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INFLUENCE OF WEATHER ON MALE MOTH CATHCES OF *SPODOPTERA LITURA* IN PHEROMONE TRAPS AND INFESTATION IN VIRGINIA TOBACCO

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Tobacco caterpillar, *Spodoptera litura* Fab. is a polyphagous pest infesting several crops including tobacco. Field experiments were conducted to study the interrelationship between the male moth catches in pheromone traps with weather parameters and the pest infestation in Virginia tobacco field crop for three seasons (2010 -13). During 2010-11, the trap catch was highest in the 7th standard week (83/trap). The correlation between trap catch, egg masses, larvae and increase in per cent plants damaged was highly significant during the season. The multiple linear regression equation for plants damaged vs. moth catch, egg masses and weather parameters explains 69.6 per cent variability of the dependent variable by pheromone trap catch together with weather parameters. During 2011-12, the trap catch was highest in the 2nd standard week (22.5/trap) followed by 8th (20/trap) and 3rd (18.25) standard weeks. The correlation between trap catch, egg masses, larvae and increase in per cent plants damaged was not significant during the season. The multiple linear regression equation for moth catch in pheromone traps vs. weather parameters explains 50.3 per cent of variation in the moth catches in pheromone traps and about 50 per cent variation in the dependent variable is unexplained. During 2012-13 the trap catch was highest in the 8th standard week (20.5/trap). The correlation between trap catch, egg masses, larvae and increase in per cent plants damaged was positive and highly significant. The fitted multiple linear regression equation for increase in per cent plants damaged vs. moth catch and weather parameters explain 76.1 per cent variability of the dependent variable by pheromone trap catch together with weather parameters.

INTRODUCTION

Tobacco caterpillar, *Spodoptera litura* F. is a major pest of tobacco. Pheromone traps proved to be reliable tools for estimating fluctuations in population density and for indicating the pest infestation. Besides various crop factors, weather factors also 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 programmes. Use of synthetic insect pheromone lures and traps to monitor the presence and density of the pest species and for forewarning the pest outbreaks has been reported (Natarajan, 2004). The present studies were undertaken to determine the fluctuations of *S.litura* male moth catches in pheromone traps, infestation in the Virginia tobacco and to determine their relationship with weather parameters that could help in timely management of the pest in Virginia tobacco field crop.

MATERIALS AND METHODS

The pheromone trap comprising a single plastic funnel (Rao *et al*., 1991) was used with the septa obtained from Pest Control India Ltd. Bangalore. The pheromone traps were installed in Black soil farm, Katheru at ICAR-Central Tobacco Research Institute, Rahjahmundry, Andhra Pradesh, located at 16.98^0 N latitude and 81.78^0 E longitude at an altitude of 14 m above mean sea level, in India, during three consecutive *Rabi* seasons of 2010-11, 2011-12 and 2012-13. Four pheromone traps were installed in four blocks of Virginia tobacco field at distance of 200 m between two traps (Rao *et al.*, 1991) at a height of 2 m above ground level (Krishananada and Satyanarayana, 1985). Each pheromone lure was replaced with a new one after an exposure of 20 days. The trap catch was recorded daily and the incidence of the pest in terms of egg masses, larvae and damage due to the pest in terms of per cent plants damaged was recorded at weekly intervals.

Key words: Virginia tobacco, *Nicotiana tabacum, Spodoptera litura*, pheromone traps, weather

