



POPULATION DYNAMICS OF COMMON CUTWORM, *SPODOPTERA LITURA* (FAB.) IN SOYBEAN

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ABSTRACT

The aim of this investigation was to observe the effect of various weather parameters on the occurrence of larval and adult population of *Spodoptera litura* and factors for their outbreak of this pest in soybean. The initial studies indicated that the population of male moths in pheromone trap appeared in 1st week of July and continued upto third week of October. During 2017, weather factors like minimum temperature and morning humidity influenced the male moth population per trap whereas maximum temperature, sunshine hrs and wind speed negatively influenced the male moth population per trap but with non-significant effect. Regression analysis indicated that the various weather parameters caused 46 per cent variations in *S. litura* male moth catches. The correlation between larval counts and pheromone trap catches were significantly positive (0.652). Initial buildup of larval population in the field was observed during the 3rd week of July and continued build uptill mid-September which resulted in severe outbreak of *S. litura* in soybean during August to September. This indicates that the more peaks in pheromone trap catches of *S. litura* in August to September months were invariably followed by an increase in the number of larval population and contributed to the outbreak of the pest in the soybean field. Thus, pheromone traps may serve as a warning device indicating the possibility of potential attack and to initiate timely management of *S. litura* in soybean.

Key words: Soybean, *Spodoptera litura*, pheromone trap, standard week, rainfall

INTRODUCTION

Soybean is mainly grown in USA, Brazil, China and Argentina among them USA, Brazil and Argentina account for 80% of the global soybean production. India ranks fifth in the area and production in the world after these countries (Agarwal *et. al.*, 2013). The major soybean growing states are Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Andhra Pradesh and Chhattisgarh. Rajasthan has become third soybean growing state in India and shares 11.63 per cent overall production of soybean in the country next to Madhya Pradesh (57.13%) and Maharashtra (24.46%). The area under cultivation was 11.67 million hectares with a production of 8.59 million tonnes and productivity of 737 kg per hectare during Kharif, 2015-2016 under soybean in the country (Anonymous, 2017). The productivity of soybean is less as compared to world average (1.8-2.2 t/ha) and this is due to several biotic and abiotic factors during the crop growth period (Sinha *et al.*, 2013; Agarwal *et. al.*, 2013).

Soybean crop is soft and succulent with the luxuriant growth in nature which may invite many insect-pest species. About 380 species of insects have been reported on soybean crop from many parts of the world. In India, 20 insect species have been recorded major pests infesting soybean crop (Singh and Singh, 1990).

The common cutworm, *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae), is one of the most important polyphagous pests of soybean. Larvae feed on the foliage resulting complete defoliation in case of severe infestation. It has been reported to attack over 112 cultivated plant species, of which 60 are from India, including cotton, tobacco, mungbean, groundnut, eggplant, rice, cabbage, leafy vegetables and soybean (Venette *et al.* 2003). Yield losses in soybean are directly associated with higher larval densities and increased defoliation (Geon Hwi *et al.* 2006). In recent years, the tobacco caterpillar has become a serious pest on soybean in some parts of India and resulting in severe outbreak of this pest in soybean (Dhaliwal *et al.*, 2010).

Pheromone baited traps provide a technique to monitor in large areas for the presence of lepidopterans moths (Punithavalli *et al.*, 2013). Therefore, the management of tobacco caterpillar at its peak time is required for maximization of yield. Weather plays an important role on the population dynamics and distribution of pests. Temperature, rainfall, relative humidity, sunshine hours and wind speed are the chief weather parameters influencing the pest incidence. Hence, an attempt was made to monitor the population of *S. litura* through pheromone traps and field population (larvae) that could help the farmers in timely management of *S. litura* in soybean crop.

MATERIAL AND METHODS

Field experiments on soybean were conducted under rainfed conditions during *Kharif* season (July-October, 2017) at Agricultural Research Station, Borwat Farm, Banswara using JS-335 as a test variety. This station is located between 73°2' to 75° E' longitude and 23°11' to 24°23' N latitude at an altitude of 660 m above mean sea level, in Humid Southern Plain Zone of Rajasthan (Zone IV b). Recommended agronomic practices like fertilizer application, weeding and irrigation etc were taken up. The crop was raised under unprotected conditions.

The pheromone traps were installed in three locations of approximately 100 m distance in the field with the help of wooden stick. Traps were set up 10 days after sowing during kharif season at a height of 2 m above ground level. The lure was regularly changed at

25 days interval. The captured moths were counted and removed at each standard week. The spodolure and pheromone traps were purchased from Pest Control India, Bangalore. Data pertaining to the larval population of semiloopers and *S. litura* incidence were taken at weekly interval starting from 2nd week of July till the harvest of the crop. Ten randomly selected sampling units at meter row length (mrl) were chosen for observations. The standard method of beat-cloth sampling was used. In this method, the white cloth of 1 m length was spread beneath the soybean plants and the plants were vigorously beaten to dislodge the larvae of semiloopers and *S. litura* on the white cloth. The number of larvae was counted per meter row length (mrl).

