CHAPTER III
MATERIALS AND METHODS

The present investigations on seasonal incidence, varietal susceptibility and biocides based management of pest complex of soybean, were carried out at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh during kharif season of 2013. The details of materials and methodology adopted for studies on the different aspects are as follows:

3.1 Seasonal incidence of pest complex of soybean

The seasonal incidence of pest complex of soybean was monitored and the impact of abiotic factors like maximum temperature, minimum temperature, relative humidity morning, relative humidity evening, sunshine hours, evaporation rate, rainfall and rainy days on the population fluctuation of pest complex of soybean was studied. The crop was grown in plot size of 20 m x 20 m keeping 45 cm x 15 cm spacing between row to row and plant to plant. The incidence of pest complex was recorded on five randomly selected plants from each quadrate of 1 m x 1 m at weekly interval on standard week basis. All the agronomical practices were adopted as per the scientific recommendations. The crop under the experiment was kept free from pesticides throughout the season. The observations were recorded on fifty randomly selected plants at weekly interval from entire area, starting from one week after germination till harvest of the crop.

Weekly meteorological data on maximum and minimum temperature, morning, evening relative humidity, evaporation rate, sunshine hours, rainfall, and rainy days, were obtained from Meteorological Observatory, Junagadh Agricultural University, Junagadh.

3.1.1 Methodology for recording observations

During present study, among sucking pests viz., whitefly Bemisia tabaci (Gennadius), aphid Aphis glycines (Koch), jassid Empoasca kerri (Pruthi), and foliage feeder viz., tobacco leaf eating caterpillar Spodoptera litura (Fabricious) were recorded and thrips, pink pod borer and green semilooper were not recorded on soybean during kharif-2013 at Junagadh.
3.1.1 Sucking pests

Observation of sucking pests *viz.*, whitefly and jassid were recorded at weekly interval by observing three leaves (upper, middle and lower) of each five tagged soybean plant per plot. Observations on aphid were recorded by counting aphid index per plant. The observations of sucking pests recorded during early morning.

3.1.1.2 Sampling technique for aphid Index

According to Patel (1980) it was observed that mustard aphids generally sit in an overlapping manner, so it was difficult to take numerical count; hence aphid index was recorded for determination of aphid population. The aphid index was determinate visually according to the following scoring system

**Aphid Index**

0 - Plant free from aphid.
1 - Aphid present but colonies not built up. No injury due to pest appearance on plant.
2 - Small colonies of aphid present on leaves of plant. Such leaves exhibit slight curling due to aphid feeding.
3 - Large colonies of aphid present on leaves and other parts damage symptoms visible due to aphid feeding.
4 - Most of leaves covered with aphid colonies counts are not possible and the plant shows more damage symptoms due to aphid feeding.
5 - The plant completely covered with aphid colonies, plant growth hindered due to pest feeding.

The average aphid index was worked out by using following formula:

\[
\text{Average Aphid Index} = \frac{0N + 1N + 2N + 3N + 4N + 5N}{\text{Total number of plant observed}}
\]

Where-
0, 1, 2, 3, 4, 5 are the Aphid index.
N – Numbers of plant showing respective aphid index.

The data thus, obtained, were statistically analyzed.

3.1.1.3 Foliage feeders

To record the observations of foliage feeders 50 plants were selected randomly and tagged. Numbers of larvae of foliage feeders were recorded on the 50 plants at
weekly interval and continued upto harvest. Mean population of larvae per plant *S. litura* were worked out separately. The data thus, obtained, were statistically analyzed.

### 3.1.2 Effect of weather parameters on seasonal incidence of pest complex

In order to study the effect of weather parameters *viz.*, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours, evaporation rate, rainfall and rainy days on population build-up of pest complex, the simple correlation co-efficient was worked out. The weekly meteorological data were obtained from Meteorological Observatory, Instructional Farm, Junagadh Agricultural University, Junagadh.

### 3.2 Varietal susceptibility against pest complex of soybean

The relative susceptibility test of different soybean varieties/genotypes against major insect pest was conducted under field conditions during *kharif*-2013. For the purpose, seeds of different cultivars of soybean were selected and procured from Pulse Research Station, Junagadh Agriculture University, Amreli.

Following different promising cultivars of soybean were studied for relative susceptibility against pest complex:

1) GS-1  
2) GS-2  
3) GS-3  
4) J-645  
5) J-659  
6) AGS-107  
7) AGS-112  
8) PK-746

Eight varieties/genotypes were grown in plot of three meter length with six rows each with 45 cm x 15 cm spacing and replicated thrice in randomized block design. All the recommended agronomical practices were adopted.

### 3.2.1 Method of observations

For recording the observations, five plants were selected randomly of each variety from each quadrat (1 m x 1 m) and tagged. The observations were recorded by examining the plant thoroughly at weekly interval from the first week after sowing till harvest of the crop.

The observations of sucking pests and foliage feeder were recorded as described in seasonal incidence trial. The data on number of larvae were subjected to
(X)\(^{1/2}\) transformation before statistical analysis for assessing the relative susceptibility of the soybean cultivars.

3.3 Biopesticides based management of pest complex of soybean

A field experiment on biopesticides based management of pest complex of soybean was conducted at Instructional Farm, College of Agriculture, Junagadh during kharif-2013.

