

Population dynamics of sucking pests in green gram, *Vigna radiata* (L.) Wilczek

Patel DS¹, S Deb^{1#}, NL Parmar¹ and VJ Joshi¹

Summary

Among the four sucking pests; Aphid, *Aphis craccivora* Koch and jassid, *Empoasca kerri* exhibited their peak activity during the 19th SMW, with populations of 6.25 per and 3.20 per three leaves, respectively. The peak population of whitefly, *Bemisia tabaci* Gennadius (6.30/3 leaves), was observed during the 21st SMW. In the case of thrips, *Megalurothrips usitatus*, the population reached a peak level (4.20/3 flowers) during 21st SMW. Among various abiotic factors, wind velocity exhibited significant or highly significant positive correlation with sucking pests viz., aphid, jassid and whitefly incidence. Weather parameters viz., minimum temperature ($r = 0.70$), evening relative humidity ($r = 0.79$), and evaporation ($r = 0.74$), exerted a significant positive impact on thrips population in summer green gram. The ladybird beetle showed a highly significant positive correlation with *A. craccivora* ($r = 0.92$) and *E. kerri* ($r = 0.92$) populations. Green lacewing exhibited a highly significant and positive correlation with *E. kerri* ($r = 0.91$) incidence, whereas significant and positive correlation with *A. craccivora* ($r = 0.751^*$) and *B. tabaci* ($r = 0.790^*$) populations. The population of spiders showed a highly significant positive correlation with aphid ($r = 0.98$) and jassid ($r = 0.94$) populations in green gram crop.

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Introduction

Green gram, *Vigna radiata* (L.) Wilczek (Family: Leguminosae) is the third most important pulse crop of India after chickpea and pigeon pea, commonly known as mung, moong, mungo, mung bean, golden gram, Chickasaw pea, oreganpea etc. Area occupied by pulses in India is 29.03 million hectares, with 23.40 million tonnes production and productivity of 806 kg/ha. Major green gram growing states are Odisha, Andhra Pradesh, Maharashtra, Karnataka, Gujarat, and Bihar. In Gujarat, the total area under cultivation of green gram is 1,53,000 ha with 86,000 tonnes production and 561 kg/ha productivity (Anon. 2018; Dayanand et al. 2023). Sucking pests viz., aphid, *Aphis craccivora* Koch; jassid, *Empoasca kerri* Pruthi; whitefly, *Bemisia tabaci* Gennadius; flower thrips, *Megalurothrips usitatus* Bagnall are known to cause significant damage to green gram foliage and flowers besides causing damage to other related legumes. The annual yield loss due to the insect pests has been estimated to the tune of 30 per cent in green gram (Soundararajan & Chitra 2011; Haldhar & Maheshwari 2021). Studies on the population dynamics of pests help in understanding the behaviour and ecology of the pests, which helps in the development of proper management strategies depending upon the stage of the crop pests.

Materials and Methods

Investigations on population dynamics of sucking pests in green gram, *Vigna radiata* (L.) Wilczek" were carried

out at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar-385 506 during summer, of 2019. For this purpose, green gram cultivar GM-4 was raised by adopting standard agronomical practices with a plot size of 10.0 m × 10.0 m and a spacing of 30 cm × 10 cm. The whole experimental plot was kept free from the application of any insecticides. For this purpose, twenty plants were selected randomly from the whole experimental plot and tagged. Number of sucking pests viz., aphid, jassid and whitefly were recorded from three leaves (top, middle and bottom) of each tagged plant at weekly interval and mean number of pests per three leaves was worked out. The number of flower thrips per three flowers was counted from the same selected plants. Both nymphs and adults of each sucking pest were counted during the course of observation. The observations on sucking pests were recorded during morning hours starting from second week after sowing (WAS) till maturity of the crop. A number of bio-agents viz., ladybird beetle (grub and adult), green lacewing (grub), and spiders (adult) were also recorded from same selected plants at weekly intervals.

