**Sucking insect pests and their natural enemies in black gram (*Vigna mungo* L.) under the climatic conditions of the Gird region**

ABSTRACT

The present study was conducted during the *Kharif* seasons of 2023 and 2024 at the Research Farm, College of Agriculture, Gwalior, Madhya Pradesh, to investigate the seasonal incidence of major insect pests and their natural enemies on black gram (*Vigna mungo* L.) variety PU-31. Weekly observations were recorded on the population dynamics of *Aphis craccivora*, *Empoasca kerri*, *Bemisia tabaci*, and their natural predator, ladybird beetles. The influence of abiotic and biotic factors on pest populations was analyzed using correlation and regression analysis to support sustainable pest management strategies. The initial infestation of whiteflies, aphids, and leafhoppers was observed in the 33rd standard meteorological week (SMW), with their activity continuing until the 41st SMW. Peak population densities of whiteflies and leafhoppers occurred in the 35th SMW, whereas aphids reached their highest population in the 38th SMW. The abundance of ladybird beetles peaked in the 39th SMW. Correlation analysis revealed non significant association between sucking pest incidence and temperature, relative humidity, rainfall and evaporation. However, a positively significant correlation was found between aphid populations and ladybird beetle abundance, highlighting the role of biotic interactions in pest regulation. These findings emphasize the importance of systematic pest monitoring and integrated pest management strategies for sustainable black gram production.

***Keywords:*** *Vigna mungo, Aphid, Ladybird beetle, Leafhopper, Whitefly, Insect incidence,* W*eather, Correlation coefficient*

1. INTRODUCTION

Black gram (*Vigna mungo* (L.) Hepper), a leguminous crop from the Fabaceae family and the genus *Vigna*, holds significant nutritional and industrial value. It is widely known in India as urd bean, mashkalai, marsh, Mahn, or black bean (Mandal *et al*., 2013). Black gram ranks as the fourth most important short-duration (90–120 days) pulse crop in India (Yadav *et al*., 2015). The production in India was 27.8 Lakh tonnes from acreage of 46.3 Lakh hectares with a productivity of 600 Kg/ha. (Anonymous, 2022a). During 2021-22 in *Kharif* Madhya Pradesh produced 7.78 lakh tonnes of Black gram from 15.35 Lakh ha area with a Productivity of 507 kg/ha. (Anonymous, 2022b). It’s yield is heavily impacted by insect pests (Jat *et al*., 2017), with losses from sucking pests, defoliators, and pod borers ranging from 25.9% to 67.8% (Justin *et al*., 2015). Whitefly, a key vector of mung bean yellow mosaic virus, can cause yield losses of 30% to 70% (Duraimurugan and Tyagi, 2014). Understanding the population behaviour of these pests and their natural enemies is crucial, as noted in previous research (Prasad *et al*., 2005; Kumar and Singh, 2016; Mohapatra *et al*., 2018; Yadav *et al*., 2020). The occurrence and population dynamics of black gram pests under the climatic conditions of the Gird region were investigated in the present study.

2. material and methods

The experiment was conducted during the *Kharif* seasons of 2023 and 2024 at the Research Farm, College of Agriculture, Gwalior, following standard recommended agronomic practices for crop cultivation. Randomised block design was followed in the experiment. Variety PU-31 was selected for study net plot size was 200 m2 with spacing between rows was 20 cm and plants was 10 cm. Observations on insect pests and their natural enemies were recorded weekly from ten randomly selected plants, starting from the initial incidence of insects until crop maturity. The population of sucking insect pests, *Aphis craccivora* (Koch.) and *Empoasca kerri* Pruthi, was recorded from three compound leaves at the top, middle, and bottom of the plant. The population of *Bemisia tabaci* (Genn.) was assessed using the cage method, expressed as the number of insects per cage per plant. Natural enemies, including adult ladybird beetles (*Coccinela septempunctata* and *Cheilomenes sexmaculata*), were recorded on ten randomly selected plants. The insect pest population was subjected to correlation and regression equation was developed by using Microsoft Excel with weekly data of abiotic or meteorological factors (temperature, relative humidity, rainfall and evaporation) and biotic factors (*Coccinela septempunctata* and *C. sexmaculata* grubs per plant), to determine the relationship of pest population with environmental factors and natural enemies.

