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Impact of Weather Factors on Population Fluctuation of *H. armigera* on Sunflower

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Abstract: Studies were conducted to ascertain the effect of the weather factors on incidence and development of *H. armigera* on different sunflower genotypes during 2008-2009. The *H. armigera* population was built up progressively from April 12 to April 27 in terms of egg count. The larval population started to increase continuously from April 12 to May 01 and a tremendous decrease was observed thereafter. The results reveal that maximum temperature during 2009 showed significant and positive correlation r-value of 0.514** with the egg counts of *H. armigera*. Whereas, on cumulative basis relative humidity and rainfall had negative and significant correlation with the eggs count with r-values of -0.525** and -0.479*, respectively. It is evident that a maximum larval population was recorded to be 5.64 per 5 plants on April 24, 2009. The determination of the effects of different weather factors on egg count and larval population of *H. armigera* in sunflower is essential for effective management of this pest.

Key words: Sunflower, genotype, *H. armigera*, weather factors, correlation

INTRODUCTION

All the living organisms are influenced by the environmental factors because they have direct impact on the biology. Several environmental factors are known to incidence the inherited characters specially those involving physiological characteristics of crop species and the associated insect pest populations (Heinrichs, 1988; Lode and Sharma, 1993). For effective pest management strategy, it is necessary to know the proper ecological requirement of a pest species. Weather factors like temperature, relative humidity and rainfall which play a vital role in multiplication and distribution of insect pests. The numbers of generations each year are influenced by temperature, host selection and host suitability. Seasonal abundance of phytophagous pests are influenced by these factors. Rainfall directly and indirectly influences seasonal abundance of pest by affecting the abundance and suitability of host plants. To develop any pest management programme for a specific agro- ecosystem complete knowledge on abundance and distribution of pest in relation to weather factors is a basic requirement (Patel and Shekh, 2006). Extreme of temperature and humidity and other weather factors (e.g., wind and hailstorm are thought to be responsible for mortality of eggs, larvae and pupae of most of insect species (Pearson, 1958; Qayyum and Zalucki, 1987). Exposure to temperatures beyond the favourable limits, extremely low or high may retard growth and development of insect stages or may even cause its death (Dhaliwal and Arora, 2001a). Moisture and relative humidity are also very important in determining the population dynamics of insect pest.

Sunflower (*Helianthus annus* L.) belongs to the family Asteraceae and is amongst the major oil seed crop grown for edible oil in the world. Sunflower oil is ranking fourth after palm, soy and rapeseed oil with a worldwide production of about 34.6 Million Tons (mt) of seed in 2010 (FAO-STAT, 2011. This crop is becoming popular among the farmers because of short duration, drought tolerance and high-income return (Khan *et al.* 2000). Pakistan is deficit in edible oil production and import bill of edible oil during current fiscal year is reaching up to $ 2 billion dollars (Anonymous, 2010), second largest after petroleum products and demand for edible oil is increasing at the rate of 11% per annum (Beg, 1983). *H. armigera* is a highly polyphagous pest of many economically significant crops in portions of Africa, Asia, Australia (including Oceania) and Europe (King, 1994). Because of potential pest of many crops, it has many common names: Scarce bordered straw worm, corn earworm, African cotton bollworm, American bollworm and tomato worm, sunflower head worm (Zhang, 1994; Begemann and Schoeman, 1999). The attack of *H. armigera* on sunflower has been reported by Bhosale *et al.* (1990) India and Makhdoomi *et al.* (1984); Hassan *et al.* (1984) and Sattar *et al.* (1984) in Pakistan.

Keeping in view the importance and pivotal role of weather factors, present study was undertaken for determining the impact of various a biotic factors on the population fluctuation of *H. armigera* on Sunflower to chalk out effective pest management strategy for the extension workers and farmers.

MATERIALS AND METHODS

Studies were conducted in the experimental areas of University of Agriculture, Faisalabad and Post Graduate Research Station (PARS) located on Jang road. Twenty

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diverse genotypes of sunflower were planted in Randomized Complete Block Design with in experimental plot of 10 x 6m with 30 cm plant to plant distance and 60 cm row to row distance during 2008-09 Rabi season at PARS. Planting was done with the help of dibbler with three seeds per hill. After germination, of all genotypes one plant per hill was maintained by manual thinning.

