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Abundance of Major Insect-Pests Infesting Green Gram and its Associated Natural Enemies

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ABSTRACT

The present investigation on abundance of major insect-pests infesting green gram and its associated natural enemies was carried at Instructional farm and Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur. Green gram variety SML-668 was sown on 18th July during *kharif* 2015 and 16th July during *kharif* 2016 with the seed rate of 15 kg/ ha; maintaining a row to row and plant to plant spacing of 30 cm x 10 cm, respectively. Major insect pests, viz., aphids, *Aphis craccivora* (Koch); jassids, *Empoasca* spp., white flies, *Bemisia tabaci* (Gennadius); blister beetle, *Mylabris* spp. and spotted pod borer, *Maruca vitrata* (Geyer) were recorded under the prevailing agro-climatic conditions of the region. Greengram was also infested by other minor insect pests, viz., hairy caterpillar, tobacco caterpillar, plant bug and pod sucking bug. The associated natural enemies, viz., coccinellids, *Coccinella septempunctata* (L); *Cheilomenes sexmaculata* (Fab.) and syrphid flies were recorded feeding aphids on greengram; besides, spiders and wasps were also collected from the crop area.

Keywords

Green gram, Insect pests,
Natural enemies,
Seasonal incidence

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Introduction

Pulses, the food legumes, have been grown by farmers since millennia providing nutritionally balanced food to the people of India (Nene, 2006) and many other countries of the world. Pulses are the major source of protein in the vegetarian diet in our country. Besides being a rich source of protein, they maintain soil fertility through biological nitrogen fixation in soil and thus play a vital role in furthering sustainable agriculture (Kannaiyan, 1999).

India is the largest producer of pulses in the world and has 25.26 million hectares area

under cultivation with 16.47 million tons production and a productivity of 652 kg/ hectare (Anonymous, 2015-16). The area covered under pulses in our country is 15.35 per cent of the total cropped area. Rajasthan, M.P. Haryana, Orissa, Maharashtra and U.P. account for 83.77 per cent of the total national area under pulses. In India, about 5.71 million hectares area is under organic cultivation and total production of organic produce is 1.35 million tons (APEDA, 2015-16). The total area and production in India under green gram were 3.83 million hectare and 1.60 million tons, respectively, with the productivity of 418 kg/ hectares (Anonymous, 2015-16); whereas,

in Rajasthan total area and production under green gram was 13.73 lakh hectares and 5.97 lakh tons with the productivity of 438 kg/ha (Anonymous, 2015-16). An estimated 200 insect pests that belong to 48 families in orders viz., Coleoptera, Diptera, Hemiptera, Hymenoptera, Isoptera, Lepidoptera, Orthoptera, Thysanoptera and 7 mites of order Acarina are known to infest greengram and blackgram. The major insect pests of green gram are aphids, *Aphis craccivora* Koch; jassids, *Empoasca kerri* Pruthi; white flies, *Bemisia tabaci* Gennadius, thrips belonging to genus *Megalurothrips sp.* and *Caliothrips indicus* Bagnall; the plant bugs viz., *Riptortus pedestris* Fabricius, *Nezara viridula* L., *Plautia fimbriata* Fabricius and the pod bug, *Clavigralla gibbosa* Spinola, spotted pod borer, *Maruca vitrata* Geyer and field bean pod borer, *Adisura atkinsoni* Moore (Talekar, 1990). They cause significant damage to greengram foliage and pods, besides causing damage to other related legumes.

Materials and Methods

In order to study the quantitative abundance of major insect-pests and their associated natural enemies of greengram, a field trial was laid out in uniformly sized plots measuring 5 m x 5 m (25 sq. m.) and replicated thrice. Greengram variety SML-668 was sown on 18th July during *kharif* 2015 and 16th July during *kharif* 2016 with the seed rate of 15 kg/ha; maintaining a row to row and plant to plant spacing of 30 cm x 10 cm, respectively.

All other recommended agronomic practices were followed as per package of practices to raise a good crop. Weekly meteorological data on mean atmospheric temperature, mean relative humidity and total rainfall were obtained from the Meteorology Unit at the Instructional farm of Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur.

