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Influence of Different Planting Dates on the Occurrence of Key Pests Affecting Blackgram in the Lower Gangetic Alluvial Plain of West Bengal

A. Banerjee[1] and Sabyasachi Ray[2*]

[1]*AICRP on MULLaRP, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal (741 252), India*

[2]*Dept. of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal (741 252), India*

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Corresponding Author

Sabyasachi Ray

: sabyasachiray1997@gmail.com

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Abstract

A field oriented experiment was executed over two consecutive summer months in 2019 and 2020 to study the influence of sowing dates of blackgram or urdbean (*Vigna mungo* L. Hepper) on the population fluctuation of its major pests *viz*., flower infesting thrips (*Megalurothrips* sp.) and spotted pod borer or legume pod borer (*Maruca vitrata* Fabr.). The blackgram variety PU 31 was sown on three different dates, with ten days apart specifically, on the 14th of March, 24th of March and 3rd of April each year, representing early, medium and late sown crops. The experiment recorded fewer incidences of flower thrips in late-sown crop (population of 2.56 per 10 flowers in first year and 1.22 in second year) than early crop (4.71 and 2.42 in those years, respectively), while higher incidences of pod borer was recorded in late-sown crop (larval population of 2.49 plant^{-1} in first year and 2.58 in second year) than early crop (0.69 and 0.42 in those years, respectively). Given that early and late-sown crops attract more thrips and pod borers, respectively, it may be recommended to sow black gram during the last week of March, especially in the lower Gangetic plains of West Bengal.

Keywords: Blackgram, Date of Sowing, Incidence, Spotted pod borer, Thrips

Introduction

Pulses are abundant in protein content and rank as the second most significant dietary component of Indian people, following cereal crops (Justin *et al*., 2015). Among the pulses black gram or white lentil (*Vigna mungo* L. Hepper) is a swiftly growing plant classified within the Fabaceae family (Verdcourt, 1970) and it holds a significant position as one of India's crucial pulse crops. Black gram belongs to the Vigna crop group found in Asia (Delic *et al.*, 2009). In India, black gram or urdbean is commonly referred to as black bean, mashkalai, marsh, or mahn (Mandal *et al*., 2013). It comprises 59.6% carbohydrates, 24% protein, and 3.2% minerals. Additionally, every 100 g of split dahl consists of 154 mg of calcium, 38 mg of beta carotene and 9.1 mg of iron (Bakr *et al.*, 2004). Urdbean is also an important supplier of necessary vitamins *viz*. 64 IU vit A, 2 mg niacin, riboflavin 0.37 mg and 0.41 mg thiamine that are present in 100g edible seeds (Nitin, 2023). It is cultivated in various states of India including Assam, Bihar, Uttar Pradesh, West Bengal, Jammu and Kashmir, Himachal Pradesh, Madhya Pradesh, Tripura, Gujarat, Haryana, Kerala, Karnataka, Rajasthan, Punjab, Maharashtra, Tamil Nadu and Andhra Pradesh (Tiwari and Shivhare, 2016). India ranked as global leader in case of both production and utilization of black gram. In the 2021-22 periods, the country produced approximately 2.84 million tonnes of urdbean from a cultivation area of 4.76 mha, achieving on an average 596 kg ha^{-1} seed yield. Black gram cultivation represents roughly 29% of India's total pulse farming area contributing 10.25% of entire pulse crop production. In the *kharif* or rainy season of 2022-23, the speculated black gram or urdbean cultivation area expanded to 4.233 million hectares, marking a 1.96% increase compared to the previous year (Anonymous, 2022a). The major *kharif* blackgram cultivating Indian states are Madhya Pradesh

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with an area of 1.54 mha, Uttar Pradesh (0.7 mha), Maharashtra (0.45 mha), Rajasthan (0.4 mha), Odisha (0.16 mha), Chhattisgarh (0.13 mha) and Telangana (0.012 mha) (Anonymous, 2022b).

