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# Seasonal incidence of major sucking pests of French bean (*Phaseolus vulgaris* L.)

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**Abstract**
The experimental study was carried out under field condition to observe the seasonal incidence and natural enemy population during 2017 to 2018. The major sucking pest observed were *viz*., Aphids (*Aphis craccivora* Koch), Whitefly (*Bemisia tabaci* Gennadius), thrips (*Megaleurothrips usitatus* Bagnal) and leafhopper (*Empoasca fabae* Harris) out which the most abundant insect pest observed were aphids. In seasonal incidence it was observed that aphid population reached to a peak level of 3.85 aphid index on the 10th WAS. Further the thrips and whitefly population reach its peak level of 7.38 and 9.25 per 3 leaves respectively, on the 10th WAS, which coincided with the peak flowering period of French bean. In correlation with weather parameters of the pest population both aphids and thrips showed (r = -0.544* and r = -0.503*) negatively significant correlation with rainfall parameters. The natural enemies observed were spiders, species of ladybird beetle like *Coccinella septempunctata* L., *Chilomenes sexmaculata Fabr*, and robber fly (*Dysmachus trigonus*).

**Keywords:** French bean, seasonal incidence, sucking pest, correlation, natural enemy

## 1. Introduction
French bean, (*Phaseolus vulgaris* L.) is the most important protein source grain legume for direct consumption in the world (Broughton, 2003) [4]. French bean or green beans are also known as 'string beans' and 'snap beans'. They rank second only to cereals as a source of sustenance for both humans and animals, making them significant foods in the majority of tropical and subtropical nations worldwide (Graham and Vance, 2003) [8]. It is cultivated for the tender vegetables, shelled green beans and dry beans (Schoonhoven and Voysest, 1991) [15]. Due to high protein content (21.1%), French bean plays a strategic role against protein calorie malnutrition in India (Kumar *et al.*, 2006) [10] and reducing the risk of chronic disease (Raju and Mehta, 2009) [13] in developing countries (Van Heerden and Schonfeldt, 2004) [21]. In World, French bean is grown over an area of 1.48 million ha with annual production of 17.65 million MT and the productivity is 11.95 t per ha. In India, its cultivation is in 0.21 million ha with production of 0.58 million MT and productivity is 2.8 tons per hectare (FAOSTAT, 2010) [1]. In Nagaland French bean is cultivated under an area 17280 hectares with a yield of 22140 MT (Statistical Handbook of Nagaland, 2021) [20].
An estimated 35 per cent to 100 per cent of crop losses worldwide are attributed to insect pests alone each year (Singh and Schwartz, 2011) [18]. The crop is attacked by a number of insect pests during its life span. About 30 species of insects have been reported damaging French bean (Srivastava and Butani, 1998) [19]. Among them the sucking insect pests like, Aphid (*Aphis craccivora* Koch), leafhopper (*Empoasca dolichi*), thrips (*Megalurothrips sjostedti* Trybom**)**, whitefly (*Bemisia tabaci* Gennadius) and mite (*Tetranychus urticae* Koch) are common one.

## 2. Materials and Methods
The field experimental was conducted in the field of the department of Entomology, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema Campus. Local cultivar seed named Jiphu Yak kholar was taken for experimental purpose and the sowing of French bean was done from last week of September to first week of October. The plot design was done by simple line sowing in 3 unit plots with a plot size of 5×2.4 m each for observation of the seasonal incidence of sucking pest and natural enemies in French bean crop. Observation on the incidence of sucking pests was recorded from the first appearance of the pest and continued till maturity of the crop at weekly intervals and data were correlated with meteorological parameters. Meteorological observations were recorded at standard week during the cropping period.

