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Seasonal variation in incidence of insect pests occurring on green gram [*Vigna radiata* (Linn.) wilczek] in lower gangetic plains of West Bengal

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Abstract
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 green gram viz. Sonali and IPM-99-125 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*, *Riptortus pedestris*, *Clavigralla gibbosa* and *Catochrysops strabo* as the major pests of the crop. *Bemisia* population has been recorded in the vegetative stage only in both the test varieties with peaks at 5 weeks after sowing (WAS) and 4 WAS during summer and *kharif* season, respectively. Maximum aphid population has been recorded in 6 WAS and 7WAS during summer and *kharif* season, respectively. Thrips population has reached its maximum in 8 WAS during both the seasons. Highest *Helicoverpa* population has been recorded in 7 WAS and 6 WAS during summer and *kharif* season, respectively, whereas, maximum population of *Maruca* was recorded in 9 WAS in both the seasons. *Bemisia* population was significantly and positively correlated with both temperatures irrespective of varieties during both the seasons. Aphid population was significantly and positively correlated with maximum temperature and bright sunshine hour in both the varieties during summer but significantly and negatively correlated with minimum temperature during *kharif*. Thrips population was significantly and negatively correlated with both temperatures during summer but the correlation was significantly negative with maximum temperature during *kharif*, while minimum relative humidity and rainfall were significantly and positively correlated with the pest population in summer crop and maximum relative humidity was significantly and negatively correlated with the pest population in *kharif* crop. *Helicoverpa* population was significantly and negatively correlated with minimum temperature in both the varieties during *kharif* season only. *Maruca* population in both the varieties was significantly and negatively correlated with minimum temperature during *kharif*.

Keywords: Green gram, *Vigna radiata*, insect pests, seasonal incidence, correlation, abiotic factors

Introduction
Green gram (*Vigna radiata)* (L.) Wilczek [Synonyms: *Phaseolus radiatus* L. (1753), *Phaseolus aureus* Roxb. (1832)], often known as moong, is native to India and Central Asia. It has been grown in these regions since prehistoric times and as an important legume crop in India throughout the year. The Sanskrit name for green gram is *Mudgaparni*or *Mashaparni* as per ancient Indian literature '*The Yajurveda'* (7000 BC). Cultivation spread over to many countries, especially in tropical and subtropical Asia. Green gram is a short duration legume crop and is an excellent source of high-quality protein. Green gram plants are branching, erect and self-pollinating. They have a rooting depth of 60–100 cm. It is grown as sole relay crop in rice fallows during *rabi* season in Andhra Pradesh, Tamil Nadu, Karnataka and Orissa and sole catch crop during spring/summer season in Uttar Pradesh, Bihar, West Bengal, Jharkhand, Punjab, Haryana and Rajasthan. In West Bengal, it is grown in *kharif* season also. Mature green gram seeds or flour enter a variety of dishes such as soups, porridge, snacks, bread, noodles and even ice-cream. Boiled whole seeds are also fried with meat or vegetables and eaten as a relish with thick maize porridge (*ugali*) and pancakes (*chapatti*), whereas consumption of split seeds (*dal*) is common among people of Asian descent. Sprouted green gram seeds are eaten raw or cooked as a vegetable; in French they are erroneously called'*germes de soja*', in English 'bean sprouts'. Sprouted whole green gram is used in south India for preparing curry or as a savoury dish. It is mostly used as *dal* in north India.