Black gram production in India is influenced by several biotic and abiotic stresses. Insect pests are major menacing factor among the biotic stress responsible for yield fluctuation and poor productivity. Numerous insect pests have been documented as affecting mungbean plants, leading to substantial damage in various stages, from seedlings to foliage, branches, stems, flower buds, flowers and fruits, resulting in significant crop failure (Sehgal and Ujagir, 1988; Litsinger *et al*., 1988). In India, approximately 18 to 20 insect pest species adversely affect black gram crops (Singh and Singh, 1977). Earlier reports suggested that various agro-climatic conditions, over two hundred pest insects, originating from 48 different families within various orders like Thysanoptera, Isoptera, Orthoptera, Hemiptera, Lepidoptera, Hymenoptera, Coleoptera, Diptera and seven species of acarine mites, have been documented to cause significant harm at various growth intervals of the crop (Naik *et al*., 2019). The extent of avoidable quantitative losses, which can range from 7% to 35%, resulting from a combination of insect pest attack in both black gram or urdbean and green gram or mung bean, fluctuates based on varying agro-climatic situations (Hamad and Dubey, 1983). Documentation suggested that loss of seed yield in black gram ranges from 15.6% to 30.9% due to infestation of several insect pests (Duraimurugan and Tyagi, 2014). Justin *et al*. (2015) reported that 27.7-67.8% urdbean yield was lost as a result of the infestation caused by defoliators and pod feeders, whereas sap suckers caused 25.9% yield loss in the same crop.

The timing of sowing significantly affects the soil temperature and the amount of moisture available to germinating seeds. Therefore, adjusting sowing periods may be an effective strategy which may help the crops to mitigate the biotic or abiotic stresses. However, the precise outcome in response to sowing dates varies depending on the specific location and the specific cultivation system in place (Nelson *et al*., 2022). The timing of sowing has a recognized impact on the damage potentiality of insect pests and the recovery capacity of plants from this damage (Rusch *et al*., 2010) Adjusting the sowing date is a vital cultural method for controlling insect pests in a crop. This practice enables the crop to avoid its most vulnerable stage when insect infestations are less prevalent. If the crop successfully progresses beyond its vulnerable stage, even when there is a high pest population during a less vulnerable stage, the impact on yield will be relatively minimal. Changing the sowing schedule can allow the crop to thrive in weather conditions that are less conducive to insect pests but beneficial for the crop. This way, the crop can navigate through its vulnerable stage while benefiting from these weather conditions. There is limited research available on this topic, especially in the context of black gram. In light of these factors, the current study was undertaken to investigate whether varying sowing dates had any impact on the pest situation in black gram cultivation within the new alluvial zone located at lower Gangetic basin of West Bengal.

Materials and Methods

This specific experiment was performed in open field condition at District Seed Farm, A-B Block, Kalyani, Nadia, West Bengal (22°87'N, 88°20'E). For the experiment summer seasons of two successive year's *viz*., 2019 and 2020 were selected. Black gram variety PU 31 was selected for the study. For this research, three distinct sowing dates, specifically, March 14th (D_1), March 24th (D_2) and April 4th (D_3), were selected as the treatment conditions for both years and considered as early, medium and late planted crop. The seeds were sown in the respective planting dates @ 25 kg seeds ha^{-1} using the spacing of 25 cm × 10 cm. The crops were maintained using the optimum recommended agronomic practices. Before sowing the urdbean seeds were mixed with Carbendazim + Mancozeb @ 2 g kg^{-1} of seeds to prevent different soil-borne diseases during the seedling stage. Fertilizers were given to the crop in a ratio of 20:40:20 of N, P_2O_5 and K_2O. Three sowing dates were considered as treatments and randomized block design (RBD) were adopted having seven replications. Whole setup of the study was maintained under totally insecticide free condition. Observation on pest scenario was started from three weeks after sowing. From each treatment (each date of sowing) five sample plants were selected and highlighted using bamboo sticks. Observations were taken early in the morning. During observation the plants were not disturbed so much to prevent the escape of the pest. For recording flower thrips (*Caliothrips* sp. and *Megaleurothrips* sp.) population ten flowers were randomly selected from each replication and shaken on a white paper. After falling of the thrips the individuals were counted. For taking observations on spotted pod borer population the plants with webs in the floral primordial were find out. The larval population from such five randomly selected plants was recorded. After that the pest population data was analyzed using analysis of variance to figure out whether any significant difference existed between the treatments or not using MS Excel 2010. The whole field experiment was extended up to the maturity of the crop.