### 2.1 Sampling technique and data collection

For whitefly and jassids population 8 plants were randomly selected and tagged. Three leaves from top, middle and lower portion of each plant was observed for the presence of nymphs and adults of jassids and whiteflies. The observation was recorded at weekly interval commencing from 10 days after sowing. For thrips and leafhopper 6 plants were tagged and from every tagged plant three leaves is observed and recorded by counting the number of population. For aphids 8 plants were selected and tagged. Population of aphids is recorded through the aphid infestation index Table 2.1, where leaves, flowers, and pods in selected plants were observed and the degree of infestation level were recorded and categorized into grades as 0,1,2,3 and 4 according to the visual and inspection counts. (Yadev *et al*., 2015) [22].

**Table 2.1:** Aphid infestation index

| Grade | Aphid Index |
|---|---|
| 0 | No population of aphid on plant |
| 1 | One or two aphids observed on plant but no colony formation |
| 2 | Small colony of aphids observed with countable numbers on plant but no damage symptoms seen |
| 3 | Big colony of aphids is observed on plant and aphids can be counted and damage symptoms seen |
| 4 | Big colony of aphids observed on plant and aphids could not be counted and severe damage symptoms seen and plant withered |

### 2.2 To study Natural enemies complex of French bean

For counting the natural enemies, the observation were recorded once in a week on randomly selected tagged plants *i.e.* 6 tagged plants per plot. The observations taken was started immediately after germination and continued till the availability of the predators. The population of the predators was recorded based on visual observation.

### 2.3 Statistical analysis

The mean data observed were transformed into suitable values and analyzed statistically using analysis of variance. The means were compared by Duncan Multiple Range Test (DMRT) at P=0.05 level of significance.

## 3. Results and Discussion

The study on the abundance of major sucking insect pest in French bean was done during October 2017 to January 2018, the finding of the study are as follows:

### 3.1 Insect pest fauna

#### 3.1.1 Aphid, *Aphis craccivora* Koch (Hemiptera: Aphididae)

The data presented in Table 3.1 and graphically depicted in Fig 3.1 revealed that the pest population started from the 2nd week after sowing (WAS) *i.e.* the 1st week of October with 1.13 aphid index. Further the aphid population continuously kept on increasing till the 9th week after sowing and reaches to a peak level of 3.85 aphid index on the 10th weeks after sowing, where is generally coinciding with the peak stage of flowering and pod formation in the last week of November to 1st week of December. The peak activity of aphid population was seen from 5th to 12th weeks after sowing. And thereafter, the aphid population gradually decreased but remained active throughout the cropping period. These results are in agreement with Rani and Hanumantharaya (2016) [14] where they stated that the incidence of aphids in French bean was noticed from 2nd week of November to 3rd week of December with its peak incidence during 3rd week of November with a mean population of 0.33 per leaf. And, also in agreement with Augustine (2011) [2] who stated that the peak activity of aphids was from 7th to 10th WAS and remain active throughout the cropping period.

#### 3.1.2 Thrips, *Megaleurothrips usitatus* Bagnal (Thysanoptera: Thripidae)

The data presented in Table 3.1 and graphically depicted in Fig 3.1 revealed that the pest population started from the 5th week after sowing (WAS) *i.e.* the 4th week of October with 0.63 per 3 leaves. Further the thrips population continuously kept on increasing till the 9th week after sowing and reaches to a peak level of 7.38 per 3 leaves on the 10th weeks after sowing, which is generally coinciding with the peak stage of flowering in the last week of November to 1st week of December. The peak activity of thrips pest population was seen from 5th to 12th weeks after sowing. And thereafter, the thrips population gradually decreased and eventually decreases to zero when the pods were matured for harvest. Buitenhuis and Shipp (2007) [5] reported that the peak of population was reached at flowering time of the crop on all the studied genotypes. Presence of flowers on the crop provides a conducive environment for perpetuating thrips through quality feeding and breeding place.

