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Weather based monitoring of male moths in pheromone trap and oviposition of *Spodoptera litura* on cotton in Gujarat

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ABSTRACT

Field trials were conducted to study the effect of various weather factors on *Spodoptera litura* male moth catches in pheromone trap and their oviposition on cotton foliage during rainy and post rainy seasons of 2003-04 and 2004-05. The male moths were active from July to January and attained five peak levels with three oviposition peak with highest moth catch and oviposition in 44th standard week. Maximum temperature and bright sunshine hour had significant positive while wind speed and rainfall had significant negative association with male moth catches in pheromone trap and oviposition on cotton foliage during both the years. The values of coefficient of determination (R^2) indicated that various weather parameters caused significant variation (45.22 and 47.15 per cent) in *S. litura* male moth catches and oviposition, respectively.

Keywords: Weather factors, pheromone trap, *Spodoptera litura,* male moth catches, oviposition, cotton

Spodoptera litura (Fabricius) (Lepidoptera : Noctuidae), commonly known as tobacco caterpillar, is one of the serious pests of cotton. The pest is widely distributed throughout tropical and temperate countries in Asia, Australia and the Pecific basin (Feakin, 1973) and causing damage to 112 plant species belonging to 44 families (Maussa and Kotbey, 1960). Its outbreak also occurs in Saurashtra region of the Gujarat State. The loss caused by *S. litura* in different cotton cultivars has been estimated to the tune of 14.0 to 25.50 per cent under Junagadh condition (Anonymous, 1986).Besides various crop factors such as sowing time, spacing and age of the crop etc., weather factors influence the density of the pest population. Moreover, detection of the pest occurrence and its further development is very essential to apply need based IPM programme. In recent time the use of synthetic insect pheromone lures and traps are being used to monitor both the presence as well as density of the pest species and the trap catches can be utilized to forewarn regarding outbreaks of the pest (Natarajan, 2004).

Effect of weather factors on pest population fluctuations through pheromone traps have been worked out by many workers (Nandihalli *et al*., 1989 and Chaudhari *et al*., 1999). However, very scanty information is available on weather based fluctuation of *Spodoptera litura* male moth in pheromone trap and its relationship with oviposition of the pest on crop foliage which could help in management of the pest. Hence, the present study was taken up in cotton ecosystem.

MATERIALS AND METHODS

Monitoring

The pheromone trap comprising a single plastic funnel (Rao *et al*., 1991a) was used with the septa obtained from Agriland Biotech Ltd., Baroda (Gujarat). The sex pheromone of *S. litura* is a mixture of 9Z, 11E, tetradecadienyl acetate and 9Z, 12E, tetradecadienyl acetate in a ratio of 9:1 (Tamaki *et al*., 1973). Such pheromone traps were installed in cotton field at College Farm, the Junagadh Agricultural University, Junagadh, located at 70.36 E longitude and 21.31 N latitude at an altitude of 60 m above mean sea level, in India, during rainy and post rainy seasons of 2003-04 and 2004-05. Five pheromone traps were placed at a distance of 200 meters between two traps (Rao *et al.*, 1991a). Initially, the traps were placed at 1 meter above the ground level. Later on, taking into consideration the growth of crop, the pheromone traps were placed

at 1.5 and 2.0m above ground level in cotton. (Krishnananda and Satyanarayana,1985; Krishnananda *et al.,*1992 ; Pawar and Prasad, 1983 and Rao *et al.*, 1991b). Each pheromone lure was replaced with a new one after an exposure for 25 days (Rao *et al.*, 1991a). A small cotton plug with a few drops of dichlorvos was placed at the bottom of polythene sleeve of pheromone traps to kill the trapped moths. The number of moths trapped was recorded at weekly interval and the trap was emptied. Simultaneously, the number of egg masses laid by the pest were recorded on foliage from randomly selected thirty spots of 1 m^2 in the field of cotton crop where pheromone traps were installed.

Data on various weather parameters were collected from the Meteorological Observatory, Junagadh Agricultural University, Junagadh. The relationship between different weather factors of previous week and male moth catches in the pheromone traps and egg masses of *S. litura* observed at weekly intervals on foliage of cotton were established by using simple correlation and multiple regression analysis adopting stepwise method.

