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Prediction models for *Helicoverpa armigera* (Hubner) based on abiotic factors in chickpea ruling variety JG-11

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ABSTRACT :

Experiments were carried out on the weather based relationship of pod borer, *Helicoverpa armigera* (Hubner) during *Rabi* 2011-12 and 2012-13 at the Main Agricultural Research Station, Dharwad. The analysis comprised correlations between the pod damage with prevailing weekly meteorological parameters during 1, 2, 3 and 4 weeks lead time (prior) and same week of the observations revealed the following results. Forecasting model for per cent pod damage shown maximum temperature at 4 weeks lead time is consistently negatively and highly significant association with per cent pod damage in early sown crop. In case of normal and late sown crop, minimum temperature at 3 weeks lead time is consistently negatively and highly significant association with per cent pod damage by the prediction model.

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INTRODUCTION

Chickpea is an important pulse crop of India, known as king of pulses. Insect pests are major threat to agricultural production. *Helicoverpa armigera* is a polyphagous insect pest of many agricultural and horticultural crops across world (Fitt, 1989), because of its high fecundity, migratory behaviour, high adaptation to various climatic conditions and development of resistance towards wide range of insecticides. However, it is a polyphagous insect pest but chickpea is its most preferred host (Tripathi and Sharma, 1985).

The changing scenario of insect pest problems in agriculture as a consequence of green revolution technology has been well documented (Kumar, 2005; Dhaliwal and Arora, 2006 and Dhaliwal and Koul, 2010). There has been further shift in the status of several insect pests after the introduction of transgenic crops and the current scenario of climate change. Recent climatic changes have also influenced the population of *Helicoverpa armigera* in different crops (Srivastava, 2009).

Climate change impacts on agriculture are being witnessed all over the world, but countries like India are more vulnerable in view of higher demographic pressure on natural resources and poor coping up mechanisms. It is also attributed mainly to diversified cropping pattern and varied geographical condition. Models generally predict that rising temperatures, increased climate variability and extreme weather events could significantly affect food production in the coming decades. Present investigation was carried out to incidence of *Helicoverpa armigera* and its relationship with abiotic factors such as minimum, maximum temperatures and relative humidity.

MATERIAL AND METHODS

A field trial was conducted to know the incidence of pests and natural enemies in both protected and unprotected conditions during *Rabi* 2011-12 and 2012-13 season in the black soils of Main Agricultural Research Station, Dharwad. Important ruling cultivar (JG-11) of chickpea was selected and sown on different sowing dates *viz.*, 4th week of September, (early), 1st week of October (normal) and 2nd week of October (late). The crop was allowed for natural incidence without any plant protection measures in order to know the interaction between varieties, *Helicoverpa armigera* and weather parameters.

Observations were taken at pod stage on number of *Helicoverpa armigera* larvae per plant and per cent pod damage. Incidence of insect pests were correlated with weather parameters *viz.*, maximum temperature, minimum temperature, rainfall, rainy days, morning RH, evening RH, wind speed, evaporation and solar radiation in order to know the influence of above mentioned parameters.

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under the following heads:

Early sowing :

Seasonal incidence of Helicoverpa armigera:

Among three dates of sowing, in normal planting incidence of *H. armigera* in JG-11 was observed from 43rd standard week and attained peak (2.37 $\pm$ 0.11 larvae per plant) during 46th standard week (vegetative stage) followed by early sown crop (2.27 $\pm$ 0.14 larvae per plant) and least in late planting (1.90 $\pm$ 0.10 larvae per plant). At 46th standard week maximum per cent foliage damage was recorded in all the dates of sowing but maximum in late sown crop. Maximum per cent pod damage (39.33 ± 1.09) was observed in late planting followed by normal and early planting (Table 1).