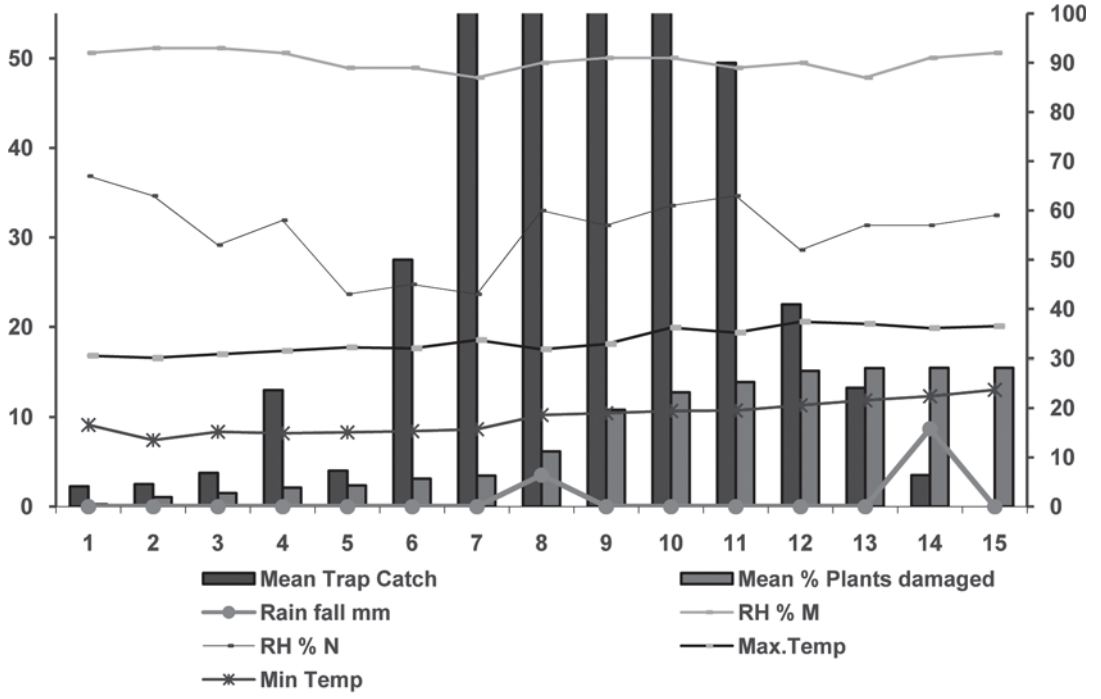

Fig. 1: Influence of weather parameters on moth catches of *S.litura*, and its infestation in Virginia tobacco-2010-11

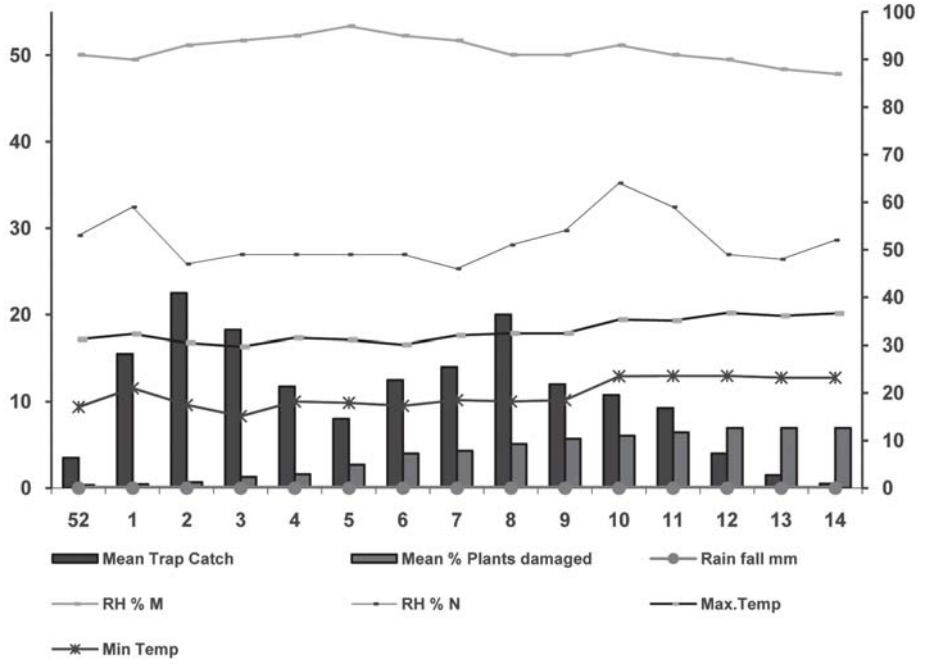

Fig. 2: Influence of weather parameters on moth catches of *S.litura*, and its infestation in Virginia tobacco-2011-12

