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# Impact of Varied Sowing Dates on Incidence of Spotted Pod Borer and Gram Pod Borer on Indian bean, *Lablab purpureus* var. *typicus* (L.) Sweet in Semi-arid Region of Rajasthan

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**ABSTRACT: Indian bean, *Lablab purpureus var. typicus* (L.) Sweet (family: Fabaceae) is an important vegetable crop in India and other countries. It is presumed that pest appearance, population fluctuation, infestation rate and crop yield are dependent on sowing time. The manipulation of sowing time helps to minimize amount of pest damage by producing asynchrony between pest and host plant. Due to staggered sowing, pests are able to complete 1-2 additional generations in the season. In order to avoid supernumerary generations, sowing dates of crop can be adjusted in such a way that the crop is less palatable to the pest.**

**The experiment was laid out in a simple Randomized Block Design (RBD) with five treatments (date of sowing), each replicated four times. The plot size was 1.8 × 1.8 $m^2$ keeping row to row and plant to plant distance of 45 cm each. The Indian bean, variety Bauni was sown from 11$^{th}$ July, 2019 at weekly interval, *i.e.*, 11$^{th}$ July (early), 18$^{th}$ July (mid early), 25$^{th}$ July (normal), 1$^{st}$ August (late) and 8$^{th}$ August (very late). The crop was raised by using all the recommended package of practices and kept unsprayed throughout the experimental period.**

**The prime challenge of the study was to determine the optimum date of sowing for Indian bean crop in semi-arid region of Rajasthan to avoid losses due to pod borers. The minimum population of spotted pod borer and gram pod borer was recorded in the early sown crop (11$^{th}$ July), followed by mid early (18$^{th}$ July) and normal sown crop (25$^{th}$ July). The pod yield was inversely proportional to the population, *i.e.*, highest in the early sown crop and least in the very late sown crop. The pod yield of Indian bean had a significant negative correlation with sowing dates (r = -0.98), population of spotted pod borer (r = -0.95) and population of gram pod borer (r = -0.98). The population of spotted pod borer and gram pod borer had a significant positive correlation with sowing dates (r = 0.97 and 0.98, respectively), means as the sowing dates delayed, increased infestation was noticed.**

**Keywords:** Indian bean, Date of sowing, Spotted pod borer, Gram pod borer, Regression.

## INTRODUCTION

Indian bean, *Lablab purpureus* var. *typicus* (L.) Sweet (family: Fabaceae) is an important vegetable crop in India and other countries. It is also called as Indian butter bean, lablab bean, dolichos bean, Egyptian bean, Australian bean, bonavist bean, waby bean (English) and *Sem phali* (local dialect). It is a perennial herbaceous plant, primarily grown for green pods, while dry seeds are used in vegetable and culinary preparations (Anvesh *et al*., 2021). The leaves are eaten as leafy vegetable and the flowers and seeds are also eaten as food. The fruit (pod) is wide and elongated pod which has seeds inside it. It is one of the major sources of proteins, minerals, and dietary fibre. The green pods have a high nutritive value, comprising of protein 3.8 g, carbohydrate 6.7 g, vitamin-A 312 IU, mineral 0.9 g, fat 0.7 g and oxalic acid 1 mg per 100 g (Bose *et al*, 1993).

Indian bean as a field crop is mostly confined to the peninsular region and cultivated to a large extent in Karnataka and adjoining districts of Tamilnadu, Andhra Pradesh and Maharashtra. Karnataka contributes a major share accounting for nearly 90 per cent in terms of both area and production in the country. In Rajasthan, beans (all type) are grown approximately in 1.29 thousand hectares area with an annual production of 2.12 thousand metric ton pods. It is cultivated in Jaipur, Bundi, Kota and Bharatpur districts. The productivity of Indian bean varies from 80-120 q green pods/ hectare (Indiastatagri, 2021). It is presumed that pest appearance, population fluctuation, infestation rate and crop yield are dependent on sowing time. The manipulation of sowing time helps to minimize amount of pest damage by producing asynchrony between pest and host plant. Due to staggered sowing, pests are able to complete 1-2 additional generations in the season. In order to avoid supernumerary generations, sowing dates of crop can be adjusted in such a way that the crop is less palatable to the pest. Such kind of study helps in finding out the best dates of sowing. The present study was intended to analyse the effect of different sowing dates on the incidence of two pod borers, *viz*., spotted pod borer and gram pod borer.