To study the instantaneous effect of weather parameters on population fluctuation of various pests, the data of abiotic factors viz., bright sunshine (BSS), rainfall (RF), wind velocity (WV), maximum (MaxT) and minimum (MinT) temperature, morning (RH₁) and evening (RH₂) relative humidity as well as evaporation (EP) were correlated with pest population. Weekly data on various weather parameters collected from the Agrometeorological observatory, Agronomy Instructional

¹Department of Entomology, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar - 385 506

#Corresponding author: S Deb, E-mail: dr_spdeb@sdau.edu.in

Farm, C. P. College of Agriculture, Sardarkrushinagar, during the Summer season of 2019. In order to determine the relation between insect pests and their natural enemies, the periodic mean incidence of sucking pests and their natural enemies was recorded and simple correlation between them was worked out by adopting standard statistical procedure (Steel & Torrie 1980).

Results and Discussion

Aphid, *Aphis craccivora* Koch

The data on the occurrence of aphid, *A. craccivora* on green gram presented in Table 1 revealed that the population was commenced from third Week After

Table 1. Incidence of sucking pests and their natural enemies on green gram during summer, 2019

SMW	WAS	Number of sucking pests/3 leaves or flowers				Natural enemies/plant		
		Aphid	Jassid	Whitefly	Thrips	Ladybird beetle	Green lacewing	Spider
14	3 rd	0.70	0.00	0.00	0.00	0.00	0.00	0.00
15	4 th	1.10	0.30	0.60	0.00	0.40	0.00	0.25
16	5 th	1.45	0.85	1.30	0.00	0.70	0.00	0.80
17	6 th	3.40	1.25	2.10	0.40	1.60	0.10	1.40
18	7 th	5.60	2.40	4.20	1.00	2.20	0.40	2.30
19	8 th	6.25	3.20	5.10	1.75	2.45	0.90	2.50
20	9 th	4.20	2.20	5.90	2.55	2.75	0.65	1.90
21	10 th	1.50	1.80	6.30	4.20	1.15	0.50	0.80
22	11 th	0.85	0.50	5.60	2.60	0.30	0.20	0.20
Mean		2.78	1.56	3.88	2.08	1.44	0.46	1.27

Note: SMW- Standard Meteorological Week, WAS- Week After Sowing

Jassid, *Empoasca kerri* Pruthi

The data (Table 1) on incidence of sucking pests indicated that jassid, *E. kerri* population appeared during 15th SMW (4th WAS) which ranged from 0.30 to 3.20 jassid (s) per three leaves with mean population of 1.56 and it remained active till crop maturity. The jassid population showed a gradual increase since the appearance on crop and reached the peak level, i.e., 3.20 jassids per three leaves during 19th SMW (8th WAS). Thereafter, the population declined gradually and recorded 0.50 jassid per three leaves at the maturity of the crop (22nd SMW). Thus, the population of jassid showed higher activity during the 18th to 20th SMW, with population ranging from 2.20 to 3.20 per three leaves.

Whitefly, *Bemisia tabaci* Gennadius

The activity of whitefly, *B. tabaci* on summer-sown green gram presented in Table 1 clearly indicated that the population of whitefly ranged between 0.60 and 6.30 with a mean population of 3.88 per three leaves. Whitefly population (0.60 whitefly/3 leaves) commenced from 15th SMW (4th WAS) and reached to its peak level (6.30/3 leaves) during 21st SMW (10th WAS). The whitefly population remained on the crop till the 22nd SMW, which recorded 5.60 whiteflies per three leaves. Thus, higher activity (4.20 to 5.60/3 leaves) of whitefly was noticed from the 18th SMW till maturity of the crop (22nd SMW).

Thrips, *Megalurothrips usitatus* Bagnall

The data on the incidence of thrips, *M. usitatus* on green gram presented in Table 1 indicated that thrips (0.40/3 flowers) appeared on the crop during 17th SMW (6th WAS) and sustained on the crop till maturity with 2.60 thrips per three flowers. The population showed a

Sowing (WAS) i.e., 14th Standard Meteorological Week (SMW) with recorded 0.70 aphid per three leaves. The population gradually increased with the crop phenology and reached the peak level (6.25 aphids/ 3 leaves) during 19th SMW, i.e., 8th WAS. Then, after, the population started to decline gradually, and at the maturity of the crop (22nd SMW), it recorded 0.85 aphid per three leaves. Thus, the population of aphid ranged between 0.70 and 6.25 with an average population of 2.78 per three leaves and relatively higher activity was observed during 17th (3.40/ 3 leaves) to 20th (4.20/ 3 leaves) SMW in green gram crop.

gradual increase since its occurrence and reached the peak level (4.20/3 flowers) during the 21st SMW (10th WAS). Thus, the population ranged between 0.40 and 4.20 with an average population of 2.08 thrips per 3 flowers, and higher activity was observed at the later stage of the crop.

