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Original Research Article

Seasonal incidence of gram pod borer, *Helicoverpa armigera* (Hübner) and tur pod fly, *Melanagromyza obtusa* (Malloch) on late maturing pigeonpea in Varanasi region of Indo-Gangetic Plain

ABSTRACT

Aim: To study the seasonal incidence pattern of gram pod borer, *Helicoverpa armigera* (Hübner) and tur pod fly, *Melanagromyza obtusa* (Malloch) in pigeonpea ecosystem.

Study Design: Complete Randomized Block Design

Place and Duration of Study: Field experiments were conducted at Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during *Kharif* seasons of 2015-16 and 2016-17.

Methodology: The pigeonpea crop (cv. Bahar) was grown in plots of 10m X 5m (50 m^2) replicated thrice and the crop fields were kept free from pesticide sprays. Five plants were selected randomly from each plot and weekly observations of the respective pests were taken through Plant Inspection Method (PIM) starting from 50 per cent flowering stage to till maturity of the crop and then correlated with the meteorological data.

Results: The results revealed that the infestation and severity of these insect pests were highly influenced by weather parameters. *H. armigera* population reached its peak (4.50 and 4.20 larvae per plant, respectively) in the 9th standard week of both the years. Similarly maximum incidence of *M. obtusa* in terms of maggot population was also recorded in 9th standard week with population of 8.00 and 7.75 maggots per plant. Correlation studies indicated that the population of these insect pests exhibited a significant positive correlation with maximum temperature whereas a significant negative correlation was established with average relative humidity. The multiple regression analysis revealed that variations of

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different weather variables caused approximately 89.6 and 86.4 per cent variations in *H. armigera* population and 90.7 and 94.6 per cent variations in *M. obtusa* population during both years, respectively.

Conclusion: Different weather parameters determine seasonal activity and population dynamics of *H. armigera* and *M. obtusa* on pigeonpea and this information would help in developing weather based forecasting models for successful development and implementation of the pest management strategies against these major insect pests of pigeonpea.

Key words: Pigeonpea, Population dynamics, Gram pod borer, Tur pod fly, Abiotic factors.

INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is an important pulse crop which is globally cultivated on 4.64 million ha, with an annual production of 3.43 million tonnes and a mean productivity of 780 kg ha^{-1} [1]. It is the second most important pulse crop grown in India after chickpea [2]. In India pigeonpea is grown on 3.88 million hectares of area with an annual production of 3.29 million tonnes and yield of 849 kg/ha [3]. Though, India is largest producer of pigeonpea, its productivity has always been a concern. The low productivity of pigeonpea in the country may be attributed to many reasons, among which damage by insect pests is of paramount importance. Nearly 250 species of insect pests are known to infest pigeonpea crop at its various growth stages in India but of these only a few cause significant and consistent damage to the crop [4].

The key pests of pigeonpea include gram pod borer, *Helicoverpa armigera* (Hübner) and tur pod fly, *Melanagromyza obtusa* (Malloch) [5]. Others such as tur pod bug, *Clavigralla gibbosa* Spinola; blue butterfly, *Lampides boeticus* (L.); plume moth, *Exelastis*

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atomosa (Walsingham) and legume pod borer, *Maruca vitrata* (Geyer) are also potential pests and occasionally cause significant grain yield losses in long duration pigeonpea [6]. Pod borers have been estimated to cause 60 to 90 per cent loss in the grain yield of pigeonpea under favourable conditions [7] and the damage of seeds by pod fly generally ranges between 14.3 to 46.6 per cent [8]. *H. armigera* and *M. obtusa* cause adequate economic damage leading to very low yield levels of 500 to 800 kg ha^{-1} as against the potential yield of 1800 to 2000 kg ha^{-1} [9,10]. In Uttar Pradesh the annual loss in pigeonpea production due to pod fly alone has been estimated to the extent of 25 to 30 per cent [11].

