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

ABSTRACT

The experiment was conducted during the *Kharif* seasons of 2023 and 2024 at the Research Farm, College of Agriculture, Gwalior, Madhya Pradesh to study seasonal incidence of major insect pests of black gram (*Vigna mungo* L.) variety PU-31 and their natural enemies. Weekly observations were recorded on *Aphis craccivora*, *Empoasca kerri*, and *Bemisia tabaci* populations, along with ladybird beetles. Population dynamics were studied in relation to abiotic and biotic factors using correlation and regression analysis to support sustainable pest management. During the *Kharif* seasons of 2023 and 2024, initial activity of whiteflies, aphids, and leafhoppers commenced in the 33rd standard meteorological week (SMW), with continuous activity observed until the 41st SMW. Peak population densities of whiteflies and leafhoppers were recorded in the 35th SMW for both years. Aphids 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.Systematic pest monitoring and integrated management are crucial for sustainable black gram production. Research on host resistance and trophic interactions is needed to enhance pest control.

\*\* need revision in abstract

***Keywords:*** *Vigna mungo, Aphid, Ladybird beetles, Leafhopper, Whitefly, Seasonal incidence,* W*eather parameters, Correlation coefficients*

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), cultivated across states such as Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, and Tripura. Its 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. 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 correlated with abiotic factors (temperature, relative humidity, and rainfall) and biotic factors (*C. septempunctata* and *C. sexmaculata* adults per plant), and a regression equation was developed to determine the relationship of pest population with environmental factors and natural enemies.

3. results and discussion

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

Whiteflies appeared during 33rd standard week (2.1 whiteflies in 2023 and 1.6 whiteflies/ plant in 2024) and remained active till 41st SMW (Standard Meteorological Week), maturity of the crop (2.0 and 2.6 whiteflies/ plant). The peak population of whitefly (7.4 whiteflies/ 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) reported that whitefly populations ranged from 0.2 to 5.2 per cage per plant, appeared during the 32nd SMW 0.2/cage/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). Correlation studies carried out between meteorological parameters and population of whitefly, showed non-significant relationship with all the abiotic and biotic parameters in both the years under study. Similar results were also reported by Bairwa and Singh (2017), as they also reported that the correlation between rainfall and whitefly population was found negatively non-significant. The lack of a significant correlation between whitefly populations and weather conditions indicates that other ecological factors, like host plant resistance and the presence of natural enemies, 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. Netam *et al.* (2013), Nitharwal *et al.* (2013) and Manju *et al.* (2016) as they also 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 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 Aphid [*Aphis craccivora* (Koch)]**

Aphids 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. Correlation studies carried out between meteorological parameters and population of aphid, showed non-significant relationship. While population of natural enemies and aphid population showed positive correlation (r=0.755, r=0.850) and (r=0.975 and r=0.774) between *Coccinela septempunctata* and *Cheilomenes sexmaculata*, in 2023 and 2024 respectively. Regression equation between the population of aphid and *C. septumpunctata* and *C. sexmaculata* were y1 = 0.1505x1 + 0.1201 and y2 = 0.2319x2 - 0.2146 during 2023 and y3 = 0.2988x3+ 0.1121 and y4 = 0.1873x4+ 0.0965 during 2024. The above mentioned equations showed that with every unit increase in *C. septumpunctata* and *C. 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. Present findings are in contrary to Kundu *et al.* 2021 and Kumar and Singh, (2016) found significant negatively correlation of *A. craccivora* with maximum temperature. Coccinellid predators are known to play a role in controlling aphid populations, the lack of a positive correlation between aphids and coccinellids in this study raises the possibility that aphid dynamics were impacted by other ecological or environmental factors.

**3.4 Ladybird beetle (*Coccinella septempunctata* Linnaeus)**

The activity of ladybird beetles *C. septempunctata* 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. septempunctata* activity peaked 1.8 and 2.2 adults/plant in 2023 and 2024, respectively. On correlation it was non-significant with weather parameters. These findings are in accordance with the findings of Yadav *et al.* (2015) and Patel *et al*. (2010).

