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Influence of abiotic factors on seasonal incidence of spotted pod borer, *Maruca vitrata* (Geyer), in black gram

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Abstract

Black gram is considered as the major pulse crops because of its high nutritional value and agronomic significance. cultivated extensively in India due to its high nutritional value and ability to improve soil fertility through nitrogen fixation. The present experiment conducted entitled “Influence of Abiotic Factors on Seasonal Incidence of Spotted Pod Borer, *Maruca vitrata* (Geyer) in Black Gram” result evaluated the seasonal incidence of *Maruca vitrata* was initiated during the 35th SMW at the flowering stage of the crop, with an initial population of 1.00 larva/5 plants. Subsequently, the larval population exhibited a steady rise as the crop developed and entered the flowering stage. The population attained its highest level during the 41st SMW, recorded 6.40 larvae/5 plants. Subsequently, the population showed a declining trend and decreased to 1.20 larvae/5 plants by the 43rd SMW. Thereafter, the population of larvae gradually increased with the development of crop growth and flowering. The population attained its highest level. during the 41st SMW, recorded 6.40 larvae/5 plants. Subsequently, the population showed a declining trend and decreased to 1.20 larvae/5 plants by the 43rd SMW. The relationship between *Maruca vitrata* larval abundance and meteorological parameters showed that maximum temperature exhibited a positive and significant association ($r = 0.667^*$) indicating that an rise in maximum temperature favoured the build-up of population of larvae. Conversely, minimum temperature ($r = 0.287$) viewed a positive but non-significant relationship, whereas relative humidity recorded during the morning hours ($r = -0.586$) relative humidity recorded during the evening hours ($r = -0.328$) and rainfall ($r = -0.592$) exhibited negative associations with larval incidence.

Keywords: Seasonal incidence, spotted pod borer and correlation

Introduction

Black gram (*Vigna mungo* (L.) Hepper), commonly referred to as urd bean. is an important pulse crop belonging to the family Fabaceae. It is broadly cultivated in India and consumed in diverse manners, including whole or split dal, both husked and unhusked, along with roasted grains. Besides its value as a nutritious food crop, black gram is also used as high-quality fodder for dairy animals and serves as an effective green manure crop, contributing to soil fertility and sustainable farming systems

Varieties of black gram grown in India were analyzed for their physical attributes and cooking qualities. The proximate composition showed that the three cultivars had protein levels ranging from 24.5 to 26.7 percent, fat content between 1.1 and 1.3 percent, ash content of 2.8 to 3.7 percent, and carbohydrates comprising 60.4 to 63.3 percent. The seeds exhibited measurements ranging from 4.66 mm to 5.11 mm in length, 3.71 mm to 3.79 mm in breadth, and 3.20 mm to 3.29 mm in thickness. True density fluctuated between 1.25 and 1.29 g mL⁻¹, with porosity spanning from 33.43 to 36.09 percent. The seeds exhibited hydration and swelling capacities between 0.036 and 0.041 g per seed, as well as 0.037 to 0.042 mL per seed, respectively. The time required to cook unsoaked seeds ranged markedly from 35.3 to 42.7 minutes. The cooked seeds exhibited hardness values between 2.12 and 2.55 kg, while their adhesiveness ranged from 0.02 to 0.99 kg. The cultivars of black gram are high in protein, and the soaking treatment augmented their cooking attributes. (Wani *et al.*, 2013) ^[1] The yield of black gram in India is around 598 kg per hectare. In 2025-26, India's black gram total production was 17.14 lakh tonnes.

India's total black gram production is 17.14 lakh tonnes for 2025, a decrease from 22.42 lakh tonnes in the previous year. Black gram occupies the third place after chickpea and pigeon pea.