#### 3.1.3 Whitefly, *Bemisia tabaci* Gennadius (Hemiptera: Aleyrodidae)

The data presented in Table 3.1 and graphically depicted in Fig 3.1 revealed that the pest population started from the 4th week after sowing (WAS) *i.e.* the 3rd week of October with 1.13 per 3 leaves. Further the whitefly population continuously kept on increasing till the 9th week after sowing and reaches to a peak level of 9.25 per 3 leaves on the 10th weeks after sowing. The peak activity of whitefly pest population was seen from 4th to 12th weeks after sowing. And thereafter, the whitefly population gradually decreased from the 13th week after sowing but remained active throughout the cropping period. These results are more or less in agreement with Rani and Hanumantharaya (2016) [14] where they stated that the whitefly population was noticed from the 2nd week of November to 2nd week of December with a peak incidence during the 3rd week of November with a mean population of 0.12 per leaf. Similarly, Pai and Dhuri (1991) [12] reported that in cowpea the pest appeared in the 1st week after germination with a peak during the 5th week of October.

### 3.2 Correlation between weather parameters and major sucking pest of French bean

The population of insect pest is never truly stable in nature, thus abiotic factors play an important role in increasing or decreasing the population density of an organism. Such abiotic factors may be like temperature, humidity, rainfall, dewpoint etc. To know the effect of such weather parameters on population fluctuation of the sucking insect pest on French bean, simple correlation data obtained are summarized.

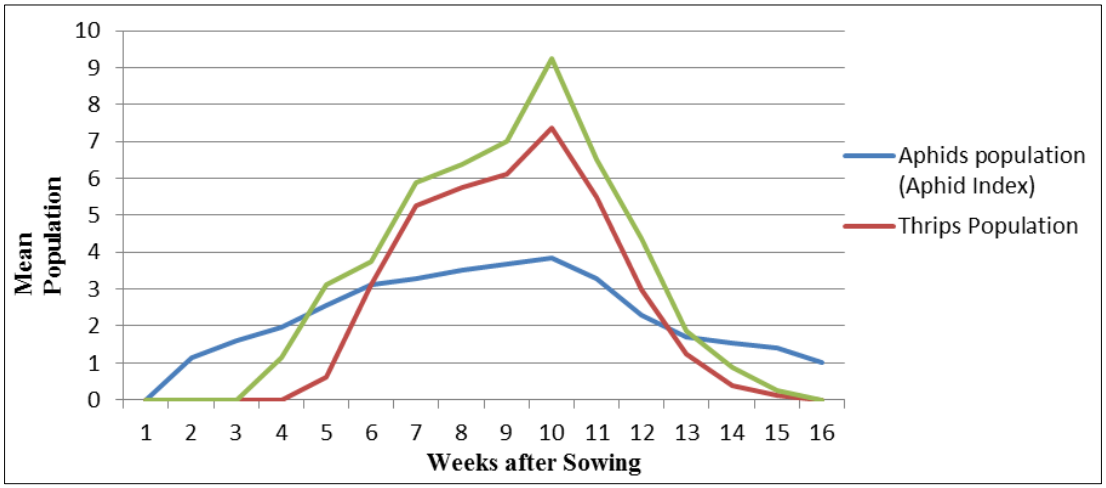


**Fig 3.1** Seasonal incidence of pest population on major sucking pest of French bean, *Phaseolus vulgaris* L. (2017-2018)