Tamang et al. (2017) in West Bengal reported the highest population of aphid during the 8th WAS in green gram crop. In another study, Bairwa & Singh (2017) observed the highest population of aphid (6.97/10 cm twig/plant) on green gram crop during the 18th SMW. At Jabalpur (Madhya Pradesh), Ahirwar and Bhowmick (2016) recorded the highest population of jassids (3.81/6 leaves) and thrips (6.91/6 leaves) during 17th SMW on green gram. In the same investigation, they recorded the peak activity of whitefly (5.53/6 leaves) during 18th SMW on green gram. Thus, the results on occurrence of sucking pests viz., aphid, jassid and whitefly on summer green gram observed by above workers are more or less similar with the findings of present investigations. However, Tamang et al. (2017) studied the population density of thrips on green gram in West Bengal and observed the maximum incidence of thrips during 6th SMW (4.37 thrips/flower). The contradiction in the results might be due to the agro-climatic variation and difference in the time of sowing of the crop.

Natural enemies

Two coccinellid species viz., *Coccinella transversalis* Fabricius and *Coccinella septempunctata* Linnaeus, were observed during the course of study. In addition, a

number of chrysopid grubs as well as adult of spiders were also recorded from green gram crop.

Ladybird beetle

The data presented in Table 1 revealed that the population of lady bird beetle ranged between 0.30 and 2.75 coccinellid(s) per plant with an average of 1.44. The lady bird beetle was found active on summer green gram between the 15th SMW and 22nd SMW. It appeared in the crop at 4th WAS (15th SMW) with 0.40 coccinellid per plant. Thereafter, its population increased gradually and reached a peak level (2.75/plant) during 9th WAS (20th SMW). The coccinellids showed a decline in their population in the subsequent weeks and remained on the crop till maturity (22nd SMW).

Green lacewing

The data on the incidence of green lacewing on summer green gram revealed that the population of chrysopid was commenced from the 6th WAS (17th SMW), which recorded 0.10 grub per plant (Table 1). The population ranged between 0.10 and 0.90 grub per plant, with an average of 0.46 and higher activity of chrysopid (0.90 grub/plant) was noticed during the second week of May, i.e., 8th WAS (19th SMW).

Spider

It is evident from the data (Table 1) that the spider appeared during 4th WAS, i.e., 15th SMW (0.25 spider/plant) and was found active on the crop till the 11th WAS i.e., 22nd SMW (0.20/plant). The peak activity of the spider was recorded on the 8th WAS i.e., 19th SMW, with 2.50 spiders per plant. Thus, the activity of the predator (spider) was witnessed throughout the cropping season with a mean population of 1.27 per plant.

Tamang et al. (2017) in West Bengal observed the highest population of ladybird beetle on green gram during the 10th WAS. Thus, the results obtained during the present investigation are more or less similar to those reported by earlier workers. Scanty information is available on the activity of chrysopids in green gram. Hence, the present findings on chrysopid remained undiscussed. However, Swathi et al. (2018) in Andhra Pradesh observed the peak incidence of spider during 8th WAS on black gram. Thus, the peak activity of the spider on green gram crop recorded by above workers is in close conformity with the present findings.

Influence of abiotic factors on incidence of sucking pests in green gram

The data obtained with respect to correlation study between sucking pests of green gram and weather parameters are presented in Table 2.

Table 2. Correlation between sucking pests of green gram and weather parameters during summer, 2019

S. No.	Pests	Weather parameters							
		Temperature		Relative Humidity		WV	RF	EP	BSS
		Max.	Min.	Morning	Evening				
1	Aphid	-0.311	0.003	0.026	-0.328	0.692*	-0.137	-0.434	0.288
2	Jassid	-0.384	0.151	-0.059	-0.010	0.843**	-0.080	-0.206	-0.426
3	Whitefly	0.020	0.659	0.016	0.669*	0.846**	-0.184	0.539	0.602
4	Thrips	0.153	0.700*	0.025	0.793*	0.655	-0.235	0.735*	0.498

Note: *Significant at 5 per cent level of significance ($r = 0.602$), **Significant at 1 per cent level of significance ($r = 0.735$), WV: Wind velocity, RF: Rainfall, EP: Evaporation, BSS: Bright sunshine.

