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Economic threshold level for soybean girdle beetle and stem fly

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Abstract

Investigation was carried out for work out the economic threshold levels of girdle beetle and stem fly on soybean at Department of Agricultural Entomology, College of Agriculture, Latur (Maharashtra) India during *kharif* 2019. An experiment was conducted to work out the gain threshold, economic injury level, actual economic injury level and economic threshold levels were worked out for girdle beetle and stem fly infesting soybean. The different treatments are constituted based on number of sprays which gave different exposure period to the pests to feed on the soybean crop. The final ETL was determined on the basis of equality of management cost and revenue of soybean yield which was saved from pest damage. For experiment purpose the insecticide used was Chlorantraniliprole 18.5% SC. Based on the equality of management cost and revenue of soybean yield which was saved from pest damage, 12.36 per cent infested plants by girdle beetle was decided as the ETL level. While, 14.29 per cent stem tunneling was decided as the ETL level for stem fly infestation.

Keywords: economic threshold, soybean, girdle beetle, stem fly

Introduction

Soybean (*Glycine max* (L.) Merril) is one of the most important leguminous crops belonging to family Leguminosae syn. Fabaceae, subfamily Papilionoideae. Soybean is native of Asia and the first known records however, indicate that soybean emerged as a domesticated crop around eleventh century BC in China, (Nagata, 1960) and was introduced in India in 1870-80 (Andole, 1984) ^[1]. Soybean, 'The miracle golden bean of 20th century' has revolutionized the agriculture as well as generated economy of many countries like China and Japan (Balsubramanian, 1972) ^[4]. Though soybean is a legume crop, yet it is widely used as oilseed. Soybean contains superior quality oil which can be processed to yield high value industrial products like lecithins, paints, soap, resins and dyeing materials. From nutritional point of view, soybean contains 43.2% protein, 19.54% fat and 20.9% carbohydrates. It improves soil fertility by adding N up to 50-300 kg/ha (Keyser and Fudi, 1992) ^[8] and adds about 1.0-1.5 tons of leaf litter per season/ha.

Several biotic and abiotic factors are responsible for low productivity of soybean, but the damage caused by insect-pests is major. Soybean is reported to be attacked by 273 species of insects (Rawat and Kapoor, 1968) ^[12] and in India, 20 insect pests species have been recorded infesting soybean Crop (Singh and Singh, 1990) ^[13]. In Maharashtra, particularly in Marathwada 19 species have been indentified attacking this crop (Mundhe, 1982) ^[10].

The basic element in pest management is the principle of EIL (Stern *et al.*, 1959) ^[14]. It is the pest population which causes damage equal to gain threshold, which is ratio between protection cost and price of the produce. In other words, knowledge regarding pest infestation and yield, protection cost and market value of the produce is essential for determining EIL (Venkatesan and Kundu, 1994) ^[15]. While, economic threshold level (ETL) is the pest density at which control measures should be applied to prevent an increasing pest population from reaching the economic injury level. ETL is the best known and most widely used index in making pest management decisions. Kundu & Mehra, (1989) ^[9] studied the relationship between per cent stem tunneling caused by the stem fly and grain yield of soybean considering the importance of stem fly as a key pest, its economic injury level was determined on soybean under natural infestation. However, the work on determination of ETL for two major stem borer pests of soybean in Maharashtra is meager.

A field experiment was conducted to determine ETL for girdle beetle and stem fly on soybean with following details. The method used by Gautam *et al.* (2013) ^[5] in okra was used for determining the ETL for girdle beetle and stem fly on soybean with relevant modification.

Material

Experimental detail

Design : Randomized Block Design
 Replications : 03 (Three)
 Treatments : 08 (Eight)
 Plot size : 2.7 m x 3.0 m
 Spacing : 45 cm x 5 cm
 Crop : Soybean
 Variety : MAUS-158
 Season : Kharif 2019

Treatment details

Tr. No.	Treatment (s)	Spray Schedule (DAG)
T1	Control	Without any spray
T2	1 spray	7
T3	2 sprays	7, 17
T4	3 sprays	7, 17, 27
T5	4 sprays	7, 17, 27, 37
T6	5 sprays	7, 17, 27, 37, 47
T7	6 sprays	7, 17, 27, 37, 47, 57
T8	7 sprays (Complete protection)	7, 17, 27, 37, 47, 57, 67

DAG-Days after germination.

Spraying of insecticide

Selection of insecticide: Insecticide used for spraying was chlorantraniliprole 18.5% SC @ 150 ml per ha which has been registered with CIB for both the pests on soybean and also widely used by the farmers.