Immature pods and young leaves are eaten as a vegetable. Plant residues and cracked or weathered seeds are feed to livestock. After harvesting the pods, green plants are uprooted or cut from ground level and chopped into small pieces and feed to the cattle. The husks of the seed can be soaked in water and used as cattle feed. Green gram is sometimes grown for fodder, green manure or as a cover crop. The seeds are said to be a traditional source of cures for paralysis, rheumatism, coughs, fevers and liver ailments (Mogotsi, 2006). It is supposed to be easily digestible and hence is preferred by patients. When green gram allowed sprouting, ascorbic acid (vitamin C) is synthesised. The amount of riboflavin and thiamine are also increased. Being a leguminous crop, it has the capacity to fix the atmospheric nitrogen. It also helps in preventing soil erosion. Being a short duration crop it fits well in many intensive crop rotations. Green gram contributes 14% in total pulses area and 7% in total pulses production of India. The nutritive value of green gram lies in its high and easily digestible protein, and contains approximately 25-28% protein, 1.0% oil, 3.5-4.5% fibre, 4.5-5.5% ash and 62-65% carbohydrates on dry weight basis. Amino acid analysis indicates that the concentration of sulphur containing amino acids, namely methionine and cystine are low. Lysine values are comparatively large and that is why, the protein of green gram is an excellent complement to rice in terms of balanced human nutrition. 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 green gram and their relationship with abiotic factors in the 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 green gram (Cultivar: Sonali and IPM-99-125) were sown having plot size 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. The mean population was worked out for all the pest species. 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 sum total of seven days rainfall.

Results and Discussion

Insect pests associated with green 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 (*Megalurothrips distalis*); spotted pod borer (*Maruca vitrata*); gram pod borer (*Helicoverpa armigera*); plant bug(*Riptortus pedestris*); pod bug (*Clavigralla gibbosa*) and blue butterfly (Catochrysops Strabo),were found to be the major insect pests attacking the crop.

Rahman *et al.*, (1981) [8] listed the 16 insect pests that attack mungbean from Bangladesh. The major insect pests are bean stemfly (*Ophiomya phaseoli*), jassid (*Empoasca kerri*), whitefly (*Bemisia tabaci*), thrips (*Megalurothrips distalis*), bean aphid (*Aphis craccivora*), hairy caterpiller (*Diacrisia obliqua*), spotted pod borer (*Maruca testulalis*), flower thrips (*Megalurothrips distalis*), and some minor pests are leaf webber (*Laprosoma indica*), leaf miner (*Acrocerphos phacospora*), epilachna beetle (*Epilachna* spp), semi loopers (*Diachrysia orochalcea)*, galerucid beetle (*Madurisia obscurella*), green semi looper (*Plusia signata*), bean lycaenid (*Euchrysops cnejus*) etc.

Incidence of insect pests on green gram

Whitefly: Whitefly population has been recorded in summer green gram in both the varieties of green gram since 3 weeks after sowing (WAS) (Table 1). The pest population has been continued upto 7 WAS in both the test varieties, however, the peak population (13.8 per plant in Sonali [Fig.1] and 9.4 per plant in IPM 99-125 [Fig.2]) was found on 5 WAS i.e. on 22.04.16. 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). The peak incidence (19.4 per plant in Sonali [Fig.3] and 16.4 per plant in IPM 99-125[Fig.4]) was recorded on 4 WAS i.e. 27.09.16 in both varieties. Kumar *et al.,* (2007) [4] also observed the peak activity of whitefly during second week of September. In summer season in cv. Sonali, whitefly population significantly positively correlated with maximum temperature, minimum temperature and bright sunshine hour but in case of IPM 99-125, it was significantly negatively correlated with maximum relative humidity. The pest population was significantly negatively correlated with minimum relative humidity and rainfall. In *kharif* season, pest population was significantly positive correlated with only maximum temperature in both varieties. Similarly Kumar *et al*. (2007) [4] also found that there was significant positive correlation between whitefly and maximum temperature, relative humidity and rainfall in green gram which corroborates the present findings. Birbal and Singh (2017) observed positive significant correlation of pest incidence with maximum temperature, while, negative non-significant correlation was found with minimum relative humidity whereas other factors was found positive but non-significant with abiotic factors. Yadav and Singh (2006) [12] observed that on green gram crop both maximum and minimum temperature and relative humidity had a significant positive correlation with whitefly population in increasing the disease transmission.