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The Spotted pod borer, *M. vitrata* (Geyer), Gram pod borer, *H. armigera* (Hubner), Bihar hairy caterpillar, *Spilosoma obliqua* (Walker) and Leafhopper *Empoasca kerri* (Pruthi) were recorded as most prominent pests. Whereas, remaining all other insect-pests like Whitefly, *Bemisia tabaci* (Gennadius), Surface grasshopper, *Chrotogonus trachypterus* (Blanchard), Stem fly, *Ophiomyia phaseoli* (Tryon), Black aphid, *Aphis craccivora* (Koch), Tobacco caterpillar, *Spodoptera litura* (Fabricus), semilooper, *Plusia orichalcea* (Fabricus), Blue butterfly, *Lampides boeticus* (Linn.) and Blister beetle, *Mylabris pustulata* (Thunberg) were observed as minor pests throughout the crop growing season i.e. Kharif, 2018 and 2019 in black gram. (Yadav *et al.*, 2020) [2]. Across India, 60 insect species are known to attack black gram at various phases of crop growth (Lal and Sachan, 1987) [3]. Among these insects-pests pod borers i.e. spotted pod borer, *Maruca vitrata* (Geyer) and gram pod borer, *Helicoverpa armigera* (Hubner) are the serious insect pests of grain legumes causing seed and pod damage. Black gram production is significantly reduced by roughly twelve insect species, which are pests (Soundararajan and Chitra, 2012) [4]. Pod borer complex include *H. armigera* (Hubner), *M. vitrata* (Geyer), *Etiella zinckenella* (Treitschke), *Apion ampulum* (Faust) and *Lampides boeticus* (Linnaeus). Among the pod borers, *M. vitrata* is a major constraint for the production of black gram at critical stages such as reproductive and pod development. Therefore, the current study was carried out to know the seasonal incidence of borers on black gram in kharif, seasons and their relationship with meteorological parameters.

The spotted pod borer represents a major pest affecting tropical food legumes, causing harm to soft leaf axils, flower buds, flowers, and pods through webbing and boring into flower or pod clusters during the cooler seasons on around 39 different hosts. Pigeon peas and cowpeas characterized by short maturation times and dense clusters are more prone to susceptibility. The extent of damage in cowpea was approximately 25-40 percent, whereas in pigeon pea, it fluctuated between 9 and 84 percent globally. Female moths placed around 200 flat, scaly eggs on flower buds, flowers, leaves, leaf axils, terminal shoots, and soft pods. The larvae are negatively responsive to light, with the larval phase spanning from 8 to 21 days on differing hosts. (Ganapathy, N. 2010) [5] *M. vitrata* is a major insect-pest of black gram, which appears attacks the crop throughout its growth period, from vegetative development to reproductive maturity, resulting in significant damage to flowers and pods by web formation and larval feeding

Materials and Methods

Experimental Site

The experiment was conducted at the Crop Research Centre (CRC) of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh. The research farm is situated 10 km from Meerut city on the Delhi-Dehradun National Highway (NH-58), at 29°17' N latitude and 77°42' E longitude, with an altitude of 237 m above mean sea level. The location represents the Western Plain Zone of Uttar Pradesh under the Upper Gangetic Plain agro-ecological region.

Meteorological data

The weekly average values of temperature, relative humidity, and cumulative rainfall observed throughout the crop growing period. i.e. Kharif, 2025 from meteorological observatory located at Department of Soil Science, SVPUA&T, Meerut and obtained for the seasonal occurrence and influence of climatic factors on population dynamics of spotted pod borers, *M. vitrata* in black gram.

Observation

Assessment of the occurrence of major pod borer pests were recorded at weekly intervals from 50% flowering stage until crop harvest. Larval population was assessed from 5 randomly selected plants in the untreated control plots and the mean value of larvae per 5 plants was computed to examine the population build-up trend. The relationship between pod borer incidence and prevailing weather parameters was analysed using simple correlation analysis as per the methodology outlined by (Gomez and Gomez, 1984) [6].

Statistical Analysis

$$r = \frac{S_{xy}}{[(S_x^2)(S_y^2)]^{1/2}}$$

Where, r = Simple correlation coefficient S_x^2 = Correlated sum of squares for meteorological parameter. S_y^2 = Correlated sum of squares for pest incidence. S_{xy} = Correlated sum of cross products

Pest Identification

The larval stage possesses a transparent and lustrous body marked with six rows of prominent black spots arranged along the thorax and abdomen. These characteristic markings give rise to the common name 'spotted caterpillar'. Larvae are agile in nature and, upon slight disturbance, escape by falling from infested flowers and pods while hanging through a silk thread. The insect completes its developmental cycle in approximately 18 to 35 days.

