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Seasonal Variation in Incidence of Insect Pests Occurring on Black Gram [*Vigna mungo* (Linn.) Hepper] in Lower Gangetic Plains of West Bengal

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A B S T R A C T

The experiment was conducted in the 'A-B' Block Farm of Bidhan Chandra Krishi Viswavidyalaya situated at Kalyani, Nadia, West Bengal during both summer and *kharif* seasons of 2016 with an objective to study the seasonal variation in incidence of insect pests on two varieties of black gram viz. Pant U-31 and Pant U-19 as well as their relationship with abiotic factors in the lower Gangetic plains of West Bengal. The results revealed *Aphis craccivora*, *Bemisia tabaci*, *Megalurothrips distalis*, *Maruca vitrata*, *Helicoverpa armigera*, *Spilarctia obliqua* as the major pests of the crop. Whitefly population on black gram reached its peak in 5 WAS in both the seasons. Maximum aphid population has been recorded in 6 WAS and 7 WAS during summer and *kharif* seasons, respectively. Flower thrips was recorded highest 9 WAS during both the seasons. Gram pod borer population has been recorded maximum in 8 WAS and 7 WAS during summer and *kharif* seasons, respectively. Spotted pod borer population reached its peak in 10 WAS in both the seasons, while, hairy caterpillar population has been recorded highest in 5 WAS in both the seasons. In black gram, whitefly population was significantly and negatively correlated with both temperatures irrespective of season, however, it was significantly and positively correlated with minimum relative humidity in summer season, but it was negative correlation during *kharif* season. Both the temperatures were significantly and positively correlated with aphid population during summer, but during *kharif* minimum temperature only was positively correlated with the pest population. In case of flower thrips, the pest population was significantly and positively associated with minimum relative humidity during summer season but the association was reverse during *kharif* season. The correlation of gram pod borer population in black gram with all the weather parameters were found non-significant irrespective of season and crop variety. Spotted pod borer population significantly and negative correlated with maximum temperature during both seasons, however, a significant and positive correlation with minimum relative humidity and rainfall, negative correlation with minimum temperature during summer and positive correlation with bright sunshine hour were also observed. Significantly negative correlations were found with hairy caterpillar population and both the relative humidity and rainfall, while, the association was significantly positive with both the temperature and bright sunshine hour during summer.

Introduction

Black gram, *Vigna mungo* (Linn.) Hepper, also known as urdbean, mash, mashkalai etc., belongs to the family Fabaceae; sub family Papilioniaceae. It is the fourth most important short-duration pulse crop grown in India due to its nutritional and industrial values. The important black gram growing states are Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Madhya Pradesh and West Bengal. India is the largest producer and consumer of black gram in the world. In West Bengal, black gram are grown in area of 70.05 thousand hectare, with productivity levels of 697 kg/ ha, whereas, the national productivity of this crop is 555 kg/ha., which are quite low as compared with other crops (Anon., 2015). Among the several constraints of low productivity, the losses due to insect pest are the foremost.

The crop is damaged by an array of insect pests from sowing to harvest in the field as well as in the harvested produce in storage (Lal and Sachan, 1987). Nearly twelve species of insects causes considerable yield loss in black gram. Whitefly (*Bemicia tabaci*), aphid (*Aphis craccivora*), flower thrips (*Megalurothrips distalis*), gram pod borer (*Helicoverpa armigera*), spotted pod borer (*Maruca testulalis*) and hairy caterpillar (*Spilarctia obliqua*) were recorded as major pests on black gram (Kumar and Chandra, 2007).

For developing an integrated and sustainable management system it is essential to know the pest dynamics as well as their seasonal incidence which is lacking particularly in West Bengal situation. Keeping this in view, the present study was undertaken to study the seasonal variation in incidence of insect pests on black gram and their relationship with abiotic factors in lower Gangetic plains of West Bengal.