Results and Discussion

Effect of Different Planting Dates on the Population of Flower Thrips on Blackgram During Summer 2019

In early sown crop (D1) thrips population started to occur from six weeks after planting. In medium (D_2) and late planted crop (D_3) the pest appeared one week earlier (Table 1, Figure 1) on the crop though their intensity of infestation were higher in the crop sown at 14th March (D1). Results showed that pest population varied significantly in the crop sown in the three different dates. Significant differences were observed in the weekly flower thrips population in all the three treatments (Table 1). In case of early sown crop (D_1) first peak (4.8 thrips per 10 flowers)

Table 1: Effect of date of sowing on the population of flower thrips on black gram during summer 2019

Date of Sowing	Population of flower thrips 10 flowers^{-1} at different weeks (Summer 2019)									Overall Mean
	3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS	10 WAS	11 WAS	
D_1 (14.03.19)	0 (0.71)	0 (0.71)	0 (0.71)	1 (1.19)	4.8 (2.29)	3.4 (1.96)	9.2 (3.10)	12.2 (3.55)	11.8 (3.50)	4.71 (2.27)
D_2 (24.03.19	0 (0.71)	0 (0.71)	1.6 (1.44)	2.2 (1.63)	2.6 (1.75)	0.4 (0.93)	6.8 (2.68)	10.6 (3.32)	8.6 (3.20)	3.64 (2.03)
D_3 (04.04.19)	0 (0.71)	0 (0.71)	0.6 (1.02)	1.8 (1.50)	1.6 (1.38)	1.8 (1.50)	4.2 (2.15)	7.6 (2.83)	5.4 (2.41)	2.56 (1.74)
S.Em. ±	NS	NS	0.08	0.09	0.11	0.1	0.11	0.13	0.1	0.06
CD (5%)	NS	NS	0.26	0.29	0.35	0.32	0.35	0.42	0.32	0.18

[WAS = Weeks after sowing]

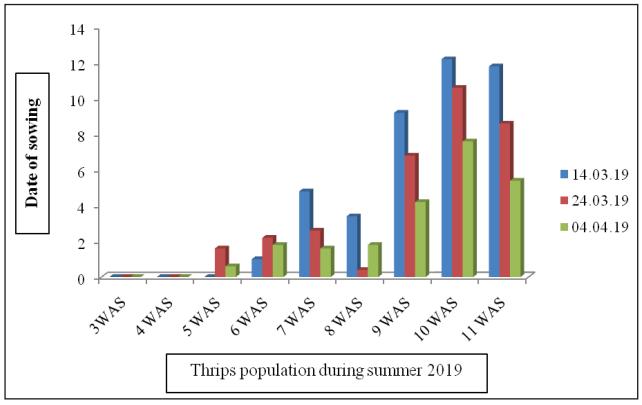

Figure 1: Effect of date of sowing on the population of flower thrips on black gram during summer 2019

and second peak (9.2 thrips per 10 flowers) population were observed during seven and nine weeks after sowing, respectively. Highest peak in the pest occurrence (12.2 thrips per 10 flowers) was observed during ten weeks after sowing in case of early sown blackgram (D_1). Medium sown (D_2) black gram crop observed comparatively less incidence of flowers thrips than early sown crop. This crop observed first peak of thrips incidence (6.8 thrips per 10 flowers) during nine week after sowing of the crop with a second and highest peak (10.6 thrips per 10 flowers) in the 10th week after sowing. Whereas, in late sown crop (D_3) highest thrips incidence (7.6 thrips per 10 flowers) was also recorded in the tenth week after sowing. Overall highest thrips population (4.71 thrips per 10 flowers) was noticed in the early sown crop (D_1) compared to the medium (D_2) and late sown (D_3) crop. Least thrips infestation (2.56 thrips per 10 flowers) was noted in the crop sown at 4th April.

