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Impact of Sowing Time on Insect Pest Incidence of Soybean, *Glycine max* (L.) in Kashmir, India

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Authors' contributions

This work was carried out in collaboration among all authors. Author SC conducted the experiment and prepared the manuscript. Authors ZHK, SM, JL and TY provided planning, suggestions and guidance during the study, and reviewed and revised the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Soybean (*Glycine max)* is a versatile legume crop crucial for global food security, edible oil production, livestock feed and soil health through crop rotation. The present study investigated the effect of three sowing dates on insect pest incidence as well as on yield of soybean crop. Seven insect pests were found to be associated with the crop belonging to three major insect orders *viz.,* Whitefly (*Bemisia tabaci)*, Aphid (*Aphis fabae)*, Jassid*(Apheliona maculosa*), and Thrips *(Thrips tabaci*) from order Hemiptera and two species of Flea beetle (*Alticahimensis* and

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Luperomorpha xanthodera) of order Coleoptera, Cabbage looper (*Trichoplusia ni*) of Lepidoptera. The crop sown on the first sowing date (10th June, 2023) had the highest infestation of sucking pests as compared to the other two sowing dates (25th June and 10th July, 2023) and observed that with the delay in sowing of soybean crops the population of sucking pest decreases while highest infestation of defoliators was recorded in crops sown on the third sowing date (10th July, 2023) than soybean crop sown earlier. The study concludes that the sowing time significantly influences the incidence of all documented insect pest, with the exception for the cabbage looper, as well as on the yield of soybean. The maximum grain yield was harvested from the crop sown on 10th of June, 2023 (1145 kg/ha) as these plants exhibited greater bushiness and vitality, characterized by a higher pod than other sowing dates (836.24 kg/ha for crop sown on 25th June and 746.66 kg/ha for crop sown on 10th July, 2023). Furthermore, the present study establishes that there was no significant yield reduction attributed to insect pests, as all recorded pests remained below the economic threshold level.

Keywords: Soybean; sowing date; incidence; sucking pests; defoliators; yield; economic threshold level.

1. INTRODUCTION

Soybean, scientifically known as *Glycine max* (L.) Merrill, is a prominent oilseed crop around the world, playing a remarkable role in the global food trade and almost every part of soybean is used for various purposes. It is used as an oilseed crop, contributing 25% to the overall production of vegetable oil and is a cheap source of high-quality protein, providing about two-thirds of the world's protein concentrate for livestock feeding and serving as a valuable ingredient in formulated feeds for poultry and fish.

India ranks 5th in soybean production with 11.23 million tonnes (Anonymous, 2023). Despite its global importance, soybean production in India struggles to meet domestic demand, primarily due to the poor average yields influenced by climatic challenges and pest infestations. The cultivation and production of soybean in the region of Jammu and Kashmir are relatively modest when compared to other states in India. Currently, this agricultural activity is predominantly practiced on a small scale to meet local demand, either in its pure form or intercropped with maize. Historically, Jammu and Kashmir played a leading role in soybean cultivation during the 1940s and 1950s, with an annual yield of 502 tonnes spread over 702.80 hectares (Shurtleff and Aoyagi, 2012).

Soybean is highly susceptible to insect pests, with around 380 species affecting the crop worldwide. While in Jammu and Kashmir 102 insect pest species *viz., Altica himensis, Liriomyza trifolii, Bemsia tabaci, Aphis craccivora, Aeolothrips meridionalis, Spodoptera litura, Pieris brassicae, Plutella xylostella* etc were found associated with vegetable crops (Bhat and Ahanger, 2018). Major insect pests of Kashmir especially on soybean includes Flea beetle, *Altica hemensis* and Gram pod borer, *Helicoverpa armigera* (Zuhaib, 2021). The luxuriant growth and tender foliage attract insects, which pose a significant threat by impairing quality and increasing production costs (Lodaya and Borad, 2017).

Addressing this challenge requires effective integrated pest management strategies that include cultural methods, like adjusting planting dates. In order to control insect and prevent plant production form pest damage, it is important to know pest and host plant relation. Sowing date is important for taking control measures against pest population. Proper timing can help soybean plants avoid synchrony with pest emergence, reducing damage. The studies of alternative control methods are important. This study is also looking for alternative control measures to find out incidence between pest and host plant. Furthermore, this study also helps to understand the pest dynamics in particular locality and helpful to the farmers for need based pest control. Although, impact of sowing time on insect pest incidence of soybean have been studied elsewhere, no such work has been done on said crop in Kashmir. Therefore, the present study was conducted to determine the effect of sowing time on insect pest incidence as well as on yield.