Materials and Methods

The experiment was laid out in the 'A-B' Block Farm of Bidhan Chandra Krishi Viswavidyalaya situated at Kalyani, Nadia, West Bengal during both summer and kharif seasons of 2016. Seeds of two varieties of black gram (Pant U-19 and Pant U-31) were sown in plots maintain plot size of 10 m x10 m. Row to row spacing of 30 cm and irrigation channel width of 50 cm were also maintained. For recording natural incidence of insect pests, simple observations were done without using any chemical pesticides. Five plants were randomly chosen as sample plants from each plot and were marked. The observation was taken at weekly intervals. First observation was taken at 21 DAS and continued up to harvest of the crop. In case of all the insect pests the mean population was worked out. The sap feeders were recorded by counting the total number of nymphs and adults per leaf during morning hours from sampled plants without disturbing to avoid their fast mobility. The larvae of borers were recorded after collecting them by shaking the plant. Meteorological data was collected from AICRP on Agrometeorology, BCKV. Afterwards the mean population of each insect pest was correlated with the weekly mean of previous seven days of seven meteorological parameters taken into consideration viz. maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity, wind speed bright sunshine hour and rainfall.

Results and Discussion

Insect pests associated with black gram

From the observations made during the cropping seasons, it was observed that insect species belonging to different taxonomic orders appeared at different stages of crop growth. Among these, the aphid (*Aphis*

craccivora), whitefly (*Bemisia tabaci)*, thrips (*Megalurothris distalis*); spotted pod borer (*Maruca vitrata*); gram pod borer (*Helicoverpa armigera*); and hairy caterpiler (*Spilarctia oblique*). Black gram is attacked by more than twenty insect pests species in India (Nayer *et al.*, 1976).Among them some major insect pests are sap feeders consisted of whitefly (*Bemisia tabaci*), jassid (*Empoasca* spp.), Aphid (*Aphis craccivora*) and thrips (*Megalurothrips distalis*), borer complex like gram pod borer (*Helicoverpa armigera*), spotted pod borer *(Maruca testulalis*), hairy caterpillar (*Spilarctia oblique*). Some minor insect pests are Tobacco caterpillar, (*Spodoptera litura*), Semilooper, (*Trichoplusia sp.*), grasshopper (*Oxya velox*.), leaf beetle (*Bruchus* sp). (Singh and Singh, 1977), Blister beetle (*Myalbris pustulata)*, Green stink bug (*Nezara virudula*) etc.

Incidence of insect pests on black gram

Whitefly

Whitefly population has been recorded in summer black gram in both the varieties of black gram since 3 weeks after sowing (WAS) (Table 1). The pest population has been continued upto 6 WAS in var. Pant U-31 and upto 7 WAS in var. Pant U-19, however, the peak population [10.8 per plant in Pant U-31 (Fig. 1) and 16.8 per plant in Pant U-19 (Fig. 2)] was found on 4 WAS i.e. on 15.04.16. During *kharif* season, whitefly was recorded from 3 WAS like summer season, however, in this season the pest population was continued upto 7 WAS in both the varieties (Table 2). Though, here also peak incidence [13.6 per plant in Pant U-31 (Fig. 3) and 20.8 per plant in Pant U-19 (Fig. 4)] was recorded on 4 WAS i.e. 27.09.16 in both varieties. These results of *kharif* season are in accordance with Chandra and Rajak (2004) who also reported the peak population of whiteflies at vegetative stage in the 1st week of October. However, during summer the present report revealed the peak population during second fortnight of April, though Kumar *et al.*, (2004) recorded the peak during first fortnight of May. This difference may be due to the difference in agro-climatic variations of the experimental locations. The present experiment recorded the highest whitefly population during 4th week of September in *kharif* crop, however, the peak population of whitefly was recorded in the second week of September 2014 by Patidar (2015) in Jabalpur which may be due to the change of experimental location.

Whitefly population on both the test varieties was significantly and negatively correlated with both maximum and minimum temperatures irrespective of season, however, it was significantly and positively correlated with minimum relative humidity in summer season, but it was significantly negative during *kharif* season. Besides, rainfall was significantly and positively correlated with pest population during summer season. Patidar (2015) obtained negative correlation with the maximum temperature and positive correlation with relative humidity which was in conformity of the present finding. Whereas Yadav *et al.*, (2017) found that the incidence and population fluctuation of whitefly was very much dependent on the prevailed climatic conditions of the cropping season. He found that Minimum temperature, maximum temperature and rainfall showed positive correlation whereas relative humidity showed negative correlation with the population of whitefly.