Effect of Different Planting Dates on the Population of Maruca vitrata on Blackgram During Summer 2019

The concerned pod borer pest (*Maruca vitrata*) is the principal borer pest of black gram. It has been observed that the pest appeared in the crop in later stages like pod initiation stage and infestation of the pest occurred after the infestation of thrips. Infestation initiated at seventh week, 6th week and 5th week after sowing in case of early (D_1), medium (D_2) and Late (D_3) sown crop. Early infestation occurred on the late sown crop (Table 2, Figure 2). Significant variation in pest population was first observed during 5th week after sowing among the different respective sowing dates. After that significant variation was noticed among the weekly larval population occurred on the urdbean crop grown at different dates. In case of early sown crop (D_1) the borers initiated their attack by appearing as 0.6 larvae plant^{-1}, then gradually increased and reached the peak level 1.6 larvae plant^{-1} at 10th week after sowing and after that the pest population started to decrease. In medium sown (D_2) black gram crop the pest population experienced its highest peak (2.8 larvae plant^{-1}) at 11th week after sowing. Significantly higher pod borer population was

Table 2: Effect of date of sowing on the incidence of *Maruca vitrata* on black gram during summer 2019

Date of Sowing	Population of *Maruca vitrata* plant^{-1} at different weeks (Summer 2019)									Overall Mean
	3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS	10 WAS	11 WAS	
D_1 (14.03.19)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0.6 (1.03)	0.8 (1.12)	1.2 (1.28)	1.6 (1.44)	2 (1.57)	0.69 (1.07)
D_2 (24.03.19	0 (0.71)	0 (0.71)	0 (0.71)	0.6 (1.03)	1.8 (1.51)	1.4 (1.34)	2 (1.57)	2.4 (1.69)	2.8 (1.81)	1.22 (1.28)
D_3 (04.04.19)	0 (0.71)	0 (0.71)	0.4 (0.92)	1.4 (1.37)	2.8 (1.80)	2.6 (1.75)	4.2 (2.16)	5.2 (2.38)	5.8 (2.49)	2.49 (1.72)
S.Em. ±	NS	NS	0.05	0.05	0.06	0.1	0.09	0.06	0.08	0.07
CD (5%)	NS	NS	0.15	0.17	0.19	0.33	0.28	0.18	0.26	0.22

[WAS = Weeks after sowing]

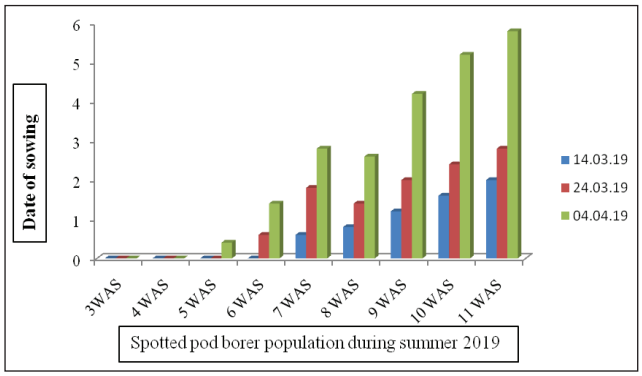

Figure 2: Effect of date of sowing on the population of spotted pod borer on black gram during summer 2019

observed in the medium grown crop compared to the early one. Maximum population of legume pod borer was documented in the 4th April (Late) sown crop. Highest peak borer incidence (5.8 larvae plant^{-1} occurred in the late sown urdbean. Overall mean pest population was minimum (0.69 larvae plant^{-1}) in early sown (D_1) crop and significantly higher mean population (1.22 larvae plant^{-1}) was recorded on medium sown crop (D_2). Highest mean larval population (2.49 larvae plant^{-1}) was noticed in the April sown crop.

