**Seasonal incidence of major pod borers, *Helicoverpa* *armigera* (Hubner) and *Maruca* *testulalis* in Mungbean (*Vigna* *radiata* L.) in organic cultivation**

**ABSTRACT**

The excessive use of conventional insecticides has led to resistance, resurgence, and environmental pollution. Therefore, eco-friendly approaches such as biorational insecticides are now being explored for sustainable pest management. The present study aimed to assesses Seasonal incidence of major pod borers, *Helicoverpa armigera* (Hubner) and *Maruca testulalis* in Mungbean (Vigna radiata L.) in organic cultivation. The present investigation was conducted during *Kharif 2024* aimed to assess the population dynamics of major pod borer species and their correlation with prevailing meteorological parameters. mungbean variety PDM-139 (Samrat) was sown in early July, 2024 under organic cultivation practices. Observations on pest incidence were recorded weekly from sowing to harvest without pesticide application. The presence of two major pod borer species, *Helicoverpa armigera* and *Maruca testulalis,* with peak incidences observed during the 36th Standard Meteorological Week (SMW). *H. armigera* population was peaked at 7.40 larvae/5 plants, showing a significant negative correlation with rainfall (r = -0.493), while *M. testulalis* peaked at 9.46 larvae/5 plants and exhibited a positive significant correlation with temperature and humidity. These findings indicate that dry, warm, and humid conditions favor pod borer proliferation. The present study revealed that the population of *Helicoverpa armigera* and *Maruca testulalis* peaked during the mid-crop growth stage under favourable climatic conditions, particularly high temperature and humidity. Understanding their seasonal incidence can aid in timely pest management strategies. The study underscores the importance of pest-weather interactions in forecasting pest outbreaks and advocates for the inclusion of biorational insecticides and weather-based surveillance in integrated pest management (IPM) strategies.

**Keywords:** Mungbean, *Helicoverpa armigera*, *Maruca testulalis*, Seasonal incidence, Weather correlation

**INTRODUCTION**

Pulses are highly rich in nutrition and hold a vital role in sustainable crop production by improving soil fertility and maintaining soil health. They are the major source of dietary protein in India (Sujatha and Bharpoda, 2017). India, being the largest producer of pulses in the world, uses this crop to boost its export revenues, highlighting its economic importance. Specifically, pulses have twice the amount of protein as wheat and three times as much as rice, making them a vital part of the Indian diet (Kumar *et al*., 2024). Among these, mungbean (*Vigna radiata* L. Wilczek), belonging to the family Leguminosae, is one of the most important pulse crops in tropical regions. It is valued for its high protein content (24%), easy digestibility, and richness in essential nutrients like lysine, phosphorus, and iron (Swaminathan *et al*., 2012; Beeranganni *et al*., 2014). Insect pests poses a significant threat to mungbean, with aphids, leafhoppers, whiteflies, thrips, pod borers, and spotted pod borers being major concerns. The impact of these pests is influenced by meteorological factors such as the degree of humidity, temperature, and precipitation (Khaire et al., 2024). Over the last decade, mung bean protein has attracted great attention as a novel protein substitute for traditional protein ingredients (animal protein and soy protein) because of its high nutrient bioavailability (Feng *et al.,* 2024). Being a leguminous crop, it fixes atmospheric nitrogen (30-40 kg N/ha) and contributes to soil conservation (Panigrahi *et al*., 2021). Mungbean is recognised for its high nutritive value. Mung beans contain about 55- 65% carbohydrates and rich in protein 20-50%, fat 2-4%, vitamins and minerals and it’s used as an important source of human food and animal feed. It plays an important role in maintaining the soil fertility by enhancing the soil physical properties and its capacity to fixing atmospheric nitrogen. Its green plants are used as fodder after removing mature pods (Chaudhary et al., 2024; Rajak et al., 2024). Mungbean is cultivated across various agroecological zones in South and Southeast Asia, Africa, and other regions (Parihar *et al*., 2017). However, productivity is often hindered by numerous insect pests, especially *Helicoverpa armigera*, which causes substantial yield losses. *Helicoverpa armigera* is a polyphagous pest that predominantly feeds on pod crops (Hossain et al., 2024). The larva feeds on the leaves, flowers, pods and seeds, inflicting severe damage, resulting in decreased yield. Infestation is identified by rounded chew marks and angular holes (Shukla & Tiwari, 2024). The excessive use of conventional insecticides has led to resistance, resurgence, and environmental pollution. Therefore, eco-friendly approaches such as biorational insecticides are now being explored for sustainable pest management.

**MATERIALS AND METHODS**

The present study was carried out during the *Kharif* 2024 at the Department of Entomology, Organic Research Farm, Kargua Ji, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.), located at 25°27′N latitude and 78°36′E longitude, with an altitude of 178.37 m above mean sea level. The region has a dry sub-humid climate with an average annual rainfall of 1200–1400 mm and temperatures ranging from 23.6°C to 37.5°C. Weekly meteorological data (temperature, humidity, rainfall) were obtained from IGFRI, Jhansi. The field was prepared using a tractor-drawn cultivator and amended with FYM (25 t/ha) and vermicompost (5 t/ha), followed by planking and levelling. Mungbean variety PDM-139 (Samrat) was sown in the first week of July in plots of 2.4 × 1.8 m with a spacing of 30 cm × 10 cm. A pre-sowing irrigation was applied, followed by irrigation as per crop requirement. Intercultural operations, including manual weeding, were carried out at 15-20-day intervals up to 45 days after sowing. Organic protection practices were adopted to maintain crop health. To record seasonal pest incidence, no pesticide application was made, and weekly observations were taken from five randomly selected and tagged plants in separate plots (2.4 × 1.8 m) from sowing to harvest.