Observation

The population of different insect-pests and their associated natural enemies were recorded weekly from five randomly selected and tagged plants in each plot during morning hours between 6:30 a.m. to 8.00 a.m. for most of the insect species and from 9:00 a.m. to 11:00 a.m. for blister beetles.

Sampling techniques

The sampling techniques adopted for estimating the populations of different insect pests were as follows:

Insect pests

Jassids, aphids and whiteflies

Visual counting method was used to record the population of sucking pests viz., jassids, aphids and whiteflies from 5 randomly selected and tagged plants in each replicate. The total number of adults and nymphs of jassids and whiteflies were counted on the entire tagged plants; whereas, the aphids were counted from 5cm floral twigs during early hours of the day (6:30- 8:00 a.m.). An aspirator was used to collect necessary sample insects for further identification. A hand-held magnifying lens (6 X) with LED illumination was used to count the insects in the field.

Blister beetle

Population of blister beetle was recorded by visual count for 2 hours during 9-11 a.m. from 5 plants randomly selected in each replication.

Spotted pod borer

The incidence was recorded in terms of mean pod damage by counting the total number of pods and the number of damaged pods at each picking, later the mean damage was calculated

after pooling all the pickings by using the following formula:

$$\text{Mean infestation (\%)} = \frac{\text{No. of infested pods} \times 100}{\text{No. of total pods}}$$

Natural enemies

The associated natural enemies including larvae of syrphid flies, adult & grubs of coccinellids and spiders were recorded weekly by visual count from the same five plants per replication on which the pest insects were observed.

Statistical analysis

In order to study the influence of key abiotic factors on the pest incidence and natural enemy complex, simple correlations were worked out between the incidence of insect pests/natural enemies and abiotic factors.

Population data of different insect pests and the natural enemy thus obtained were subjected to statistical analysis to find out the co-efficient of correlation with abiotic factors using following formula (Fowler *et al.*, 1998).

$$r_{xy} = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{n}}{\sqrt{\left[\sum X^2 - \frac{(\sum X)^2}{n} \right] \left[\sum Y^2 - \frac{(\sum Y)^2}{n} \right]}}$$

Where,

r_{xy} = Simple correlation coefficient

X = Variable *i.e.* abiotic component. (Average temperature and relative humidity)

Y = Variable *i.e.* mean number of insect pests

n = Number of paired observations

The correlation coefficient (r) values were subjected to the test of significance using t-test:

$$t = \frac{r}{\sqrt{1 - r^2}} \times \sqrt{n - 2} \sim t_{n-2 \text{ d.f.}}$$

The calculated t-value obtained was compared with tabulated t-value at 5% level of significance.

Results and Discussion

Aphid [*Aphis craccivora* (Koch)]

The observations recorded on seasonal incidence of aphids revealed that aphid infestation initiated in the 3rd week of August (33rd SMW) during both the 2015 and 2016. The population increased gradually and reached to its peak in the 1st week of September (36th SMW) with mean population of 43.31 aphids/5 plants in 2015 and 36.96 aphids/5 plants in 2016 (Table 1).

Jassid [*Empoasca* spp.]

Jassid infestation initiated in the 2nd week of August (32st SMW) during 2015 and 2016. The population increased gradually and reached to its peak in the 4th week of August (34th SMW) with mean population of 25.67 jassids/5 plants in 2015 and 25.35 jassids/5 plants in 2016. Thereafter, the population declined and reached to a minimum level of 4.0 jassids/5 plants in 2015 and 4.42 jassids/5 plants in 2016. Jassids population exhibited a significant negative correlation ($r = -0.73$) with mean temperature and a significant positive correlation ($r = 0.71$) with mean relative humidity during 2016.

Whitefly [*Bemisia tabaci* (Gennadius)]

Whitefly infestation was first observed in the 2nd week of August (32st SMW) during 2015.

The population increased gradually and reached to its peak in the last week of August (35th SMW) with mean population of 24.45 whiteflies/ 5 plants. At the peak, the mean atmospheric temperature and mean relative humidity were 27.2 °C and 69.95 per cent, respectively. Whereas, whitefly infestation was first observed in the 2nd week of August (32st SMW) during 2016. The population increased gradually and reached to its peak in the last week of August (35th SMW) with mean population of 22.26 whiteflies/5 plants. At the peak, the mean atmospheric temperature, mean relative humidity and total rainfall were 26.95 °C, 80.25 per cent and 14.4 mm during 2016.