Criteria for spray schedule: Considering that stem fly may lay eggs from cotyledon leaves and second generation of girdle beetle start infestation after about 50 to 55 days, the spraying was initiated after seven days after germination and thereafter at 10 days interval up to 67 DAG. In all maximum seven sprays were given in treatment T8 and it was considered as 'complete protection' against both the pests. Different treatments will provide different exposure periods to the crop for attack of the pests and create different levels of girdle beetle and stem fly infestation to find out their impact on soybean grain yield.

Observation procedures

Girdle beetle: 1 m length rows were marked at 3 places. At weekly interval, total number of plants and girdled plants were recorded from each row and data is presented in per cent plant infestation. Observation from same rows were recorded throughout the season.

Stem fly: Plant height and length of stem tunneled in 25 randomly selected plants from each plot was recorded at physiological maturity and mean stem tunneling was expressed in per cent for respective treatment.

The yield of net plot from each treatment was converted to quintal per hectare. The 'additional yield' for each treatment was worked out by subtracting the yield of control plot from the yield of treatment. The value of additional yield was considered as 'revenue'.

Mathematical procedure and steps

Cost of insecticide application (cost of insecticide, labour charge, etc.) and market price of soybean declared by Govt. of Maharashtra for the year (Rs. 3710/- per quintal) was used for calculating the ETL. The EIL was determined as suggested by Stone and Pedigo (1972) and further modified by Ogunlana

and Pedigo (2004). The economic threshold level (ETL) was then calculated as 75% of EIL.

Gain threshold (GT) = Management cost (Rs/ha)/Marketed value (Rs/Qtl)

The cost of management includes cost of insecticide and labour charges per hectare.

Gain threshold (Qtl/ha)

Calculated Economic injury level (EIL) = -----
 Regression coefficient

Regression coefficient was worked out by linear regression of grain yield with pest population/infestation using WASP 2.0 Software (<https://ccari.res.in>).

Actual Economic injury level = Calculated EIL + UI.

Where, UI = Unavoidable infestation observed in complete protection treatment.

Management cost = Expenditure on control measure.

Final ETL for the pest was determined based on equality of management cost and revenue of soybean crop yield which was saved from pest damage.

Result and Conclusion

Economic threshold level for girdle beetle on soybean

The data pertaining to computation of gain threshold, EIL and ETL on the basis of per cent infestation due to girdle beetle are presented in Table 1.

The regression equation obtained for per cent infestation by girdle beetle on soybean was $Y = 13.858 + (-0.312) X + 0.611$. The data revealed that the gain threshold (GT) computed on the basis of soybean price at Rs. 3710/- per quintal ranged in between 0.74 for one spray to 5.19 for seven sprays (complete protection). The values of EIL varied in between 2.38 to 16.63 for one spray and seven sprays, respectively while the values of actual EIL varied from 4.60 per cent for one spray to 18.85 per cent for seven sprays. The values of ETL ranged from as low as 3.45 per cent infestation for one spray to as high as 14.14 per cent infested plants for complete protection i.e. seven sprays. The final ETL was determined on the basis of equality of management cost and revenue of soybean yield which was saved from pest damage. Accordingly, 12.36 per cent infested plants by girdle beetle was decided as the ETL level.

Economic threshold level for stem fly on soybean

The regression equation obtained for per cent tunneling by stem fly in soybean was $Y = 14.477 + (-0.270) X + 0.831$. The data from Table 2 revealed that the gain threshold (GT) computed on the basis of soybean price at Rs. 3710/- per quintal ranged in between 0.74 for one spray to 5.19 for seven sprays (complete protection). The values of EIL varied from 2.75 per cent stem tunneling due to stem fly for one spray to 19.22 per cent stem tunneling due to stem fly for seven sprays. The values of actual EIL ranged from as low as 5.33 per cent tunneling for one spray to as high as 21.80 per cent tunneling for complete protection i.e. seven sprays. The ETL worked out ranged in between 3.99 per cent stem tunneling for one spray to 16.35 per cent stem tunneling for seven sprays. The final ETL was determined on the basis of equality of management cost and revenue of soybean yield which was saved from pest damage. Accordingly, 14.29 per cent stem

tunneling was decided as the ETL level.