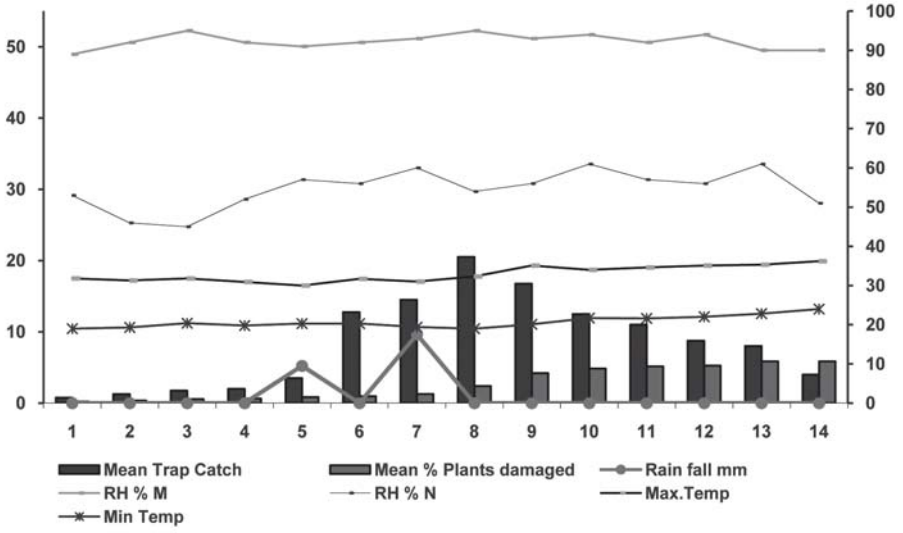

Fig. 3: Influence of weather parameters on moth catches of *S.litura*, and its infestation in Virginia tobacco-2012-13

Table 1: Correlation matrix of pheromone trap catch of S.*litura* vs. plant damage and weather parameters (2010-11)

	Trap catch	Plants damaged (%)	Max. Temp. (C)	Min. Temp. (C)	R.H. (M) (%)	R.H. (A.N.) (%)	Rain fall (mm)
Trap catch	1.00						
Plants damaged (%)	0.728**	1.00					
Max. Temp.(C)	0.038	-0.105	1.00				
Min. Temp.(C)	-0.083	0.004	0.825**	1.00			
R.H. (M) %	-0.352	-0.169	-0.410	-0.291	1.00		
R.H. (A.N.) %	-0.484	-0.065	-0.206	0.177	0.388	1.00	
Rain fall (mm)	-0.095	0.091	0.243	0.501	0.100	0.061	1.00

Table 2: Correlation matrix of pheromone trap catch of S.*litura* vs. plant damage and weather parameters (2011-12)

	Trap catch	Plants damaged (%)	Max. Temp. (C)	Min. Temp. (C)	R.H. (M) (%)	R.H. (A.N.) (%)
Trap catch	1.00					
Plants damaged (%)	0.427	1.00				
Max. Temp.(C)	0.471	-0.804	1.00			
Min. Temp.(C)	0.527	-0.804	0.952	1.00		
R.H. (M) %	-0.599	0.521	-0.593	-0.512	1.00	
R.H. (A.N.) %	-0.457	-0.423	0.368	0.503	-0.250	1.00

In each block a grid of 500 plants were selected and from each grid observations on incidence and damage in 100 plants was recorded at random. The weather parameters viz., maximum temperature, minimum temperature, R.H. morning (M) and R.H. noon (N) and rain fall were collected from the meteorological database of ICAR-CTRI. An attempt was made to study the influence of weather parameters on trap catch, incidence of the pest and the resultant plant damage through correlation and regression analysis.

RESULTS AND DISCUSSION

During 2010-11 season, the trap catch was highest in the 7th standard week (83/trap) followed by 8th (72.5) and 9th (69.5) standard weeks (Fig. 1). The results indicated that with the increase in the trap catch (lagged variable) there is an increase in the mean per cent plants damaged in the following week. The correlation between trap catch and per cent plants damaged was highly significant in all the four blocks. During the season there was no correlation between the weather parameters and trap catch. The correlation matrix shows that there is a highly significant and positive correlation between trap catch, egg masses, larvae and increase in per cent plants damaged (Table 1). The multiple linear regression equation for moth catch in pheromone traps vs. weather parameters explains only 30.3 per cent of variation in the male moth catches in pheromone traps (Table 4). The linear regression equation for plant damage vs. moth catch showed 53 per cent variability (Table 5). The multiple linear regression equation for increase in per cent plant damage vs. moth catch and weather parameters explains 67.8 per cent variability of the dependent variable by pheromone trap catch together with weather parameters and about 32 per cent variation in the plants damaged by *S.litura* went unexplained during the season (Table 6).

During 2011-12 crop season the trap catch was relatively less and it was highest in the 2nd standard week (22.5/trap) and another two peaks were recorded during 3rd (18.25) and 8th (20) standard weeks (Fig. 2). The incidence of the pest and the plant damage was low during the season. The highest damage recorded was 6.95%. The correlation between trap catch, egg masses, larvae and increase in per cent plants damaged was not significant in any of the four blocks. The correlation was highly significant only in case of egg masses/plant and the larvae/plant. There was no correlation between the weather parameters and moth catch in the traps. The correlation matrix also shows that there is no correlation between trap catch, egg masses, larvae and increase in plants damaged (Table 2). The multiple linear regression equation for moth catch in pheromone traps vs. weather parameters explains 50.3 per cent variation in the moth catches in pheromone traps (Table 4). The linear regression equation for per cent increase in plant damage vs. moth catch in the pheromone traps showed that only 27.7 per cent variability of the plant damage was explained by pheromone trap catch (Table 5). The multiple linear regression equation for increase in plant damage vs. moth catch and weather parameters was highly significant and explains 69.3 per cent variability in the dependent variable by pheromone trap catch together with weather parameters (Table 6).

