)
T_4- *Beauveria bassiana* 1 x 10^8 CFU @ 4 g/l	0.60b	0.83c	1.17b	0.87	0.73b	0.93b	1.32b	0.99
	(0.98)	(1.15)	(1.29)	(1.17)	(1.08)	(1.20)	(1.35)	(1.22)
T_5-Indoxacarb 15.8 EC @ 0.60 ml/l	0.19cd	0.09c	0.07c	0.12	0.15c	0.08c	0.00c	0.08
	(0.83)	(0.77)	(0.75)	(0.79)	(0.81)	(0.76)	(0.71)	(0.76)
T_6- Emamectin benzoate 5 SG @ 0.3 g/l	0.20c	0.08c	0.05c	0.11	0.13c	0.06c	0.00c	0.06
	(0.84)	(0.75)	(0.76)	(0.78)	(0.79)	(0.75)	(0.71)	(0.75)
T_7 -Fenvalerate 20 EC @ 0.50 ml/l	0.11d	0.07c	0.04c	0.07	0.09c	0.05c	0.01c	0.05
	(0.78)	(0.75)	(0.73)	(0.75)	(0.77)	(0.74)	(0.71)	(0.74)
T_8-Control (Water spray)	0.83a	1.33a	1.74a	1.3	0.93a	1.53a	1.99a	1.48
	(1.15)	(1.35)	(1.50)	(1.34)	(1.20)	(1.42)	(1.58)	(1.41)
F Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
S.E.(±)	0.07	0.07	0.05	0.06	0.07	0.07	0.06	0.06
C.D. (P=0.05)	0.20	0.21	0.15	0.18	0.22	0.22	0.19	0.18
CV	12.94	13.14	9.31	10.46	14.06	13.45	11.44	10.61

Figures in parenthesis indicates square root transformation

Table 2 : Soybean grain yield

Treatments	Yield kg/plot				
	R_1	R_2	R_3	Mean	Yield q/ha
T_1-Neem seed extract (NSE) @ 5%	1.1 (1.26)	1.46 (1.40)	0.89 (1.18)	1.15 (1.28)	12.28
T_2-Neem oil @ 2%	1.4 (1.38)	1.35 (1.36)	1.32 (1.35)	1.36 (1.36)	14.52
T_3-Spinosad 45 SC @ 0.25 ml/l	1.72 (1.49)	1.77 (1.51)	1.84 (1.53)	1.78 (1.51)	19.02
T_4- *Beauveria bassiana* 1x10^8 CFU @ 4 g/l	1.05 (1.24)	1.27 (1.33)	1.33 (1.35)	1.22 (1.31)	13.03
T_5-Indoxacarb15.8 EC @ 0.60 ml/l	1.94 (1.56)	1.81 (1.52)	1.89 (1.55)	1.88 (1.54)	20.10
T_6- Emamectin benzoate 5 SG @ 0.3 g/l	1.7 (1.48)	1.69 (1.48)	1.75 (1.50)	1.71 (1.49)	18.30
T_7-Fenvalrate 20 EC @ 0.50 ml/l	1.72 (1.49)	2.05 (1.60)	2.1 (1.61)	1.97 (1.57)	21.05
T_8-Control (Water spary)	0.8 (1.14)	1.02 (1.23)	1.09 (1.26)	0.97 (1.21)	10.36
F Test	-	-	-	Sig	Sig
S.E.(±)	-	-	-	0.12	0.8
C.D. (P=0.05)	-	-	-	0.37	2.14
CV	-	-	-	14.82	10.31

Figures in parenthesis indicates square root transformation

2.8 per cent EC, 0.002 per cent (25 g a.i./ha) and endosulfan 35 per cent EC, 0.07 per cent (525 g a.i./ha) against pod borer *Helicoverpa armigera* in pigeonpea.

