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CONTENTS

Measuring the antixenosis responses of *Spodoptera litura* larvae to different soybean germplasms by leaf choice method

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ABSTRACT: *S. litura*, the larval form of a destructive pest, poses a significant threat to soybean crops, primarily by defoliating the leaves. To protect the crops and implement effective pest management strategies, it is crucial to understand the preference and antixenosis responses of the larvae towards different soybean germplasms. In this study, an antixenosis experiment was conducted to evaluate the preference index (C value) of eight soybean germplasms against third-instar *S. litura* larvae. The results revealed that the larvae exhibited a preference for two specific germplasms, JS-335 and JS21-72, with preference values (C values) ranging from 1.0 to 1.02. On the other hand, five other germplasms, DS-3108, Himso-1689, NRC-149, NRC-152, and VL-99, showed a slight antixenosis response with C values ranging from 0.93 to 0.99. DS-9421 exhibited a moderate antixenosis response with a C value of 0.75. The findings of this study align with previous research on antixenosis mechanisms of resistance in soybean germplasms. The feeding behaviour of *S. litura*, characterized by irregular holes and leaf scratching, was also observed. These results provide valuable insights for crop protection and resistance breeding programs. Overall, understanding the preference and antixenosis responses of *S. litura* larvae towards different soybean germplasms is crucial for developing effective pest management strategies and selecting resistant varieties. Further studies could explore additional factors influencing the feeding behaviour and resistance mechanisms, contributing to the sustainable protection of soybean crops against *S. litura* infestations.

Key words: Antixenosis, germplasm, choice based assay, *Spodoptera litura*

Soybean (*Glycine max* (L.) Merr.) is an extremely important crop worldwide, playing a vital role in the economy. It serves as a primary source of edible oil, meeting 25% of the global demand, and consumed by millions of people (Agarwal *et al.,* 2013). Additionally, soybean is utilized in the production of numerous chemical products (Tiwari, 2006). Soybean is produced in 127.91 million hectares globally, with India contributing approximately 9.22% of the world's production from 119.982 million hectares and an annual output of 118.888 million metric tons (SOPA, 2021). Moreover, Soybean productivity is subject to the influence of numerous abiotic and biotic factors. In the case of biotic stress, insect pests are responsible for a yield loss of over 25% (Harish *et al.*, 2009). Among the most detrimental pests of soybean are foliage feeders, stem borers, gram pod borers, and stink bugs. *Spodoptera litura (Fabricius)*, also known as the tobacco armyworm, is a polyphagous pest that can attack soybean from early growth stages up to harvest time. After hatching, the first and second instars engage in gregarious feeding on the leaf, completely skeletonizing it (Biswas, 2013). Subsequently, the third instars disperse and solely feed on the leaves, leaving only the veins. Larvae of *S litura* is mainly occurs during vegetative stage to flowering stage in crop (Howe and Jander, 2008). This pest is the primary cause of defoliation and can lead to a yield loss of up to 68% (Bayu *et al.,* 2018). The excessive use of insecticide can lead to insects developing resistance to it. To avoid any harm to the environment, utilizing IPM practices is a beneficial approach to keep the population below the ETL threshold. Host plant resistance is considered one of the most effective mechanisms to combat phytophagous insects in plants Beck (1965). It is crucial to adopt a valuable strategy of utilizing resistant varieties for controlling this insect pest. Apart from this, antixenotic resistance is usually conferred resistance to pest and is helpful to decrease the damage. Antixenosis refers to the set of plant traits and insect reactions that either attract or repel the use of a specific plant, obtain nourishment, seek shelter, or a combination of these factors. (Kogan and Ortman, 1978) The overall aims of the present study are to investigation the antixenotic resistance of soybean germplasm with no-choice based test against *S. litura*.

MATERIALS AND METHODS

The study was carried out at the Insect Morphology Laboratory, Department of Entomology, College of Agriculture, Govind Ballabh Pant University of Technology and Agriculture (GBPUAT), Pantnagar, Uttarakhand.

Plant material

Eight soybean germplasm (including susceptible germplasm), namely DS-3108, DS-9421, Himso-1689, JS21-72, NRC-149, NRC-152, and VL-99, were procured from AICRP, Soybean and grown in the N. E. B. Crop Research Centre, GBPUAT, Pantnagar, along with the susceptible soybean germplasm (JS-335) during kharif *season*. The leaves of various soybean germplasm were utilized for feeding larval instars of *S. litura*.