2. MATERIALS AND METHODS

The study was conducted in the experimental field of Sher-e-Kashmir University of Agricultural Sciences and Technology, Shalimar Srinagar, Jammu and Kashmir during Kharif season of 2023. Seeds of soybean, *Swarna vasundhara*

was sown on three different sowing times i.e. June 10th, June 25th and 10th July 2023. The different sowing dates were treated as treatments and each treatment had 6 replications in a randomized block design, with each plot (1mx1m) having a row and plant spacing of 45 and 15 cm, respectively. Insect pest observations were recorded during the morning and evening hours at weekly intervals starting from the crop emergence till the maturity of crop. Randomly, five plants from each treatment (six replications) were selected, and pest observations on the sap-sucking pests were documented from three leaves per plant (top, middle and bottom), while defoliator pests were counted per plant. The insect pests found associated with the soybean were collected and brought to the Biosystematics laboratory of the Division of Entomology, SKUAST-K, Shalimar for further analysis and identification. Harvesting was done manually when the leaves and pods of the crop reached a yellow coloration, indicating their readiness for collection with the help of a sickle at 3-4 cm above the ground level and were left for sun drying. Pods were harvested manually, during this process, care was taken to prevent any mixing of crops from various treatments. Seeds from plots that shared the same sowing date were gathered. Randomly five plots were selected and weighed for assessment of yield and accordingly, the yield data was converted into kg per hectare.

3. RESULTS AND DISCUSSION

Seven insect pests belonging to three major insect orders *viz.,* Whitefly (*Bemisiatabaci,* Gennadius, 1889), Aphid (*Aphis fabae,* Scopoli, 1763), Jassid (*Apheliona maculosa,* Distant, 1918), Thrips (*Thrips tabaci,* Lindeman, 1889) from Hemiptera order, two species of Flea beetle, *Alticahimensis,*(Shukla, 1960) and *Luperomorpha xanthodera* (Fairmaire, 1888) from order Coleoptera and Cabbage looper, *Trichoplusiani* (Hübner, 1802) of order Lepidoptera were found associated with the crop across three sowing dates.

3.1 Effect of Different Sowing Dates on the Infestation of Sucking Pests on Soybean, *Swarna vasundhara* during the Year 2023

The data presented in Table 1 and Fig. 1 showcases the impact of different sowing dates on the infestation levels of sucking pests in soybean crop. The highest infestation of sucking pests *viz*., whitefly (*Bemisia tabaci*), aphid *(Aphis fabae)*, jassid *(Apheliona maculosa)* and thrips *(Thrips tabaci),* were observed in the crop sown on 10th June 2023 with a mean population of 2.40±0.02, 12.46±0.05, 2.10±0.03, and 4.41±0.15, respectively. The infestation of all the documented pests decreased slightly for the crop sown on 25th June 2023, while the lowest population was observed when the crop sown on 10th July 2023 with an average population of 2.23±0.01, 5.92±0.03, 1.71±0.08 and 3.62±0.05, respectively. The statistical analysis revealed that the incidence of all the documented sucking pests across the three sowing dates were statistically significant and the population decreases with the delay of sowing time.

The observation of Kalyan and Ameta (2017) and Sable et al*.* (2018) supports our current findings revealing significantly higher mean population of whiteflies in early sown crops than late sown. Similar finding regarding aphids was reported by Tun et al. (2020). The findings on jassid population align with the findings of Sable et al*.* (2018). The current finding on thrips is consistent with those of Sreekanth et al. (2002) and Prodhan et al. (2008) observation.

3.2 Effect of Different Sowing Dates on the Infestation of Defoliator Pests on Soybean, *Swarna vasundhara* during the Year 2023

The data presented in Table 2 and Fig. 2 represents the impact of different sowing dates on the infestation levels of defoliator pests in soybean crop. The lowest population of defoliators including flea beetle *(Alticahi mensis)*, red-headed flea beetle *(Luperomorpha xanthodera)* and cabbage looper *(Trichoplusia ni)* were recorded on 10th June with a mean population of 0.76±0.01, 0.81±0.03 and 0.37±0.01, respectively. The infestation of all the documented pests increased slightly for thecropsown on 25th June, while the highest population was observed on the crop sown on 10th July with a mean population of 0.86±0.01, 0.97±0.03 and 0.39±0.01, respectively. The statistical analysis revealed that the incidence of the documented defoliator pests across the three sowing dates were statistically significant with the exception of cabbage looper and the population increases with the delay of sowing time.