Under these circumstances, the scientific investigations for the effective management of *H. armigera* and *M. obtusa* in pigeonpea ecosystem are needed to be further strengthened. Before developing insect pest management programme for specific agro ecosystem, it is necessary to have basic information on abundance and distribution of pest in relation to weather parameter as it helps in determining appropriate time of action and suitable effective method of control [12]. Hence, an attempt has been made to study the incidence and population density of *H. armigera* and *M. obtusa* on long duration pigeonpea with respect to some abiotic factors in Varanasi region of India.

MATERIALS AND METHODS

To study the seasonal incidence of *H. armigera* and *M. obtusa* on pigeonpea, field experiments were conducted at Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during *Kharif* 2015-16 and 2016-17. The pigeonpea crop (cv. Bahar) was grown in plots of 10m X 5m (50 m^2) replicated thrice and the crop fields were kept free from pesticide sprays. Five plants were selected randomly from each plot and weekly observations of the respective pests were taken through Plant Inspection Method (PIM) starting from 50 per cent flowering stage to till maturity of the crop [13]. The

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observations were recorded as number of larvae per plant in case of *H. armigera* whereas for *M. obtusa*, number of maggots per 10 pods per plant was counted using pod destruction method.

Influence of weather parameters on population build up of *H. armigera* and *M. obtusa* were also worked out. For this, the data were subjected to correlation and regression analysis with weather parameters *viz*., maximum and minimum temperatures, average relative humidity, sunshine hours, wind velocity and evaporation in respect of the corresponding standard week. The meteorological data for the above analysis were obtained from the meteorological observatory of the university.Significance of simple correlation was estimated by using *t*-test [14] and the regression equations were derived by using the formula as suggested by Panse and Sukhatme [15].

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads:

Incidence pattern of gram pod borer, *H. armigera*

During *Kharif* 2015-16, the first incidence of pod borer (*H. armigera*) was noticed during 2nd standard week. The population persisted in the field from 2nd to 14th standard week and ranged from 1.25 to 4.50 larvae per plant. The mean larval population of *H. armigera* attained its peak level during 9th standard week (4.50 larvae/ plant) (Table 1 and Figure 1). Similarly, during *Kharif* 2016-17, *H. armigera* incidence was first observed in the 2nd standard week (1.25 larvae/ plant). The mean larval population of *H. armigera* per plant varied from 1.00 to 4.20 during the season and the population reached its peak (4.20 larvae/ plant) in the 9th standard week (Table 2 and Figure 2). Similar trend of population build up of

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H. armigera on long duration pigeonpea was also observed by [16], [17] and [18]. Kumar and Nath [19] also studied the population of pod borers on pigeonpea cultivar Bahar. The activity of *H. armigera* started with pod formation and grain filling stage i.e., the 4th standard week and lasted until the 14th standard week.

Incidence pattern of tur pod fly, *M. obtusa*

During *Kharif* 2015-16, the incidence of tur pod fly (*M. obtusa*) commenced in the 2nd standard week and continued till 14th standard week (Table 1 and Figure 1). After attaining its peak (8.00 maggots/ plant) in the 9th standard week, the population declined sharply. Similarly, during *Kharif* 2016-17, *M. obtusa* incidence was first observed in the 2nd standard week (1.26 maggots/ plant). The mean population of *M. obtusa* varied from 1.26 to 7.75 maggots/ plant during the season and the population reached its peak (7.75 maggots/ plant) in the 9th standard week (Table 2 and Figure 2). The present findings are in accordance with the findings of Meena *et al.* [20] who examined the seasonal incidence of *M. obtusa* on long duration pigeonpea in Varanasi region and revealed that maximum incidence of *M. obtusa* in terms of maggot population was recorded in 9th standard week with population of 35.6 and 2.6/plant. During 2008-2009, pupal activity of *M. obtusa* was maximum (39.2 pupae) in 12th standard week and in 2009-2010 it was 9 pupae in the 11thstandard week. Similar trend of population build up of *M. obtusa* on long duration pigeonpea was also observed by [19] and [21].