The fertilizer and other inter cultural practices including thinning, hoeing, weeding out and earthling up that required for sunflower crop were also carried out at critical growth stages of sunflower crop. Number of eggs from randomly selected five plants in each genotype were recorded with the help of hand lenses for eight dates at 3 days interval from 12-04-2008 to 4-05-2008 for preliminary screening experiments, while there were eight dates of observations for final screening experiments at 3 days intervals from 12-04-2009 to 04-05-2009. The average egg count per five plants for each genotype was calculated.

Number of larvae from randomly selected five plants in each genotype were recorded for eight dates at 3 days interval from 12-04-2008 to 4-05-2008 for preliminary screening experiments, while there were eight dates of observations for final screening experiments at 3 days intervals from 12-04-2009 to 04-05-2009. The average larval population per 5 plants for each genotype was calculated. Meteorological data relevant to temperature, relative humidity and rainfall, were recorded from the adjoining meteorological observatory of the University of Agricultural, Faisalabad to study the affect of weather on egg and larval population of *H. armigera* infesting different sunflower genotypes. The impact of weather factors on egg and larval population of *H. armigera* infesting different genotypes of sunflower was determined by working out simple correlation (Steel *et al.*, 1997).

RESULTS

Weather data: The results given in Fig. 1 during 2008 reveal an increasing trend in number of eggs observed during April 12 to April 27. The egg load decreased on the subsequent dates of observation. Furthermore, the peak in number of eggs was observed at maximum temperature of 39.83°C, minimum of 20.83°C and average temperature of 30.33°C with 18.00% RH and seems to be the most favourable period for the development of the pest. The larval population started to increase continuously from April 12 to May 01 and a tremendous decrease was observed thereafter. There was only one peak during May 01 with 3.11 larvae per 5 plants at maximum temperature of 41°C, minimum of 21.37°C and average temperature of 31.19°C with 15 percent RH and these weather conditions were found to be the most favourable for the development of the larvae there was only one peak observed on April 21 with maximum number of eggs (14.38 per 5 plants) at maximum temperature of 37.5, minimum of 22.33 and average of 29.91 with 29 percent RH and these weather conditions were found to be favourable for the

Weather data

Dates of observation	During (2008)				
	Temperature				
	Maximum	Minimum	Average	RH (%)	RF (mm)
Apr 12	31.66 (5.67)	19.16 (4.43)	25.4 (5.09)	40.66 (6.41)	1.3 (1.34)
Apr 15	32.00 (5.70)	20.00 (4.53)	26.00 (5.14)	38.66 (6.25)	1.2 (1.30)
Apr 18	30.33 (5.55)	15.5 (4.00)	22.92 (4.83)	34.00 (5.87)	6.1 (2.56)
Apr 21	35.66 (6.01)	19.33 (4.45)	27.49 (2.29)	23.66 (4.91)	0.00 (0.71)
Apr 24	38.33 (6.23)	23.33 (4.88)	30.83 (5.59)	23.00 (4.84)	0.00 (0.71)
Apr 27	39.83 (6.31)	20.83 (4.61)	30.33 (5.55)	18.00 (4.30)	0.00 (0.71)
May 1	41.00 (6.44)	21.37 (4.67)	31.19 (5.62)	15.00 (3.93)	0.00 (0.71)
May 4	43.00 (6.59)	24.33 (4.98)	33.66 (5.84)	13.66 (3.76)	0.00 (0.71)
Dates of observation	During (2009)				
	Temperature				
	Maximum	Minimum	Average	RH (%)	RF (mm)
Apr 6	30.6 (5.57)	18.33 (4.33)	24.53 (5.00)	51.00 (7.17)	3.80 (2.07)
Apr 9	26.0 (5.15)	15.50 (4.00)	20.75 (4.60)	65.66 (8.13)	18.10 (4.31)
Apr 12	29.83 (5.51)	16.16 (4.08)	22.99 (4.84)	55.00 (7.44)	0.00 (0.71)
Apr 15	35.66 (6.5)	21.66 (4.70)	28.66 (5.40)	41.00 (6.44)	0.00 (0.71)
Apr 18	33.0 (5.78)	17.66 (4.26)	25.33 (5.08)	37.00 (6.12)	0.00 (0.71)
Apr 21	37.5 (6.16)	22.33 (4.78)	29.91 (5.51)	29.00 (5.43)	1.00 (1.22)
Apr 24	34.83 (5.94)	18.50 (4.36)	26.66 (5.21)	28.00 (5.33)	0.00 (0.71)
Apr 27	36.83 (6.10)	18.50 (4.36)	27.66 (5.31)	27.33 (5.27)	0.00 (0.71)
May 1	39.25 (6.30)	23.87 (4.94)	31.56 (5.66)	29.50 (5.47)	0.00 (0.71)