## MATERIALS AND METHODS

The present investigations were conducted at Horticulture Farm of S.K.N. College of Agriculture, Jobner (Rajasthan) on Indian bean crop under field conditions during *Kharif*, 2019. Geographical location of Jobner pertains to 26°06′ North latitude, 75°28′ East longitude and an elevation of 427 metres above mean sea level (MSL).

*A. Experimental layout*

The experiment was laid out in a simple Randomized Block Design (RBD) with five treatments (date of sowing), each replicated four times. The plot size was 1.8 × 1.8 $m^2$ keeping row to row and plant to plant distance of 45 cm each. The Indian bean, variety Bauni was sown from 11$^{th}$ July, 2019 at weekly interval, *i.e.*, 11$^{th}$ July (early), 18$^{th}$ July (mid early), 25$^{th}$ July (normal), 1$^{st}$ August (late) and 8$^{th}$ August (very late). The crop was raised by using all the recommended package of practices and kept unsprayed throughout the experimental period. The pictorial representation of the experimental field at vegetative and flowering stage is depicted in Plate-I and II, respectively.

**Plate I:** Experimentation on different dates of sowing.

**Plate II:** Field view during flowering stage.

*B. Observations*

The observations on larval populations of *M. vitrata* and *H. armigera* were recorded from their appearance to harvesting of the crop. For this purpose, five plants were randomly selected from each plot and earmarked by tagging. The incidence of *M. vitrata* and *H. armigera* was determined by counting the population of larvae on five randomly selected and tagged plants at weekly interval. The incidence was also studied in terms of mean pod damage by counting the total number of pods and damaged pods on five randomly selected and tagged plants.

*C. Statistical analysis*

The data obtained on pod borers populations from experimental plots were transformed into √x+0.5 value and subjected to analysis of variance (Gomez and Gomez, 1976). The correlation and regression analysis between date of sowing, pest population and yield were determined by subjecting the data to simple correlation coefficient and linear regression analysis. Coefficient of determination ($R^2$) was also calculated. The data on pod yield per plot was converted into quintal per hectare and analyzed statistically.

## RESULTS AND DISCUSSION

A commendable work on effect of sowing dates on incidence of pod borers in different crops was done earlier by many workers (Hossain *et al*., 2009; Ogah and Ogah, 2012; Dialoke *et al*., 2014; Berani *et al*., 2018; Jat *et al*., 2018 etc.). An effort to carry out studies on this line has been done during *Kharif*, 2019. Owing to the high population of pod borers, *i.e*., spotted pod borer, *Maruca vitrata* (Geyer) and gram pod borer, *Helicoverpa armigera* (Hubner) on Indian bean, *Lablab purpureus var. typicus* (L.) Sweet, these were regarded as the major pod borers.

**Incidence of pod borers during the experimental period:** The observations on the incidence of pod borers were taken at weekly interval from appearance to harvest of the crop.

**Spotted pod borer, *Maruca vitrata* (Geyer)**

The incidence of spotted pod borer was greatly influenced by change in the sowing dates. The borer started appearing after four weeks of sowing in early sown crop (11th July) and after three weeks of sowing in mid early date (18th July) and normal date (25th July) sown crops. It appeared after a couple of weeks of sowing in late date (1st August) and very late date (8th August) sown crops. In the beginning of fourth week of August (22.08.2019), the presence of borer was seen in all plots sown on different dates. The population of the pest started increasing gradually and attained a peak during second week of September (12.09.2019) and then started declining. During the peak, the minimum infestation was recorded on early (5.75 larvae/ five plants) and mid early (7.25 larvae/ five plants) sown crops, both being at par with each other. The maximum infestation was recorded on very late (13 larvae/ five plants), followed by late (11.75 larvae/ five plants) and normal (10.25 larvae/ five plants) sown crops and statistically these were at par. However, the data in the Table 1 indicates that the mean larval population at peak and overall mean larval population of spotted pod borer was minimum in early sown crop and maximum in very late sown crop.