Table 1: Insect pest population recorded on different varieties of green gram during summer season

Date of observation	Weeks after sowing	Whitefly per trifoliate leaf		Aphid per top 5cm twig		Jassid per leaf		Thrips per 10 flowers		Gram pod borer per plant		Spotted per plant		Blue butterfly per plant		Plant bug per plant		Pod bug per plant	
		Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125
08.04.16	3	1.4	0.6	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
15.04.16	4	10.4	5.4	5.4	1.8	0.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.4
22.04.16	5	13.8	9.4	12.8	6.6	3.4	1.4	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	1.8
29.04.16	6	5.0	2.4	44.8	21.4	4.6	2.8	1.2	1.0	2.6	1.8	0.8	0.4	1.2	0.4	0.2	0.0	2.4	1.8
06.05.16	7	0.8	0.6	12.4	5.6	1.8	0.8	21.8	14.6	3.8	2.2	3.4	2.2	2.6	1.8	1.6	0.8	1.8	1.6
13.05.16	8	0.0	0.0	0.0	0.0	0.0	0.0	34.8	22.4	1.6	0.8	4.2	3.6	3.4	3.2	2.8	1.4	1.2	0.8
20.05.16	9	0.0	0.0	0.0	0.0	0.0	0.0	27.2	15.6	0.8	0.6	5.4	4.4	2.2	1.4	3.4	2.2	0.6	0.2
Correlation coefficient with meteorological parameters																			
Tmax		0.71*	0.61	0.73*	0.73*	0.65*	0.60*	-0.66*	-0.62*	0.14	0.11	0.14	0.11	-0.68*	-0.71*	0.63*	0.50	-0.48	-0.48
Tmin		0.70*	0.67	-0.44	-0.45	0.83*	0.79*	-0.61*	-0.58*	0.20	0.05	0.20	0.05	-0.69*	-0.69*	0.80*	0.69*	-0.42	-0.40
RHmax		-0.48	-0.56*	-0.40	-0.37	-0.70*	0.21	0.16	0.11	0.68*	0.68*	-0.68*	-0.68*	0.22	0.28	-0.88*	-0.92*	0.01	0.03
RHmin		-0.64*	-0.53*	-0.47	-0.46	-0.43	-0.30	0.67*	0.63*	-0.01	-0.01	-0.01	-0.01	0.74	-0.77	-0.42	-0.30	0.53*	0.50
RF		-0.63*	-0.57*	0.45	0.48	-0.59*	-0.51*	0.92*	0.89*	0.00	0.00	0.00	0.00	0.92*	0.97*	-0.40	-0.35	0.79*	0.80*
WS		0.08	0.16	0.45	0.43	0.55	0.13	-0.06	-0.10	0.31	0.31	0.31	0.31	0.15	0.12	0.41	0.44	-0.02	-0.20
BSH		0.51*	0.44	0.73*	0.73*	0.44	0.36	-0.27	-0.24	0.22	0.22	0.22	0.22	-0.16	-0.16	0.63*	0.47	-0.03	0.03

* Significant at 5% level

Table 2: Insect pest population recorded on different varieties of green gram during kharif season