3. results and discussion

Seasonal incidence of whitefly, leafhopper, aphid, and ladybird beetles were studied where commencements of insects started fron 15 days after showing till crop maturity stage in the year 2023 and 2024 presented in fig.1 and 2, table 1 and 3, respectively. Correlation coefficient and regression equation was calculated for both years and data presented in table 2 and 4, respectively.

**3.1 Whitefly [*Bemisia tabaci (Genadius*)]**

Table (1 and 3) and Fig. (1 and 2) provides the details of incidence of insect pests and their predators in black gram during 2023 and 2024 respectively. Whiteflies appeared during 33rd standard week (2.1 whiteflies/cage/plant in 2023 and 1.6 whiteflies/cage/ plant in 2024) and remained active till 41st SMW (Standard Meteorological Week), maturity of the crop (2.0 and 2.6 whiteflies/cage plant). The peak population of whitefly (7.4 whiteflies/cage/ plant) was recorded on 35th and 36th SMW, in year 2023 and 2024, respectively. Present findings more or less supported by the findings of Yadav and Singh (2015) where whitefly populations ranged from 0.2 to 5.2 whiteflies per cage per plant. Netam *et al.* (2013) and Nitharwal *et al.* (2013) recorded the first appearance of whitefly on green gram during 30th and 32nd SMW respectively. Manju *et al.* (2016) found that whitefly infestation began in mid-August, peaked in the second week of September (37th SMW). Shreedhar *et al.* (2024), Sneha *et al.* (2016), Singh *et al.* (2017) and Duraimurugan and Tyagi (2014) observed whitefly peak incidence during 37th SMW. Correlation studies carried out between whitefly population and biotic and abiotic parameters, showed non-significant relationship in both the years under study (table 2 and table 4). The lack of a significant correlation between whitefly populations and weather conditions indicates that other ecological factors might be influencing whitefly abundance.

**3.2 Leaf hopper [*Empoasca kerri* (Pruthi)]**

Occurrence of Leafhopper noticed in the crop from 33rd standard week (2.80 and 2.22 leaf hoppers/three compound leaves/plant) and remained active till 41st SMW, crop's maturity presented in table 1 and 3. Fig. 1 and 2. Netam *et al.* (2013), Nitharwal *et al.* (2013) and Manju *et al.* (2016) reported that first appearance of jassids was recorded during 30th, 31st and 32nd SMW, respectively Leafhopper nymphs and adults have both been seen sucking the cell sap from the leaves. The 35th and 36th standard week had the highest incidence of leafhoppers (7.60 and 8.44 leaf hoppers /three compound leaves/plant in 2023 and 2024, respectively. Sneha *et al.* (2016) and Sarode *et al.* (2003) also reported similar incidence. Correlation studies carried out between meteorological parameters and population of leafhopper, showed non- significant relationship with all the abiotic and biotic parameters under study in both the years. These results agree with those of Mohapatra *et al.* (2018). The lack of correlation with abiotic and biotic parameters might be due to heavy rainfall in peak vegetative stage of crop. It also suggests that other factors might be influencing the leafhopper population dynamics.