Spotted pod borer

Spotted pod borer population has been recorded in summer black gram in both the varieties of black gram since 7 weeks after sowing (WAS) (Table 1). The pest population has been continued upto 10 WAS in both varieties, however, the peak population [1.2

per plant in Pant U-31 (Fig. 1) and 2.4 per plant in Pant U-19 (Fig. 2)] was found on 10 WAS i.e. on 27.05.16. The highest pod borer population (1.2 per plant) in var. Pant U-31 was also observed during 9 WAS i.e. on 20.05.16. During *kharif* season, spotted pod borer was recorded from 8 WAS and continued upto 10 WAS (Table 2). The peak incidence [1.8 per plant in Pant U-31(Fig. 3) and 3.2 per plant in Pant U-19 (Fig. 4)] was recorded on 10 WAS i.e. on 08.11.16 in both varieties. These findings on the incidence of *M. vitrata* are in agreement with the reports of Sonune *et al.,* (2010) and Naik and Mallapur (2015). However, Srivastava *et al.,* (1992) found two population peaks in moth catches from light traps at ICRISAT, Hyderabad i.e. 1st peak during September and second peak in early November to first fortnight of December. Spotted pod borer population on both the test varieties was significantly and negatively correlated with maximum temperatures irrespective of season, however, it was significantly and positively correlated with both minimum relative humidity and rainfall in summer season, and with bright sunshine hour in *kharif* season. Significantly negative correlation existed among pest population and minimum temperature during summer season only. Similar findings are also observed by Sonune *et al.,* (2010) and Berani *et al.,* (2017). Where as Yadav and Singh (2013) found a significant negative correlation of spotted pod borer with minimum relative humidity and positive correlation with sunshine and evaporation on green gram crop which is also more or less similar with present findings.

Gram pod borer

Gram pod borer population has been recorded in summer black gram in both the varieties since 6 weeks after sowing (WAS) (Table 1). The pest population has been continued upto 8 WAS in var. Pant U-31 and upto 9 WAS in var. Pant U-19, however, the peak population [2.6 per plant in Pant U-31(Fig. 1) and 3.0 per plant in Pant U-19 (Fig. 2)] was found on 7 WAS i.e. on 13.05.16 in case of both the varieties. During *kharif* season, gram pod borer was recorded from 5 WAS, however, in this season the pest population was continued upto 7 WAS in var. Pant U-31and upto 8 WAS in var. Pant U-19 (Table 2). The peak population of gram pod borer [2.0 per plant in Pant U-31 (Fig. 3) and 2.4 per plant in Pant U-19 (Fig. 4)] was recorded on 7 WAS i.e.18.10.16 in both varieties. Whereas Umbarkar *et al.,* (2010) revealed that in case of green gram the pest started appearing at pod formation stage of the crop with population density during 4th week after sowing. The pest population increased fast during succeeding weeks, and peak density was recorded during 10th weeks after sowing. After reaching the peak, the gram pod borer population declined rapidly with the maturity of the crop. Gram pod borer population on both the test varieties was not significantly correlated with any of the weather parameters taken into consideration during both summer and *kharif* season. Although Srilaxmi *et al.,* (2008) found that on red gram their seasonal abundance was found to be influenced by various weather factors, yet the mean maximum and minimum temperature and relative humidity were found to be a conducive factor for their prevalence in Karnataka.

Flower thrips

Thrips population has been recorded in summer black gram in both the varieties of black gram since 6 weeks after sowing (WAS) (Table 1). The pest population has been continued upto 10 WAS in both varieties, however, the peak population [21.6 per plant in Pant U-31 (Fig. 1) and 25.8 per plant in Pant U-19 (Fig. 2)] was found on 9 WAS i.e. on 20.05.16.