Date of observation	Weeks after sowing	Whitefly per trifoliate leaf		Aphid per top 5cm twig		Jassid per leaf		Thrips per 10 flowers		Gram pod borer per plant		Spotted per plant		Blue butterfly per plant		Plant bug per plant		Pod bug per plant	
		Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125	Sonali	IPM 99-125
20.09.16	3	3.6	2.8	0.0	0.0	0.4	0.2	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27.09.16	4	19.4	16.4	8.4	2.2	1.8	0.8	0.0	0.0	1.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04.10.16	5	10.6	8.6	23.8	16.4	4.8	3.6	0.0	0.0	2.8	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11.10.16	6	6.8	3.2	54.8	37.8	3.2	2.2	2.6	1.8	3.2	2.2	0.0	0.0	0.8	0.2	0.8	0.4	0.8	0.4
18.10.16	7	2.2	1.4	157.4	54.8	2.0	0.8	16.8	12.4	3.0	2.2	2.8	1.8	1.6	0.8	2.8	1.4	2.8	1.4
25.10.16	8	0.0	0.0	78.4	41.0	0.8	0.0	20.4	15.8	2.8	1.6	4.6	3.4	2.8	1.6	5.4	2.8	5.4	2.8
01.11.16	9	0.0	0.0	10.6	3.8	0.0	0.0	12.0	8.6	1.0	0.0	6.0	4.6	1.8	0.8	6.2	3.6	6.2	3.6
Correlation coefficient with meteorological parameters																			
Tmax		0.62*	0.60*	-0.02	0.06	0.30	0.27	-0.71*	-0.70*	0.15	0.14	0.15	0.14	-0.58*	-0.59*	0.00	0.22	0.00	0.22
Tmin		0.23	0.38	-0.66*	-0.78*	-0.04	0.03	-0.43	-0.45	-0.70*	-0.64*	-0.70	-0.64*	-0.57*	-0.55*	-0.56*	-0.36	-0.56*	-0.36
RH-I		0.06	0.05	-0.06	-0.02	0.31	0.55*	-0.79*	-0.79*	0.08	0.25	0.08	0.25	-0.41	-0.41	0.29	0.27	0.29	0.27
RH-II		0.14	0.14	-0.51*	-0.43	0.24	0.28	-0.35	-0.36	-0.24	-0.10	-0.24	-0.10	-0.65*	-0.62*	-0.02	0.07	-0.02	0.07
RF		-0.02	0.01	0.06	0.13	0.19	0.14	0.47	0.45	0.14	0.34	0.14	0.34	-0.43	-0.43	0.21	0.22	0.21	0.22
WS		-0.02	-0.11	0.86*	0.65*	0.04	-0.09	-0.05	-0.06	0.49	0.49	0.37	0.49	0.15	0.09	0.24	0.18	0.24	0.18
BSH		0.45	0.06	-0.01	-0.17	0.39	0.52*	-0.27	-0.24	0.39	0.20	0.39	0.20	0.12	0.13	0.45	0.36	0.45	0.36

* Significant at 5% level

Pulse aphid: Aphid population has been recorded in summer green gram in both the varieties of green gram since 4 WAS (Table 1). The pest population has been continued upto 7 WAS in both the test varieties, the peak population (44.8 per plant in Sonali [Fig.1] and 21.4 per plant in IPM 99-125[Fig.2]) was found on 5 WAS i.e. on 29.04.16. During *kharif* season, whitefly was recorded from 4 WAS like summer season, however, in this season the pest population was continued upto 9 WAS in both the varieties (Table 2). The peak incidence (157.4 per plant in Sonali [Fig.3] and 54.8 per plant in IPM 99-125[Fig.4]) was recorded on 7 WAS i.e. 18.10.16 in both varieties. The results are more or less in agreement with Tamang *et al.*, (2017) [10] who stated that aphid population reached its peak in 9 WAS. In summer season aphid population was significantly positively correlated with maximum temperature and bright sunshine hour in both the test varieties. However, during *kharif* season association among pest population with minimum temperature observed were completely reverse. In both varieties the pest population was significantly and positively correlated with wind speed but only for cv. Sonali minimum relative humidity was significantly and negatively correlated. These results are more or less similar with Tamang *et al.*, (2017) [10] who recorded that aphid population exhibited highly significant positive correlation with maximum temperature and significant negative correlation with evening relative humidity and rainfall respectively during first and second seasons. The present findings differed with above said authors which might be due to the variations in climatological factors in this region. The finding of present investigation is in close conformity with the finding of Birbal and Singh (2017)