Blister beetle (*Mylabris* spp.)

The incidence of blister beetle in greengram initiated in the 4th week of August (34th SMW) during 2015. The population increased gradually and reached to its peak in the 1st week of September (36th SMW) with mean population of 11.36 beetles/5 plants. At the peak, the mean atmospheric temperature and mean relative humidity were 26.3 °C and 62.45 per cent respectively.

The incidence of blister beetle in greengram initiated in the 4th week of August (34th SMW) during 2016 (Table 3). The population increased gradually and reached to its peak in the 1st week of September (36th SMW) with mean population of 10.62 adults/5 plants. At the peak, the mean atmospheric temperature and mean relative humidity were 26.05 °C, 68.20 per cent during 2016.

Spotted pod borer [*Maruca vitrata* (Geyer)]

Spotted pod borer larvae infestation started in the 4th week of August (34th SMW) with a mean population of 1.8 larvae/5 plants during 2015. The population increased gradually and reached to its peak in the 2nd week of September (37th SMW) with mean population

of 8.77 larvae/5 plants. The mean atmospheric temperature and relative humidity at the peak period were 28.65 °C and 56.00 per cent respectively. Spotted pod borer larvae infestation started in the 4th week of August (34th SMW) with a mean population of 2.2 larvae/5 plants during 2016. The population increased gradually and reached to its peak in the 2nd week of September (37th SMW) with mean population of 7.82 larvae/5 plants. The mean atmospheric temperature and relative humidity at the peak period were 26.75°C and 63.7 per cent during 2016.

Natural enemies

Syrphid flies

Syrphid fly population was first observed in the 4th week of August (34th SMW) during 2015. The population increased gradually and reached to its peak in the 1st week of September (36th SMW) with mean population of 3.15/5 plants. At the peak, the mean atmospheric temperature and mean relative humidity during 2015 were 26.3 °C and 62.45 per cent respectively. Similarly, syrphid fly larvae population was first observed in the 4th week of August (34th SMW) during 2016. The population increased gradually and reached to its peak in the 2nd week of September (37th SMW) with mean population of 2.74/5 plants. At the peak, the mean atmospheric temperature and mean relative humidity during 2016 were 26.75 °C and 63.7 per cent (Table 2).

Coccinellids [*Coccinella septempunctata* (L.) and *Cheilomenes sexmaculata* (Fab.)] grubs and adults

The coccinellid occurrence initiated in the 4th week of August (34th SMW) during 2015. The population increased gradually and reached to its peak in the 1st week of September (36th SMW) with mean population of 10.45/5 plants.

Table.1 Influence of abiotic factors on the incidence of major insect pests infesting greengram during *kharif*, 2015

S.M.W.	Date of observation	Abiotic factors			Mean per five plants					
		Mean Temp. (°C)	Mean R.H. (%)	Total Rainfall (mm)	Aphids	Jassids	White flies	Blister beetle	Spotted pod borer	
									Larval population	Pod damage (%)
32	July 30 - Aug 5, 2015	27.95	76.3	43.4	0	12.32	7.28	0	0	0
33	Aug 06 - 12, 2015	26.7	81.5	62.0	5	19.67	9.61	0	0	0
34	Aug 13 - 19, 2015	27.05	70.35	0.0	11.62	25.67	16.67	5.87	1.8	8.24
35	Aug 20 - 26, 2015	27.2	69.95	0.0	25.52	13.40	24.45	8.10	4.03	10.71
36	Aug 27- Sept 2, 2015	26.3	62.45	0.0	43.31	10.65	17.23	11.36	6.97	12.66
37	Sept 03 - 09, 2015	28.65	56	0.0	21.57	8	21.57	4.23	8.77	13.41
38	Sept 10 - 16, 2015	27	79.1	41.6	10.33	4	15.57	0	3.61	6.98
39	Sept 17 - 23, 2015	25.6	59.45	0.00	6.24	0	7.62	0	0	0
Coefficient of correlation (r_1) for population and Mean Atm. Temperature					0.12	0.19	0.38	0.12	0.65	0.63
Coefficient of correlation (r_2) for population and Mean Relative Humidity					-0.43	0.40	-0.33	-0.37	-0.52	-0.42
Coefficient of correlation (r_3) for population and Total Rainfall					-0.51	0.13	-0.56	-0.62	-0.43	-0.55