**Table 3.1:** Seasonal incidence data on major sucking pest of French bean (2017-2018)

| Day of Observation | Weeks after sowing | SMW | Aphids (Aphid Index) | Thrips | Whitefly |
|---|---|---|---|---|---|
| 28/9/2017 | 1 | 39 | 0.00$^{j}$ (0.71) | 0.00$^{j}$ (0.71) | 0.00$^{j}$ (0.71) |
| 5/10/2017 | 2 | 40 | 1.13$^{i}$ (1.27) | 0.00$^{j}$ (0.71) | 0.00$^{j}$ (0.71) |
| 12/10/2017 | 3 | 41 | 1.59$^{ig}$ (1.44) | 0.00$^{j}$ (0.71) | 0.00$^{j}$ (0.71) |
| 19/10/2017 | 4 | 42 | 1.98$^{gfe}$ (1.57) | 0.00$^{j}$ (0.71) | 1.13$^{j}$ (1.27) |
| 26/10/2017 | 5 | 43 | 2.55$^{d}$ (1.75) | 0.63$^{j}$ (1.06) | 3.13$^{j}$ (1.90) |
| 3/11/2017 | 6 | 44 | 3.13$^{c}$ (1.90) | 3.13$^{i}$ (1.90) | 3.75$^{i}$ (2.06) |
| 10/11/2017 | 7 | 45 | 3.28$^{cb}$ (1.94) | 5.25$^{h}$ (2.40) | 5.88$^{h}$ (2.52) |
| 17/11/2017 | 8 | 46 | 3.51$^{cba}$ (2.00) | 5.75$^{h}$ (2.50) | 6.38$^{h}$ (2.62) |
| 24/11/2017 | 9 | 47 | 3.68$^{cba}$ (2.04) | 6.13$^{hg}$ (2.57) | 7.00$^{hg}$ (2.74) |
| 1/12/2017 | 10 | 48 | 3.85$^{ba}$ (2.09) | 7.38$^{g}$ (2.81) | 9.25$^{g}$ (3.12) |
| 8/12/2017 | 11 | 49 | 3.28$^{cb}$ (1.94) | 5.50$^{h}$ (2.45) | 6.50$^{h}$ (2.65) |
| 15/12/2017 | 12 | 50 | 2.31$^{ed}$ (1.68) | 3.00$^{i}$ (1.87) | 4.38$^{i}$ (2.21) |
| 22/12/2017 | 13 | 51 | 1.69$^{cde}$ (1.48) | 1.25$^{j}$ (1.32) | 1.88$^{j}$ (1.54) |
| 29/12/2017 | 14 | 52 | 1.54$^{hgf}$ (1.43) | 0.38$^{j}$ (0.94) | 0.88$^{j}$ (1.17) |
| 5/1/2018 | 15 | 1 | 1.42$^{h}$ (1.38) | 0.13$^{j}$ (0.79) | 0.25$^{j}$ (0.87) |
| 12/1/2018 | 16 | 2 | 1.00$^{i}$ (1.22) | 0.00$^{j}$ (0.71) | 0.00$^{j}$ (0.71) |
| | SE | | 0.00 | 0.01 | 0.01 |
| | CD(p≤0.05) | | 0.01 | 0.04 | 0.03 |

*SMW: Standard Meteorological weeks
*Figures in the table are mean values, Figures in the parentheses are square root transformed values
Within column values followed by different letter(s) are significantly different (P=0.05) by DMRT

**Table 3.2** Correlations table on seasonal incidence of sucking pests with meteorological parameters on French bean, *Phaseolus vulgaris* L. (2017-2018)

| | Max. temp | Min. temp | Dewpoint | RH | Rainfall | Aphids | Thrips | Whitefly |
|---|---|---|---|---|---|---|---|---|
| Max. temp | 1 | .916** | .930** | 0.162 | .742** | -0.35 | -0.325 | -0.362 |
| Min. temp | .916** | 1 | .958** | 0.018 | .810* | -0.383 | -0.366 | -0.371 |
| Dewpoint | .930** | .958** | 1 | -0.006 | .734** | -0.257 | -0.313 | -0.312 |
| RH | 0.162 | 0.018 | -0.006 | 1 | 0.105 | -0.202 | 0.04 | -0.128 |
| Rainfall | .742** | .810** | .734** | 0.105 | 1 | -.544* | -.503* | -0.49 |
| Aphids | -0.35 | -0.383 | -0.257 | -0.202 | -.544* | 1 | .889** | .929** |
| Thrips | -0.325 | -0.366 | -0.313 | 0.04 | -.503* | .889** | 1 | .977** |
| Whitefly | -0.362 | -0.371 | -0.312 | -0.128 | -0.49 | .929** | .977** | 1 |

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

### 3.2.1 Aphid, *Aphis craccivora* Koch (Hemiptera: Aphididae)

It is evident from Table 3.2 that aphid population exhibit significant negative correlation with rainfall (r = -0.544*). However, Maximum temperature (r = -0.35), Minimum temperature (r =-0.38), Dew point (r =-0.26) and relative humidity (r =-0.20) showed negatively non-significant correlation with aphid population on French bean. Similar result was also reported by Kataria and Kumar (2017) [9] who observed that aphid population showing negative correlation with minimum temperature, relative humidity and rainfall. As the maximum and minimum temperatures decreased, the multiplication of aphid population was found to have increased. Gami *et al.* (2002) [7] observed significant negative correlation of aphid population with maximum and minimum temperature.