Table 1: Seasonal incidence of *Helicoverpa armigera* in chickpea in unprotected condition on JG-11

Standard week	Early		Normal		Late	
	Larvae/plant	Foliage and pod damage (%)	Larvae/plant	Foliage and pod damage (%)	Larvae/plant	Foliage and pod damage (%)
41th	0.00	0.00	0.00	0.00	0.00	0.00
42th	0.18±0.07	0.62±1.10	0.00	0.00	0.00	0.00
43th	0.53±0.17	1.11±0.14	0.60±0.20	3.64±0.20	0.00	0.00
44th	1.12±0.13	2.18±1.13	1.07±0.16	6.04±1.16	0.65±0.19	9.44±1.19
45th	1.90±0.14	2.90±1.21	1.90±0.15	6.18±1.21	1.17±0.12	12.49±1.11
46th	2.27±0.14	3.50±1.17	2.37±0.11	5.15±1.11	1.90±0.10	13.88±1.10
47th	0.60±0.24	0.80±1.24	0.62±0.18	1.89±1.18	1.67±0.13	5.85±1.23
48th	0.95±0.20	0.45±0.75	0.92±0.22	1.48±1.22	0.85±0.14	7.24±1.14
49th	1.40±0.14	18.38±1.10	1.15±0.17	11.50±1.17	1.25±0.14	10.64±1.04
50th	1.54±0.13	24.62±1.15	1.35±0.16	19.51±0.93	1.37±0.15	19.43±1.15
51th	0.62±0.23	29.42±1.24	0.75±0.21	27.60±0.45	0.85±0.22	21.20±1.21
52th	0.32±0.22	30.93±1.09	0.47±0.24	32.35±1.24	0.60±0.21	23.90±1. 10
1st	0.00	0.00	0.17±0.13	35.15±1.13	0.30±0.12	33.03±1.12
2nd	0.00	0.00	0.00	0.00	0.12±0.09	39.33±1.09
3rd	0.00	0.00	0.00	0.00	0.00	0.00

Correlation studies and regression analysis :

Correlation co-efficients showed negative and non-significant association with minimum temperature (r = -0.132), morning RH (r= -0.096) and evening RH (r= -0.161), while negative and significant correlation with wind speed (r= -0.498*). The association was positive and non-significant relationship with maximum temperature (r= 0.336), evaporation (r= 0.175) and solar radiation (r= 0.325) in case of JG-11 (Table 2). Regression analysis showed a R^2 value of 0.351 indicating 35.1 per cent influence of weather parameters on incidence of number of larvae per plant. The multiple regression equation fitted with weather parameters and larval population is as follows:

$$Y=1.539 - 0.075X_2$$

The results indicated that increase in 1°C minimum temperature would lead to decrease of 0.075 mean number of larvae per plant.

Forecasting model for pod damage at 4 weeks lead time :

$$Y= 374.87 – 12.12X_1 \qquad (R^2= 0.599)$$

The maximum temperature (r= -0.774**) at 4 weeks lead time is consistently negatively and highly significant association with per cent pod damage in case of crop sown during last week of September month. The equation can forecast per cent pod damage 4 weeks before upto 59.90 per cent accuracy (Table 3).

Normal sowing :

Correlation studies and regression analysis:

At reproductive stage correlation co-efficients showed negative and non-significant correlation with minimum temperature (r = -0.413), evening RH (r= -

Table 2: Correlation with weather parameters for *Helicoverpa armigera* in chickpea during 2011-13

Sr. No.	MaxT (X_1)	MinT (X_2)	RHm (X_3)	RHe (X_4)	RF (X_5)	TNRD (X_6)	WS (X_7)	Evaprtn (X_8)	Solar radiation (X_9)	R square value
JG-11 (UP)										
Early	0.336	-0.132	-0.096	-0.161	-	-	-0.498*	0.175	0.325	0.351
Normal	-0.609**	-0.413	0.028	-0.206	-	-	0.177	-0.211	0.116	0.483
Late	-0.406	-0.446*	-0.059	-0.449*	-	-	-0.035	0.055	0.233	0.653

** - Highly significant   * - Significant

Table 3 : Correlation co-efficients for per cent pod damage during *Rabi* in chickpea during 2011-13