**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 it was non-significant with weather parameters. These findings are in accordance with the findings of Yadav *et al.* (2015) and *Patel et al.* (2010).

**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** | | **Larval population/plant** | | | **Natural Enemies grubs/plant** | |
| Max. | Min. | Mor. | Eve. |  |  |  | **Leaf**  **hoppers** | **Aphids** | ***Lampiodes boeticus ?*** | ***Maruca vitrata ?*** | ***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 | - | 0.3 | 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 | - | 1.3 | 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 | 1.37 | 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 | 2 | 1.83 | 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 | 4 | 2.8 | 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 | 3 | 2.2 | 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 | 2 | 2 | 0.4 | | 0.2 |

*SMW= Standard Meteorological Week.*

**Table 2. Correlation and regression coefficient 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 (%)** | | **Evap pr. (mm)** | **Rainfall (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** |  |  |  |  |  |  | **y = 0.1505x + 0.1201 R² = 0.3817** | **y = 0.2319x - 0.2146 R² = 0.9462** |
| ***Lampiodes boeticus*** | **r** | 0.388NS | -0.760\* | -0.028NS | -0.479NS | -0.419NS | 0.052NS | 0.853\*\* | 0.374NS |
| **Reg. Eqn** |  | **y = -1.3x + 25.2 R² = 0.3925** |  |  |  |  | **y = 0.2769x + 0.4154 R² = 0.3956** |  |
| ***Maruca vitrata*** | **r** | 0.373NS | -0.736\* | -0.090NS | -0.411NS | -0.125NS | -0.009NS | 0.871\*\* | 0.583NS |
| **Reg. Eqn** |  | **y = -1.4813x + 25.14 R² = 0.2681** |  |  |  |  | **y = 0.5358x - 0.0318 R² = 0.6005** |  |
| ***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** | | **Larval population/plant** | | **Natural Enemies grubs/plant** | |
| Max. | Min. | Mor. | Eve. | **Leafhoppers** | **Aphids** | ***Lampiodes boeticus*** | ***Maruca vitrata*** | ***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 | 0 | 0 |
| 34 | Aug 20-26 | 35.1 | 25.9 | 86.1 | 56.6 | 115.4 | 1.3 | 3.2 | 2.65 | 2.8 | 1.2 | 0 | 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 | 1.6 | 0 | 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 | 2 | 0.6 | 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 | 2.4 | 1.83 | 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 | 4.2 | 2.2 | 2 | 1.3 |
| 39 | Sept24-30 | 33.2 | 25.2 | 86.0 | 64.4 | 20.2 | 0.9 | 4.8 | 4.2 | 4.4 | 3.7 | 2.37 | 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 | 3.2 | 2.2 | 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 | 2.6 | 2 | 0.4 | 0 |

*SMW= Standard Meteorological Week.*

**Table 4. Correlation and regression coefficient 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 (%)** | | **Evap pr. (mm)** | **Rainfall (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** |  |  |  |  |  |  | **y = 0.2988x + 0.1121 R² = 0.7283** | **y = 0.1873x + 0.0965 R² = 0.5183** |
| ***Lampiodes boeticus*** | **r** | -0.500NS | -0.704\* | -0.266NS | 0.239NS | -0.011NS | -0.386NS | 0.747\* | 0.766\* |
| **Reg. Eqn** |  | **y = -0.7217x + 20.301 R² = 0.4953** |  |  |  |  | **y = 0.3692x + 0.3325 R² = 0.2436** | **y = 0.3247x - 0.0282 R² = 0.3415** |
| ***Maruca vitrata*** | **r** | -0.579NS | -0.764\* | -0.404NS | 0.286NS | 0.069NS | -0.495NS | 0.616NS | 0.630NS |
| **Reg. Eqn** |  | **y = -0.2815x + 8.7222 R² = 0.2649** |  |  |  |  |  |  |
| ***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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