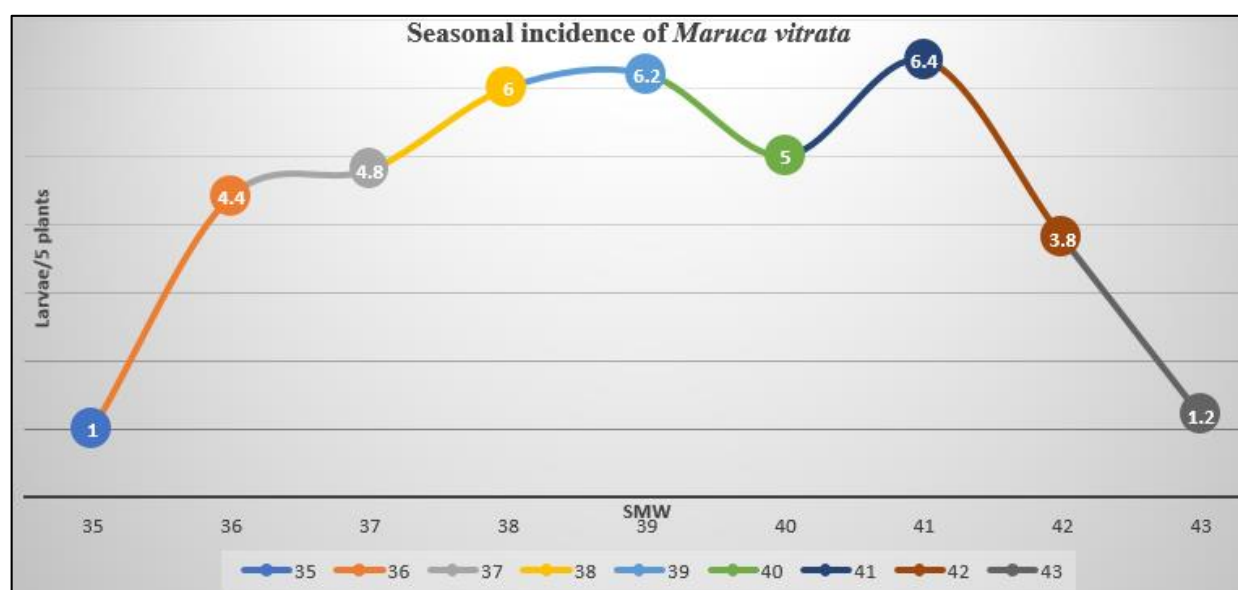
Table 1: Seasonal abundance of *Maruca vitrata* (Fabricius) and prevailing weather parameters.

SMW	Date	Larva/5 plant	Temperature		Relative humidity		Rainfall (mm)
			Max.	Min.	Morning	Evening	
35	25Aug-31Aug	1.00	29.90	24.80	96.00	82.40	201.80
36	01Sep-07Sep	4.40	34.10	25.00	90.90	80.40	41.20
37	08Sep-14Sep	4.80	34.20	25.50	87.40	76.40	8.40
38	15Sep-21Sep	6.00	35.10	25.00	83.70	73.10	8.00
39	22Sep-28Sep	6.20	35.70	25.00	78.10	58.10	0.00
40	29Sep-05Oct	5.00	31.50	22.40	88.60	73.60	35.00
41	06Oct-12Oct	6.40	31.50	19.20	84.10	62.60	0.00
42	13 Oct-19Oct	3.80	32.70	19.20	85.40	65.00	0.00
43	20Oct-26Oct	1.20	31.10	16.90	84.40	63.70	0.00

Table 2: Correlation coefficients (r) between *Maruca vitrata* (Fabricius) larval population and weather parameters.