RESULTS AND DISCUSSION

Fluctuation in S. litura male moth catches

The result of two years pooled data on pheromone trap catches of *S. litura* male moths (Fig.1) indicated that the moths were active from July to January and attained five peaks with maximum catch (260.5 moths $trap^{-1}$ $week^{-1}$) in 44th standard week (5th week of October). Nandihalli *et al.*(1989) observed that the pest was active throughout the year with particularly large populations in July to January in pheromone traps kept in various crops. Singh and Sachan (1991) observed five peaks of *S. litura* male moths during the rainy season (June-October) on groundnut and soyabean. Chaudhari *et al.* (1999) stated that male moths of *S. litura* were active throughout the year with highest activity during 43rd to 46th standard weeks on cotton.

Weather parameters and S. litura male moth catches in pheromone trap

The results of correlation study between *S. litura* male moth catches with weather parameters (Table 1) revealed that moth catches in pheromone trap was positively correlated with maximum temperature (r = 0.619) and bright sunshine hours (0.316) while they were negatively correlated with afternoon relative humidity (r = -0.278), wind speed (r = -0.466) and rainfall (r = -0.387). Similarly, Senapati *et al.* (1990) observed positive association between maximum temperature and *S. litura* male moth catches in cotton, whereas Chaudhari *et al.* (1999) reported that the activity of male moths in cotton was negatively influenced by rainfall, wind speed and relative humidity, while bright sunshine hours had positive impact on male moths.

In order to determine the predictability of the male moths of *S. litura* in cotton, stepwise regression analysis was carried out between weather parameters and male moth catches. The regression equation is fitted for both years of (Table 2) between weather factors of previous week and *S. litura* male moth catches.

The resultant regression equations showed that an increase in 1°C of maximum temperature increased the male moth catches by 13.45 moths per trap per week of *S. litura* while an increase in 1 mm rainfall decreased the male moths to the tune of 0.35 per trap per week. The coefficient of determination (R^2) indicated that various weather parameters had significantly contributed to the tune of 45.22 per cent to *S. litura* male moth catches in pheromone trap in cotton crop during 2003-04 and 2004-05. Nandihalli *et al.*(1989) and Chaudhari *et al.* (1999) reported that various weather parameters caused 42 and 69 per cent variations in *S. litura* male moth catches, respectively.

Oviposition trend of S. litura in cotton

The pooled mean of *S. litura* oviposition on foliage during 2003-04 and 2004-05 indicated that the egg masses first appeared in mid July (30th standard week) and continued till last week of December (52nd standard week). Three peaks of egg masses were observed with the highest oviposition (2.20 / m^2 / week) during 44th standard week i.e. 5th week of October (Fig.1). Singh and Sachan (1993) recorded the highest peaks of *S.litura* eggmasses from 36th to 39th standard week and 43rd to 45th standard week during rainy and post rainy seasons, respectively on groundnut and cauliflower. Thanki *et al.* (2003) reported that egg

Table 1: Correlation between weather parameters and weekly moth catches in pheromone trap and oviposition of S. litura in cotton

	Temperature (°C		Relative humidity (%)		Wind speed (km hr^{-1})	Bright sunshine hours	Rainfall (mm)
	Max.	Min.	Morning	Afternoon			
	(X1)	(X2)	(X3)	(X4)	(X5)	(x6)	(X7)
Moth catch	0.619**	0.005	-0.167	-0.278*	-0.466**	0.316*	-0.387**
Oviposition	0.654**	0.133	-0.107	-0.207	-0.448**	0.280*	-0.297*

* Significant at 5% (r=0.250), ** Significant at 1 % (r=0.325), n = 62

Table 2: Multiple regression between weather and weekly moth catches in pheromone trap and oviposition of S. litura in cotton

