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

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A B S T R A C T

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, Empoassca 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 gramm, Insect pests, Natural enemies, Seasonal incidence

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/ha (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.

**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).

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

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:

\[
t = \frac{r}{\sqrt{1 - r^2}} \times \sqrt{n - 2}
\]

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 (32nd 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 (32nd 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 ºC and 69.95 per cent, respectively. Whereas, whitefly infestation was first observed in the 2nd week of August (32nd 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 ºC, 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 ºC 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 ºC, 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 ºC 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 ºC 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 ºC 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 ºC 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 Atm. Temperature | Mean Relative Humidity | Total Rainfall (mm) | Aphids | Jassids | White flies | Blister beetle | Spotted pod borer |
|--------|---------------------|-----------------|----------------------|------------------------|------------------------|---------------------|---------|---------|-------------|----------------|-----------------|
|        |                     | Mean Temp. (°C) | Mean R.H. (%)        | Total Rainfall (mm)    | Aphids                 | Jassids             | White flies | Blister beetle | Spotted pod borer |
| 32     | July 30 - Aug 5, 2016 | 25.15           | 92                   | 104.5                  | 0                      | 11.43               | 6.97     | 0       | 0           | 0              | 0               |
| 33     | Aug 06 - 12, 2016    | 26.5            | 74.6                 | 0.6                    | 5                      | 17                  | 9.83     | 0       | 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               | 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:
- $0.11$ (Significant at 5% level of significance)
- $-0.73$*
- $-0.41$
- $-0.56$
- $-0.25$
- $-0.42$

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:
- $-0.54$
- $0.35$
- $-0.19$
- $0.26$
- $-0.16$
- $0.19$
**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

Coefficient of correlation ($r_2$) for population and Mean Relative Humidity

Coefficient of correlation ($r_3$) for population and Total Rainfall

* Signficant 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 chlorideae Uchida, Bracon sp., Herpector 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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