Impact of abiotic factors on *H. armigera* population

Simple correlation was worked out between the weather parameters and *H. armigera* population in order to study the impact of different abiotic factors on population build up of this pest insect. The analytical data on correlation coefficient during 2015-16 indicated that population of *H. armigera* exhibited a significant positive correlation with maximum

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temperature (r = 0.753**), minimum temperature (r = 0.583*) and sunshine hours (r = 0.644*) whereas a significant negative relationship was found with average relative humidity (r = - 0.683*). The other abiotic factors did not show any significant impact on incidence of the pest (Table 3). Similarly during 2016-17, the results showed that there was a positive significant association of the pest population with maximum temperature (r = 0.887**) while a significant negative relationship was exhibited with average relative humidity (r = - 0.694**). Correlation coefficient with other abiotic factors was found to be non significant (Table 3).

The regression coefficient revealed that the various abiotic factors were found to be most influencing factor, which contributed (R^2 = 0.896 and 0.864) 89.6 and 86.4 per cent variations in *H. armigera* population during both the years, respectively. Similarly, Bajya *et al.* [18] correlated population fluctuations of *H. armigera* with weather parameters and found that among different weather parameters, temperature had greater role in the incidence on pigeonpea. Ali *et al.* [22] who reported that mean temperature was positively correlated with infestation of *H. armigera* on tomato further supports the present findings. Rathore *et al.* [1] also reported that the larval population of *H. armigera* on pigeonpea had significant positive correlation with mean temperature and negative non-significant correlation with relative humidity.

Impact of abiotic factors on *M. obtusa* population

It is evident from the Table 3 that population of *M. obtusa* exhibited a significant positive correlation with maximum temperature (r = 0.796**), minimum temperature (r = 0.659*) and sunshine hours (r = 0.690**) whereas a significant negative relationship was found with average relative humidity (r = - 0.785**). The other abiotic factors did not show any significant impact on incidence of the pest (Table 3). Similarly during 2016-17, the

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results showed that there was a positive significant association of the pest population with maximum temperature (r = 0.883**) and sunshine hours (r = 0.587*) while a significant negative relationship was exhibited with average relative humidity (r = - 0.710**). Correlation coefficient with other abiotic factors was found to be non significant (Table 3).

The regression coefficient revealed that the various abiotic factors were found to be most influencing factor, which contributed (R^2 = 0.907 and 0.946) 90.7 and 94.6 per cent variations in *M. obtusa* population during both the years, respectively. The results are in conformity with Meena *et al.* [20] who reported that the maggot population of *M. obtusa* showed significant positive correlation with maximum and minimum temperatures but significant negative correlation with maximum and minimum relative humidity on pigeonpea. Keval and Srivastava [21] also reported that the larval population of *M. obtusa* on pigeonpea had a significant and positive correlation with temperature and sunshine hours whereas, a significant negative correlation was found with relative humidity.

