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Effect of Abiotic Factors on the Populations of Pod Borer, *Helicoverpa armigera* (Hubner) on Marigold, *Tagetes erecta* in Jammu, India

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A B S T R A C T

The results of the investigation on population dynamics of pod borer (*Helicoverpa armigera* Hubner) in relation to abiotic factors revealed that the pest commenced from 7th standard week, which remained till 18th standard week with its peak activity during 15th standard week. The correlation studies indicated highly significant positive association between larval population of *H. armigera* and mean maximum temperature (0.349**) and highly significant negative association between *H. armigera* and mean relative humidity (morning) (-0.284**). The non-significant effect was observed between larval population of *H. armigera* and mean relative humidity (evening) (-0.256) and mean rainfall (-0.174). Mean minimum temperature had significant effect on the *H. armigera* population (0.404).

Introduction

Helicoverpa armigera Hubner (Lepidoptera: Noctuidae), the cotton bollworm, also known as the gram pod borer or the tomato fruit worm, is a polyphagous agricultural pest with a wide geographical distribution, recorded from Europe, Asia, Africa, Oceania, and recently South America. Larvae of *H. armigera* have been reported from over 67 host families, including Asteraceae, Fabaceae, Malvaceae, Poaceae and Solanaceae and this pest has caused losses to economically important crops such as cotton, legumes, sorghum, maize, tomato, soybean, ornamental plants, and fruit trees (Krinski and Godoy, 2015). Marigold (*Tagetes* spp.) (Asterals: Asteraceae), a native of Mexico, is one of the most popular cut flowers in the world having the highest economic importance in the floriculture industry and comprises about 33 species (Adriana *et al.*, 2012).

The area under floriculture production in India during the year 2015-2016 was estimated to be as 243 thousand hectares with a production of 2236 thousand matric tonnes (Anonymous, 2016). Among the various factors responsible for low yield of marigold in India, *H. armigera* is most important, which cause very heavy losses in yield. Excessive use of chemicals not only causes the economic restrain on farmers, but also produces the harmful side effects on the environments as well as mammals.

The best way to overcome this situation is to destroy the pest at initial stage of the life cycle (Chatar *et al.*, 2010). This is possible if timely prediction of the incidence of the pest can be made. Hence, an attempt was made to investigate the incidence of pod borer, *H. armigera* infesting marigold in relation to different abiotic factors.

Materials and Methods

The effect of abiotic factors on fluctuation in population of pod borer, *H. armigera* was carried out on marigold variety "Pusa Narangi Gainda" for two consecutive years (2014 and 2015) at University Farm, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu.

The crop was raised with recommended agronomic practices in the plot size of 3 x 1 m with row to row and plant to plant distance of 45 cm and 20 cm, respectively. Weekly observations were recorded from 5 randomly selected plants. With a view to study the impact of different abiotic factors on pest incidence, a simple correlation between population of pest and abiotic factors was worked out using Statistical Package for the Social Sciences (SPSS 16.0) software.

Results and Discussion

Pooled data (2014 and 2015) on the seasonal incidence of *H. armigera* are presented in table 1 and figure 1. This reveals that *H. armigera* population (1.17 larvae plant^{-1}) was observed from the 7th standard week, when mean maximum, minimum temperature, mean relative humidity (morning and evening) and rainfall were 20.85 and 7.85^{o}C, 88.50 and 55.00 per cent and 5.80 mm, respectively. The larval population was to be increasing gradually with some fluctuations till 10th standard week recording a population of 6.49 larvae per plant, when mean maximum and minimum temperature, mean relative humidity (morning and evening) and rainfall were 21.40 and 10.00^{o}C, 90.00 and 60.50 per cent and 34.10 mm, respectively.