Weather parameters like maximum and minimum temperatures, morning and evening relative humidity, rainfall (mm), sunshine hours, and wind speed (km/hr) were recorded from the metrological unit located at Agricultural research station, Banswara. The data were analyzed by using simple correlation and regression tools with the help of Indostat software to workout the relationship between weather parameters and pest incidence.

RESULTS AND DISCUSSION

Fluctuations of adult moth population density with the traps

Pheromone traps provided an efficient tool for estimating fluctuations in population density and for indicating adult peaks (Fig. 1). The studies indicated that

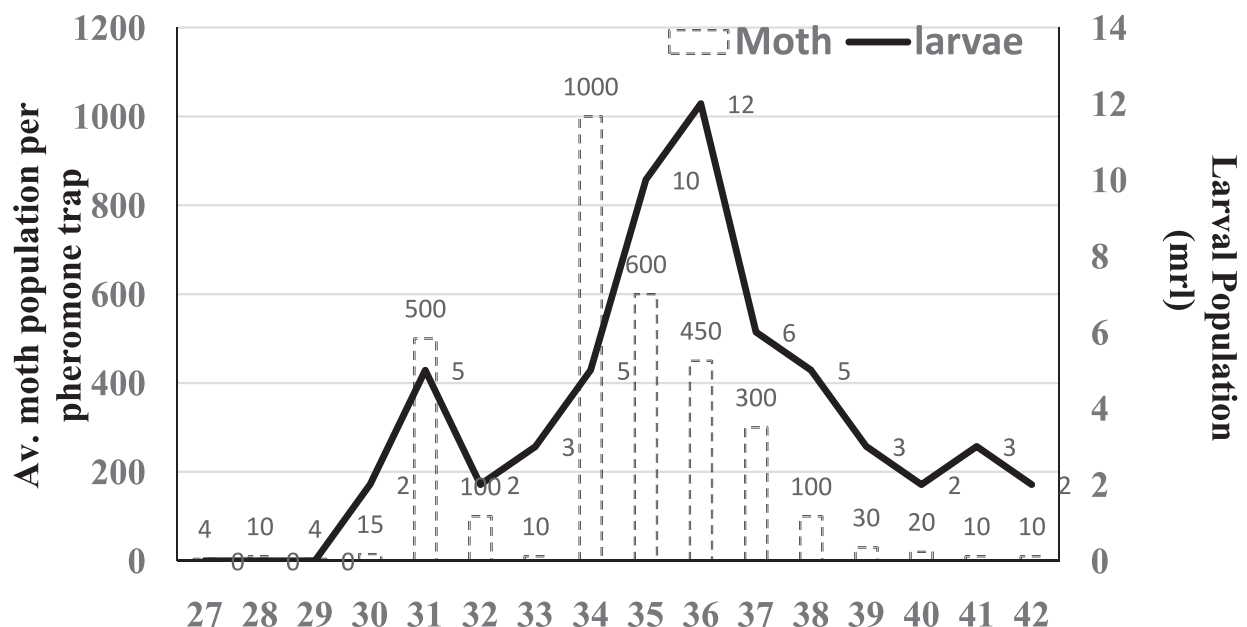


Fig. 1: Weekly male moth catches in pheromone trap of *S. litura* observed in soybean

the population of male moths in pheromone trap appeared in 1st week of July and continued upto third week of October. Similarly, Punithavalli *et al* 2013 reported the occurrence of male moths of *S. litura* from late July or early August and continued through October. During the stages from vegetative to reproductive of soybean crop, the adult moth population per trap was of 2973 male moths/trap in 2017. It indicates that the activity of *S. litura* increased according to the climatic condition of the zone. The adult trapping started in first week of July, the size of catches increased rapidly and the peak appearance was observed during 31st standard week (SW) then followed by 34 to 37th SW (3rd August to 2nd week of September). The maximum population was observed during 34 and 35th SW. These results are similar to the observation made by Punithavalli *et al* 2013 in soybean cropping system. Whereas, the peak period of moth catches was observed in 36th, 43rd and 44th standard weeks and 40th and 43th standard week in castor and groundnut crop, respectively (Gedia *et al.*, 2007 and Singh and Sachan 1993). Prasannakumar *et al* (2012) reported peak moth population during 37th SW in potato crop.

The populations were high from August to mid-October and decreased sharply in late October. Similarly, peak period of *S. litura* male moths was observed on groundnut and soybean during the rainy season (July-October) (Singh and Sachan 1993).