The data presented in Table 2 indicates that the wind velocity exhibited significant or highly significant positive correlation with sucking pests viz., aphid ($r = 0.69$), jassid ($r = 0.84$) and whitefly ($r = 0.85^{**}$) incidence (Table 3). It is also evident from the data that the incidence of *B. tabaci* was significantly and positively influenced by the fluctuation of evening relative humidity ($r = 0.67^{*}$). As far as the population of thrips, *M. usitatus* is concerned, weather parameters viz., minimum temperature ($r = 0.70$), evening relative humidity ($r = 0.79$), and evaporation ($r = 0.74^{*}$) exerted a significant positive impact on thrips population in summer green gram during 2019.

Looking at the past works of literature, Jakhar and Chaudhary (2013) found that wind velocity ($r=0.59^{*}$) played a significant positive role in the building up of aphid population. Leaf hopper ($r = 0.65^{*}$) and whitefly ($r = 0.62^{*}$) had a significantly positive correlation with evening relative humidity. Tamang et al. (2017) reported that humidity exhibited a significant negative correlation with aphid population in green gram crop in West

Bengal. In another report, maximum temperature showed a highly significant and positive correlation with the whitefly population in mungbean crop in West Bengal (Tamang et al. 2017). Further, positive correlation of MaxT, RH and RF against whitefly was reported by Kumar et al. (2007) in black gram. Bairwa & Singh (2017) observed that thrips population on green gram crop was non-significant and positively correlated with MaxT. Similarly, Ahirwar & Bhowmick (2016) revealed that thrips population was significantly and positively correlated with BSS in summer-grown green gram at Jabalpur. Thus, the relationship between abiotic factors and sucking pests population observed in the present investigation are more or less in accordance with reports of earlier workers.

Influence of biotic factors on incidence of sucking pests of green gram

The data in regards to correlation study between various sucking pests and their natural enemies are presented in Table 3.

Table 3. Correlation between sucking pests and natural enemies on summer green gram, 2019

S. No.	Pests	Natural enemies		
		Ladybird beetle	Green lacewing	Spider

1	Aphid, <i>A. craccivora</i>	0.917**	0.751*	0.983**
2	Jassid, <i>E. kerri</i>	0.921**	0.913**	0.943**
3	Whitefly, <i>B. tabaci</i>	0.576	0.790*	0.478
4	Thrips, <i>M. usitatus</i>	0.307	0.636	0.167

Note: *Significant at 5 per cent level of significance ($r = 0.602$); **Significant at 1 per cent level of significance ($r = 0.735$).

Based on the results (Table 3), it is clear that ladybird beetle showed a highly significant positive correlation with *A. craccivora* ($r = 0.917^{**}$) and *E. Kerri* ($r = 0.92$) populations. Green lacewing exhibited a highly significant and positive correlation with *E. kerri* ($r = 0.91$) incidence, whereas significant and positive correlation with *A. Craccivora* ($r = 0.75$) and *B. tabaci* ($r = 0.79$) population. It is also clear from the results that the population of spiders showed a highly significant positive correlation with aphid ($r = 0.98$) and jassid ($r = 0.94$) population in green gram crop during summer, of 2019. The results obtained during the present investigation confirm with those reported by Srikanth & Lakkundi (1990), who found highly significant positive correlations between weekly aphid and predator population. Pawar *et al.* (2017) observed ladybird beetle, green lacewing and spider had highly significant and positive correlation with population of sucking pests viz., jassid ($r = 0.83, 0.82$ and 0.78 , respectively), whitefly ($r = 0.71, 0.84$ and 0.86 , respectively) and thrips ($r = 0.87, 0.90$ and 0.75 , respectively) on clusterbean at Sardarkrushinagar (Gujarat). Jakhar & Chaudhary (2013) noted that spider had a significant positive correlation with aphid ($r = 0.88$) and thrips ($r = 0.84$). The ladybird beetle exhibited a significant positive correlation with aphids ($r = 0.57$). the population at Sardarkrushinagar (Gujarat) on French bean crop which is more or less in accordance with the findings of present investigations.

Conclusion

It can be concluded from the results that the population of natural enemies had significant or non-significant positive association with the activity of the sucking pests which indicated that with increase in sucking pests population in green gram, the population build-up of their natural enemies also increased numerically.

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