**Gram pod borer, *Helicoverpa armigera* (Hubner).**

The incidence of gram pod borer was also influenced by change in the sowing dates. The pest started appearing after four weeks of sowing in early sown crop (11th July) and after three weeks of sowing in mid early (18th July) and normal (25th July) sown crops. It appeared after a couple of weeks of sowing in late (1st August) and very late (8th August) sown crops. In the beginning of fourth week of August (22.08.2019), the presence of borer was seen in all plots sown on different dates. The population of the pest started increasing gradually and attained a peak during third week of September (19.09.2019) and then started declining. During the peak, the minimum infestation was recorded on early (3 larvae/ five plants) and mid early (3.75 larvae/ 5 plants) sown crops, both being at par with each other. The maximum infestation was recorded on very late (13 larvae/ five plants), followed by late (11.75 larvae/ five plants) sown crops and were statistically at par. Moderate infestation was recorded on normal (7.50 larvae/ five plants) sown crop. However, the data in the Table 2 indicated that the mean larval population at peak and overall mean larval population of spotted pod borer was minimum in early sown crop and maximum in very late sown crop. The larva of spotted pod borer and gram pod borer are depicted in Plate III.

**A.** Larva of gram pod borer, *Helicoverpa armigera* (Hubner).

**B.** Larva of spotted pod borer, *Maruca vitrata* (Geyer) with web.

**Plate III:** Larvae of spotted pod borer and gram pod borer feeding on Indian bean pods.

**Table 1: Larval population of spotted pod borer, *Maruca vitrata* (Geyer) on Indian bean sown at various dates in *Kharif*, 2019.**

| Sowing dates | Population/ five plants at different dates | | | | | | | | | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 08/8 | 15/8 | 22/8 | 29/8 | 5/9 | 12/9* | 19/9 | 26/9 | 03/10 | 10/10 | 17/10 | 24/10 | 31/10 | 7/11 | |
| 11th July | 0.50 | 1.25 | 2.25 | 3.25 | 4.50 | 5.75 | 5.25 | 4.50 | 4.00 | 3.00 | 2.00 | 1.50 | 0.75 | 0.75 | 2.80 |
| | (0.97) | (1.31) | (1.65) | (1.93) | (2.21) | (2.49) | (2.38) | (2.22) | (2.11) | (1.86) | (1.56) | (1.40) | (1.10) | (1.10) | (1.81) |
| 18th July | 1.00 | 2.25 | 3.50 | 4.75 | 5.75 | 7.25 | 6.50 | 5.50 | 4.75 | 3.75 | 3.00 | 2.25 | 1.75 | 1.25 | 3.80 |
| | (1.22) | (1.65) | (2.00) | (2.28) | (2.49) | (2.77) | (2.64) | (2.44) | (2.28) | (2.06) | (1.86) | (1.65) | (1.49) | (1.31) | (2.06) |
| 25th July | 0.00 | 0.75 | 2.50 | 3.25 | 6.00 | 10.25 | 8.75 | 7.50 | 5.75 | 3.50 | 2.25 | 1.25 | 0.75 | 0.50 | 3.78 |
| | (0.71) | (1.10) | (1.73) | (1.93) | (2.55) | (3.27) | (3.04) | (2.82) | (2.50) | (2.00) | (1.65) | (1.31) | (1.10) | (0.97) | (2.06) |
| 1st Aug. | 0.00 | 2.25 | 3.50 | 5.25 | 8.00 | 11.75 | 10.50 | 9.00 | 7.75 | 5.75 | 3.50 | 2.25 | 1.50 | 1.00 | 5.14 |
| | (0.71) | (1.65) | (2.00) | (2.39) | (2.91) | (3.50) | (3.31) | (3.08) | (2.78) | (2.49) | (2.00) | (1.65) | (1.40) | (1.22) | (2.37) |
| 8th Aug. | 0.00 | 0.00 | 3.00 | 5.25 | 8.75 | 13.00 | 11.25 | 8.75 | 7.75 | 6.75 | 4.50 | 3.50 | 2.75 | 2.25 | 5.53 |
| | (0.71) | (0.71) | (1.86) | (2.39) | (3.04) | (3.67) | (3.42) | (3.04) | (2.86) | (2.68) | (2.23) | (2.00) | (1.80) | (1.65) | (2.45) |
| S.Em. ± | 0.07 | 0.08 | 0.09 | 0.10 | 0.11 | 0.12 | 0.12 | 0.12 | 0.11 | 0.10 | 0.08 | 0.08 | 0.12 | 0.10 | 0.09 |
| CD at 5% | 0.21 | 0.26 | 0.28 | 0.30 | 0.34 | 0.36 | 0.38 | 0.37 | 0.33 | 0.32 | 0.24 | 0.25 | 0.36 | 0.32 | 0.27 |

*Peak population Figures in the parentheses are √X+0.5 values.

