**Population Dynamics of Lepidopteran Pests and Natural Enemies in Black Gram (*Vigna mungo L.*)** **During The *Kharif* Season in The Gird Region**

**Abstract:**

Population dynamics of lepidopteran insect pests and natural enemies in blackgram (*Vigna mungo* L.) was studied during the *Kharif* seasons of 2023 and 2024 at the Research Farm, College of Agriculture, Gwalior, Madhya Pradesh. The experiment followed a randomized block design using the variety PU-31. The lepidopteran pests *Maruca vitrata* (Geyer) and *Lampides boeticus* L. were monitored by counting larvae on ten randomly selected plants. The population dynamics of these insect pests were analyzed in relation to biotic and abiotic factors, and a regression model was developed. The peak population of *L. boeticus* was observed in the 38th Standard Meteorological Week (SMW), while *M. vitrata* reached their maximum abundance in the 39th SMW. Correlation analysis revealed a significant negative relationship between the populations of *L. boeticus* and *M. vitrata* with minimum temperature. Additionally, *L. boeticus* populations exhibited a significantly positive correlation with coccinellid populations. These findings provide insights into the seasonal fluctuations of insect pests and their natural enemies, which can aid in the development of integrated pest management strategies for black gram cultivation.

**Keywords:** Blak gram (*Vigna mungo*), Spotted pod borer (*Maruca vitrata*), Blue butterfly (*Lampides boeticus*), Ladybird beetle and Population dynamics

**Introduction**

Black gram (*Vigna mungo* L. Hepper), also known as Urdbean, is a pulse crop from the Fabaceae family. It is primarily grown in the *Kharif* season in northern and central India and in the Rabi season in southern states (Anjali *et al.,* 2021). India is the largest producer and consumer of black gram, contributing 27.8 lakh tonnes from 46.3 lakh hectares, with a productivity of 600 kg/ha (Anonymous, 2022a). Major producing states include Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Madhya Pradesh, and West Bengal (Anonymous, 2020). Additionally, India imports around 0.5 million tonnes, mainly from Myanmar (Anonymous, 2020). 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). Spotted pod borer (*Maruca vitrata*) and blue butterfly *Lampides boeticus* being key pests. Yield losses due to *M. vitrata* range from 20-80%, and in some cases, total yield loss has been recorded (Jayasinghe *et al.,* 2015). It is necessary to study the population dynamics of these pests along with their predators like ladybird beetles, as has been done earlier (Prasad *et al.,* 2005; Kumar and Singh, 2016; Mohapatra *et al.,* 2018; Yadav *et al.,* 2020). This study investigates the occurrence and population dynamics of black gram insect pests and natural enemies under the climatic conditions of the Gird region.

**Materials 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. The research was carried out using the PU-31 variety, with a net plot size of 200 m². The spacing between rows was 20 cm, while the spacing between plants was 10 cm. The lepidopteran pests *Maruca vitrata* (Geyer) and *Lampides boeticus* L. and natural enemies, including ladybird beetles *Coccinela septumpunctata* and *Cheilomenes sexmaculata* were monitored by counting the number of larvae per plant on ten randomly selected plants. The insect pest population was correlated with biotic factors Ladybird beetles; (*Coccinela septumpunctata* and *Cheilomenes sexmaculata*) abiotic factors (temperature, relative humidity, and rainfall) and a regression equation was developed using Microsoft excel to determine the relationship of pest population with environmental factors.

**Result and discussion:**

**Blue butterfly *Lampides boeticus* L.)**

Blue butterflies appeared on the crop from reproductive stage of crop, 37th SMW (1larva/plant) in 2023 and from 34th SMW (1.2 larva/plant) and infestation continued till maturity of the crop. The peak population (4 larvae/plant) was recorded on 39th SMW and 38th SMW in 2023 and 2024, respectively. Agreeing with the incidence reported by Mahore and Pandey (2023) and Sujayanand *et al.,* (2021). Correlation studies carried out between meteorological parameters and population of *Lampides boeticus,* showed negatively significant relationship with minimum temperature (r= ˗0.760 in 2023 and r= -0.704 in 2024). While correlation of *Lampides boeticus* population showed positively significant relationship with *Coccinela septumpunctata.*  (r=0.853 in 2023 and r=747 in 2024) whereas *Lampides boeticus.*with *Cheilomenes sexmaculata.* (r=0.766 in 2024).