Table.1 Insect pest population recorded on different varieties of urdbean during summer season of 2016

Date of observation	Weeks after sowing	Whitefly per trifoliate leaf		Spotted pod borer per plant		Gram pod borer per plant		Thrips per 10 flowers		Aphid per top 5cm twig		Hairy caterpillar per plant	
		Pant-U-31	Pant-U-19	Pant-U-31	Pant-U-19	Pant-U-31	Pant-U-19	Pant-U-31	Pant-U-19	Pant-U-31	Pant-U-19	Pant-U-31	Pant-U-19
08.04.16	3	2.2	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
15.04.16	4	10.8	16.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.4
22.04.16	5	6.6	9.8	0.0	0.0	0.0	0.0	0.0	0.0	8.8	18.8	2.0	3.4
29.04.16	6	2.4	5.4	0.0	0.0	1.2	1.6	3.8	5.2	27.6	57.8	1.4	2.8
06.05.16	7	0.0	3.2	0.8	1.0	2.6	3.0	8.4	12.4	5.4	32.4	0.0	1.3
13.05.16	8	0.0	0.0	1.0	1.4	1.8	2.4	17.8	19.4	0.0	19.0	0.0	0.0
20.05.16	9	0.0	0.0	1.2	1.8	0.0	1.0	21.6	25.8	0.0	0.0	0.0	0.0
27.05.16	10	0.0	0.0	1.2	2.4	0.0	0.0	13.4	18.4	0.0	0.0	0.0	0.0
Correlation coefficient with meteorological parameters													
Tmax		-0.72*	-0.75*	-0.78*	-0.82*	-0.16	0.05	-0.66*	-0.69*	0.74*	0.83*	0.68*	0.76*
Tmin		-0.70*	-0.75*	-0.75*	-0.72*	-0.08	-0.05	0.40	0.41	0.53*	0.57*	0.88*	0.87*
RHmax		0.30	0.36	0.42	0.54*	-0.49	-0.40	-0.76*	0.78*	-0.24	-0.34	-0.63*	-0.79*
RHmin		0.78*	0.81*	0.80*	0.85*	-0.16	-0.02	0.94*	0.88*	-0.76*	-0.85*	-0.53*	-0.62*
RF		0.97*	0.96*	0.79*	0.68*	-0.18	0.41	0.02	0.01	-0.57*	-0.63	-0.55*	-0.62*
WS		0.11	0.17	-0.17	-0.25	0.00	0.14	-0.23	-0.28	-0.12	-0.10	0.48	0.53*
BSH		-0.17	-0.22	-0.38	-0.46	0.30	0.28	-0.66*	-0.69*	0.57*	0.63*	0.56*	0.58*

* Significant at 5% level

Table.2 Insect pest population recorded on different varieties of urdbean during kharif season of 2016

Date of observation	Weeks after sowing	Whitefly per trifoliate leaf		Spotted pod borer per plant		Gram pod borer per plant		Thrips per 10 flowers		Aphid per top 5cm twig		Hairy caterpillar per plant	
		Pant-U-31	Pant-U-19	Pant-U-31	Pant-U-19	Pant-U-31	Pant-U-19	Pant-U-31	Pant-U-19	Pant-U-31	Pant-U-19	Pant-U-31	Pant-U-19
20.09.16	3	3.8	9.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27.09.16	4	13.6	20.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.8
4.10.16	5	8.8	16.6	0.0	0.0	1.0	1.4	0.0	0.0	9.6	10.8	4.4	6.4
11.10.16	6	3.4	5.8	0.0	0.0	1.4	2.2	1.6	2.6	17.6	23.0	3.2	5.8
18.10.16	7	1.2	2.0	0.0	0.0	2.0	2.4	6.4	8.0	24.4	36.8	0.0	2.2
25.10.16	8	0.0	0.0	0.2	1.2	0.0	0.6	9.8	12.4	13.6	22.2	0.0	0.0
01.11.16	9	0.0	0.0	1.0	2.8	0.0	0.0	13.4	15.4	8.2	17.8	0.0	0.0
08.11.16	10	0.0	0.0	1.8	3.2	0.0	0.0	2.0	4.4	6.8	5.2	0.0	0.0
Correlation coefficient with meteorological parameters													
Tmax		-0.56*	-0.60*	-0.94*	-0.84*	0.24	0.31	-0.18	-0.26	0.38	0.46	0.32	0.33
Tmin		-0.64*	-0.61*	-0.47	-0.50	-0.32	-0.40	-0.51*	-0.60*	0.70*	0.55*	0.05	-0.06
RHmax		0.39	0.37	-0.03	-0.17	0.32	0.27	-0.35	-0.35	0.41	0.31	0.23	0.34
RHmin		-0.63*	-0.59*	-0.02	-0.17	-0.07	0.10	-0.61*	-0.62*	0.55*	0.52*	0.28	0.25
RF		0.38	0.38	-0.23	-0.33	0.37	0.36	-0.32	-0.32	0.27	0.20	0.18	0.32
WS		0.10	0.07	0.23	-0.27	0.43	0.54	-0.18	0.18	-0.22	-0.24	-0.23	0.04
BSH		0.16	0.10	0.74*	0.63*	0.06	0.06	0.00	0.08	-0.48	-0.47	0.26	0.21