### 3.2.2 Thrips, *Megaleurothrips usitatus* Bagnal (Thysanoptera: Thripidae)

Form the data in Table 3.2 the thrips population showed negatively non-significant correlation with maximum temperature (r = -0.325), minimum temperature (r = -0.366),

dew point (r =-0.313) and relative humidity (r = 0.04). However, rainfall (r = -0.503*) showed negatively significant correlation with thrips population in French bean. The results and findings are supported by Nitharwal *et al.* (2013) [11] who founded negative correlation between population of thrips in maximum and minimum temperature.

### 3.2.3 Whitefly, *Bemisia tabaci* Gennadius (Hemiptera: Aleyrodidae)

The data presented in the Table 3.2 indicate that the whitefly population showed negatively non-significant correlation for all the weather parameters *i.e.* maximum temperature (r =-0.36), minimum temperature (r =-0.37), dew point (r =-0.312), relative humidity (r =-0.128) and rainfall (r =-0.49) in whitefly population in French bean. Bairwa and Singh (2017) [3] also reported a negatively non-significant correlation between rainfall. Singh and Kumar (2011) [17] reported that minimum temperature and relative humidity had non-significant positive correlation, whereas maximum temperature and rainfall had a non-significant negative one in black gram.

### 3.3 Predatory fauna

For the natural enemy complex on sucking pests of French bean the observations recorded are presented in Table 3.3 and graphically presented in Fig 3.2. The first incidence of coccinellids was observed in 3rd week after sowing *i.e.* on 41st SMW (0.25 coccinellids/ 6 plants). The highest attended density was observed in 9th week after sowing *i.e.* 47th SMW (6.75 coccinellids/ 6 plants). The results of our present study are comparable to that of some prior researchers Nitharwal and Kumawat (2013) [11] who reported that *C. septempunctata* was higher during cropping season. The present findings are in agreement with Srikanth and Lakkundi (1990) [16] who observed a rapid increase in *A. craccivora* population with the crop growth and recorded the population of coccinellids coincided with the peak aphid population.

The incidence of rober fly (*Dysmachus trigonus*) was first observed in 4th week after sowing *i.e.* on 42nd SMW (0.25/ 6 plants). The highest attended density was observed in 10th week after sowing *i.e.* 48th SMW (4.25/ 6 plants).

The first incidence of spiders was observed in 2nd week after sowing *i.e.* on 40th SMW (0.5/ 6 plants). The highest attended density was observed in 8th week after sowing *i.e.* 46th SMW (6.60/ 6 plants) and the population gradually decreases in the later weeks of the cropping period. Dawar *et al.* (2022) [6] reported higher population of spider during 8th WAS coinciding from 1st week of September (37thSMW) to 14th WAS coinciding from 3rdweek of October (43rdSMW). Thereafter, spider population started decreasing and completely disappeared from 15thWAS *i.e.* 4th week of October (44thSMW).

Through this experimental study on natural enemy of the pests it was observed that the natural enemy Coccinellids were highest in population among all the natural enemies (6.75 coccinellids/ 6 plants) followed by spiders in the cropping season. However as per literatures searched there was no literature found under robber fly as natural enemy on sucking pest of French bean but during the field study this natural enemy was observed.