Effect of Different Planting Dates on the Population of Flower Thrips on Blackgram During Summer 2020

The thrips population appeared on the crop five weeks after planting in second season in early-sown crop (D_1). For the medium (D_2) and late-sown crop (D_3), pest incidence was observed one week earlier, as indicated in table 1. Although the magnitude of thrips infestation was higher in the crop planted early, similar to previous year, the medium and late-sown crops exhibited thrips incidence earlier. The study revealed significant variations in pest population among crops sown on three different dates. Weekly flower thrips populations showed notable differences in all three treatments (Table 3, Figure 3). In the early-sown crop (D_1), the first and second peaks in thrips population (3.60 thrips per 10 flowers and 6.80 thrips per 10 flowers, respectively) were observed at seven and eight weeks after sowing. The highest peak in pest occurrence (6.80 thrips per 10 flowers) was noted in the eighth week after sowing for the early-sown crop (D_1). The medium-sown crop (D_2) of black gram demonstrated relatively lower flower thrips incidence compared to the early-sown crop, similar to the previous year. This crop recorded its highest peak (4.80 thrips per 10 flowers) in the eighth week after sowing. Conversely, the late-sown crop (D_3) exhibited the peak thrips incidence (4 thrips per 10 flowers) in the ninth week after sowing. Overall, the maximum thrips population (2.42 thrips per 10 flowers) was detected in the early-planted urdbean (D_1) compared to the medium (D_2) as well as late-sown (D_3) ones. The late-sown urdbean had the least thrips infestation (1.22 thrips per 10 flowers). These results were consistent with the findings of the previous year.

Table 3: Effect of date of sowing on the population of flower thrips on black gram during summer 2020

Date of Sowing	Population of flower thrips 10 flowers^{-1} at different weeks (Summer 2020)									Overall Mean
	3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS	10 WAS	11 WAS	
D_1 (14.03.20)	0.00 (0.71)	0.00 (0.71)	1.20 (1.25)	1.00 (1.15)	3.60 (1.98)	6.80 (2.65)	4.60 (2.24)	2.80 (1.80)	1.80 (1.50)	2.42 (1.67)
D_2 (24.03.20)	0.00 (0.71)	1.00 (1.18)	1.80 (1.47)	1.80 (1.45)	1.60 (1.29)	4.80 (2.24)	3.60 (2.00)	0.60 (1.00)	1.00 (1.18)	1.80 (1.42)
D_3 (04.04.20)	0.00 (0.71)	0.80 (1.12)	0.60 (1.03)	0.20 (0.82)	0.60 (1.01)	3.20 (1.85)	4.00 (2.12)	1.20 (1.25)	0.40 (0.74)	1.22 (1.26)
S.Em. ±	NS	0.09	0.10	0.16	0.18	0.20	0.10	0.13	0.10	0.11
CD (5%)	NS	0.30	0.30	0.50	0.56	0.63	0.31	0.40	0.30	0.36

[WAS = Weeks after sowing]

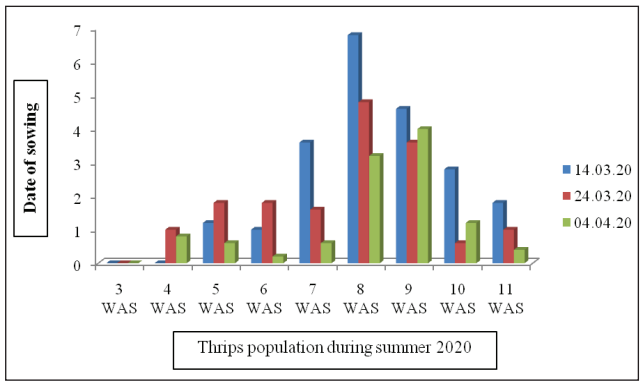

Figure 3: Effect of date of sowing on the population of flower thrips on black gram during summer 2020

Effect of Different Planting Dates on the Population of Maruca vitrata on Blackgram During Summer 2020

Almost similar trend of pest occurrence was observed in the summer 2020 also. Spotted pod feeder or bean pod borer (*Maruca vitrata*) is a significantly important borer of blackgram pods. It has been observed that the pest appeared in the crop in later stages like pod initiation stage and infestation of the pest occurred after the infestation of thrips just like previous year. Infestation initiated at 8th week after sowing, in case of early (D_1) sown crop and 7th week after sowing for medium (D_2) and Late (D_3) sown crop. Early infestation occurred on the later sown crop (Table 4, Figure 4). Significant variation in pest population was first observed during 7th week after sowing among the different

Table 4: Effect of date of sowing on the population of *Maruca vitrata* on black gram during summer 2020