No	Lead time (weeks)	MaxT	MinT	RHm	RHe	RF	TNRD	WS	Evaprtn	Solar radiation
					JG-11 (UP)					
1 Early	4	-0.774**	-0.507	-0.091	-0.105	-0.385	-	0.083	-0.619*	0.495
	3	0.493	0.385	0.422	-0.071	0.207	0.162	-0.452	0.364	-0.102
	2	-0.643*	-0.437	-0.326	-0.236	-	-	0.417	0.248	0.240
	1	0.403	-0.458	0.009	0.137	-	-	0.044	-0.200	0.399
	0	0.123	-0.030	-0.235	0.099	-	-	-0.256	-0.355	-0.182
2 Normal	4	0.518	0.538*	0.455	0.018	0.202	0.139	-0.055	0.080	-0.279
	3	-0.339	-0.721**	-0.578*	-0.487	-	-	0.176	0.283	0.434
	2	-0.161	-0.185	0.334	0.499	-	-	0.362	-0.124	-0.256
	1	-0.193	-0.382	0.160	-0.253	-	-	0.222	-0.626*	-0.293
	0	-0.422	-0.286	0.084	0.149	-	-	0.166	-0.008	-0.376
Late	4	0.449	-0.014	0.217	-0.235	-	-	0.289	0.110	0.044
	3	-0.390	-0.643*	0.219	0.523	0.465	0.465	0.435	-0.357	-0.629*
	2	-0.125	-0.049	-0.068	0.068	0.465	-	-0.128	0.404	-0.315
	1	0.373	0.639*	-0.061	0.337	-	-	-0.133	-0.415	-0.173
	0	-0.229	-0.336	0.707**	-0.664**	-	-	-0.727**	-0.209	0.516

** - Highly significant   * - Significant

0.206) and evaporation (r= -0.211), while negative and significant correlation with maximum temperature (r= -0.609**). The association was positive and non-significant relationship with morning RH (r= 0.028), wind speed (r= 0.177) and solar radiation (r= 0.116) (Table 2). Regression analysis showed a R^2 value of 0.483 indicating 48.3 per cent influence of weather parameters on incidence of number of larvae per plant. The multiple regression equation fitted with weather parameters and larval population is as follows:

$$Y= 5.79 - 0.16X_1$$

The results indicated that increase in 1°C maximum temperature would lead to decrease of 0.16 mean number of larvae per plant.

Forecasting model for pod damage at 3 weeks lead time:

$$Y= 76.82 – 2.98X_2 \quad (R^2= 0.520)$$

The minimum temperature (r= -0.721**) at 3 weeks lead time is consistently negatively and highly significant association with per cent pod damage and the equation can forecast per cent pod damage 3 weeks before upto 52 per cent accuracy in case of crop sown during 1st week of October month (Table 3).

Late sowing :

Correlation studies and regression analysis:

Correlation co-efficients showed negative and non-significant correlation with minimum temperature (r = -0.446*) and evening RH (r= -0.449*), while negative and non-significant correlation with maximum temperature (r= -0.406), morning RH (r= -0.059) and wind speed (r= -0.035), while positive and non-significant association evaporation (r= 0.055) and solar radiation (r= 0.233) (Table 2).

Regression analysis showed a R^2 value of 0.653 indicating 65.3 per cent influence of weather parameters on incidence of number of larvae per plant. The multiple regression equation fitted with weather parameters and larval population is as follows:

$$Y=1.25 - 0.083X_2 - 0.009X_4$$

The results indicated that increase in 1°C minimum temperature and 1 per cent evening RH would lead to decrease of 0.083 and 0.009 mean number of larvae per plant.

Forecasting model for pod damage at 3 weeks lead time :

$$Y= -50.64 - 4.20X_2 \quad (R^2= 0.413)$$

The minimum temperature (r= -0.643**) at 3 weeks lead time is consistently highly significant negatively associated with per cent pod damage and equation can forecast per cent pod damage 3 weeks before upto 41.30 per cent accuracy during 2nd week of October month. (Table 3).