Regression equation between the population of *Lampides boeticus* and temperature minimum and *Coccinela septumpunctata were* y= -1.3x+25.2 and y= 0.2769x+0.4154 respectively in 2023 and in 2024 Regression equation between the population of *Lampides boeticus* andminimum temperature*, Coccinela septumpunctata and Cheilomenes sexmaculata were* y = -0.7217x + 20.301, y = 0.3692x + 0.3325 and y = 0.3247x - 0.0282 respectively.

**Spotted pod borer [*Maruca vitrata* (Geyer)]**

The occurrence of spotted pod borer on the crop was noticed from 35th and 36th SMW (0.3 and 0.6 larva/plant) and infestation continued till maturity of the crop. The peak population (2.8 and 2.37 larvae/plant) was recorded on 39th SMW. The results of the present study indicate that the pest became active from the pod formation stage and remained present until crop maturity. A similar pattern of pest population was also observed in the *kharif* season of various pulse crops by Saxena *et al.,* (1984), Pithava (1996). These results are in close proximity to the findings of Shreedhar *et al.,* (2024), Patel and Borad (2016) and Sneha *et al.,* (2016) reported its peak activity during 37th and 38th SMW. Correlation studies carried out between meteorological parameters and population of *Maruca vitrata*showed negatively significant (r= -0.736 and r= -0.764) with minimum temperature in 2023 and 2024, respectively. Whereas non significant relationship with relative humidity, rainfall and evaporation. Correlation of *Maruca vitrata*population showed positively significant relationship (0.871) with *Coccinela septumpunctata* in 2023. Present findings are strongly agreeing to the findings of Umbarkar *et al.,* (2010). Whereas in contrary to the results of Sravani *et al.,* (2015). Regression equation between the population of *Maruca vitrata* and minimum temperature *were* y= -1.4813x+25.14 andy = -0.2815x + 8.7222 in 2023 and 2024, respectively while with *Coccinela septumpunctata* y = 0.5358x - 0.0318 in 2023.

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

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SMW | Period-2023 | Abiotic parameters | | | | | | Biotic parameters | | | |
| Temp. (0 C) | | RH (%) | | Rainfall (mm) | Evap(mm) | Larval population/plant | | Natural enemies **(**grubs/plant) | |
| T max. | T min. | Mor. | Eve. | ***Lampides boeticus*** | ***Maruca vitrata*** | ***Coccinela septumpunctata*** | ***Cheilomenes sexmaculata*** |
| 33 | Aug 13-19 | 34.3 | 26.6 | 82.2 | 61.7 | 24.6 | 5.8 | - | - | - | - |
| 34 | Aug 20-26 | 33.4 | 26.0 | 87.4 | 62.5 | 13.4 | 3.7 | - | - | - | - |
| 35 | Aug-Sept. 27-2 | 35.4 | 22.8 | 70.2 | 53.5 | 0.0 | 8.0 | - | 0.3 | 0.2 | 0.4 |
| 36 | Sept 3-9 | 34.4 | 25.3 | 82.2 | 65.0 | 89.0 | 4.8 | - | 1.3 | 0.5 | 1.2 |
| 37 | Sept10-16 | 32.2 | 24.4 | 82.7 | 68.1 | 84.2 | 1.8 | 1 | 1.37 | 1 | 1.4 |
| 38 | Sept 17-23 | 33.7 | 24.9 | 86.0 | 61.8 | 3.2 | 5.6 | 2 | 1.83 | 1.2 | 1.6 |
| 39 | Sept24-30 | 35.4 | 20.7 | 87.2 | 55.2 | 5.0 | 4.9 | 4 | 2.8 | 1.8 | 1.2 |
| 40 | Oct 1-7 | 35.6 | 20.4 | 73.0 | 45.4 | 0.0 | 6.0 | 3 | 2.2 | 1 | 0.6 |
| 41 | Oct 8-14 | 37.5 | 20.0 | 63.8 | 37.4 | 0.0 | 7.0 | 2 | 2 | 0.4 | 0.2 |