**Table 2: Larval population of gram pod borer, *Helicoverpa armigera* (Hubner) on Indian bean sown at various dates in *Kharif*, 2019.**

| Sowing dates | Population/ five plants at different dates | | | | | | | | | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 08/8 | 15/8 | 22/8 | 29/8 | 5/9 | 12/9 | 19/9* | 26/9 | 03/10 | 10/10 | 17/10 | 24/10 | 31/10 | 7/11 | |
| 11th July | 0.25 | 0.50 | 0.75 | 1.25 | 2.00 | 2.75 | 3.00 | 2.25 | 2.25 | 1.50 | 0.75 | 0.75 | 0.50 | 0.50 | 1.36 |
| | (0.84) | (0.97) | (1.10) | (1.31) | (1.56) | (1.79) | (1.84) | (1.63) | (1.64) | (1.40) | (1.10) | (1.10) | (0.97) | (0.97) | (1.36) |
| 18th July | 0.50 | 0.75 | 1.00 | 1.75 | 2.75 | 3.25 | 3.75 | 3.00 | 2.75 | 1.75 | 1.25 | 1.50 | 1.00 | 1.00 | 1.86 |
| | (0.97) | (1.10) | (1.22) | (1.49) | (1.80) | (1.92) | (2.05) | (1.86) | (1.79) | (1.48) | (1.31) | (1.40) | (1.22) | (1.22) | (1.54) |
| 25th July | 0.00 | 0.25 | 1.50 | 3.00 | 4.25 | 7.00 | 7.50 | 5.50 | 3.75 | 2.25 | 1.75 | 1.00 | 0.75 | 0.75 | 2.80 |
| | (0.71) | (0.84) | (1.40) | (1.86) | (2.17) | (2.73) | (2.82) | (2.44) | (2.05) | (1.65) | (1.49) | (1.22) | (1.10) | (1.10) | (1.82) |
| 1st August | 0.00 | 1.75 | 3.00 | 4.75 | 7.75 | 9.50 | 11.00 | 8.25 | 6.50 | 4.75 | 2.75 | 1.75 | 1.25 | 0.50 | 4.53 |
| | (0.71) | (1.49) | (1.86) | (2.29) | (2.78) | (3.16) | (3.38) | (2.95) | (2.64) | (2.28) | (1.80) | (1.49) | (1.31) | (0.97) | (2.22) |
| 8th August | 0.00 | 0.00 | 2.50 | 4.75 | 7.75 | 10.25 | 12.00 | 8.00 | 6.75 | 6.25 | 3.75 | 2.75 | 2.25 | 1.75 | 4.91 |
| | (0.71) | (0.71) | (1.73) | (2.28) | (2.87) | (3.27) | (3.53) | (2.91) | (2.69) | (2.59) | (2.05) | (1.80) | (1.65) | (1.49) | (2.33) |
| S.Em. ± | 0.08 | 0.10 | 0.10 | 0.09 | 0.11 | 0.12 | 0.14 | 0.13 | 0.12 | 0.10 | 0.10 | 0.09 | 0.10 | 0.08 | 0.09 |
| CD at 5% | 0.25 | 0.30 | 0.31 | 0.28 | 0.33 | 0.37 | 0.43 | 0.39 | 0.37 | 0.32 | 0.30 | 0.28 | 0.32 | 0.25 | 0.26 |

* Peak population Figures in the parentheses are √X+0.5 values.

**Effect of different sowing dates on pod yield of Indian bean.** As evident in Table 3, there was a considerable variation in the pod yield of Indian bean due to different sowing dates. The pod yield was maximum (58.43 q/ ha) in early sown crop, followed by mid early sown crop (55.60 q/ ha) and both were statistically at par. The pod yield was minimum in very late sown crop (46.26 q/ ha), followed by late (46.82 q/ha) and normal (51.24 q/ ha) sown crops. However, there was a comparable variation in yield of normal sown crop with that of early and very late sown crops. The regression equation between sowing dates and pod yield is represented by Fig. 3.