**3.3 Aphids [*Aphis craccivora* (Koch.)]**

Aphid appeared on the crop on 33rd SMW (1.4 and 1.6 aphids/three compound leaves/plant) and infestation continued till 41st SMW (2.2 and 1.2 aphids/three compound leaves/plant). The peak population was recorded on 38th SMW (8.6 and 6.8 aphids/three compound leaves/plant) in 2023 and 2024, respectively Table 1 and 3, Fig. 1 and 2. Correlation studies carried out between meteorological parameters and population of aphid, showed non-significant relationship. While population of ladybird beetles and aphid population showed highly significant positive correlation; between *Coccinela septempunctata* and aphids (r=0.755), *Cheilomenes sexmaculata* and aphids (r=0.975) in 2023 (Table 2). Correlation between *Coccinela septempunctata* and aphids (r=0.850), *Cheilomenes sexmaculata* and aphids r= (0.774) in 2024 (table 4) respectively. Regression equation between the population of aphid and *Coccinela septempunctata* and *Cheilomenes sexmaculata* were y1 = 0.1505x1 + 0.1201 and y1 = 0.2319x2 - 0.2146 during 2023 (Table 2) and y1 = 0.2988x1+ 0.1121 and y1 = 0.1873x2+ 0.0965 during 2024 (Table 4). The above mentioned equations showed that with every unit increase in *Coccinela septempunctata* and *Cheilomenes sexmaculata* there was increase in 0.15 and 0.23 aphid population per plant respectively in 2023 and increase in 0.29 and 0.18 aphid population per plant, respectively in 2024. (Table 2 and 4.)

**3.4 Ladybird beetle (*Coccinella septempuctata* Linnaeus.)**

The activity of ladybird beetles *Coccinella septempuctata* were first noticed in the crop in 35th standard week (0.2 and 0.8 adult/plant) and continued to be active till crop's maturity. During the 39th standard week ladybird beetle *C. septempuctata* activity peaked (1.8 and 2.2 adults/plant) in 2023 and 2024, respectively. Table 1 and 3, Fig. 1 and 2. Present findings are similar to Yadav *et al.* (2015) and Sujatha and Bharpoda (2017) where the peak occurrence was during the 37th SMW. On correlation ladybird beetle *C. septempunctata* showed non-significant positive correlation with maximum temperature and morning relative humidity while non-significant negative correlation with evaporation in both the years. These findings are in accordance with the findings of Yadav *et al.* (2015) and Patel *et al*. (2010) in terms of maximum temperature.

**3.5 Ladybird beetle [*Cheilomenes sexmaculata* (Fabricius)]**

*C. sexmaculata* appeared on the crop on 35th SMW (0.4 and 0.6 adult/plant) and infestation continued till maturity of the crop. The peak population (1.6 adult/plant) was recorded on 38th and 39th SMW in 2023 and 2024, respectively. On correlation ladybird beetle population was non-significant with weather parameters. These findings are in more or less similar to the findings of Yadav *et al.* (2015) and *Patel et al.* (2010) where *C. sexmaculata population* showed non-significant correlation in terms of temperature and rainfall.

**Table 1: Seasonal incidence of insect pests of black gram and their natural enemies during *Kharif* 2023**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SMW** | **Period-2024** | **Abiotic parameters** | | | | | | **Biotic parameters** | | | | |
| **Temp. (0 C)** | | **RH (%)** | | **Rain**  **fall (mm)** | **Evap. (mm)** | **White**  **fly/ cage** | **Population per three compound leaves/plant** | | **Natural Enemies grubs/plant** | |
| Max. | Min. | Mor. | Eve. | **Leaf**  **hoppers** | **Aphids** | ***Coccinela septempunctata*** | ***Cheilomenes sexmaculata*** |
| 33 | Aug 13-19 | 34.3 | 26.6 | 82.2 | 61.7 | 24.6 | 5.8 | 2.1 | 2.80 | 1.4 | - | - |
| 34 | Aug 20-26 | 33.4 | 26.0 | 87.4 | 62.5 | 13.4 | 3.7 | 4.6 | 4.80 | 2.17 | - | - |
| 35 | Aug-Sept. 27-2 | 35.4 | 22.8 | 70.2 | 53.5 | 0.0 | 8.0 | 7.4 | 7.60 | 2.87 | 0.2 | 0.4 |
| 36 | Sept 3-9 | 34.4 | 25.3 | 82.2 | 65.0 | 89.0 | 4.8 | 5.2 | 7.00 | 5.27 | 0.5 | 1.2 |
| 37 | Sept10-16 | 32.2 | 24.4 | 82.7 | 68.1 | 84.2 | 1.8 | 5.8 | 6.90 | 6.6 | 1 | 1.4 |
| 38 | Sept 17-23 | 33.7 | 24.9 | 86.0 | 61.8 | 3.2 | 5.6 | 6.2 | 6.40 | 8.6 | 1.2 | 1.6 |
| 39 | Sept24-30 | 35.4 | 20.7 | 87.2 | 55.2 | 5.0 | 4.9 | 5.9 | 5.77 | 5.8 | 1.8 | 1.2 |
| 40 | Oct 1-7 | 35.6 | 20.4 | 73.0 | 45.4 | 0.0 | 6.0 | 4.1 | 3.33 | 3.6 | 1 | 0.6 |
| 41 | Oct 8-14 | 37.5 | 20.0 | 63.8 | 37.4 | 0.0 | 7.0 | 2.0 | 2.20 | 2.2 | 0.4 | 0.2 |