Table 1. Effect of different sowing dates on the infestation of sucking pests in soybean, *Swarna vasundhara* during the year 2023

S. No	Treatment (Sowing date)	No. of whiteflies/3 leaves*	No. of aphids/3 leaves*	No. of jassids /3 leaves*	No. of thrips/3 flowers*
1	10th June	2.40±0.02	12.46±0.05	2.10±0.03	4.41±0.15
2	25th June	2.29±0.02	10.28±0.05	1.79±0.01	3.61±0.03
3	10th July	2.23±0.01	5.92±0.03	1.71±0.08	3.62±0.05
C.D at 5%		**0.08**	**0.15**	**0.07**	**0.32**
SE(d)		**0.03**	**0.07**	**0.03**	**0.14**

** Mean ± S.E.M = Mean values ± Standard error of means of six replications*

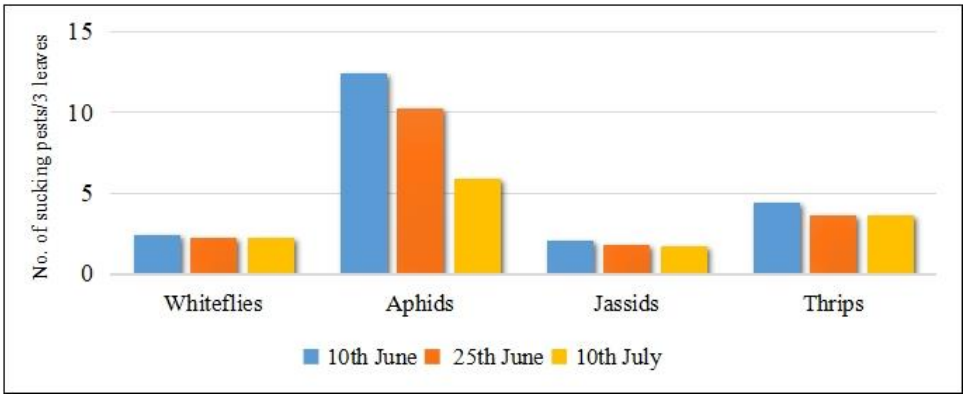

Fig. 1. Effect of different sowing dates on the infestation of sucking pests on soybean, *Swarna vasundhara* during the year 2023

Table 2. Effect of different sowing dates on the infestation of defoliator in soybean, *Swarna vasundhara* during the year 2023

S. No	Treatment (Sowing date)	No. of flea beetles/plant*	No. of red-headed flea beetles/plant*	No. of cabbage loopers/plant*
1	10th June	0.76±0.01	0.81±0.03	0.37±0.01
2	25th June	0.84±0.02	0.84±0.36	0.38±0.01
3	10th July	0.86±0.01	0.97±0.03	0.39±0.01
C.D at 5%		**0.06**	**0.10**	**NS**
SE(d)		**0.02**	**0.04**	

** Mean ± S.E.M = Mean values ± Standard error of means of six replications*

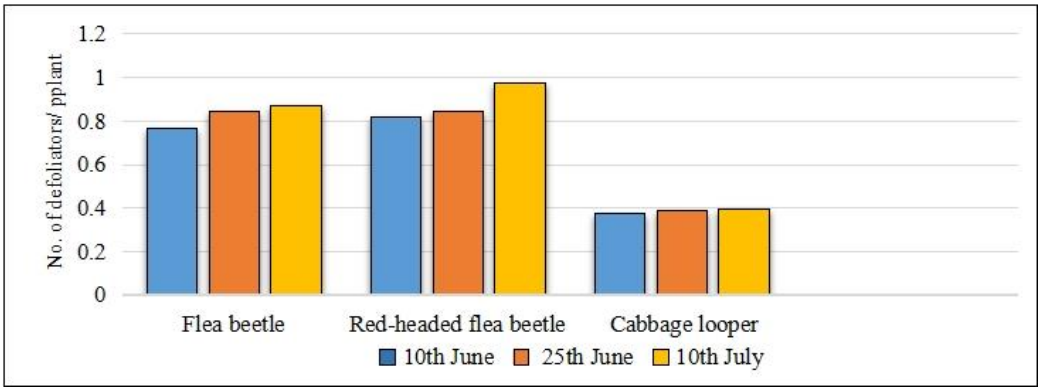

Fig. 2. Effect of different sowing dates on the infestation of defoliators on soybean, *Swarna vasundhara* during the year 2023

Table 3. Effect of sowing dates on yield of soybean, *Swarna vasundhara* during the year 2023

S. No	Treatment (Sowing Date)	Pests population		Seed yield (kg/ha)
		Sucking pests/3 leaves	Defoliators/ plant	
1	10-Jun	5.34	0.64	1145.00
2	25-Jun	4.49	0.68	836.24
3	10-Jul	3.37	0.74	746.66
C.D at 5%				**48.22**
SE(d)				**21.36**