**RESULTS**

The seasonal incidence of the pod borer complex on mungbean revealed the presence of two major species, *Helicoverpa armigera* (gram pod borer) and *Maruca testulalis* (spotted pod borer) during the *Kharif,* 2024. The population of *H. armigera* was first recorded in the 31st SMW on August 5th with 0.40 larvae per five plants, gradually it was raised to reach the peak of 7.40 larvae per five plants during the 36th SMW. A population decline was noted thereafter, with only trace infestation observed in the 38th SMW. The highest larval count coincided with meteorological parameters of 37.0°C maximum temperature, 28.0°C minimum temperature, 97% relative humidity, and 19.00 mm rainfall. Correlation analysis revealed a significant negative relationship between pod borer incidence and rainfall (r = -0.493), while other weather parameters, such as minimum temperature and relative humidity, showed non-significant effects at the 5% level of significance. These findings suggest that dry conditions with moderate to high humidity favour pod borer proliferation.

Similarly, the spotted pod borer, *M. testulalis*, was also first observed during the 31st SMW with an initial population of 0.55 larvae per five plants. The population increased steadily, reaching its peak of 9.46 larvae per five plants in the 36th SMW. The peak incidence was recorded under weather conditions of 37.0°C maximum temperature, 28.0°C minimum temperature, 95% relative humidity, and no rainfall (0.00 mm). Unlike *H. armigera*, correlation analysis indicated a positive significant correlation between the spotted pod borer population and weather parameters at the 5% level of significance. This indicates that high temperature and humidity, coupled with a lack of rainfall, are conducive to *M. testulalis* build-up. The results highlight the importance of understanding pest-weather interactions for forecasting pest outbreaks and implementing timely management practices. (Table 1)

**Table 1: Seasonal incidence of *Helicoverpa armigera* (Hubner) and *Maruca testulalis (*Geyer) on mungbean during *Kharif* season.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **SMW** | ***H. armigera*** | ***M. testulalis*** | **Temperature (0C)** | | **Rain**  **fall** | **Relative Humidity (%)** | |
| **Maxi.** | **Min.** | **Mor.** | **Eve.** |
| **31** | 0.40 | 0.55 | 34.6 | 23.8 | 8.0 | 73 | 42 |
| **32** | 1.40 | 1.72 | 34.9 | 23.9 | 2.0 | 70 | 45 |
| **33** | 2.06 | 2.55 | 32.0 | 23.7 | 7.0 | 74 | 52 |
| **34** | 2.72 | 4.57 | 32.4 | 27.0 | 3.0 | 71 | 52 |
| **35** | 4.06 | 5.74 | 36.2 | 27.1 | 0.0 | 60 | 38 |
| **36** | 7.40 | 9.46 | 37.0 | 28.0 | 0.0 | 95 | 55 |
| **37** | 4.40 | 5.12 | 28.0 | 25.0 | 4.0 | 97 | 54 |
| **38** | 2.00 | 2.15 | 36.5 | 24.5 | 19.0 | 87 | 66 |

**Table 2: Correlation Coefficient**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Correlation Coefficient (r)** | **Temperature (0C)** | | **Rainfall** | **Relative Humidity (%)** | |
| **Maximum** | **Minimum** | **Morning** | **Evening** |
| ***H. armigera*** | 0.086 | 0.803 | -0.493NS | 0.519 | 0.186 |
| ***M. testulalis*** | 0.111 | 0.889 | 0.394 | 0.394 | 0.106 |

\*NS- non-significant

**Discussion**

The seasonal occurrence of the pod borer complex on mungbean revealed that both *Helicoverpa armigera* and Maruca testulalis were active during the crop season, with their peak infestations observed during the 36th Standard Meteorological Week under favourable environmental conditions. The negative correlation of *H. armigera* with rainfall and the positive significant correlation of *M. testulalis* with temperature and humidity suggest that dry spells and warm, humid weather promote their population build-up. These results are consistent with the findings of Mahendra Singh *et al*. (2019), who reported that *H. armigera* populations flourish during dry conditions. Similar trends were observed by Panigrahi *et al*. (2021) and Sundararajan and Chitra (2017), who emphasised the influence of weather on the biology and behaviour of pod borers. Beeranganni *et al*. (2014) and Manjunath *et al*. (1989) also noted the polyphagous nature of *H. armigera*, which contributes to its adaptability and persistence under diverse agro-climatic zones. The infestation pattern observed in the current study underscores the importance of regular pest surveillance and the incorporation of weather-based forecasting models in pest management strategies (Sigsgaard *et al*., 2002; Swaminathan *et al*., 2012). Furthermore, the potential of biorational insecticides such as Emamectin benzoate and Spinosad, as highlighted by Shinde (2016), should be explored in integrated pest management (IPM) modules to reduce pest pressure while ensuring environmental safety.

**CONCLUSION:**

The present study revealed that the population of *Helicoverpa armigera* and *Maruca testulalis* peaked during the mid-crop growth stage under favourable climatic conditions, particularly high temperature and humidity. Understanding their seasonal incidence can aid in timely pest management strategies. The use of biorational insecticides offers a promising, eco-friendly approach for controlling pod borer infestations in mungbean.

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1.

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