CONCLUSION

From the present study, it can be concluded that *H. armigera* and *M. obtusa* are the two major insect pests infesting long duration pigeonpea in Varanasi region of Uttar Pradesh, India. Different weather parameters determine seasonal activity and population dynamics of these insect pests on pigeonpea. The information generated in present study gives an indication about the importance of the different weather parametersin developing weather based forecasting models for successful development and implementation of the pest management strategies against insect pests of pigeonpea for increasing production efficiency, profit, besides safety tothe environment.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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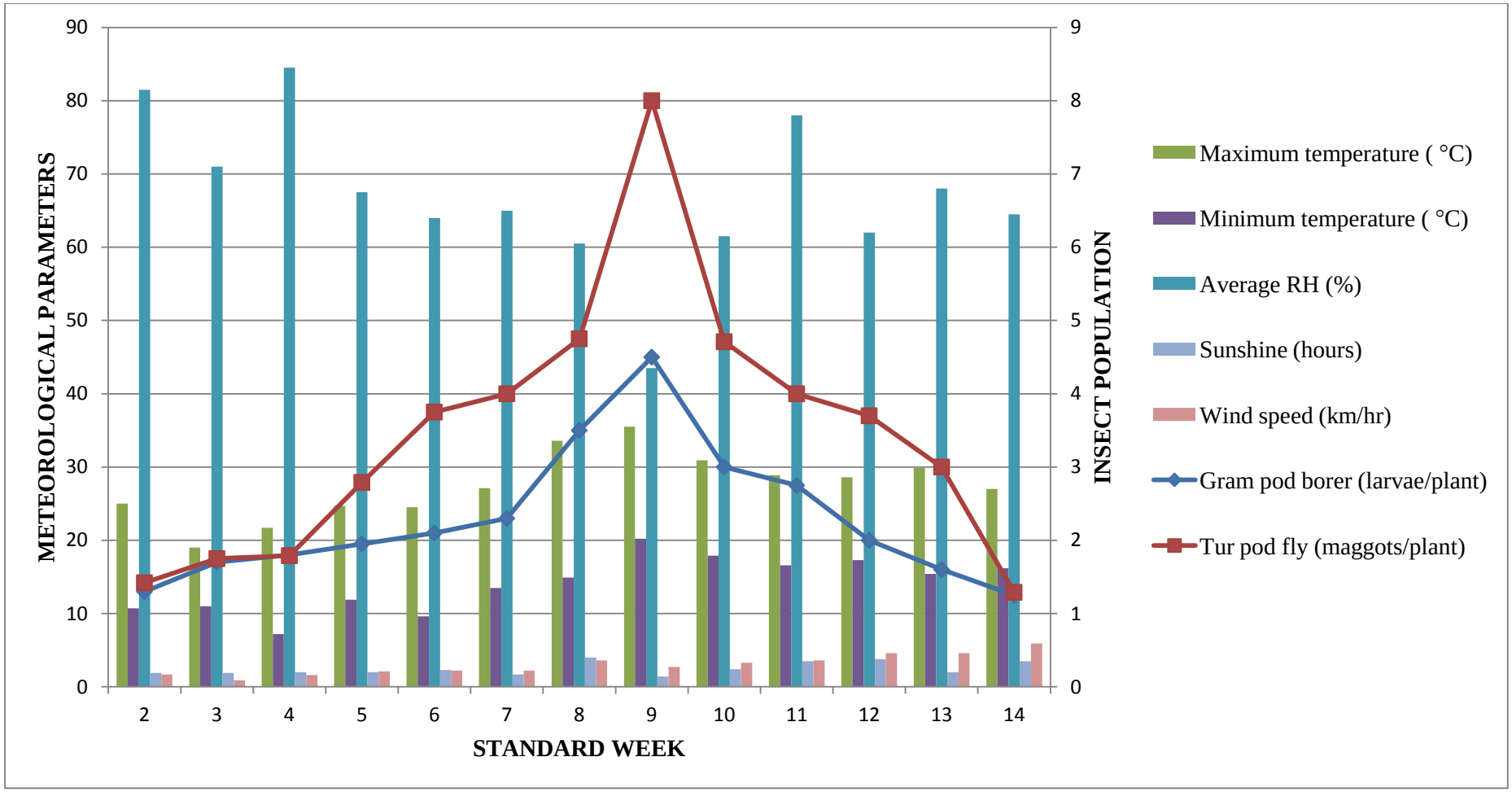

Figure 1: Population fluctuation of *H. armigera* and *M. obtusa* on pigeonpea (cv. Bahar) in relation to meteorological observations during *Kharif* 2015-16.