Effect of weather parameters on *S. litura* male moth catches

Correlation studies

The correlation coefficients worked out between the weather parameters and pheromone trap moth catches in

soybean and the results of the correlation studies (Table 1) revealed that the tobacco caterpillar populations recorded periodically from the pheromone traps was greatly influenced by agrometeorological conditions. Overall correlation studies confirmed that the fluctuations in the male moth catches of *S. litura* per pheromone trap is mainly due to weather factors like, maximum temperature, morning and evening humidity, rainfall, sunshine and wind speed. During 2017, weather factors like minimum temperature and morning humidity influence the male moth population per trap whereas maximum temperature, sunshine hrs and wind speed had negative influence but non-significant. These results are contradictory to the results in castor and groundnut where the population of male moth catches had a significant positive correlation with maximum temperature, afternoon relative humidity and sunshine hours and negative correlations with rainfall (Bhalani *et al.*, 2004). Maximum temperature had significant positive correlation with trap catches while trap catches had significantly negative correlation with rainfall and relative humidity in castor (Gedia *et al.*, 2007). All the weather parameters except morning relative humidity had highly significant negative influence on the pheromone trap catch of tobacco caterpillar in cotton (Prasad *et al.*, 2008). The weather parameters *viz.*, wind speed and evaporation influenced the activity of the moths. The correlation matrix on trap catches of potato cut worm exerted a negative association with morning relative humidity; after noon relative humidity and rainfall and a positive relation with maximum temperature; minimum temperature and wind speed (Prasannakumar *et al.*, 2012). The differences in results may be due to place and crops.

Table 1. Correlation co-efficient between pheromone trap catches of *Spodoptera litura* and weather parameters on soybean (2017)

| Year | Larval population | Maxi. Temp. (°C) | Mini. Temp. (°C) | Mor. RH (%) | Eve. RH (%) | Rainfall (mm) | Rainy days | Sunshine (hrs) | Windspeed (Km/hr) |
|----------------|-------------------|------------------|------------------|-------------|-------------|---------------|------------|----------------|-------------------|
| 2017 (n=16) | 0.652* | -0.239 | 0.245 | 0.429 | 0.259 | 0.107 | 0.312 | -0.282 | -0.100 |

*Significant at 5%

Table 2. Regression equations for prediction of moth trap catches of *S. litura* in soybean (2017)

| Year | Prediction equations | R ² |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 2017 | Y=-5879.02 + (-29.41x ₁) + (110.93x ₂) + (86.41x ₃) + (-41.55x ₄) + (0.71x ₅) + (31.57.62x ₆) + (-62.91x ₇) + (-21.22*x ₈) + 318.42 | 0.46* |

**Significant at 1% *Significant at 5%

X₁= Maximum temperature (°C) X₂= Minimum temperature (°C) X₃= Morning relative humidity (%) X₄= Evening relative humidity (%) X₅= Rainfall (mm) X₆= Rainy days X₇=Sunshine (hrs) X₈=Wind speed (km/hr)