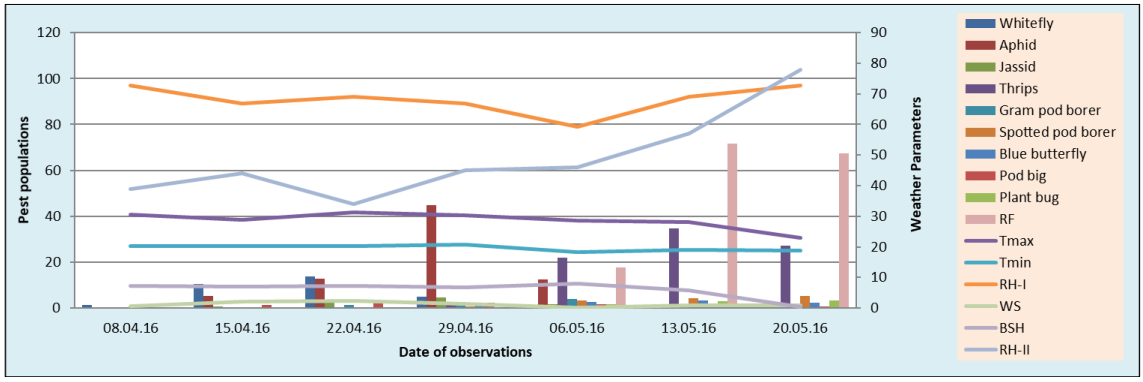

Fig 1: Pest population along with weather parameters in cv. Sonali during summer season.

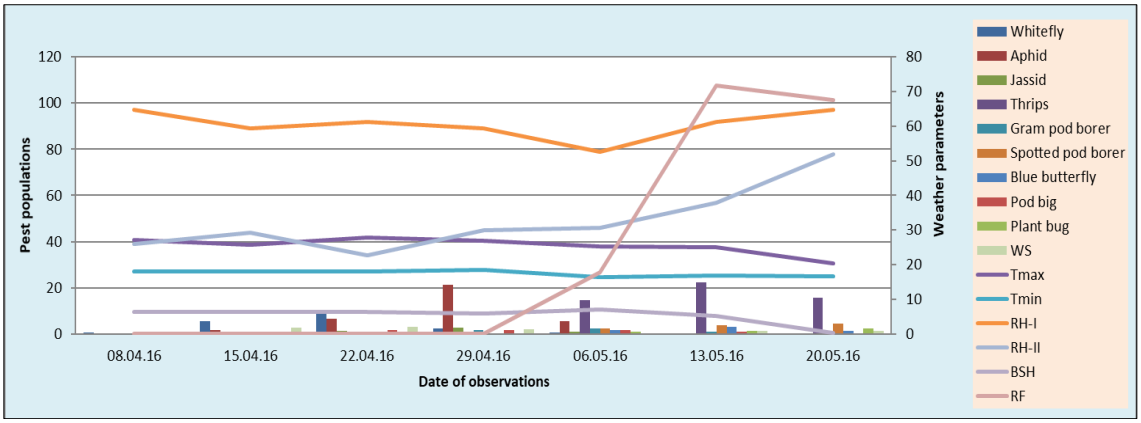

Fig 2: Pest population along with weather parameters in cv. IPM 99-125 during summer season.