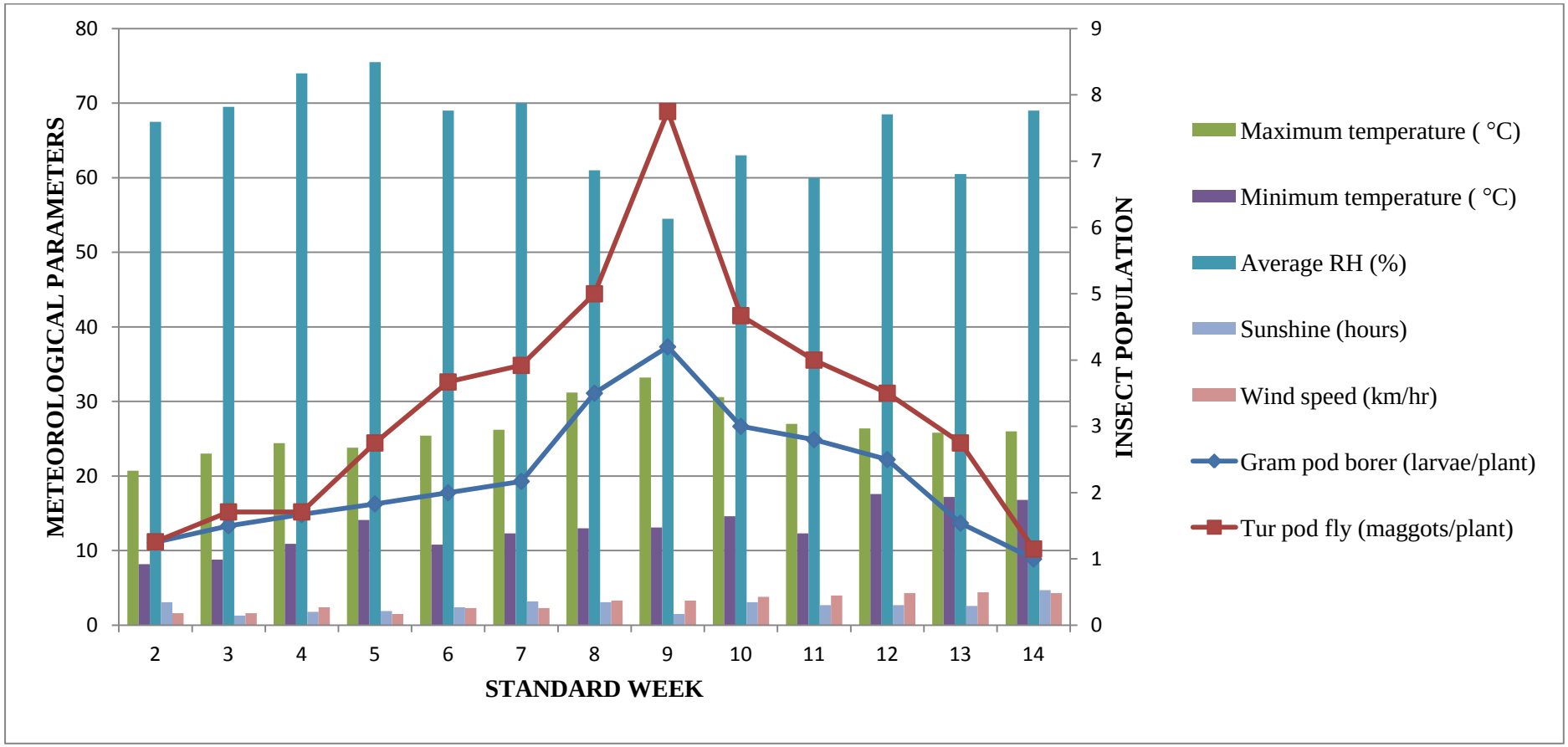

Figure 2: Population fluctuation of *H. armigera* and *M. obtusa* on pigeonpea (cv. Bahar) in relation to meteorological observations during *Kharif* 2016-17.