Larval/5 plant	max.	min.	morning	evening	Rainfall(mm)
	0.667*	0.287	-0.586	-0.328	-0.592

*Significant at 0.05%

**Fig 1:** Seasonal Incidence of Spotted Pod Borer (*Maruca vitrata*, Fabricius) on Black Gram

Result

The findings related to the population dynamics of *Maruca vitrata* in relation to weather variables, along with their correlation analysis, are presented in Table 2 for the *Kharif* season of 2025.

Population dynamics

Table 1 and Fig. 1 illustrate the seasonal incidence of spotted pod borer, *Maruca vitrata* (Fabricius), on black gram. The occurrence of *M. vitrata* was first observed during the 35th SMW at the flowering stage of the crop, with a abundance of 1.00 larva per 5 plants. Thereafter, The larval abundance showed a gradual increase with the progression of crop growth and flowering. The population attained its maximum level during the 41st SMW, recorded 6.40 larvae/5 plants. Subsequently, the population revealed a declining trend and decreased to 1.20 larvae/5 plants by the 43rd SMW (20-26 October).

The current findings are in agreement with. conformity with the observations of Yadav and Singh (2015) [7], who noted that the incidence of *Maruca vitrata* commenced throughout the 35th SMW and reached maximum abundance during the subsequent weeks of crop growth. Comparable results were documented by Rathod *et al.* (2017), who observed the initiation of spotted pod borer incidence during the later

vegetative to flowering phase of the crop. Further, Berani *et al.* (2017) [9] also concluded that the occurrence of *M. vitrata* persisted from September to October, which is in agreement with the present observations of peak larval activity during the flowering stage followed followed by a gradual decrease as the crop approached maturity

Correlation

Correlation analysis between the data on larval abundance of *M. vitrata* in relation to weather variables, as presented in Table 2, indicated that maximum temperature showed a positive and significant association ($r = 0.667^*$) indicating that an enhancement in maximum temperature conditions were conducive to the build-up of population of larvae. Conversely, the minimum temperature ($r = 0.287$) revealed a positive but non-significant relationship, while relative humidity at morning hours ($r = -0.586$) relative humidity during evening hours ($r = -0.328$) and rainfall ($r = -0.592$) exhibited negative associations with larval incidence.

The observations of the present study are corroborated by the observations of Manjunath (2014) [10], who reported a significant positive association between maximum temperature and larval incidence of *Maruca vitrata*. Similar results were also documented by Sravani *et al.* (2015) [11], who recorded a significant positive association between

highest temperature and *M. vitrata* population. Kapoor and Shankar *et al.* (2019) ^[12] further reported that minimum temperature exhibited a positive influence on pest incidence which is consistent with the findings of the present study. The inverse relationship between rainfall and larval abundance recorded in the present study is in agreement with the observations of Sravani *et al.* (2015) ^[11], who reported a Negative association between rainfall and *M. vitrata* incidence. Comparable observations were recorded by Kapoor and Shankar *et al.* (2019) ^[12], who recorded a negative association of rainfall with pest population build-up. However, the present findings regarding relative humidity during morning hours are in contrast with the observations of Sravani *et al.* (2015) ^[11], who reported a positive relationship between morning relative humidity and larval population. The differences observed in the results may be attributed to differences in agro-climatic conditions, crop season, and prevailing environmental factors during the course of investigation.

Conclusion

The present investigation revealed that the incidence of *Maruca vitrata* commenced during the 35th SMW at the flowering phase of the crop and attained peak population during the 41st SMW. Similarly, the larval abundance showed a gradual reduction as the crop approached maturity. Correlation studies indicated that maximum temperature exhibited a significant positive effect on larval abundance build-up, whereas rainfall and relative humidity exhibited negative association with pest incidence. The study clearly demonstrated that warm and comparatively dry weather conditions favoured the multiplication and seasonal occurrence of *M. vitrata*. Therefore, timely monitoring of pest occurrence in association with prevailing weather parameters may be useful for forecasting pest outbreaks and adopting suitable management practices at the Flowering phase of the crop for effective suppression of *M.vitrata* infestation.

Declaration

The authors declare that they have no conflicts of interests.

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