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INFLUENCE OF WEATHER FACTORS ON THE PHEROMONE TRAP CATCHES OF *HELICOVERPA ARMIGERA* (HUBNER)

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ABSTRACT : Correlation of weather factors like maximum temperature, minimum temperature, rainfall, maximum relative humidity, minimum relative humidity, sunshine, wind speed and evaporation with the sex Pheromone trap catches of *Helicoverpa armigera* (Hubner) studied at Basuregadi village, Ranga Reddy dist. Andhra Pradesh. It was found that the pheromone trap catches had correlation with all the weather factors.

Key words : *Weather factors, Pheromone, H.armigera.*

INTRODUCTION

All chemicals that are produced by any organism to make a communication with individuals of the same species are called pheromone (Karlson & Luscher,1959 and Karlson & Butenandt,1959). Pheromones regulate the behavioral aspects of an individual or among members of a group of organisms. Based on various modes of activities, pheromones are classified into 1) Aggregation pheromones, 2) Alarm pheromones, 3) Sex pheromones, 4) Trailing pheromones etc. (Shorey,1977; Jackson & Lewis,1981 and Borden,1990). The function of sex pheromone as an attractant was exploited by man especially in monitoring and controlling the agricultural pests (Karlson and Luscher,1959). Man has developed and used insect pheromones particularly to attract the opposite sex insects and destroy them. This helps in monitoring and controlling various pests and it has great importance in agricultural, Household, Medical and Veterinary etc. pest management practices (Karlson & Butenandt,1959; Shorey,1977; Cork *et al.*,1998; William,1999 and Christopher Asaro *et al.*, 2001). Many of the insect pheromones have been artificially synthesized either to attract or repel the insects of opposite sex like Bombycol in case of *B.mori*, Gyplure in case of Gypsy moth, Litlure in case of *S.litura*, Helilure in case of *H.armigera* etc. (Atwal,1976; Krishnaiah, 1986 and Padmavathi & Paul,1996).

Environmental factors like temperature; rain, wind velocity, humidity and seasonal changes have effects on pheromone catches. There is definite correlation between pheromone catches and environmental factors (Patil *et al.*, 1996 and Korat & Lingappa,1997). Some researchers accept it and some researchers reject it totally. For reference Kehat *et al.* (1980) reported no correlation between moth catches and weather factors while monitoring *S.litura*. In case of *H.armigera* catches were zero in pheromone traps, when mean hourly temperature was 11°C (Dent and Pawar,1988). *P.opeerculella* activity was very less below 15°C and high humidity (Chandla *et al.*,1987). *S.litura* catches are high at higher temperatures (Senapathi *et al.*,1990). Minimum temperature shows negative influence on trap catches of *P. xylostella* (Chandramohan,1985) and also on *H.armigera* and *E.vitella* (Dhawan and Simwat,1996). But in case of *P.gossypiella* and *E.insulana* showed a positive significant correlation with minimum temperature (Dhawan and Simwat, 1996).

Wind speed affects the moth activity. Some researchers reported negative influence and some reported positive influence of the wind speed. For example in case of *E.vitella* positive correlation was reported by Naik *et al.* (1997) where as for the same insect negative correlation was reported by (Dhawan and Simwat,1996). However effect of wind velocity is negative on *E.insulana* and *H.armigera* (Dhawan and Simwat,1996) and positive on *P.gossypiella* (Dhawan & Simwat,1996 and Naik *et al.*,1997). Rain has a negative correlation on trap catches as it may be due to arrest of flight during the rain. It is true for insects like *H.armigera* (Kulkarni & Patil,1996 and Chaudhari *et al.*,1999) (Dhawan and Simwat, 1996), *P.xylostella* (Chandramohan,1985), *E.insulana* (Dhawan and Simwat,1996). Effect of relative humidity (RH) on trap catches was studied by various Scientists. Not even a single *H.armigera* was trapped when average RH was below 86.3% (Sinha and Jain,1992). A positive correlation was observed between RH and trap catches of insect such as *E.vitella* (Naik *et al.*,1997), *S.litura* in tomato field (Patnaik *et al.*,1998) *H.armigera* (Sinha & Jain,1992 and Gupta *et al.*,1996). In case of *P.operculella*, it was negative correlation (Chandramohan, 1995). Chaudhari *et al.* (1999) reported negative influence of RH on the pheromone trap catches of *H.armigera* moths. As per season is concerned according to Gupta *et al.* (1990) the activity of *P.gossypiella* was there through out the year with peaks between third week of August to second week of November. Patil *et al.* (1996) observed maximum catches of *H.armigera, E.vittella* and *P.gossypiella* during November to January, October to January and October to April respectively in these insects.