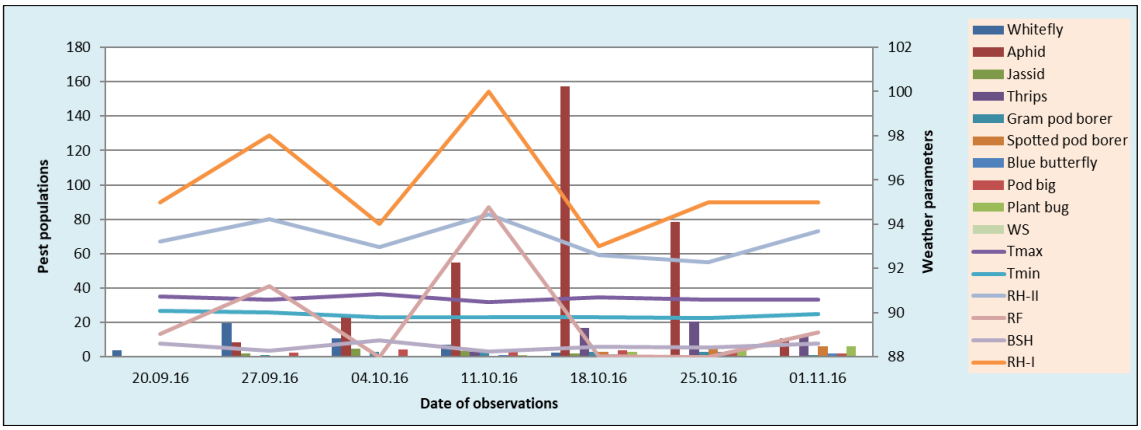

Fig 3: Pest population along with weather parameters in cv. Sonali during kharif season.

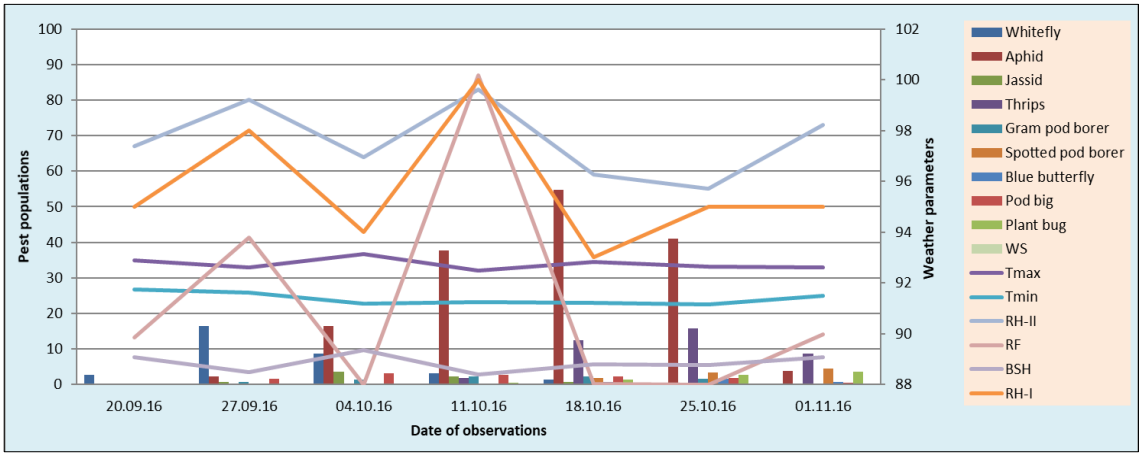

Fig 4: Pest population along with weather parameters in cv. IPM 99-125 during kharif season.

Jassid: Jassid population has been recorded in summer green gram in cv. Sonali since 6 WAS but in case of IPM 99-125 it was 4WAS (Table 1). The pest population has been continued upto 7 WAS in both the test varieties, the peak population (4.6 per plant in Sonali [Fig.1] and 2.8 per plant in IPM 99-125[Fig.2]) was found on 6 WAS i.e. on 29.04.16. During *kharif* season, jassid was recorded from 3 WAS and continued upto 8 WAS in Sonali variety and in IPM 99-125 it was 7 WAS (Table 2). The peak incidence (4.8 per plant in Sonali (Fig.3) and 3.6 per plant in IPM 99-125(Fig.4)) was recorded on 5 WAS i.e. 04.10.16 in both varieties. Yadav *et al.,* (2015) [13] observed that its population incresed two week later from the date of germination on green gram crop during *kharif* season. During summer season in both the test varieties pest population are significantly positively correlated with maximum temperature and negatively correlated with rainfall. Only in Sonali variety maximum relative humidity was negatively correlated where in *kharif* season it is completely reverse in cv. IPM 99-125. During *kharif* season in cv. IPM 99-125 pest populations was significantly positively correlated with bright sunshine hour. This result was found more or less similar with Birbal and Singh (2017).