**Table 3: Pod yield of Indian bean as influenced by different dates of sowing.**

| Sr. No. | Date of Sowing | Yield (q/ha) |
|---|---|---|
| 1. | 11th July | 58.43 |
| 2. | 18th July | 55.6 |
| 3. | 25th July | 51.24 |
| 4. | 1st August | 46.82 |
| 5. | 8th August | 46.26 |
| **S.Em. ±** | | **2.12** |
| **CD (p=0.05)** | | **6.54** |

**Correlation coefficient and regression equation between sowing dates, spotted pod borer population and pod yield of Indian bean.**

The data presented in Table 4 indicates that the pod yield of Indian bean had significant negative correlation with sowing dates (r= -0.980) and population of spotted pod borer (r= -0.951). Whereas, the population of spotted pod borer showed significant positive correlation with sowing dates (r= 0.966).

The regression equation shown in the Table 4 indicates that 93.4 and 96.1 per cent variation in spotted pod borer population and yield is attributable to sowing dates, respectively. The data given in the same table indicates that 90.5 per cent variation in the yield is attributable to spotted pod borer population. Thus, the pod yield of Indian bean is significantly influenced by sowing dates and population of spotted pod borer. The regression equation between sowing dates and spotted pod borer is represented by Fig. 1.

**Correlation coefficient and regression equation between sowing dates, gram pod borer population and pod yield of Indian bean**

The data presented in Table 4 indicates that the pod yield of Indian bean had significant negative correlation with sowing dates (r= -0.980) and population of gram pod borer (r= -0.984). Whereas, the population of gram pod borer showed significant positive correlation with sowing dates (r= 0.978).

The regression equation indicated that 95.6 and 96.1 per cent variation in spotted pod borer population and yield is attributable to sowing dates, respectively. The data given in the same table indicated 97.0 per cent variation in the yield which is attributable to spotted pod borer population. Thus, the pod yield of Indian bean is significantly influenced by sowing dates and population of spotted pod borer. The regression equation between sowing dates and gram pod borer is represented by Fig. 2.