Hence, in the present study an attempt was made to understand the influence of weather factors trap catches of synthetic pheromones available commercially in India by testing against lepidopteron pests *H.armiger*, Hubner (Lepidoptera : Noctiudae) commonly present in different crops.

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MATERIAL AND METHODS

Experimental trails were carried out to study the influence of weather factors on synthetic sex pheromones trap catches of *H.armiger*, Hubner, its larvae "Cotton boll worm" is a major pest on the cotton. During the years 2000-2001, 2001-2002, 2002-2003 and 2003-2004 the experiments were carried out at Basuregadi village of Medchal Mandal, Ranga Reddy district, located about forty kilo meters Northwest to Hyderabad in Andhra Pradesh. In this village most of the farmers cultivated cotton. The field selected was cotton field and farmer-practiced fields. Cotton was cultivated in seven acres of land as annual crop, from June to February some times up to March.

H.armigera sex pheromone is commonly know as 'Helilure' The sex pheromone lures of *H.armigera* was made of rubber septa. Type of the traps used for the experiment was funnel type trap. Trap was made up of plastic material. Pheromone traps were tied to the long sticks with rope, erected in the fields and lures were placed in the trap. A total of eight pheromone traps were erected in octagonal fashion. Each trap was at equal distance of fifteen meters apart from its adjacent trap. Kehat *et al.* (1980) and Pillai *et al.* (1993) suggested erection of pheromone traps from 10 to 15 meter distance apart. The height of the trap kept fifteen centimeter above the crop height. Every time the height was checked and changed to maintain height difference between the crop and the traps. Siddiqi (1988) reported that pheromone traps at fifteen centimeter above the crop height caught more moths than at any other heights. Pawar *et al.* (1988) also reported that traps just above the crop height caught more moths. Pheromone lures were placed on the day when traps were erected in the field. These lures were tested up to a decided time period and then all the pheromone lures were replaced with another set of pheromone lures after a decided time period. In the crop season 2000-2001, lures were changed on last day of every fourth week *i.e.* on twenty-eighth day from the date of pheromone traps erection and during the crop seasons 2001-2002, 2002-2003 and 2003-2004 lures were changed on last day of every fifth week i.e. on thirty fifth day. Likewise all the pheromone lures were changed with next set of pheromone lures on completion of decided time duration from the date of erection.

Moth catches data was recorded at weekly intervals. Pawar *et al.* (1983) and Naik *et al.* (1996) monitored *H.armigera* and *P.gossypiella* with pheromone traps to study the correlations with weather factors and pest populations. Field was visited on every sunday, early mornings and data was collected. Weather data was collected from the Agro-meteorological center of Ranga Reddy district to study the correlations. Weather factors for which data collected were Maximum Temp., Minimum Temp., Maximum relative humidity, Minimum relative humidity, Rain fall, sunshine hours, wind speed and evaporation. Weekly average data of all weather factors were considered for the study except rain. For rain weekly total rain fall and weekly total number of rainy days were considered for the study. Weekly weather data collected was for the crop seasons 2000-2001, 2001-2002, 2002-2003 and 2003-2004.

The data collected was subjected to statistical analysis for further conclusions. This statistical analysis was done at Center for Quantitative Methods, Science College, Osmania University, Hyderabad. The collected data was put for Correlation analysis. To study correlations, Pearson's Correlation coefficient formula was used. This formula was proposed by Karl Pearson, a great statistician. This formula helps in measuring the magnitude of relationship between two variables.

$$\gamma = \Sigma dx \, \Sigma dy / \sqrt{\Sigma dx^2 \Sigma dy^2}$$

Where as,

γ is correlation coefficient,

Σdx is sum of differences between variable 'x' and its mean,

Σdx^2 is square of sum of differences between variable 'x' and its mean,

Σdy is sum of differences between variable 'y' and its mean and

Σdy^2 is square of sum of differences between variable 'x' and its mean.

The value of correlation coefficient 'γ' shall always be lie between +1 to -1. When γ value is positive then there is positive correlation *i.e.* both x and y variables go in one direction, if values of one variable increases second variable values also increases or if values of one variable decreases second variable values also decreases. When γ value is negative then there is negative correlation *i.e.* both x and y variables go in opposite direction, if values of one variable increases second variable values also decreases or if values of one variable decreases second variable values also increases. Depending on the value of 'γ' degree of correlation between the variables can be decided. To measure degree of correlation; correlation value range is given in the Table.1.