The present findings are in contradictory with Chatar *et al.* (2010) who reported the pest (*H. armigera*) population in chickpea showed highly significant positive correlation with morning relative humidity (r = -0.7098), evening RH (r = -0.7293) and mean relative humidity (r = -0.8063). Minimum temperature at 3 weeks lead time is consistently highly significant negatively associated with per cent pod damage by the forecasting model for late sowing.

Correlation analysis revealed that morning RH per cent exhibited significantly positive correlation with eggs population on November 07 (r= 0.60), December 27 (r= 0.64) and maximum temperature on December 17 (r= 0.57) while, significantly negative correlation (r= -0.61) was found with evening RH per cent on December 17 sown crop, respectively. Minimum larval population (1.74/mrl) was observed on November 07 sown crop which was significantly superior over other six sowing dates. Correlation co-efficient of larval population with sunshine hours exhibited significantly positive correlation (r =0.55) on November 07 sown crop. Whereas, maximum temperature (r= 0.66) showed positively significant association with mean larval population while, both morning and evening RH per cent exhibited negative correlation (r= -0.54, -0.55) on November 27 sown crop. On December 07 sown crop, the correlation of mean larval population with maximum and minimum temperature was also exhibited significantly positive (r= 0.70, 0.62). Maximum grain yield 1855 kg/ha was recorded from early sown crop on November 07, whereas minimum yield 612 kg/ha was obtained from late sown crop of chickpea (Parmar *et al.*, 2015).

Abiotically stressful environment in changing climate is predicted to impact negatively the diversity and abundance of insect-pests and ultimately the extent of damage caused in economically important agricultural crops. This may affect perilously the agricultural production and the livelihood of farmers especially in tropical and subtropical countries where larger proportion of work force is directly depending on climate sensitive sectors such as agriculture. The climate change induced challenges that the crop growers have to face in near future in managing harmful insect pests of their crops along with its socio-economic impacts on farming community.

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REFERENCES

Chatar, V.P., Raghvani, K.L., Joshi, M.D., Ghadge, S.M., Deshmukh, S.G. and Dalave, S.K. (2010). Population dynamics of pod borer, *Helicoverpa armigera* (Hubner) infesting chickpea. *Internat. J Plant Protect.*, **3** (1): 65-67.

Dhaliwal, G.S. and Arora, R. (2006). *Integrated pest management: Concepts and approaches*. Kalyani Publishers, NEW DELHI, INDIA.

Dhaliwal, G.S. and Koul, O. (2010). *Quest for pest management: From green revolution to gene revolution*. Kalyani Publishers, NEW DELHI, INDIA.

Fitt, G. P. (1989). The ecology of *Heliothis* species in relation to agroecosystem. *Annual. Rev. Ento.*, **34** : 17-52.

Kumar, A. (2005). Changing scenario of insect pests problems. In: H.C.L. Gupta, A. Kumar, O.P. Ameta and S. Jain (eds) *Alternatives to Chemical Pesticides in Pest Management.* Agrotech Publishing Academy, Udaipur, pp. 21-38.

Parmar, S.K., Thakur, A.S. and Marabi, R.S. (2015). Effect of sowing dates and weather parameters on the Incidence of *Helicoverpa armigera* (hubner) in chickpea. *Bioscan,* **10** (1) : 93-96.

Srivastava, C.P. (2009). Impact of climate change on insect pests of pulses and their management. 3-5 in *National Conference: Applied Entomology, Impact of Global Warming on the incidence and management of insect pests in agriculture*, Entomological Research Association, Maharana Pratap University of Agriculture and Technology, Udaipur, (RAJASTHAN) INDIA.

Tripathi, S.R. and Sharma, S.K. (1985). Population dynamics of *Heliothis armigera* (Hub.) on gram in the Terai belt of NEPU. *Giornale Italiana di Entomologia*, **2**(10) : 347 - 352.