SMW= Standard Meteorological Week.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SMW** | **Period-2023** | **Abiotic parameters** | | | | | | **Biotic parameters** | | | |
| **Temp. (0 C)** | | **RH (%)** | | **Rainfall (mm)** | **Evap(mm)** | Larval population/plant | | Natural Enemies grubs/plant | |
| T max. | T min. | Mor. | Eve. | ***Lampides boeticus*** | ***Maruca vitrata*** | ***Coccinela septumpunctata*** | ***Cheilomenes sexmaculata*** |
| 33 | Aug 13-19 | 34.7 | 26.4 | 84.9 | 56.0 | 80.2 | 1.3 | 0 | 0 | 0 | 0 |
| 34 | Aug 20-26 | 35.1 | 25.9 | 86.1 | 56.6 | 115.4 | 1.3 | 1.2 | 0 | 0 | 0 |
| 35 | Aug-Sept. 27-2 | 35.7 | 25.8 | 84.4 | 52.1 | 7.0 | 1.7 | 1.6 | 0 | 0.8 | 0.6 |
| 36 | Sept 3-9 | 35.6 | 25.8 | 83.1 | 49.9 | 3.2 | 1.6 | 2 | 0.6 | 1.6 | 0.8 |
| 37 | Sept10-16 | 33.0 | 24.7 | 86.1 | 62.3 | 252.8 | 0.9 | 2.4 | 1.83 | 1.8 | 1.1 |
| 38 | Sept 17-23 | 32.6 | 23.2 | 84.3 | 60.4 | 141.0 | 1.0 | 4.2 | 2.2 | 2 | 1.3 |
| 39 | Sept24-30 | 33.2 | 25.2 | 86.0 | 64.4 | 20.2 | 0.9 | 3.7 | 2.37 | 2.2 | 1.6 |
| 40 | Oct 1-7 | 36.0 | 24.5 | 70.4 | 45.6 | 0.0 | 1.6 | 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 | 0.4 | 0 |

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

SMW= Standard Meteorological Week.

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

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Insect pest and natural enemies** | | **Abiotic and biotic parameters (2023)** | | | | | | | | |
| **Temp.(0 C )** | | **RH (%)** | | **Evap pr. (mm)** | **Rainfall (mm)** | ***Coccinela septumpunctata*** | ***Cheilomenes sexmaculata*** |
| **Max.** | **Mini.** | **Mor.** | **Eve.** |
| ***Lampides 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** |  |  |  |  | **y = 0.2769x + 0.4154** |  |
| ***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** |  |  |  |  | **y = 0.5358x - 0.0318** |  |
| ***Coccinela septumpunctata*** | **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** |  |  |  |  |  |  |  |  |

**Table 3. Correlation and regression coefficient of insect pests population with biotc and abiotic factors during 2023.**

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Insect pest and natural enemies** | | **Abiotic and biotic parameters (2024)** | | | | | | | |
| **Temp.(0 C )** | | **RH (%)** | | **Evap pr. (mm)** | **Rainfall (mm)** | ***Coccinela septumpunctata*** | ***Cheilomenes sexmaculata*** |
| **Max.** | **Mini.** | **Mor.** | **Eve.** |
| ***Lampides 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** |  |  |  |  | **y = 0.3692x + 0.3325** | **y = 0.3247x - 0.0282** |
| ***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** |  |  |  |  |  |  |
| ***Coccinela septumpunctata*** | **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** |  |  |  |  |  |  |  |  |

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

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

**Conclusion:**

*Lampides boeticus* populations peaked in the 38th SMW, while *Maruca vitrata* reached maximum abundance in the 39th SMW. Correlation analyses indicated a significant negative relationship between *L. boeticus* and *M. vitrata* populations with minimum temperature, and significantly positive correlation between *L. boeticus* populations with coccinellids. Understanding the relationship between insect pests and weather conditions is important for devising effective pest management practices.

**Disclaimer (Artificial intelligence)**

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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