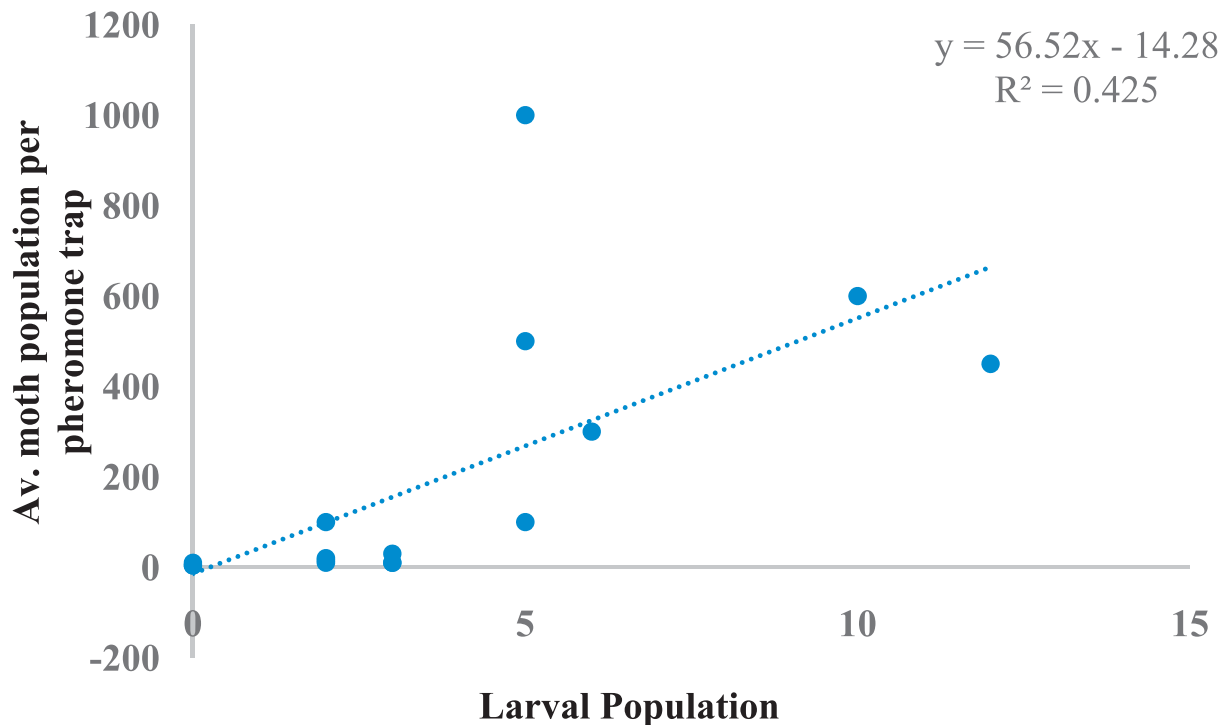


Fig. 2: Regression of pheromone moth catches on larval population of *S. litura* in soybean (2017)

Regression analysis

Data indicated that the various weather parameters caused 46 per cent variations in *S. litura* male moth catches. The regression equation indicated that increase in 1°C temperature decreased the male moth catches of *S. litura* of 29.41 per trap per week whereas, increase in 1% morning and evening relative humidity influenced the moth population of *S. litura*. Also, due to the increase in sunshine hours negatively influence the moth population of 62.91 per trap per week. Similarly, 46 per cent variations in *S. litura* male moth catches were observed due to various weather parameters in 2017. Increase in 1 per cent morning humidity reduced the moth catches in castor (Gedia *et al.*, 2007). These results are contradictory of the present study in soybean. All weather parameters combined with rainfall significantly contributed in variations in the male moth catches of *S. litura* in soybean.

Relationship between pheromone trap catches and corresponding field population

Pest monitoring is only reliable when the relationship between pheromone trap catches and corresponding field population estimates are consistent and good (Srivastava *et al.*, 2010). During 2017, larval population of *S. litura* was correlated with the increase in population of moth catches in soybean. The correlation between larval counts and pheromone trap catches were

significantly positive (0.652). Initial buildup of larval population in the field was observed during the 3rd week of July and continued upto mid-September and resulted in severe outbreak of *S. litura* in soybean during August to September. This indicates that the more peaks in pheromone trap catches of *S. litura* in August to September months were invariably followed by an increase in the number of larvae population and contributed to the outbreak of the pest in the soybean field. The peak population of larvae also coincided with the reproductive stage of the soybean crop. Similarly, Punithavalli *et al* (2013) studied the seasonal occurrence of *S. litura* in a soybean ecosystem. The peak appearance of egg masses and larvae of *S. litura* corresponded with the peak activity of male moths recorded during mid-September.

Correlation studies indicated that there existed a significantly positive correlation between moth catches in pheromone trap and larval population of *S. litura* in soybean with the r value of 0.652. Earlier Punithavalli *et al* (2013) also reported that weekly trap catches were linear and positively correlated with masses and larval populations in soybean crop.

In recent years, frequent occurrences of outbreak of *S. litura* have been observed in the soybean field (Prasad *et al.*, 2013). In 2007, outbreak of this pest was observed

in soybean crop during 38th SW. During this week, the rainfall of 195 mm and sudden rise in temperature contributed the egg and larval population in the farmers field. It means that continuous rainfall followed by dry condition favours the incidence of this pest on soybean field (Babu *et al.*, 2015). Similar condition was reported by Choudhary and Bajpai, 2006. In this period, pest may undergo shorter life cycle and feeds on the reproductive stage of the soybean crop and generates overlapping populations in the field. Insecticide resistance in *S. litura* due to continuous exposure of same group of insecticides, misuse or overdose of pesticides and low activity of natural enemies may result in outbreak of this pest. Xue *et al* (2010) reported that the larvae in second generation developed faster, survived more, had heavier pupae and oviposited more. Similarly, Gao *et al* (2004) identified several factors like monoculture, increased acreage of preferred crops, high temperature and less rainfall in summer, misuse of pesticides that cause resistance against insecticides and less natural enemies.

Prasad *et al* (2013) reported the frequent outbreaks of *S. litura* on soybean. Analysis indicated that the occurrence of widespread and frequent rainfall during June-September, other rainfall events reflected in the low incidence of *S. litura*. They reported rainfall events coinciding with adult emergence time had a detrimental effect on pupal survival and moth emergence initiating the next generation.

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