**Table 3.3:** Population fluctuation of natural enemy per 6 plants

| Day of Observation | Week after sowing | SMW | *Coccinella* spp / 6 plants | *Dysmachus trigonus* / 6 plants | Spider spp / 6 plants |
|---|---|---|---|---|---|
| 28/9/2017 | 1 | 39 | 0 | 0 | 0 |
| 5/10/2017 | 2 | 40 | 0 | 0 | 0.5 |
| 12/10/2017 | 3 | 41 | 0.25 | 0 | 0.75 |
| 19/10/2017 | 4 | 42 | 0.50 | 0.25 | 0.25 |
| 26/10/2017 | 5 | 43 | 1.25 | 0.5 | 3.40 |
| 3/11/2017 | 6 | 44 | 2.75 | 0.75 | 4.25 |
| 10/11/2017 | 7 | 45 | 4.25 | 1.25 | 5.60 |
| 17/11/2017 | 8 | 46 | 5.80 | 2.25 | 6.60 |
| 24/11/2017 | 9 | 47 | 6.75 | 2.50 | 5.9 |
| 1/12/2017 | 10 | 48 | 5.5 | 4.25 | 5.5 |
| 8/12/2017 | 11 | 49 | 5.75 | 4.10 | 4.4 |
| 15/12/2017 | 12 | 50 | 5.20 | 3.25 | 3.75 |
| 22/12/2017 | 13 | 51 | 3.25 | 2.05 | 3.25 |
| 29/12/2017 | 14 | 52 | 2.25 | 1.75 | 1.75 |
| 5/1/2018 | 15 | 1 | 1.25 | 0.75 | 0.2 |
| 12/1/2018 | 16 | 2 | 0.75 | 0.5 | 0 |

*SMW: Standard Meteorological weeks

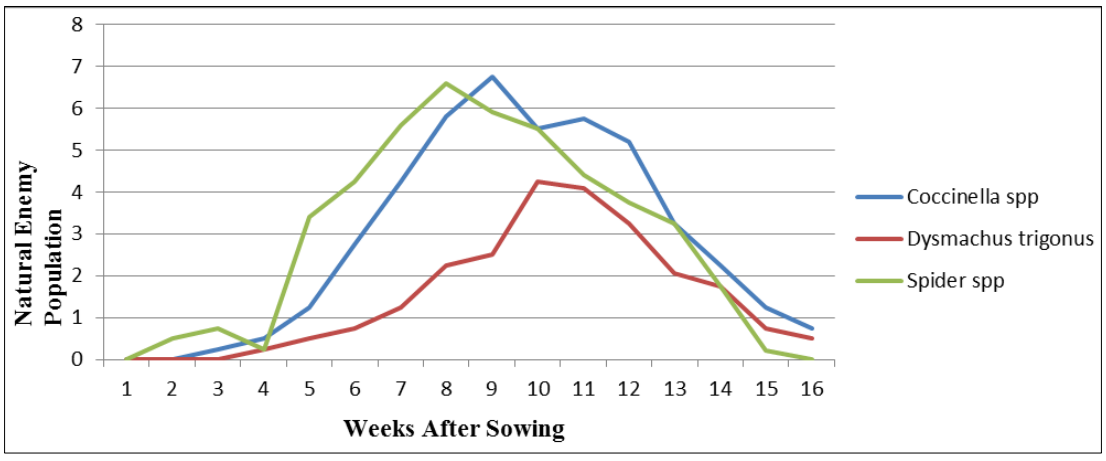


**Fig 3.2:** Natural enemy complex of French bean, *Phaseolus vulgaris* L.

## 4. Conclusion

In the experiment of seasonal incidence of major sucking pests on French bean the major pest observed were Aphids (*Aphis craccivora* Koch), thrips (*Megaleurothrips usitatus* Bagnal) and whitefly (*Bemisia tabaci* Gennadius). From which the most abundant sucking pest observed was Aphids. Aphids and whitefly population showed negative significant correlation with Rainfall parameter. The natural enemies observed in the study were spiders, species of ladybird beetle like *Coccinella septempunctata L.*, *Chilomenes sexmaculata Fabr.*, and robber fly (*Dysmachus trigonus*).

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