* Significant at 5% level

Fig.1 Pest population along with weather parameters in cv. Pant-U-31 during summer season

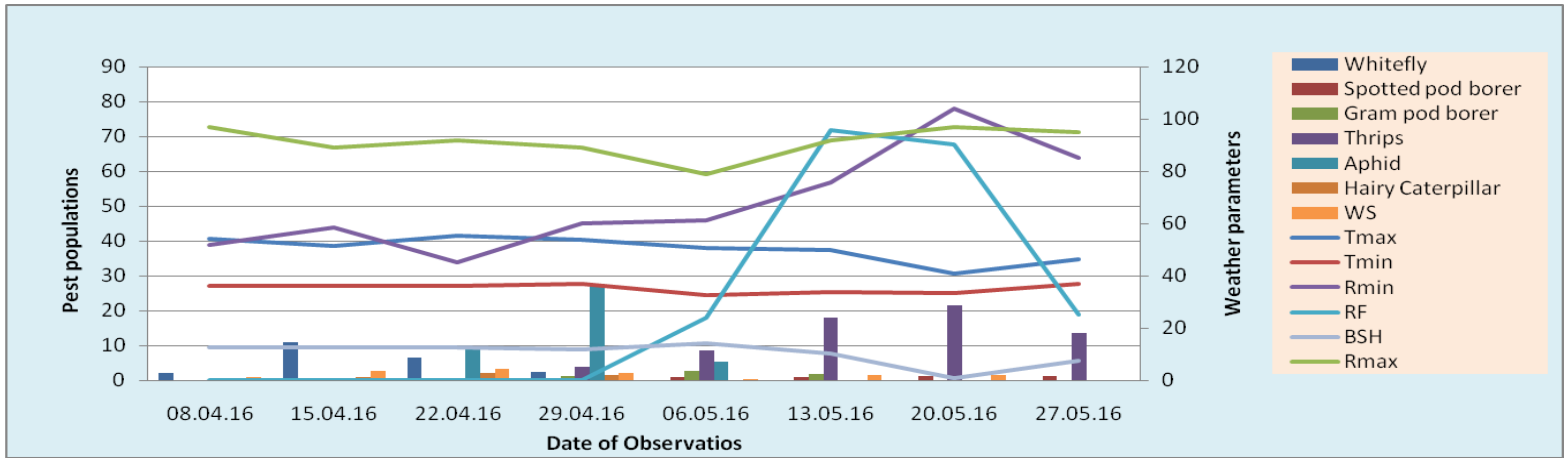


Fig.2 Pest population along with weather parameters in cv. Pant-U-19 during summer season