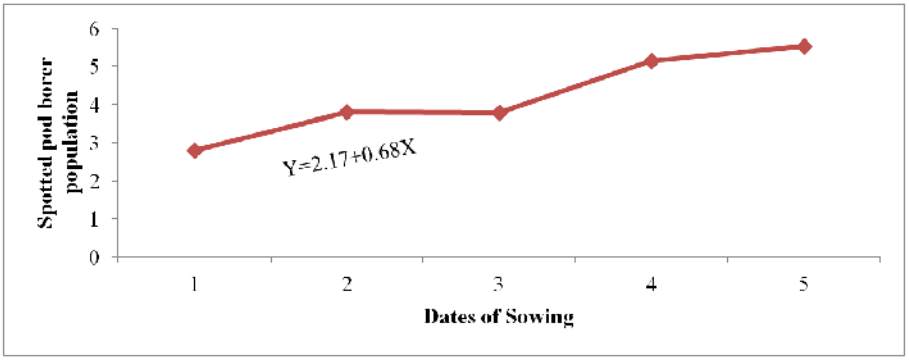


**Fig. 1.** Regression equation between dates of sowing and population of spotted pod borer.

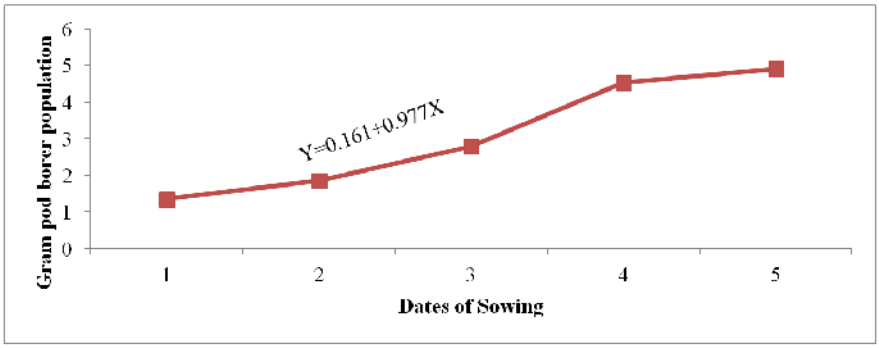


**Fig. 2.** Regression equation between dates of sowing and population of gram pod borer.

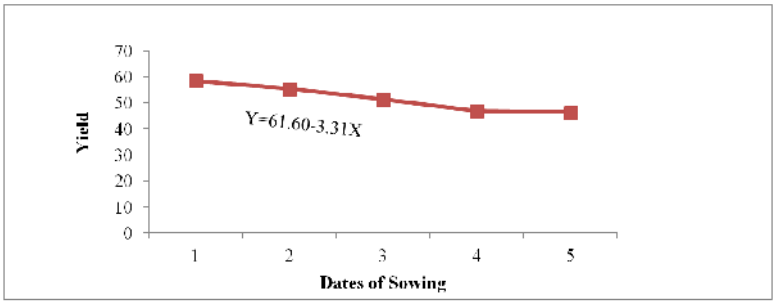


**Fig. 3.** Regression equation between dates of sowing and yield.

**Table 4: Relationship between sowing dates, populations of pod borers, *Maruca vitrata* (Geyer) and *Helicoverpa armigera* (Hubner) and pod yield of Indian bean**

| Sr. No. | Variable | Correlation coefficient | Regression equation (Y= a+bX) | $R^2$ value |
|---|---|---|---|---|
| 1. | Sowing dates (X) *vs*. Larval population of spotted pod borer (Y) | 0.966** | Y= 2.17 + 0.68 X | 0.934 |
| 2. | Sowing dates (X) *vs*. Larval population of gram pod borer (Y) | 0.978** | Y= 0.161 + 0.977 X | 0.956 |
| 3. | Sowing dates (X) *vs*. Yield (Y) | -0.980** | Y= 61.60 – 3.31 X | 0.961 |
| 4. | Larval population of spotted pod borer (X) *vs*. Yield (Y) | -0.951* | Y= 70.91 – 4.57 X | 0.905 |
| 5. | Larval population of gram pod borer (X) *vs*. Yield (Y) | -0.984** | Y= 61.97 – 3.33 X | 0.970 |
| **Significant at 1 per cent level of significance (LOS), *Significant at 5 per cent LOS. | | | | |


## SUMMARY

In order to study the effect of manipulation of date of sowing/ time of sowing, the crop was sown on different dates with a weekly interval between each sowing. The mean larval population of spotted pod borer, *M. vitrata* and gram pod borer, *H. armigera* was minimum in early sown crop (11th July), followed by Mid early (18th July), normal (25th July), late (1st August) and very late sown (8th August) crops. The pod yield was maximum in early sown crop (58.43 q/ha), followed by mid early (55.60 q/ha), normal (51.24 q/ha), late (46.82 q/ha) and very late sown crop (46.26 q/ha). The difference in population and pod yield was found to be significantly low between two consecutive dates but there was a significant variation in yield and pest population between early and very late sown crops. Hence in the semi-arid region of Rajasthan sowing of Indian bean crop in second or third week of July is appropriate to minimize damage by pod borers and to get higher yields. There was a positive correlation between sowing dates and larval population. Pod yield had negative correlation with sowing dates and larval population.


## CONCLUSIONS

— The mean larval population of spotted pod borer, *M. vitrata* and gram pod borer, *H. armigera* was minimum in early sown crop (11th July), followed by Mid early (18th July), normal (25th July), late (1st August) and very late sown (8th August) crops.

— The pod yield was maximum in early sown crop (58.43 q/ha), followed by mid early (55.60 q/ha), normal (51.24 q/ha), late (46.82 q/ha) and very late sown crop (46.26 q/ha). The difference in population and pod yield was found to be significantly low between two consecutive dates but there was a significant variation in yield and pest population between early and very late sown crops. Hence in the semi-arid region of Rajasthan sowing of Indian bean crop in second or third week of July is appropriate to minimize damage by pod borers and to get higher yields.

— There was a positive correlation between sowing dates and larval population. Pod yield had negative correlation with sowing dates and larval population.

## FUTURE SCOPE

A detailed multilocation experimentation on dates of sowing of Indian bean and its impact on crop yield and loss estimation give a clear idea of optimum date of sowing. Correlating and analysing the results gives the reasons behind the positive and negative impacts of a particular date of sowing on yield and pest population.


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