Flower thrips: Thrips population has been recorded in summer green gram in both the varieties of green gram since 6 WAS (Table 1). The pest population has been continued upto 9 WAS in both the test varieties, the peak population (34.8 per plant in Sonali [Fig.1] and 22.4 per plant in IPM 99-125[Fig.2]) was found on 8 WAS i.e. on 13.05.16. During *kharif* season, thrips was recorded from 6 WAS and continued upto 9 WAS in both the varieties like summer season (Table 2). The peak incidence (20.4 per plant in Sonali [Fig.3] and 15.8 per plant in IPM 99-125 [Fig.4]) was recorded on 8 WAS i.e. 25.10.16 in both varieties. Kumar *et al.,* (2016) also recorded the peak incidence of thrips in 3rd week of May.
In both summer and *kharif* season in both the test varieties pest populations recorded significantly negative correlated with maximum temperature but significantly negatively correlated with minimum temperature only in summer season. In summer season pest population was significantly positively correlated with both minimum relative humidity and rainfall. In case of *kharif* season pest incidence was negatively correlated with maximum relative humidity. These results are in close conformity with the finding of Nitharwal and Kumawat (2009) [7] who found a significant negative correlation of thrips with maximum temperature.

Gram pod borer: Gram pod borer population has been recorded in summer green gram in case of cv. Sonali of green gram since 5 WAS and in IPM 99-125 6 WAS (Table 1). The pest population has been continued upto 9 WAS in both the test varieties, the peak population (3.8 per plant in Sonali [Fig.1] and 2.2 per plant in IPM 99-125[Fig.2]) was found on 7 WAS i.e. on 06.05.16. During *kharif* season, gram pod borer was recorded from 6 WAS in cv. Sonali and in IPM 99-125 it was 4 WAS and continued upto 9 WAS in both the varieties (Table 2). The peak incidence (3.2 per plant in Sonali [Fig.3] and 2.2 per plant in IPM 99-125[Fig.4]) was recorded on 6 WAS i.e. 11.10.16 in both varieties. The present observations on the incidence of the *H. armigera* on greengram are more or less in accordance with Umbarkar *et al.,* (2010) who observed the incidence on 4th WAS and peak density was recorded during 10th WAS. After reaching the peak, the gram pod borer population declined rapidly with the maturity of the crop. The results obtained during the present study indicated that the gram borer started its activity from pod formation stage of the crop and remained up to maturity of the crop. This difference may be influenced by the different agro climatic region. During summer season the pest population was significantly negatively correlated with maximum relative humidity in both the varieties. During *kharif* season pest population was significantly negatively correlated with minimum temperature in both the varieties. These findings are more or less similar with the findings of Khan *et al.,* (2018) [6].

Spotted pod borer: Spotted pod borer population has been recorded in summer green gram in both the varieties of green gram since 6 weeks after sowing (WAS) (Table 1). The pest population has been continued upto 9 WAS in both the test varieties, however, the peak population (5.4 per plant in Sonali [Fig.1] and 4.4 per plant in IPM 99-125[Fig.2]) was found on 9 WAS i.e. on 20.05.16. During *kharif* season, whitefly was recorded from 7 weeks after sowing (WAS) (Table 2). The pest population has been continued upto 9 WAS in both the test varieties, however, the peak population (6.0 per plant in Sonali (Fig.3) and 4.6 per plant in IPM 99-125[Fig.4]) was found on 9 WAS i.e. on 01.11.16. Similar findings were observed by Sravani *et al.,* (2015) [9] who reported that the incidence started during second week of November *i.e.*, 4th week after sowing. During summer season pest population was significantly negatively correlated with maximum relative humidity in both the test varieties whereas during *kharif* season pest population was negatively correlated with minimum temperature only in the var. IPM 99-125. Umbarkar *et al.,* (2010) reported that correlation coefficient between population of *M. testulalis* and weather parameters revealed that among all the weather parameters, only minimum temperature showed significant negative correlation with this pest population. Rest of the weather parameters viz., maximum temperature, morning and evening relative humidity, wind speed, bright sunshine hour, rainfall and rainy days were non-significant and negatively correlated which show more or less similar with the present findings.