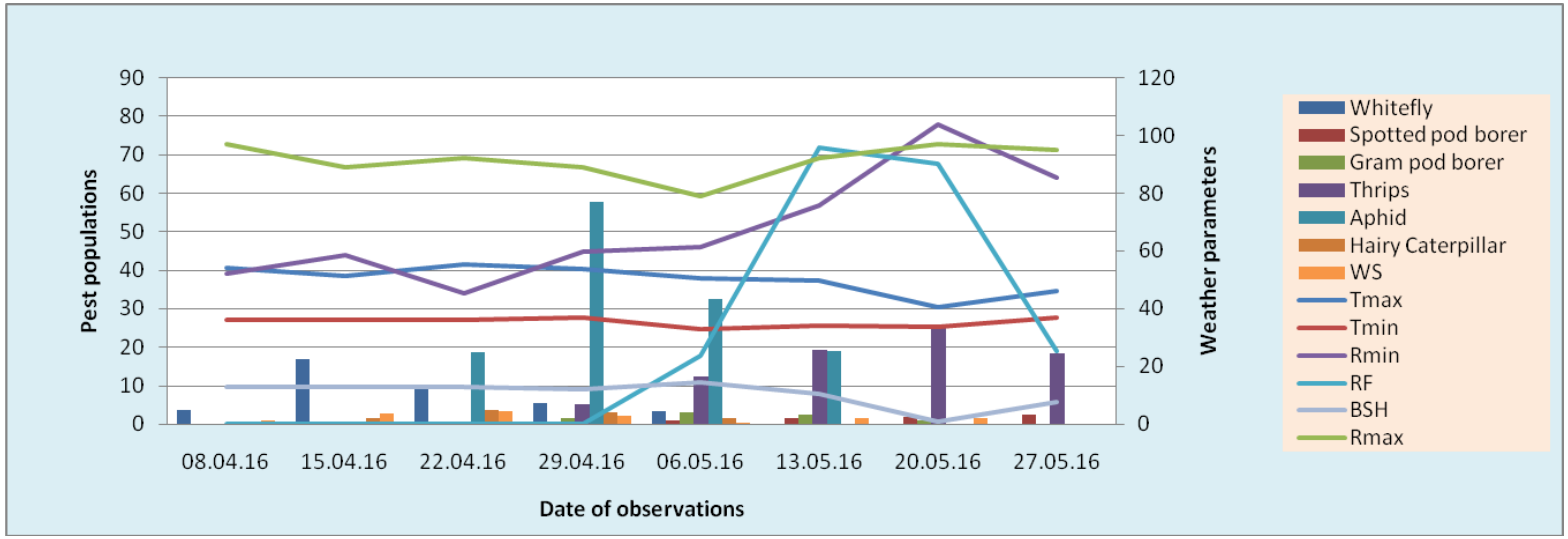


Fig.3 Pest population along with weather parameters in cv. Pant-U-31 during kharif season