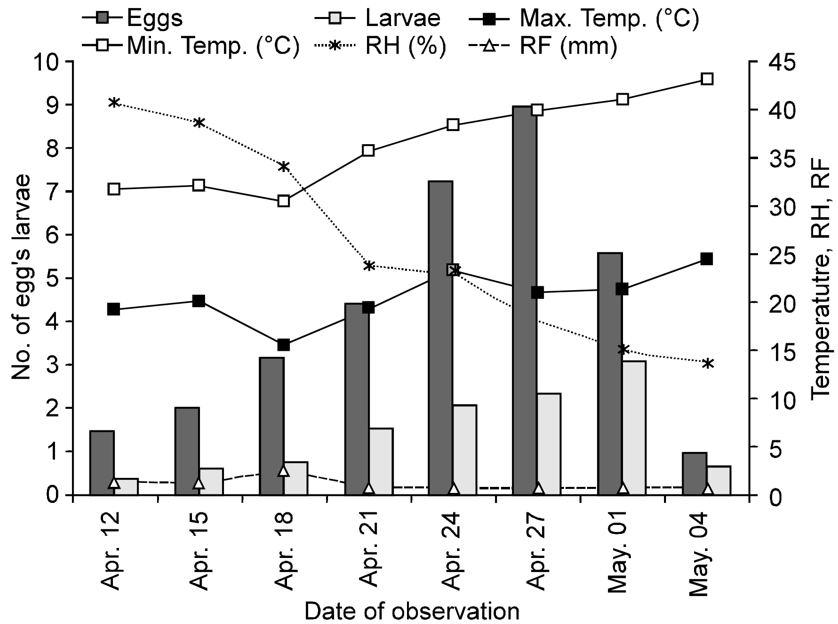

Fig. 1: Graphical presentation of number eggs and larvae during 2008

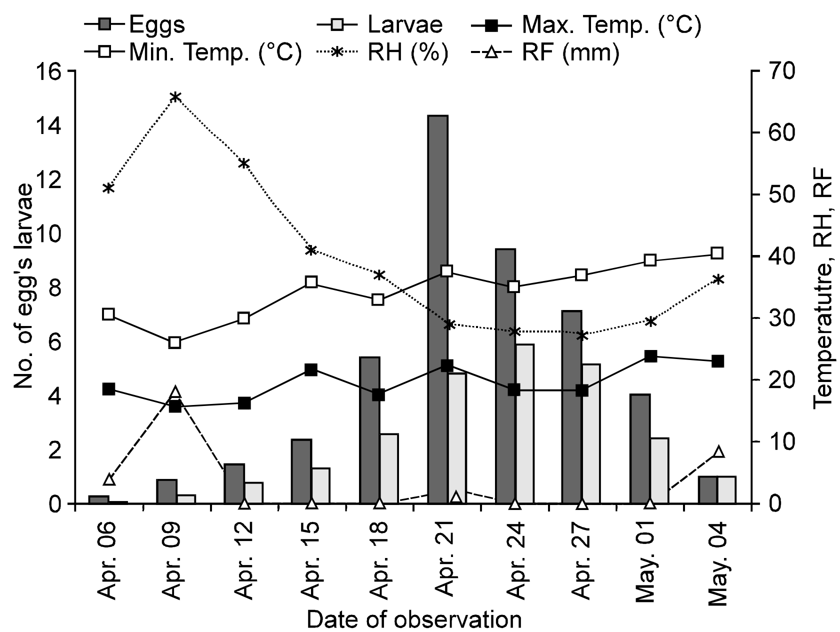

Fig. 2: Graphical presentation of number of eggs and larvae during 2009

development of the pest during 2009 for larval population of the pest. It is evident from Fig. 2 that a maximum larval population was recorded to be 5.64 per 5 plants on April 24, 2009. There was only one peak observed during the crop season. This highest peak was observed at a maximum temperature of 34.83°C, minimum of 18.5°C and average temperature of 26.66°C with 28 percent RH and these weather conditions were found to be the most favourable for the development of the larval population during 2009.