The details of the experiment are as under

1) **Location** : Instructional Farm, College of Agriculture, JAU, Junagadh

2) **Design** : Randomized Block Design

3) **Replication** : 3

4) **Treatments** : 12 (detail given in Table-1)

5) **Crop, Variety** : Gujarat Soybean-3

6) **Plot size**
   - (a) **Gross** : 3.00 m × 2.70 m
   - (b) **Net** : 2.70 m × 1.80 m

7) **Spacing** : 45 cm × 15 cm

8) **Seasons** : *Kharif*, 2013

9) **Date of sowing** : 2\(^{nd}\) September, 2013

10) **Date of harvesting** : 7\(^{th}\) December, 2013

11) **Date of spraying**
   - **First spraying**: 11\(^{th}\) October, 2013
   - **Second spraying**: 2\(^{nd}\) November, 2013
Table- 1: Biopesticides/insecticide used against pest complex of soybean during *kharif* –2013

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Bacillus thuringiensis</em> (Bt)</td>
<td>2.0 kg/ha</td>
</tr>
<tr>
<td>2</td>
<td>Bt + NSKE</td>
<td>1.0 kg/ha + 2.5 %</td>
</tr>
<tr>
<td>3</td>
<td>Bt + Monocrotophos</td>
<td>1.0 kg/ha + 0.02 %</td>
</tr>
<tr>
<td>4</td>
<td><em>Beauveria bassiana</em> (Bb)</td>
<td>2.0 kg/ha</td>
</tr>
<tr>
<td>5</td>
<td>Bb + NSKE</td>
<td>1.0 kg/ha + 2.5 %</td>
</tr>
<tr>
<td>6</td>
<td>Bb + Monocrotophos</td>
<td>1.0 kg/ha + 0.02 %</td>
</tr>
<tr>
<td>7</td>
<td><em>Verticillium lecanii</em></td>
<td>2.0 kg/ha</td>
</tr>
<tr>
<td>8</td>
<td>V. <em>lecanii</em> + NSKE</td>
<td>1.0 kg/ha + 2.5 %</td>
</tr>
<tr>
<td>9</td>
<td>V. <em>lecanii</em> + Monocrotophos</td>
<td>1.0 kg/ha + 0.02 %</td>
</tr>
<tr>
<td>10</td>
<td>NSKE</td>
<td>5%</td>
</tr>
<tr>
<td>11</td>
<td>Monocrotophos</td>
<td>0.04 %</td>
</tr>
<tr>
<td>12</td>
<td>Control</td>
<td>-</td>
</tr>
</tbody>
</table>
3.3.1 Time and method of application of biopesticides

All the biopesticides/insecticides were applied in the form of foliar spray with the help of knapsack sprayer (15 liter capacity). For deciding the quantity of spray fluid required, control plots were sprayed with water. Spray fluid was prepared by mixing measured quantity of water and biopesticides. All necessary care was taken to prevent the drift of biopesticides to reach the adjacent plots. The spraying of biopesticides / insecticides at mentioned dose were carried out twice, when the population of insect pest was sufficient, the first application at 50 per cent flowering stage and second at 50 per cent pod formation stage.

3.3.2 Method of recording observations

The observations on number of pest were recorded from five randomly selected plants from each quadrate (1 m x 1 m) in each treatment plot and tagged. Observation on sucking pests and foliage feeder were taken as mentioned in seasonal incidence trial.

The observations were recorded at weekly intervals from the second week after sowing till harvesting of crop. Observations were also recorded before one day and three, seven and fifteen days after spraying of different biopesticides/insecticides treatments.

The data thus obtained were converted to per cent mortality and were then statistically analyzed.

The grain yields obtained from each net plot of treatments were converted on hectare basis and subject to statistical analysis. The per cent increases in yield over control were calculated by using following formula:

\[ \text{Yield increase over control} = \frac{T-C}{C} \times 100 \]

Where,

\[ T = \text{Yield of respective treatment (kg/ha)} \]
\[ C = \text{Yield of control (kg/ha)} \]
Material and Methods

Table-2: Biopesticides/insecticides used for their efficacy against pest complex of soybean

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Technical Name</th>
<th>Trade Name</th>
<th>Formulation</th>
<th>Concentration (%)</th>
<th>Manufacturing agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Bacillus thuringiensis</em> (Bt)</td>
<td>Halt</td>
<td>5 % WP</td>
<td>2 Kg/ha</td>
<td>Wockhardt Life Science Ltd., Mumbai</td>
</tr>
<tr>
<td>2</td>
<td><em>Beauveria bassiana</em> (Bb)</td>
<td>Biosoft</td>
<td>$2 \times 10^8$ cfu/g</td>
<td>2 Kg/ha</td>
<td>Agriland Biotech Ltd., Vadodara</td>
</tr>
<tr>
<td>3</td>
<td><em>Verticillium lecanii</em></td>
<td>Verticel</td>
<td>$10^8$ cfu/g</td>
<td>2 Kg/ha</td>
<td>M/S Excel Industries Ltd., Mumbai</td>
</tr>
<tr>
<td>4</td>
<td>Neem Seed Kernel Extract</td>
<td>Plant product</td>
<td>Crude Extract</td>
<td>5</td>
<td>Seed of local neem trees</td>
</tr>
<tr>
<td>5</td>
<td>Monocrotophos</td>
<td>Nuvacron</td>
<td>36 % EC</td>
<td>0.04</td>
<td>Novartis Ind. Ltd</td>
</tr>
</tbody>
</table>