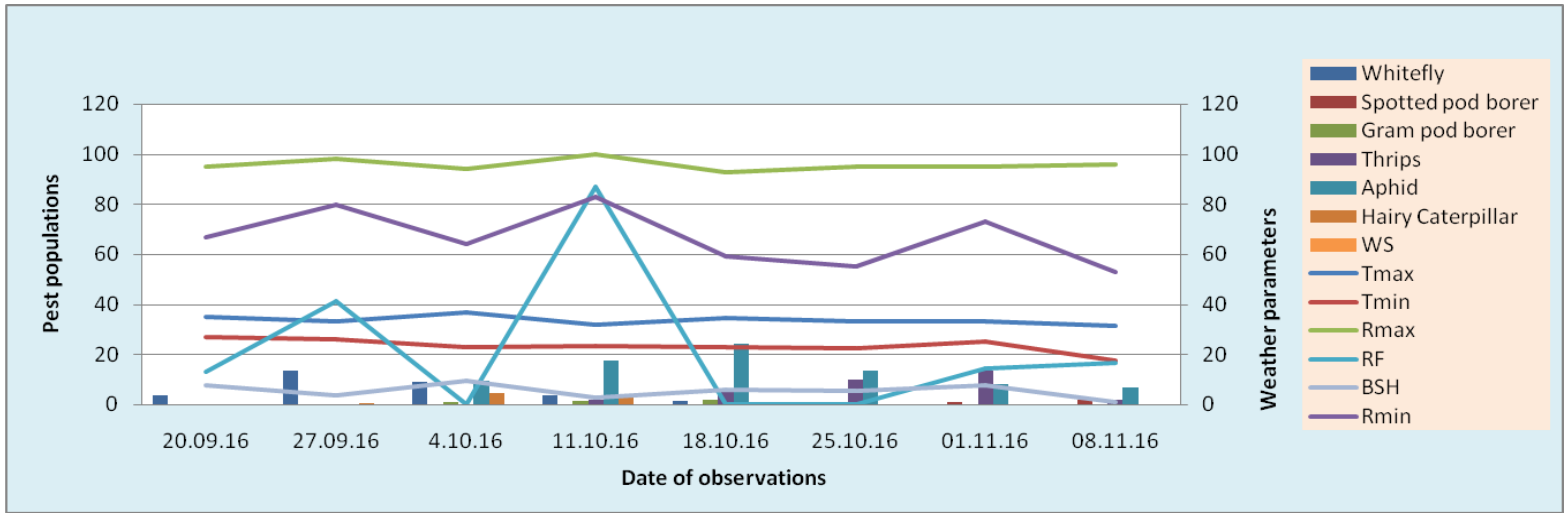
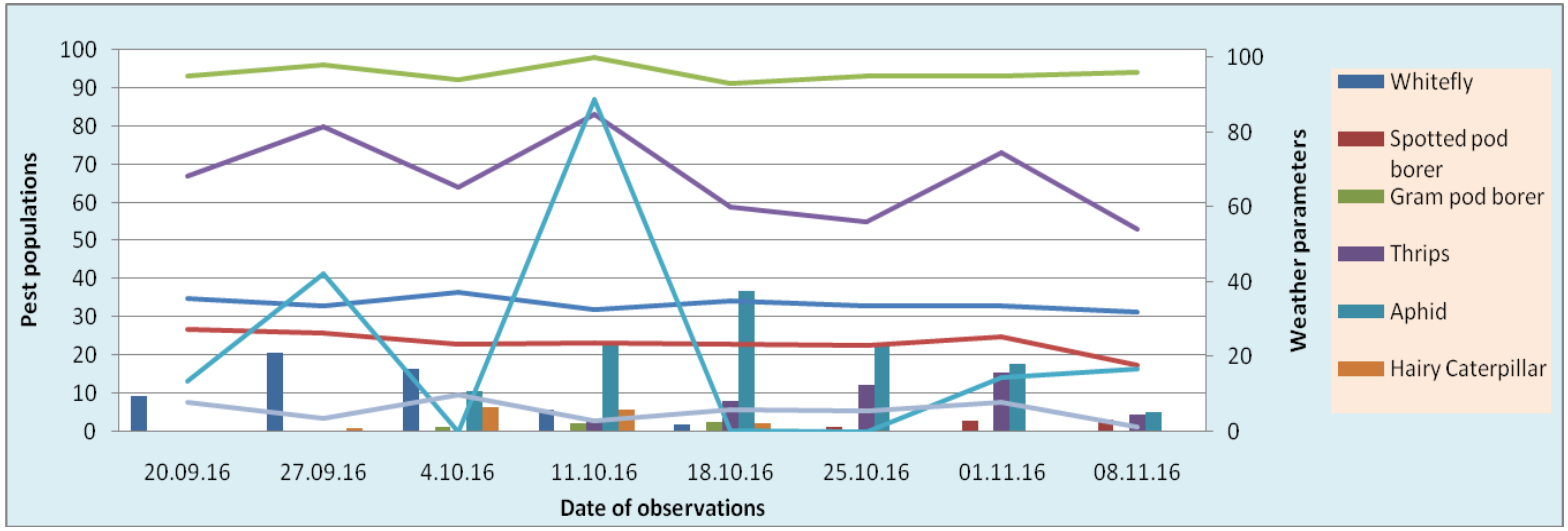


Fig.4 Pest population along with weather parameters in cv. Pant-U-19 during kharif season



During *kharif* season also, flower thrips was recorded from 6 WAS and continued upto 10 WAS in both the varieties like summer season (Table 2). Here also, peak incidence [13.4 per plant in Pant U-31 (Fig. 3) and 15.4 per plant in Pant U-19 (Fig. 4)] was recorded on 9 WAS i.e. 01.11.16 in both varieties. Reproductive stage was more vulnerable than vegetative and maturity stage. These findings also supported by Kumar and Singh (2016).