*SMW= Standard Meteorological Week.*

**Table 2. Correlation and regression of insect pests population with biotic and abiotic factors during 2023.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Insect pest and natural enemies** | | **Abiotic and biotic parameters (2023)** | | | | | | | |
| **Temp. (0 C)** | | **RH (%)** | | **Rainfall (mm)** | **Evap pr. (mm)** | ***Coccinela septempunctata*** | ***Cheilomenes sexmaculata*** |
| **Max.** | **Mini.** | **Mor.** | **Eve.** |
| **Whitefly** | **r** | 0.381NS | 0.048NS | 0.304NS | 0.406NS | 0.110NS | -0.112NS | 0.390NS | 0.594NS |
| **Reg. Eqn** |  |  |  |  |  |  |  |  |
| **Leafhopper** | **r** | -0.510NS | 0.270NS | 0.370NS | 0.605NS | 0.424NS | -0.248NS | 0.253NS | 0.638NS |
| **Reg. Eqn** |  |  |  |  |  |  |  |  |
| **Aphids** | **r** | -0.449NS | 0.051NS | 0.480NS | 0.431NS | 0.298NS | -0.400NS | 0.755\* | 0.975\*\* |
| **Reg. Eqn** |  |  |  |  |  |  | **Y1 = 0.1505x1 + 0.1201** | **Y1 = 0.2319x2 - 0.2146** |
| ***Coccinela septempunctata*** | **r** | 0.021NS | -0.475NS | 0.295NS | -0.018NS | -0.040NS | -0.239NS | - | - |
| **Reg. Eqn** |  |  |  |  |  |  |  |  |
| ***Cheilomenes sexmaculata*** | **r** | -0.385NS | -0.019NS | 0.410NS | 0.404NS | 0.414NS | -0.396NS | - | - |
| **Reg. Eqn** |  |  |  |  |  |  |  |  |

***\*Significant at 5% level; \*\* Significant at 1% level; NS = Non significant.***

**Table 3: Seasonal incidence of insect pests of black gram and their natural enemies during *Kharif* 2024**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SMW** | **Period-2023** | **Abiotic parameters** | | | | | | **Biotic parameters** | | | | |
| **Temp. (0 C)** | | **RH (%)** | | **Rainfall (mm)** | **Evap. (mm)** | **Whitefly/ cage** | **Population per three compound leaves/plant** | | **Natural Enemies grubs/plant** | |
| Max. | Min. | Mor. | Eve. | **Leafhoppers** | **Aphids** | ***Coccinela septempunctata*** | ***Cheilomenes sexmaculata*** |
| 33 | Aug 13-19 | 34.7 | 26.4 | 84.9 | 56.0 | 80.2 | 1.3 | 1.6 | 2.22 | 1.6 | 0 | 0 |
| 34 | Aug 20-26 | 35.1 | 25.9 | 86.1 | 56.6 | 115.4 | 1.3 | 3.2 | 2.65 | 2.8 | 0 | 0 |
| 35 | Aug-Sept. 27-2 | 35.7 | 25.8 | 84.4 | 52.1 | 7.0 | 1.7 | 7.0 | 7.2 | 3.6 | 0.8 | 0.6 |
| 36 | Sept 3-9 | 35.6 | 25.8 | 83.1 | 49.9 | 3.2 | 1.6 | 7.4 | 8.44 | 5.4 | 1.6 | 0.8 |
| 37 | Sept10-16 | 33.0 | 24.7 | 86.1 | 62.3 | 252.8 | 0.9 | 5.6 | 7.4 | 5.8 | 1.8 | 1.1 |
| 38 | Sept 17-23 | 32.6 | 23.2 | 84.3 | 60.4 | 141.0 | 1.0 | 5.2 | 6.3 | 6.8 | 2 | 1.3 |
| 39 | Sept24-30 | 33.2 | 25.2 | 86.0 | 64.4 | 20.2 | 0.9 | 4.8 | 4.2 | 4.4 | 2.2 | 1.6 |
| 40 | Oct 1-7 | 36.0 | 24.5 | 70.4 | 45.6 | 0.0 | 1.6 | 4.0 | 3.8 | 2.3 | 0.8 | 0.8 |
| 41 | Oct 8-14 | 34.0 | 22.7 | 76.3 | 55.0 | 0.0 | 1.4 | 2.6 | 2.8 | 1.2 | 0.4 | 0 |