* Significant at 5% level of significance

Table.2 Influence of abiotic factors on the incidence of natural enemies of greengram during *kharif*, 2015

S.M.W.	Date of observation	Abiotic factors			Mean per five plants		
		Mean Temp. (°C)	Mean R.H. (%)	Total Rainfall (mm)	Syrphid fly (maggots)	Coccinellids (grubs & adults)	Spiders
32	July 30 - Aug 5, 2015	27.95	76.3	43.4	0.00	0.00	0.00
33	Aug 06 - 12, 2015	26.7	81.5	62.0	0.00	0.00	0.00
34	Aug 13 - 19, 2015	27.05	70.35	0.0	1.42	3.21	1.05
35	Aug 20 - 26, 2015	27.2	69.95	0.0	2.12	6.42	1.52
36	Aug 27- Sept 2, 2015	26.3	62.45	0.0	3.15	10.45	2.25
37	Sept 03 - 09, 2015	28.65	56	0.0	2.42	6.90	2.98
38	Sept 10 - 16, 2015	27	79.1	41.6	1.00	2.72	1.42
39	Sept 17 - 23, 2015	25.6	59.45	0.00	0.75	1.23	1.15
Coefficient of correlation (r_1) for population and Mean Atm. Temperature					0.33	0.29	0.53
Coefficient of correlation (r_2) for population and Mean Relative Humidity					-0.62	-0.53	-0.75
Coefficient of correlation (r_3) for population and Total Rainfall					-0.71	-0.60	-0.64

* Significant at 5% level of significance

Table.3 Influence of abiotic factors on the incidence of major insect pests infesting greengram during *kharif*, 2016

S.M.W.	Date of observation	Abiotic factors			Mean per five plants					
		Mean Temp. (°C)	Mean R.H. (%)	Total Rainfall (mm)	Aphids	Jassids	White flies	Blister beetle	Spotted pod borer	
									Larval population	Pod damage (%)
32	July 30 - Aug 5, 2016	25.15	92	104.5	0	11.43	6.97	0	0	0
33	Aug 06 - 12, 2016	26.5	74.6	0.6	5	17	9.83	0	0	0
34	Aug 13 - 19, 2016	25.4	85	61.2	13	25.35	11.97	7	2.2	9.00
35	Aug 20 - 26, 2016	26.95	80.25	14.4	29	18.67	22.26	8.93	3.17	10.71
36	Aug 27- Sept 2, 2016	26.05	68.2	0.0	36.96	12	18.13	10.62	5.97	12.03
37	Sept 03 - 09, 2016	26.75	63.7	0.0	25.36	9.23	13.73	7.23	7.82	13.29
38	Sept 10 - 16, 2016	28.95	64.6	3.4	18.97	4.42	6.23	3.15	3.37	6.98
39	Sept 17 - 23, 2016	28.7	58.35	0.00	9.21	0	2.12	0	0	0
Coefficient of correlation (r_1) for population and Mean Atm. Temperature					0.11	-0.73*	-0.41	-0.56	-0.25	-0.42
Coefficient of correlation (r_2) for population and Mean Relative Humidity					-0.37	0.71*	0.24	0.37	-0.17	0.21
Coefficient of correlation (r_3) for population and Total Rainfall					-0.54	0.35	-0.19	0.26	-0.16	0.19

* Significant at 5% level of significance

Table.4 Influence of abiotic factors on the incidence of natural enemies of greengram during *kharif*, 2016