The results regarding correlation coefficient values between eggs count of *H. armigera* per 5 plants and various weather factors during 2008, 2009 and on cumulative basis of both the study years are given in Table 1. The results reveal that maximum temperature during 2009 showed significant and positive correlation

Table 1: Correlation coefficient values between egg counts of *Helicoverpa armigera* per 5-plants and various weather factors during 2008, 2009 and on cumulative Basis

	Temperature °C				
Years	Maximum	Minimum	Average	RH (%)	Rainfall (mm)
2008	0.336	0.093	-0.004	-0.413	-0.340
2009	0.514**	0.223	0.179	-0.565	-0.386
Cumulative	0.385	0.195	0.101	-0.525**	-0.479*

*: Significant at P≤0.05. **: Significant at P≤0.01a.

Table 2: Correlation coefficient values between larval population of *Helicoverpa armigera* per 5-plants and various weather factors during 2008, 2009 and on cumulative basis

	Temperature °C				
Years	Maximum	Minimum	Average	RH (%)	Rainfall (mm)
2008	0.517	0.223	0.179	-0.565	-0.386
2009	0.527	0.243	0.427	-0.860**	-0.579
Cumulative	0.497*	0.223	0.220	-0.576**	-0.444

*: Significant at P≤0.05. **: Significant at P≤0.01.

(0.514**) with the egg counts of *H. armigera*. whereas, on cumulative basis relative humidity and rainfall had negative and significant correlation with the eggs count with r-values of -0.525** and -0.479*, respectively. Maximum temperature during 2008 and on cumulative basis, minimum and average temperature during 2008, 2009 and on cumulative basis, relative humidity and rainfall during 2008 and 2009 had non significant correlation with the egg counts of the pest.

Effect of weather factors on larval population

Simple correlation: The results regarding correlation coefficient values between larval population of *H. armigera* per 5 plants and weather factors during year 2008, 2009 and on cumulative basis are depicted in Table 2. It is evident from the results that maximum temperature on cumulative basis resulted in significant and positive correlation with the larval population of *H. armigera*. The r-value was found to be 0.497*. Relative humidity during 2009 and on cumulative basis exerted significant (P<0.01) and negative correlation with the larval population of the pest showing r-values of 0.860 and 0.576, respectively. All the other factors had non significant correlation on larval population of the pest.

DISCUSSION

The role of weather factors in variation of eggs count and larval population of *Helicoverpa armigera* was determined for 2008 and 2009 separately and on cumulative basis through simple correlation and analysis of variance. It was evident from the results that during 2009, maximum temperature showed positive and significant (P≤0.01) correlation (r = 0.514) with the eggs count of *H. armigera* while on cumulative basis of both the study years, relative humidity (r = -0.525**) and rainfall (r = -0.479*) exerted negative and significant correlations with the eggs count. In case of larval population, relative humidity during 2009 and on cumulative basis of both the study years showed negative and significant effect (P≤0.01) on the larval population of the pest. The maximum temperature exerted positive and significant correlation (P≤0.05) with the larval population of the pest on cumulative basis of both the study years. Maximum temperature during 2008, relative humidity during 2009 and maximum temperature on cumulative basis of both the study years had maximum impact. The present findings can partially be in agreement with those of Ellington and El-Sokkari (1986) and Isely (1935) who reported that temperature had effect on the reproductive period of the pest. Similarly, fecundity of the pest mainly influenced by temperature, relative humidity and nutrition of larva and adult (Fye and McAda, 1972; Rabb *et al*., 1975; Johnson *et al*., 1983; Adjei-Maafo and Wilson, 1983; Wilson, 1983; Willers *et al*., 1987). According to Tripathy and Sharma (1985) the number of generations is directly influenced by temperature and host preference and these findings are also in partial agreement with the present study. Present findings will be helpful in planning effective integrated pest management techniques for the control of *H. armigera* on sunflower field crop.

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