Date of Sowing	Population of *Maruca vitrata* at different weeks (Summer 2020)									Overall Mean
	3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS	10 WAS	11 WAS	
D_1 (14.03.20)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0.2 (0.83)	0.8 (1.11)	1.2 (1.29)	1.6 (1.44)	0.42 (0.91)
D_2 (24.03.20)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0.6 (1.03)	0.6 (1.03)	1.6 (1.42)	2 (1.56)	1 (1.19)	0.64 (1.05)
D_3 (04.04.20)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	1.6 (1.42)	1.8 (1.50)	3.8 (2.06)	6.8 (2.70)	9.2 (3.09)	2.58 (1.73)
S.Em. ±	NS	NS	NS	NS	0.07	0.08	0.09	0.09	0.11	0.1
CD (5%)	NS	NS	NS	NS	0.2	0.26	0.29	0.28	0.34	0.3

[WAS = Weeks after sowing]

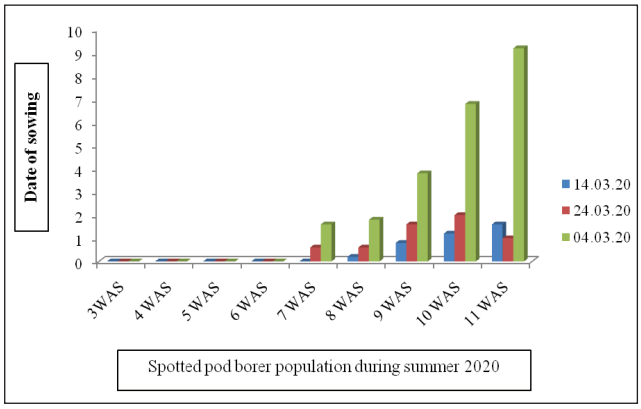

Figure 4: Effect of date of sowing on the population of spotted pod borer on black gram during summer 2020

respective sowing dates. After that significant variation was noticed among the weekly larval population occurred on the differently dated sown urdbean crop. In case of early sown crop (D_1) the borers initiated to appear with a population strength of 0.2 larvae individual plant^{-1}, then progressively uplifted and attained the highest level at 11th week after sowing and after that the pest population started to decrease. In medium sown (D_2) black gram crop the pest population experienced its highest peak (2 larvae plant^{-1}) at 10th week after sowing. Significantly higher incidence of borer pest was observed in the medium planted crop compared to the early sown urdbean. Maximum number of borers was detected in the 4th April (Late) sown crop. Highest peak borer incidence (9.2 larvae plant^{-1}) occurred in the late sown crop at 11th week after sowing. Over all mean population of spotted pod borer were minimum (0.42 larvae plant^{-1}) in early sown (D_1) crop and significantly higher mean population (0.64 larvae plant^{-1}) was recorded on medium sown crop (D_2). Highest mean larval population (2.58 larvae plant^{-1}) was noticed in the April sown crop.

Results from the two years of experiment indicated that pest infestation changes significantly with the changes of sowing time. Sowing of urdbean early in the season experienced higher infestation of thrips and late sowing resulted in higher infestation of spotted pod borer population. Former reports suggested that advanced and delayed sowing caused more thrips incidence in greengram (Sreekanth *et al*., 2002) as well as in blackgram also (Prodhan *et al*., 2008). Outcomes of the concerned experiment are partially endorsed by their experimental results. Present findings are also partially supported by Berani *et al*. (2018) who revealed that infestation of spotted pod borer was greater in late seeded urdbean. The observations are also in accordance with Hadiya *et al*. (2019) who found that early sowing of mungbean within first seven days of February invited more thrips infestation. Discoveries of this experiment has partial conformity with the reports of Anvesh *et al*. (2022) who noted that earlier sowing of Indian bean (*Lablab purpureus*) experienced minimum infestation of *Maruca vitrata* compared to late and very late sowing.

Conclusion

After observing the outcomes of the two years of experiment, conclusion may be drawn as- sowing date or planting time had significant impact on pest occurrence of black gram. So that by adjusting the date of sowing the pest damage can be reduced. As early and late sowing coincided with more flower thrips and spotted pod borer incidence respectively then the sowing of black gram crop can be done at last week of March, particularly in lower Gangetic plains of West Bengal.

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