S.M.W.	Date of observation	Abiotic factors			Mean per five plants		
		Mean Temp. (°C)	Mean R.H. (%)	Total Rainfall (mm)	Syrphid fly (maggots)	Coccinellids (grubs & adults)	Spiders
32	July 30 - Aug 5, 2016	25.15	92	104.5	0.00	0.00	0.00
33	Aug 06 - 12, 2016	26.5	74.6	0.6	0.00	0.00	0.00
34	Aug 13 - 19, 2016	25.4	85	61.2	0.82	1.11	1.05
35	Aug 20 - 26, 2016	26.95	80.25	14.4	1.11	2.21	1.65
36	Aug 27- Sept 2, 2016	26.05	68.2	0.0	1.46	5.10	2.88
37	Sept 03 - 09, 2016	26.75	63.7	0.0	2.74	9.48	1.96
38	Sept 10 - 16, 2016	28.95	64.6	3.4	1.35	4.54	1.38
39	Sept 17 - 23, 2016	28.7	58.35	0.00	1.24	1.42	1.18
Coefficient of correlation (r_1) for population and Mean Atm. Temperature					0.14	0.04	-0.10
Coefficient of correlation (r_2) for population and Mean Relative Humidity					-0.50	-0.46	-0.25
Coefficient of correlation (r_3) for population and Total Rainfall					-0.26	-0.35	-0.18

* Significant at 5% level of significance

At the peak, the mean atmospheric temperature and mean relative humidity during 2015 were 26.3 °C and 62.45 per cent respectively. The coccinellid initiated in the 4th week of August (34th SMW) during 2016. The population increased gradually and reached to its peak in the 2nd week of September (37th SMW) with mean population of 9.48/5 plants during 2016. At the peak, the mean atmospheric temperature and mean relative humidity during 2016 were 26.75 °C and 63.7 per cent respectively (Table 4).

Spiders

Spider population was first observed in the 4th week of August (34th SMW) during 2015. The population increased gradually and reached to its peak in the 2nd week of September (37th SMW) with mean population of 2.98/5 plants. At the peak, the mean atmospheric temperature and mean relative humidity during 2015 were 28.65 °C and 56 per cent respectively. While, spider population was first observed in the 4th week of August (34th SMW) during 2016. The population increased gradually and reached to its peak in the 1st week of September (36th SMW). At the peak, the mean atmospheric temperature and mean relative humidity during 2016 were 26.05 °C and 68.2 per cent

From the available literature, pest incidence studies on greengram are scanty, however, the work on greengram during kharif has been reviewed are presented Umbarkar *et al.*, (2010) observed that the population density of spotted pod borer on greengram was 0.75 larvae per plant during 5th week after sowing (32nd standard week) that reached to a peak of 3.81 larvae per plant in 34th standard week (7th week after sowing). Among the weather parameters, minimum temperature exhibited highly significant negative correlation with the spotted pod borer population ($r = -0.559$). Jain *et al.*, (2013) reported that the aphid, *A. craccivora*, jassid, *E. kerri* and whitefly, *B. tabaci* infested the greengram in the last week of July 2013; while the incidence of blister beetle, *M. pustulata* and pod borer initiated in the fourth

week of August and third week of August during 2013, respectively. The population of aphid, jassid, whitefly, blister beetle and pod borer attained its peak during second week of August (36.75/5 plants), first week of September (27.67/5 plants), third week of August (34.5/5 plants), first week of September (10.67/5 plants) and second week of September (11.33/5 plants), respectively. Similar findings have also been reported by Pawar *et al.*, (2014), Duraimurugan and Tyagi (2014), Singh and Singh (2014), Kumar and Kumar (2015) and Yadav *et al.*, (2015).

The findings of the present investigation are in close agreement with the findings of Earlier Thejaswi *et al.*, (2008) recorded natural enemies from field bean that included *Campoletis chloridae* Uchida, *Bracon* sp., *Herpactor costalis* (Str.), *Cryptopeltis tenuis*, ladybird beetles, mirids, syrphids, spiders and carabid predators. Rekha *et al.*, (2009) recorded nine species of predatory coccinellids, of which 3 common species viz., *Coccinella transversalis* Fabricius, *Menochilus sexmaculatus* Fabricius and *Brumoides suturalis* Mulsant were found in cereals, pulses and vegetable crops.

Agarwal *et al.*, (2010) enlisted 16 parasitoids and predators belonging to Dictyoptera, Neuroptera, Hemiptera, Hymenoptera, Diptera and Coleoptera.

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