Thereafter, the *H. armigera* larvae population increased with some fluctuations till 15th standard week (12.03 larvae plant^{-1}) reaching its peak, when mean maximum and minimum temperature, mean relative humidity (morning and evening) and rainfall were 30.50 and 14.85^{o}C, 75.00 and 42.50 per cent and 0.00 mm, respectively. The pod borer population thereafter decreased till 18th standard week (2.01 larvae plant^{-1}), when mean maximum and minimum temperature, mean relative humidity (morning and evening) and rainfall were 35.80 and 18.60^{o}C, 65.50 and 32.50 per cent and 5.75 mm, respectively.

The results are in agreement with Shah and Shahzad (2005) who reported that population of *H. armigera* was low during 49th to 6th standard weeks but increased from 7th standard week onwards and declined again during 14th standard week. Similarly, Singh and Ali (2006) also reported two peaks in the larval population of *H. armigera* throughout the crop season, first from 46th to 49th and second from 5th to 13th standard weeks, which is in line with our results. Reddy *et al.*, (2009) also reported that the incidence of *H. armigera* commenced from second week of February with 0.05 mean larval population/ plant. The larval populations started increasing and reached its maximum of 12.97 mean larva / plant during 4th week of March (12th standard week).

Table.1 Population dynamics of *Helicoverpa armigera* on marigold (pooled)

Standard week	*Mean *Helicoverpa* larval population/plant	Meteorological Parameters				
		Temperature (^{o}C)		Relative Humidity (%)		Rainfall (mm)
		Maximum	Minimum	Morning	Evening	
7	**1.17**	20.85	7.85	88.50	55.00	5.80
8	**0.86**	22.10	10.00	91.00	61.50	27.65
9	**2.82**	19.90	9.40	90.00	60.00	59.60
10	**6.49**	21.40	10.00	90.00	60.50	34.10
11	**2.97**	24.10	11.20	87.00	57.50	72.90
12	**6.14**	26.70	13.00	84.50	58.00	6.70
13	**5.70**	26.65	14.20	85.00	58.00	51.20
14	**6.61**	25.30	14.30	83.50	55.50	65.75
15	**12.03**	30.55	14.85	75.00	42.50	0.00
16	**7.74**	30.35	15.95	79.00	45.00	26.50
17	**5.67**	35.45	18.20	66.50	45.00	0.00
18	**2.01**	35.80	18.60	65.50	32.50	5.75
Range	**0.86-12.30**	**19.90-35.80**	**7.85-18.60**	**65.50-91.00**	**32.50-61.50**	**0.00-72.90**
Mean	**5.02**	**26.60**	**13.13**	**82.13**	**52.58**	**29.66**
S.Em(±)	**0.93**	**1.57**	**1.01**	**2.56**	**2.63**	**7.78**