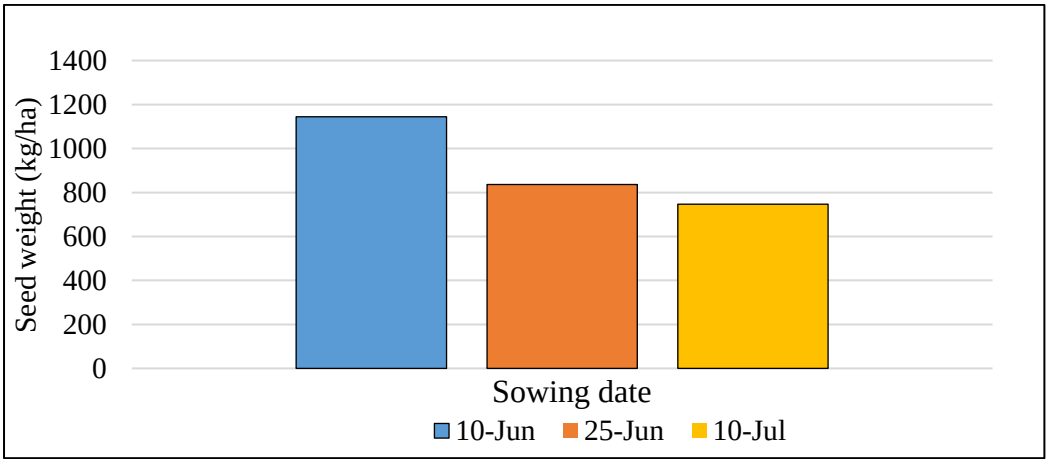

Fig. 3. Effect of sowing dates on the yield of soybean, *Swarna vasundhara* during the year 2023

The current investigation on flea beetles corroborate with the findings of Prodhan et al. (2008), Khajehzadeh et al. (2009), Patel et al. (2017) and Patra et al. (2024). The observations of Mandal et al. (1998), Meena and Sharma (2006) and Bateman (2017) supports the present finding on Cabbage looper.

3.3 Effect of Sowing Dates on Yield of Soybean, *Swarna vasundhara* during the Year 2023

Perusal of data in Table 3 indicates that differences in seed yield between sowing dates are statistically significant. The highest yield was harvested from the crop sown on 10th June with an average yield of 1145 kg/ha followed by significant reduction in yield of 836.24 kg/ha for crop sown on 25th June. The lowest seed yield was recorded from the crop sown on 10th July with an average yield of 746.66 kg/ha. The results indicate a clear decline in seed yield as the sowing date is delayed from 10th June to 10th July. The highest yield was achieved with the earliest sowing date (10th June), suggesting that early sowing is advantageous for maximizing seed yield in soybean illustrated in Fig. 3. The statistically significant differences between the sowing dates emphasize the importance of optimal sowing time in achieving higher yields. Therefore, early sowing is recommended as the optimal time for sowing soybean.

The current discoveries align with the results of Kumar et al. (2008), Ram et al. (2010), Shivaji (2016) and Lodaya and Borad (2017), who noted a significant difference in seed yield based on different sowing dates.

4. CONCLUSION

The application of chemical control strategies serves as a noteworthy contributor to environmental degradation and adversely affects beneficial insects. Besides implementing chemical measures, cultural strategies must be utilized to combat the infestation of these pests to mitigate the harm caused by pests. The cultural technique has the potential to decrease pest prevalence on the agricultural produce and plays an important role in advancing integrated pest management strategies.The study concludes that among the three sowing dates, highest infestation of sucking pests including

whitefly, aphid, jassid and thrip were documented in the first sowing date i.e.10th June, 2023. The infestation of sucking pests decreases with delay of sowing time. Conversely, the number of defoliators including flea beetle red-headed flea and cabbage loopers increases with the delaying of sowing dates, recording the highest population in the crop sown on 10th July. All the recorded pests showed significant difference in infestation across the sowing dates with the exception of cabbage loopers. Although the highest sap-sucking pests was observed in the crop sown on 10th June, the optimal grain yield was achieved from this same sowing date (1145 kg/ha), attributed to the crops being more bushy and healthier containing a higher number of pods than other sowing dates (836.24 kg/ha for crop sown on 25th June and 746.66 kg/ha for crop sown on 10th July). Moreover, crops later sown experienced higher infestation of defoliator pests, which may further elucidate the observed reduction in yield.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) 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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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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