The present findings found to be conformity with Radhika *et al.,* (2018). Vikrant *et al.,* (2013) revealed that the appearance of thrips became significant on black gram from 2nd week of August and the peak mean population of thrips 1st week of September. Differences in results of past workers and present finding maybe due to effect of climate change.

Seasonal variation among the weather parameters with thrips population was recorded during two seasons of the experiment. Thrips population on both the test varieties was significantly and positively correlated with minimum relative humidity in summer season but significantly and negatively correlated with minimum relative humidity in *kharif* season. However, maximum temperature was significantly and negatively correlated with pest population during summer season only. Again, minimum temperature was significantly and negatively correlated with pest population during *kharif* season only. On the other hand, bright sunshine hour was significantly and negatively correlated with pest population during summer season only. These findings showed more or less similar with Kumar and Singh (2016) revealed that the maximum and minimum temperature and sunshine hours showed non-significant negatively correlation, while maximum and minimum relative humidity and total rainfall showed non-significant positive correlation with population of flower thrips on black gram crop.

Black aphid

Aphid population has been recorded in summer black gram in both the varieties of black gram since 5 weeks after sowing (WAS) (Table 1). The pest population has been continued up to 7 WAS in var. Pant U-31 and up to 8 WAS in var. Pant U-19, however, the peak population [27.6 per plant in Pant U-31 (Fig. 1) and 57.8 per plant in Pant U-19 (Fig. 2)] was found on 6 WAS i.e. on 29.04.16.

During *kharif* season, aphid was recorded from 5 WAS like summer season, however, in this season the pest population was continued up to 10 WAS in both the varieties (Table 2).

Though, here also peak incidence [24.4 per plant in Pant U-31 (Fig. 3) and 36.8 per plant in Pant U-19 (Fig. 4)] was recorded on 7 WAS i.e. 18.10.16 in both varieties. These findings are in accordance with the findings of Kumar and Singh (2016) whereas Sneha *et al.,* (2016) observed populations two weeks later from the date of germination on black gram.

Aphid population on both the test varieties was significantly and positively correlated with minimum temperature irrespective of season. However, association among pest population and minimum relative humidity observed during two seasons are completely reverse. During summer the correlation was significantly negative, however, it was significantly positive during *kharif* season.

The table also described the significant positive correlation among aphid population with maximum temperature and bright sunshine hour during summer season only. These results are in accordance with the findings of Tamang *et al.,* (2017). Whereas D. Sneha *et al.,* (2016) observed that the population of aphids showed positive and non significant correlation with maximum temperature and sunshine hours.

Hairy caterpillar

Hairy caterpillar population has been recorded in summer black gram since 3 weeks after sowing (WAS) in var. Pant U-19 but it was recorded in var. Pant U-31 since 4 WAS (Table 1). The pest population has been continued upto 6 WAS in var. Pant U-31 and upto 7 WAS in var. Pant U-19, however, the peak population [2.0 per plant in Pant U-31 (Fig. 1) and 3.4 per plant in Pant U-19 (Fig. 2)] was found on 5 WAS i.e. on 22.04.16 in both the varieties.

During *kharif* season, hairy caterpillar was recorded from 4 WAS in both the varieties, however, in this season the pest population was continued upto 6 WAS in var. Pant U-31 and upto 7 WAS in var. Pant U-19 (Table 2). The peak population of hairy caterpillar [4.4 per plant in Pant U-31 (Fig. 3) and 6.4 per plant in Pant U-19 (Fig. 4)] was recorded on 5 WAS i.e. on 04.10.16.

Hairy caterpillar population was significantly and positively correlated with both maximum and minimum temperatures along with bright sunshine hour in both varieties during summer season, however, it was significantly and negatively correlated with maximum and minimum relative humidity along with rainfall in summer season. However, during *kharif* season, all the correlations observed were non-significant. These results are in accordance by Berani *et al.*, (2017) and Mohapatra *et al.*, (2018) and Chandra *et al.*, (2010). Contrast in results of past workers and present finding maybe due to effect of climate change.

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