During 2012-13 season the trap catch started increasing from 6th standard week (12.75/trap) and remained more or less stable up to 11th standard week (11/trap). The male moth catch was highest in the 8th standard week (20.5/trap) followed by 9th standard week (16.75/trap). The incidence of the pest and damage were also low during the season. The highest damage recorded was only 5.85% (Fig. 3). The correlation between trap catch, egg masses, larvae and increase in per cent plants damaged was positive and highly significant in all the four blocks. During the season the correlation between weather parameters and trap catch was highly significant. Earlier studies also indicated variations in *S.litura* moth catches due to abiotic factors (Rudraswamy *et al.*, 2006; Gedia *et al.*, 2007; Prasannakumar *et al.*, 2011. The multiple linear regression equation for moth catch in pheromone traps vs. weather parameters explains 80.2 per cent of variation in the moth catches in pheromone traps and was highly significant (Table 4). The linear regression equation fitted for per cent increase in plant damage vs. moth catch in the pheromone traps showed that 64.2 per cent variability of the plant damage was explained by pheromone trap catch which was

Table 3 Correlation matrix of pheromone trap catch of S.*litura* vs. plant damage and weather parameters (2012-13)

	Trap catch	Plants damaged (%)	Max. Temp. (C)	Min. Temp. (C)	R.H. (M) (%)	R.H. (A.N.) (%)	Rain fall (mm)
Trap catch	1.00						
Plants damaged (%)	0.905**	1.00					
Max. Temp.(C)	0.853**	-0.400	1.00				
Min. Temp.(C)	0.801**	-0.409	0.790	1.00			
R.H. (M) %	-0.206	0.228	-0.073	-0.234	1.00		
R.H. (A.N.) %	-0.307	0.366	0.258	0.242	-0.097	1.00	
Rain fall (mm)	0.430	0.705**	-0.459	-0.260	-0.001	0.351	1.00

** Highly Significant at 5%

Table 4: Relationship between moth catch in traps and weather parameters

Year	Intercept (a)	Max. Temp. (x1)	Min. Temp. (x2)	Rain fall (x3)	R.H. M (x4)	R.H.N (x5)	R^2
2010-11	475.67	-4.98	4.28	-0.895	-2.720-	1.980	0.303
2011-12	153.9	-5.46	2.89	-0.244	0.020	0.503	153.9
2012-13	-143.5	0.37	-1.45	0.451	1.405	0.720	0.802**

Table 5 Relationship between Plants damaged and moth catch in traps

Year	Intercept (a)	Moth catch (x)	R^2
2010-11	0.151	0.0325	0.530**
2011-12	0.086	0.0320	0.277
2012-13	-0.147	0.064	0.642*

Table 6 Relationship between plant damage vs moth catch and weather parameters

Year	Intercept (a)	Moth catch(x1)	Max. Temp. (x2)	Min. Temp. (x3)	Rain fall (x4)	R.H.M (x5)	R.H.N (x6)	R^2
2010-11	2.967	0.0398	-0.119	0.065	0.044	-0.0318	0.460	0.678**
2011-12	0.767	0.012	-0.007	-0.081	-	-0.018	-0.007	0.693**
2012-13	5.137	0.062	-0.002	-0.025	0.290	-0.040	-0.020	0.761**

* Significant at 5%
** Highly Significant at 5%

significant. The multiple linear regression equation for increase in per cent plants damaged vs. moth catch and weather parameters explain 76.1 per cent variability of the dependent variable by pheromone trap catch together with weather parameters (Table 6). Singh and Sachan (1983); Sridhar *et al.*, (1988); Thanaki *et al.*, (2003); Gedia *et al.*, (2007) also reported similar observations in various crops.

Based on the study it can be inferred that, the *S.litura* moth catches were influenced to an extent of 30.3 - 80.2 per cent by the weather parameters chosen for analysis. Whereas, the damage due to the pest could be explained by the moth catch in the traps to an extent of 27.7 to 64.2 per cent. The plant damage due to *S.litura* in Virginia tobacco field crop could be explained together with the trap catch and the weather parameters to an extent of 67.8 - 76.1 per cent.

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