*SMW= Standard Meteorological Week.*

**Table 4. Correlation and regression of insect pests population with biotic and abiotic factors during 2024.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Insect pest and natural enemies** | | **Abiotic and biotic parameters (2024)** | | | | | | | |
| **Temp. (0 C)** | | **RH (%)** | | **Rainfall (mm)** | **Evap pr. (mm)** | ***Coccinela septempunctata*** | ***Cheilomenes sexmaculata*** |
| **Max.** | **Mini.** | **Mor.** | **Eve.** |
| **Whitefly** | **r** | 0.086NS | 0.114NS | 0.225NS | -0.090NS | -0.026NS | 0.158NS | 0.643NS | 0.583NS |
| **Reg. Eqn** |  |  |  |  |  |  |  |  |
| **Leafhopper** | **r** | -0.053NS | 0.040NS | 0.269NS | -0.019NS | 0.185NS | 0.052NS | 0.657NS | 0.550NS |
| **Reg. Eqn** |  |  |  |  |  |  |  |  |
| **Aphids** | **r** | -0.497NS | -0.102NS | 0.477NS | 0.416NS | 0.490NS | -0.465NS | 0.850\*\* | 0.774\* |
| **Reg. Eqn** |  |  |  |  |  |  | **Y1= 0.2988x1 + 0.1121** | **Y1= 0.1873x2 + 0.0965** |
| ***Coccinela septempunctata*** | **r** | -0.573NS | -0.259NS | 0.244NS | 0.457NS | 0.219NS | -0.532NS | - | - |
| **Reg. Eqn** |  |  |  |  |  |  |  |  |
| ***Cheilomenes sexmaculata*** | **r** | -0.491NS | -0.179NS | 0.173NS | 0.408NS | 0.176NS | -0.512NS | - | - |
| **Reg. Eqn** |  |  |  |  |  |  |  |  |

*\*Significant at 5% level; \*\* Significant at 1% level; NS = Non significant.*

Fig. 1. Seasonal incidence of insect pests of black gram and their natural enemies during *Kharif* 2023

Fig.2. Seasonal incidence of insect pests of black gram and their natural enemies during *Kharif* 2024

4. Conclusion

During the *Kharif* seasons of 2023 and 2024, initial activity of whiteflies, aphids, and leafhoppers commenced in the 33rd standard meteorological week, with continuous activity observed until the 41st SMW. Peak population densities of whiteflies and leafhoppers were recorded in the 35th SMW for both years. Aphid population peaked in the 38th SMW, while Coccinellids reached maximum abundance in the 39th SMW. Correlation analysis revealed no significant linkage between pest abundance and meteorological variables, indicating the potential influence of other ecological determinants. These findings underscore the necessity of systematic pest surveillance and integrated pest management strategies for sustainable black gram production. Further investigations into host plant resistance and trophic interactions are warranted to refine pest suppression tactics.

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