Blue butterfly: Blue butterfly population has been recorded in summer green gram in both the varieties of green gram since 6 weeks after sowing (WAS) (Table 1). The pest population has been continued upto 9 WAS in both the test varieties, however, the peak population (3.4 per plant in Sonali [Fig.1] and 3.2 per plant in IPM 99-125[Fig.2]) was found on 8 WAS i.e. on 20.05.16. During *kharif* season, blue butterfly was recorded from 6 weeks after sowing (WAS) like summer season. The pest population has been continued upto 9 WAS in both the test varieties, (Table 2). However, the peak population (2.8 per plant in Sonali (Fig.3) and 1.6 per plant in IPM 99-125 [Fig.4]) was found on 8 WAS i.e. on 01.11.16. During summer season in both the test varieties the pest populations was significantly negatively correlated with maximum and minimum temperature and significantly positively correlated with rainfall. During kharif season in both the test varieties the pest populations was significantly and negatively correlated with maximum temperature, minimum temperature and minimum relative humidity.

Plant bug: Plant bug population has been recorded in summer green gram in both the varieties of green gram since 6 WAS (Table 1). The pest population has been continued upto 9 WAS in both the test varieties, the peak population (3.4 per plant in Sonali [Fig.1] and 2.2 per plant in IPM 99-

125 [Fig.2]) was found on 9 WAS i.e. on 20.05.16. During *kharif* season, thrips was recorded from 6 WAS and continued upto 9 WAS in both the varieties like summer season (Table 2). The peak incidence (6.2 per plant in Sonali [Fig.3] and 3.6 per plant in IPM 99-125[Fig.4]) was recorded on 8 WAS i.e. 01.11.16 in both varieties. In summer season only in var. Sonali pest population was significantly and positively correlated with maximum temperature and significantly negative correlation with maximum relative humidity in both the test varieties. During summer season pest populations were significantly and positively correlated with minimum temperature where as it was significantly negatively correlated only in var. IPM 99-125 in *kharif* season.

Pod bug: Pod bug population has been recorded in summer green gram in the Sonali variety of green gram since 3 weeks after sowing (WAS) but in IPM 99-125 4 WAS (Table 1). The pest population has been continued upto 9 WAS in both the test varieties, however, the peak population (2.6 per plant in Sonali (Fig.1) and 1.8 per plant in IPM 99-125(Fig.2)) was found on 5 WAS i.e. on 22.04.16 and in case of IPM 99-125 population found remain same on the next week i.e. 29.04.16. During *kharif* season, Pod bug was recorded from 3 weeks after sowing (WAS) and the pest population has been continued upto 9 WAS in both the test varieties (Table 2). However, the peak population (2.8 per plant in Sonali [Fig.3] and 1.6 per plant in IPM 99-125 [Fig.4]) was found on 5 WAS i.e. on 04.10.16. Garg (1992) [3] reported its incidence during August-September with maximum population in 1st week of September. During summer season in cv. Sonali the pest population was significantly and positively correlated with minimum relative humidity where as in *kharif* season in the var. IPM 99-125 it was completely reverse. During summer season pest population was significantly and positively correlated with rainfall. In *khar*if season in case of both the test varieties pest population was significantly negatively correlated with minimum temperature and minimum relative humidity.

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