The data on cumulative mean number of larvae of semilooper/mrl recorded at 14 DAT are presented in Table 2. The result was found to be statistically significant. However, numerically minimum cumulative average number semilooper larvae (0.05/mrl) was recorded in treatment of Fenvalerate 20 EC @ 0.50 ml/l (T_7) found to be superior compared to other treatments. The next effective treatments were Emamectin benzoate 5 SG @ 0.3 g/l (T_6:0.06/mrl) and also in Spinosad 45 SC @ 0.25 ml/l (T_3:0.07/mrl), Indoxacarb 15.8 EC @ 0.60 ml/l (T_5:0.08/mrl) found to be at par with above mentioned treatment. However, the treatment Neem Oil 2 per cent (T_2) recorded 0.78 semilooper larvae/mrl. Whereas, NSE @ 5 per cent (T_1:0.95/mrl) and *Beauveria bassiana* $1x10^8$ CFU @ 4 g/l (T_4:0.99/mrl) were found to be least effective in reducing larval population/mrl. Maximum mean larval population (1.48/mrl) was recorded in control (Water spray, T_8).

Present investigation is in accordance with the the efficacy of Knight *et al*. (2000) who reported that indoxacarb, methoxy fenozide and spinosad were having greater potential to control *Thysanoplusia orichalcea* in soybean. Agnihotri *et al.* (1987) reported cypermethrin at 60 g a.i./ha, permethrin at 90 g a.i./ha and fenvalerate at 120 g a.i./ha as more effective insecticides in controlling American bollworm than the traditional insecticides, carbaryl, acephate and quinalphos applied at 300 g a.i./ha. Ahmed *et al*. (2004) studied the comparative efficacy of three insecticides, *viz*., indoxacarb 15 SC, methomyl 40 SP and Cholorpyriphos 20 EC @ 100, 400 and 500 ml per 100 lit of water aginst *H.armigera* and *S.litura.*

Soybean grain yield :

The treatment of Fenvalerate 20 EC @ 0.50 ml/l recorded maximum yield of 21.05 q/ha with an increase of 10.69 q/ha yield over control (T_8). The treatment of Indoxacarb 15.8 EC @ 0.60 ml/l (T_5) obtained the yield of 20.10 q/ha of with an increase 9.74 q/ha grain yield over control, followed by Spinosad 45 SC @ 0.25 ml/l (T_3) which recorded yield of 19.02 q/ha with 8.66 q/ha increase yield over control. The treatment of Emamectin benzoate 5 SG 0.3 g/l (T_6) recorded 18.30 q/ha yield with 7.94 q/ha increase yield over control.

The treatment of Neem Oil @ 2 per cent (T_2) yielded 14.52q/ha with 4.16 q/ha increase yield over control followed by *Beauveria bassiana* $1x10^8$ CFU @ 4 g/l (T_4) which recorded 13.03 q/ha yield with 2.67q/ha increase yield over control and the treatment of Neem Seed Extract @ 5 per cent (T_1) yielded 12.28 q/ha with 1.92 q/ha increase yield over control. Thus, the treatments in descending order in respect to yield were $T_7>T_5>T_3>T_6>T_2>T_4>T_1>T_8$.

However, the information or reference is lacking on yield of soybean, but the references related to other crops are discussed where the chemicals are same. Giraddi *et al*. (2002) reported the performance of Indoxacarb 15.8 EC @ 0.60 ml/l yielded 16.13 q/ha grain yield with 9.61q/ha increase yield over control in pigeonpea crop. The highest grain yield of 1486 kg/ha was recorded with indoxacarb 0.0075% treatment which was followed by spinosad 0.009% (1451 kg/ha). The rest of the insecticides gave the yield of 1417 to 875 kg/ha in pigeonpea crop.

The results are also comparable with the studies of Murugaraj *et al.* (2006) who studied emamectin benzoate 5 SG @ 11 g a.i./ha as well as highly effective in reducing the larval population and fruit damage as well as in increasing the yield of tomato. Kumar and Devappa, (2006a) reported emamectin benzoate 5 SG @ 200 g/ha as effective in reducing dead hearts and also fruit damage in brinjal, total yield was also higher in this treatment.

Similar findings are studied by Kumar and Devappa (2006b) who reported emamectin benzoate 5 SG @ 150 and 200 g/ha to be effective in suppressing the larval population of the pest compared to other insecticides. These two treatments also recorded higher yield of cabbage heads per hectare.

Wakil *et al*. (2009) studied the management of the pod borer, *Helicoverpa armigera* at Pakistan showed the integration of weeding, hand picking of larvae and indoxacarb sprays as the the most effective in reducing the larval population, pod infestation and maximum grain yield in chickpea crop.

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