Weather parameter	Partial 'b' value	't' value for 'b'	R^2	Intercept
	Moth catch			
x_1 = Maximum temperature (°C)	13.45**	3.63		
x_4 = Afternoon relative humidity (%)	1.01	1.12		
x_5 = Wind speed (km/hr)	-10.2	-1.77	0.4522**	- 350.21
x_6 = Bright sunshine hours	1.29	1.15		
x_7 = Rainfall (mm)	-0.35*	-2.18		
	Ovipositor			
x_1 = Maximum temperature (°C)	0.12**	4.85		
x_5 = Wind speed (km/hr)	-0.05	1.27	0.4715**	-3.26
x_6 = Bright sunshine hours	-0.03	1.12		
x_7 = Rainfall (mm)	-0.001	0.85		

* Significant at 5 % (t= 2.000 , R= 0.380), ** Significant at 1 % (t=2.66, R=0.442) , n = 62

masses of *S. litura* appeared from first week of October and continued till January on castor crop in Gujarat and observed maximum oviposition during 1st week of October and 4th week of November.

Effect of weather parameters on oviposition of S.litura in cotton

The result of the correlation study (Table 1) between oviposition of *S. litura* and various weather parameters showed that maximum temperature and bright sunshine hours had significant positive (r = 0.654 and r = 0.280, respectively) and wind speed and rainfall had significant negative (r = -0.448 and r = –0.297, respectively) relationship with oviposition of *S. litura* on cotton. Thanki, *et al.* (2003) showed that egg masses had significant negative correlation with afternoon relative humidity whereas morning relative humidity, wind speed and rainfall had non-significant negative association and bright sunshine had non-significant positive association with egg masses of *S. litura* on castor.

The regression equations fitted after stepwise regression analysis (Table 2) between various meteorological parameters and egg masses observed on foliage of cotton indicated that an increase in 1°C of maximum temperature increased the egg mass of *S. litura* to the tune of 0.12 . The coefficient of determination (R^2) indicated that the weather parameters had contributed to the tune of 47.15 cent to number of egg masses in cotton field during 2003-04 and 2004-05. Thanki *et al.* (2003) stated that various weather factors caused 66.0 per cent variation in the egg masses in castor.

The results of the present finding show that various weather parameters (one week earlier) influenced the *S. litura* moth catches in pheromone trap and their oviposition on foliage of cotton. Apart from this, the peak activities of the moth catches coincided with the peak oviposition except at later stages of crop growth. However, a highly positive correlation was obtained between male moth catches in pheromone trap

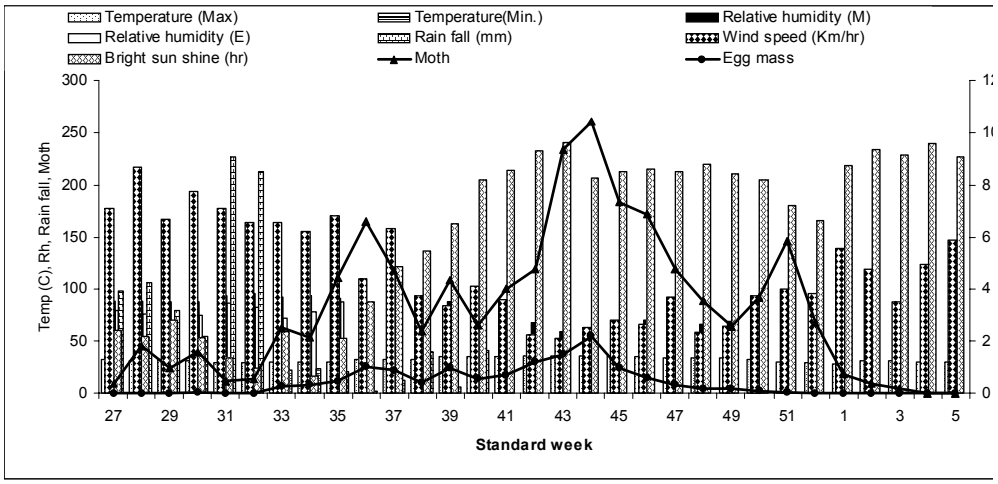

Fig. 1: Weather parameters and male moth catches in pheromone trap and egg masses of *S. litura*

and their oviposition in cotton field. Therefore, trap catches can give indication on timing of insecticide application to contain the insect or pheromone trap values may be included as a component in Integrated Management of *S. litura* in cotton ecosystem.

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