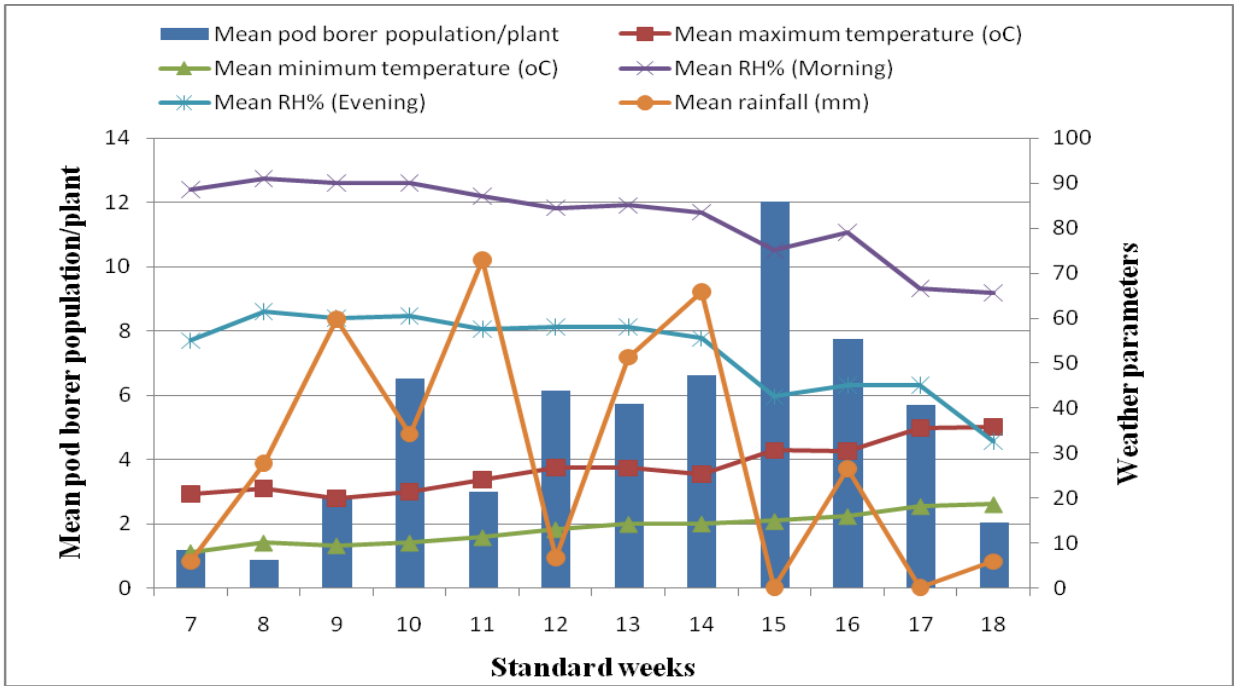
*Mean of five plants

Table.2 Correlation coefficients and regression model between Pod borer population and abiotic factors

Characters	'r' values
	Pooled
X_1	0.349**
X_2	0.404
X_3	-0.284**
X_4	-0.256
X_5	-0.174
Regression Model	$Y = -20.580 - 0.678X_1 + 1.807X_2 + 0.314X_3 - 0.080X_4 - 0.055X_5$ ($R^2 = 0.286$)

**Correlation is significant at 0.01level, *Correlation is significant at 0.05level
Where, Y= Mean pod borer population; X_1= Maximum temperature (°C); X_2= Minimum temperature (°C); X_3= Mean relative humidity morning (%); X_4= Mean relative humidity evening (%); X_5= Rainfall (mm)

Fig.1 Population dynamics of pod borer, *Helicoverpa armigera* (pooled)



The studies are in line with Shinde *et al.,* (2013) who reported that the larval population of *H. armigera* was recorded with two peak period during entire crop season, first from 17th November to 10th December (47th to 50th standard weeks) and second from 12th March to 5th April (10th to 14th standard weeks) in year 2009-10 and first peak from 22nd November to 13th December (47th to 50th standard weeks) and second from 13th March to 4th April (10th to 14th standard weeks) during 2010-11.

The results on correlation studies revealed (Table 2) that mean maximum temperature had highly significant but positive effect on pod borer population with 'r' value (r = 0.349**). On the other hand mean relative humidity (morning) had highly but negative significant effect with 'r' value (r = -0.284**) on pod borer population, while as mean relative humidity (evening) and mean rainfall had negative effect on pod borer population with 'r' values (r = -0.256 and r = -0.174). Mean minimum temperature had positive effect on the pod borer population (r = 0.404). Regression studies for the effect of abiotic factors on the build-up of pod borer population were significantly influenced by weather factors and their contribution being 28.60 per cent. Nadaf and Kulkarni (2006) in a similar study reported that maximum temperature and minimum temperature had positive significant effect on *H. armigera* population. The results are in agreement with Reddy *et al.,* (2009) who reported that the pod borer population had significantly positive correlation with both minimum and maximum temperature and the correlation coefficient being 0.71 and 0.82, respectively. The correlation coefficient of morning and evening relative humidity was -0.66. Singh *et al.,* (2010) and Pandey *et al.,* (2012) reported negative correlation of rainfall and relative humidity with the pest activity, whereas maximum and minimum temperature, were positively correlated with pest activity, which is in line with our results.

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