RESULTS AND DISCUSSION

Correlation coefficient was calculated for *H.armigera* moth catches and weather factors like temperature maximum and minimum, relative humidity maximum and minimum, rainfall, sunshine hours, wind speed and evaporation. In 2000-2001 crop season correlation coefficient γ value for catches of *H.armigera* moths and Maximum temp. is -0.002, which is negligible negative correlation. Moths and minimum temperature correlation coefficient γ value is 0.062 and degree of correlation is very low and positive. Moths and maximum relative humidity correlation coefficient γ value is 0.333, which is positive and low degree of correlation. Moths and minimum relative humidity correlation coefficient ã value is 0.117, which is positive and very low degree of correlation. Moths and rainfall correlation coefficient γ value is -0.080 and degree of correlation is very low and negative.

Moths and sunshine hours correlation coefficient γ value is 0.070, which is positive and very low degree of correlation. Moths and wind speed correlation coefficient γ value is -0.385 and degree of correlation is negative and low. Moths and evaporation correlation coefficient γ value is -0.402, which is negative and low degree of correlation (Table.2).

In the crop season 2001-2002, for catches of *H.armigera* moths and maximum temp. correlation coefficient γ value is -0.121, which is negative and very low correlation. Moths and minimum temperature correlation coefficient γ value is 0.125 and degree of correlation is positive very low. Moths and maximum relative humidity correlation coefficient γ value is 0.002, which is negligible positive correlation. Moths and minimum relative humidity correlation coefficient γ value is 0.131, which is positive and very low degree of correlation. Moths and rainfall correlation coefficient γ value is -0.216 and degree of correlation is very low and negative. Moths and sunshine hours correlation coefficient γ value is 0.066, which is positive and very low degree of correlation. Moths and wind speed correlation coefficient γ value is 0.105 and degree of correlation is positive and very low. Moths and evaporation correlation coefficient γ value is 0.042, which is negligible positive correlation (Table.2).

In 2002-2003 crop season, for catches of *H.armigera* moths and maximum temp. correlation coefficient γ value is -0.335, which is negative and low correlation. Moths and minimum temperature Correlation coefficient γ value is -0.232, and degree of correlation is negative very low. Moths and maximum relative humidity correlation coefficient γ value is 0.193, which is positive and very low degree of correlation. Moths and Minimum relative humidity correlation coefficient γ value is 0.058, which is positive and very low degree of correlation. Moths and rainfall correlation coefficient γ value is -0.098 and degree of correlation is very low and negative. Moths and sunshine hours correlation coefficient γ value is 0.010, which is positive negligible correlation. Moths and wind speed correlation coefficient γ value is -0.220 and degree of correlation is negative and very low. Moths and evaporation correlation coefficient γ value is -0.320, which is negative and low degree of correlation (Table.2).

In 2003-2004 crop season, for catches of *H.armigera* moths and maximum temperature Correlation coefficient γ value is -0.287, which is negative and low correlation. Moths and minimum temperature correlation coefficient γ value is -0.371 and degree of correlation is negative very low. Moths and maximum relative humidity correlation coefficient γ value is 0.132, which is positive and very low degree of correlation. Moths and minimum relative humidity correlation coefficient γ value is -0.143, which is negative and very low degree of correlation. Moths and rainfall correlation coefficient γ value is -0.271 and degree of correlation is low and negative. Moths and sunshine hours correlation coefficient γ value is 0.265, which is positive and low degree of correlation. Moths and wind speed correlation coefficient γ value is -0.223 and degree of correlation is negative and very low. Moths and evaporation correlation coefficient γ value is -0.290, which is negative and low degree of correlation (Table.2).

Average correlation coefficient values for four crop seasons were also calculated for *H.armigera* moth catches and weather factors. For Moth catches and maximum temperature correlation coefficient γ value is -0.186, which is negative and very low correlation. Moths and minimum temperature correlation coefficient γ value is -0.104, and degree of correlation is negative very low. Moths and maximum relative humidity correlation coefficient γ value is 0.165, which is positive and very low degree of correlation. Moths and Minimum relative humidity correlation coefficient γ value is -0.041, which is negligible and negative correlation. Moths and rainfall correlation coefficient γ value is -0.166 and degree of correlation is very low and negative. Moths and sunshine hours correlation coefficient γ value is 0.103, which is positive and very low degree of correlation. Moths and wind speed correlation coefficient γ value is -0.181 and degree of correlation is negative and very low. Moths and evaporation correlation coefficient γ value is -0.243, which is negative and very low degree of correlation (Table.2).