In the present study the ETL observed for girdle beetle is 12.36 per cent infested plants and that for stem tunneling by stem fly is 14.29 per cent. The research work on determination of gain threshold, EIL and ETL for the soybean pests in recent years is scanty. However, Kundu and Mehra (1989) [9] reported the EIL of stem fly on soybean was 26 per cent. Also, Gunjal and Mote (1993) studied on determination of economic injury level of stem fly *O. phaseoli* (Tryon) on French bean and concluded by collecting and observing 125 plants that percentage tunnelling is a better parameter of

judging the injury, when affected percentage tunnel length goes beyond 27.02 the reduction in yield is significant and contributed to all yield components. Venkatesan *et al.* (1994) [15] reported the economic injury levels of 6.40 and 11.23 per cent stem tunneling with quadratic and linear form of relationship, respectively. Gawali (2005) [6] worked out the economic threshold level (ETL) of soybean leaf roller, *A. census* for vegetative and reproductive stage is 1 and 4 in per meter sq., respectively. Thus the present finding was in line with those of earlier workers.

Table 1: Computation of gain threshold, EIL and ETL on the basis of per cent girdle beetle infested soybean plants

T N	Chlorantraniliprole 18.5% SC @ 150 ml/ha	Soybean price (Rs/q)	Gain threshold (q/ha)	EIL (Per cent plant infestation by girdle beetle)	Actual EIL (Per cent plant infestation by girdle beetle)	ETL (Per cent plant infestation by girdle beetle)	Mean per cent plant infestation by girdle beetle	Yield (q/ha)	Additional yield (q/ha)	Revenue (Rs.)	Protection Cost (Rs.)
T1	Untreated control	3710	--	--	--	--	16.49	8.11	--	--	--
T2	1 Spray	3710	0.74	2.38	4.60	3.45	12.29	10.56	2.45	9089.50	2750.00
T3	2 Sprays	3710	1.48	4.75	6.97	5.23	8.04	10.70	2.59	9608.90	5500.00
T4	3 Sprays	3710	2.22	7.13	9.35	7.01	8.04	12.13	4.02	14914.20	8250.00
T5	4 Sprays	3710	2.96	9.50	11.72	8.79	6.17	12.37	4.26	15804.60	11000.00
T6	5 Sprays	3710	3.71	11.88	14.10	10.57	4.63	12.67	4.56	16917.60	13750.00
T7	6 Sprays	3710	4.45	14.25	16.47	12.36	2.39	12.70	4.59	17028.90	16500.00
T8	7 Sprays	3710	5.19	16.63	18.85	14.14	2.22	12.80	4.69	17399.90	19250.00

Protection cost = Cost of insecticide + labour cost.

Cost of insecticide = Rs. 2150/- per ha (Chlorantraniliprole 18.5% SC @ 150 ml/ha dose).

Labor cost = Rs. 600/- (1 M+1F per spray per ha).

Soybean price = Rs. 3710/- per q.

Table 2: Computation of gain threshold, EIL and ETL on the basis of per cent stem tunneling by stem fly on soybean

T N	Chlorantraniliprole 18.5% SC @ 150 ml/ha	Soybean price (Rs/q)	Gain threshold (q/ha)	EIL (per cent stem tunneling by stem fly)	Actual EIL (per cent stem tunneling by stem fly)	ETL (per cent stem tunneling by stem fly)	Mean per cent stem tunneling by stem fly	Yield (q/ha)	Additional yield (q/ha)	Revenue (Rs.)	Protection Cost (Rs.)
T1	Untreated control	3710	--	--	--	--	18.43	8.11	--	--	--
T2	1 Spray	3710	0.74	2.75	5.33	3.99	16.61	10.56	2.45	9089.50	2750.00
T3	2 Sprays	3710	1.48	5.49	8.07	6.05	14.67	10.70	2.59	9608.90	5500.00
T4	3 Sprays	3710	2.22	8.24	10.82	8.11	10.91	12.13	4.02	14914.20	8250.00
T5	4 Sprays	3710	2.96	10.98	13.56	10.17	9.74	12.37	4.26	15804.60	11000.00
T6	5 Sprays	3710	3.71	13.73	16.31	12.23	8.58	12.67	4.56	16917.60	13750.00
T7	6 Sprays	3710	4.45	16.47	19.05	14.29	6.48	12.70	4.59	17028.90	16500.00
T8	7 Sprays	3710	5.19	19.22	21.80	16.35	2.58	12.80	4.69	17399.90	19250.00

Protection cost = Cost of insecticide + labour cost.

Cost of insecticide = Rs. 2150/- per ha (Chlorantraniliprole 18.5% SC @ 150 ml/ha dose).

Labor cost = Rs. 600/- (1 M+1F per spray per ha).

Soybean price = Rs. 3710/- per q.

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