Table 1: Population dynamics of gram pod borer, *H. armigera* and tur pod fly, *M. obtusa* on late maturing pigeonpea (cv. Bahar) in relation to different weather parameters during *Kharif* 2015-16.

Standard week	*H. armigera* (larvae/plant)	*M. obtusa* (maggots/10 pods/plant)	WEATHER PARAMETERS				
			Temperature (º C)		Average Relative Humidity (%)	Sunshine (hours)	Wind speed (km/hr)
			Maximum	Minimum			
2	1.30	1.42	25.0	10.7	81.5	5.9	1.9
3	1.70	1.75	19.0	11.0	71.0	0.6	1.9
4	1.80	1.79	21.7	7.2	84.5	5.2	2.0
5	1.95	2.79	24.7	11.9	67.5	6.5	2.0
6	2.10	3.75	24.5	9.6	64.0	6.3	2.3
7	2.30	4.00	27.1	13.5	65.0	6.3	1.7
8	3.50	4.75	33.6	14.9	60.5	8.5	4.0
9	4.50	8.00	35.5	20.2	43.5	9.4	1.4
10	3.00	4.71	30.9	17.9	61.5	7.6	2.4
11	2.75	4.00	28.9	16.6	78.0	6.4	3.5
12	2.00	3.70	28.6	17.3	62.0	6.6	3.8
13	1.60	3.00	29.9	15.4	68.0	6.0	2.0
14	1.25	1.29	27.0	16.2	64.5	6.4	3.5

Table 2: Population dynamics of gram pod borer, *H. armigera* and tur pod fly, *M. obtusa* on late maturing pigeonpea (cv. Bahar) in relation to different weather parameters during *Kharif* 2016-17.

Standard week	*H. armigera* (larvae/plant)	*M. obtusa* (maggots/10 pods/plant)	WEATHER PARAMETERS				
			Temperature (º C)		Average Relative Humidity (%)	Sunshine (hours)	Wind speed (km/hr)
			Maximum	Minimum			
2	1.25	1.26	20.7	8.2	67.5	3.2	3.1
3	1.50	1.71	23.0	8.8	69.5	1.0	1.3
4	1.67	1.71	24.4	10.9	74.0	1.8	1.8
5	1.83	2.75	23.8	14.1	75.5	4.1	1.9
6	2.00	3.67	25.4	10.8	69.0	7.1	2.4
7	2.17	3.92	26.2	12.3	70.0	4.6	3.2
8	3.50	5.00	31.2	13.0	61.0	6.4	3.1
9	4.20	7.75	33.2	13.1	54.5	7.4	1.5
10	3.00	4.67	30.6	14.6	63.0	5.7	3.1
11	2.80	4.00	27.0	12.3	60.0	7.6	2.7
12	2.50	3.50	26.4	17.6	68.5	6.2	2.7
13	1.54	2.75	25.8	17.2	60.5	6.8	2.6
14	1.00	1.15	26.0	16.8	69.0	6.5	4.7

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Table 3: Correlation and regression coefficients between weather parameters and population of *H. armigera* and *M. obtusa* on pigeonpea during *Kharif* 2015-16 and 2016-17

Weather Parameters	***H. armigera* population**		***M. obtusa* population**	
	2015-16	**2016-17**	**2015-16**	**2016-17**
Maximum temperature (ºC)	0.753**	0.887**	0.796**	0.883**
Minimum temperature (ºC)	0.583*	0.112 ns	0.659*	0.160ns
Average relative humidity (%)	- 0.683*	- 0.694**	- 0.785**	- 0.710**
Sunshine (hours)	0.644*	0.502 ns	0.690**	0.587*
Wind velocity (km/hr)	0.010 ns	0.401 ns	- 0.070ns	- 0.245ns
Regression coefficient (R^2)	0.896	0.864	0.907	0.946

*****Correlation is significant at the 0.05 level (Two-tailed), **Correlation is significant at 0.01 level (Two-tailed), ns = non significant