Correlation studies were made to know the effect of weather factors on the pheromone trap catches of moths in the fields. The pheromone traps could catch various types of insects based on pheromone bioefficacy, quantity, pest population status and also climatical conditions (Doane,1976; Carde *et al.*,1977 and Liebhold *et al.*,1992). Many workers have done the correlation studies for weather factors and moth catches and their suggestions were differed. Mahalingan *et al.* (2003) found that *S.litura* moth catches have a positive correlation with rainfall, maximum and minimum temperature, sunshine and negative correlation with relative humidity.

Table. 1 Correlation values.

Degree of correlation	Values for positive correlation	Values for negative correlation
Perfect correlation	1	-1
Very high correlation	Greater than 0.9 to less than 1	Greater than -0.9 to less than -1
High correlation	From 0.75 to 0.9	From -0.75 to -0.9
Moderate correlation	From 0.5 to 0.75	From -0.5 to -0.75
Low correlation	From 0.25 to 0.5	From -0.25 to -0.5
Very low correlation	Less than 0.25	Less than -0.25
No correlation	0	0

Senapathi *et al.* (1990) found a significant positive correlation between trap catches of *S.litura* and maximum temperature only. Gupta *et al.* (1996) reported negative correlation of maximum temperature with *H.armigera* moth catches, where as Gupta *et al.* (1996) reported positive influence of relative humidity on pheromone trap catches of *H.armigera* moths. Chaudhari e*t al.* (1999) studied the relationship between weather parameters and Pheromone trap catches of *H.armigera* and *S.litura* with other bollworm moths affecting cotton yields and reported that bollworm moth activity was negatively influenced by rainfall, wind speed, minimum temperature, relative humidity and vapour pressure, whereas bright sunshine hours were positively correlated. Nasar El Sayed *et al.* (1974) found negative correlation of *S.litura* moth catches with relative humidity and positive correlation with wind speed. They suggested that peak occurrence of *H.armigera*, *P.gossypiella* and *S.litura* populations corresponded to the periods when weekly mean temperature and relative humidity ranged from 20 to 30° and 50 to 65%, respectively and maximum average temp. greater than 37°C during summer and intensive rainfall in monsoon months inhibited insect growth and development.

Table. 2 Correlation coefficient values of pheromone trap catches of *Helicoverpa armigera* moths with weather factors.

Years	Temperature °C		R.H. %					
	Max.	Min.	Max.	Min.	Rain fall (mm)	Sun shine (hrs.)	Wind speed (km/hr)	Evap. (mm)
2000-2001	-0.002	0.062	0.333	0.117	-0.080	0.070	-0.385	-0.402
2001-2002	-0.121	0.125	0.002	0.131	-0.216	0.066	0.105	0.042
2002-2003	-0.335	0.232	0.193	0.058	0.098	0.010	-0.220	-0.320
2003-2004	-0.287	-0.371	0.132	-0.143	-0.271	0.265	-0.223	-0.290
Avg.	**-0.186**	**-0.104**	**0.165**	**0.041**	**-0.166**	**0.103**	**-0.181**	**-0.243**

Because of these differences of opinions, the correlation was calculated to understand the trend and to come out with a conclusion. Rai *et al.* (2002) did the same, they collected 26 years data of yellow stem borer trap catches and correlate with the weather factors from different research works and found that catches were some time positively correlated and the some times negatively correlated with all the weather factors when they tried to interpret week wise. Hence they calculated average of twenty-six years correlation data and suggested that the trap catches of moths were mostly negatively correlated with maximum temperature and rainfall and positively correlated with minimum temperature, maximum relative humidity, minimum relative humidity and sunshine.

Correlation coefficient was calculated for pheromone moth catches of this selected pest moth with maximum and minimum temp. maximum and minimum relative humidity, total rain fall, sunshine, wind speed and evaporation. correlation coefficient values for four crop seasons as observed in this study has shown some difference in correlation values with different weather factors, in different crop seasons and with different pest moth catches. Hence average correlations were calculated for the four-crop seasons and the data was used for correlation.

Average correlation coefficient values shown that *H.armigera* moth catches have positive correlation with maximum relative humidity (0.165) and sunshine (0.103). *H.armigera* moth catches have shown negative correlation with maximum and minimum temperature (-0.186 & -0.104), total rainfall (-0.166), wind speed (-0.181) and evaporation (-0.243). *H.armigera* moth catches have shown insignificant positive correlation with minimum relative humidity (0.041).

Correlation coefficient studies for moth catches of *H.armigera* and weather factors revealed both positive and negative correlations. Average of four season's correlation coefficient values suggests that *H.armigera* moth catches generally has positive correlation with maximum relative humidity and sunshine. Negative correlation was observed with maximum temperature, minimum temperature, rainfall, wind speed and evaporation and insignificant correlation with minimum relative humidity.

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