Mother culture of S. litura

Egg masses of *S. litura* were collected from soybean which were sown in N. E. B. Crop Research Centre (CRC) placed in petri dishes lined with moistened filter paper. The newly hatched larvae were then transferred to a plastic box (12×6 cm) containing fresh castor leaves. The larvae were fed daily. A wet cotton swab was placed over the castor leaf's petiole to prevent drying. When the larvae were ready to pupate, they were moved to glass jars with a moistened filter paper lining and a layer of sand. Fresh soybean leaves were then provided daily to encourage egg laying during the adult emergence stage.

Choice based test of S. litura against soybean germplasm

The antixenotic effect of different soybean germplasm against *S. litura* was evaluated through a bioassay using the choice-based method (Bayu *et al.*, 2018). The leaf disc choice test was conducted to investigate the preference of *S. litura* larvae in soybean germplasm, using six-day-old larvae taken from culture. Petri dishes lined with moist filter paper were used to place two sets of leaf discs, each with an area of 4 cm^2, of the standard (A) and test (B) host plant in an AM-AM pattern. Six larvae were released per petri dish after a two-hour starvation period. The experiment ran until more than 75% of the leaf disc area of the standard host was consumed in any treatment. The consumed leaf area was calculated using graph paper, and preference index was measured following Kogan and Goeden (1978).

The preference index (C) was calculated as follows:

$$C = 2A/(A+M)$$

Where, A = Feeding on the test plant
M = Feeding on the check plant

C Value	Antixenotic Response
0.10 to 0.25	Extreme antixenosis
0.26 to 0.50	Strong antixenosis
0.51 to 0.75	Moderate antixenosis
0.76 to 0.99	Slight antixenosis
1.00 or > 1.00	Preferred host

RESULTS AND DISCUSSION

The larval form of this pest causes severe damage to the soybean crop by defoliating the leaves. After hatching the first and second instars gregariously feed on the leaf and completely skeletonize it then the third instars disperse and feed on leaves only remaining the veins. Thus, to protect the crop from damage the incidence of pest must be known so that proper management can be taken. For that, an Antixenosis experiment was conducted in order to address the preference index (C value) for eight soybean germplasms (including susceptible germplasm) against *S. litura*. The data that was collected is presented in (Table 1). In order to analyze the antixenosis level of third instar of *S. litura* against the above-mentioned soybean germplasms, a preference index was calculated based on the mean leaf area consumed by the *S. litura* after 8 hours of feeding using a graph. Upon conducting the

Table 1: C-value and category of soybean germplasm by *S. litura* prior to choice based assay

S No.	Germplasm	C value	Antixenosis response
1	DS-3108	0.93	Slight antixenosis
2	DS-9421	0.75	Moderate antixenosis
3	Himso-1689	0.95	Slight antixenosis
4	JS21-72	1.02	Preferred host
5	NRC-149	0.99	Slight antixenosis
6	NRC-152	0.96	Slight antixenosis
7	VL-99	0.99	Slight antixenosis
8	JS-335 (CHECK)	1.00	Preferred host

experiment, it was discovered that the larvae feed on two particular germplasms, JS-335 and JS21-72, which showed a preferred host against the third instar larvae of *S. litura*. The preference value (C value) for these two germplasms ranged from 1.0 to 1.02. On the other hand, five other germplasms, namely DS-3108, Himso-1689, NRC-149, NRC-152, and VL-99, showed a slight antixenosis response against third instar larvae with the C value ranging from 0.93 to 0.99. Lastly, the germplasm DS-9421 exhibited a moderate antixenosis response against third instar larvae with a C value of 0.75.

Biswas (2013) reported the feeding behaviour of *S litura* and observed that *S. litura* mainly feeds on the leaves and shoots by feeding voraciously infested leaves irregular holes and shown in and small larvae of *S litura* scratch the leaves due to their mandible is not developed properly, due to which they scratch the chlorophyll from the leaves. The results were in partial agreement with (Gaur *et al.,* 2018; Azmi and Sharma, 2020) where several germplasms were screened for antixenosis and results shows that the preference and non-preference soybean germplasms was based on the antixenosis mechanism of resistance. Sulistyo and Inayati (2016) performed an experiment on soybean germplasm to establish the antixenotic resistance through no-choice assay. Similarly, Boica Junior *et al.* (2015) reported that the largest consumption of the leaf (high MLAC) shows that the genotype is susceptible to the pest while resistance in plant creates difference in consumption by pest. Gowthish *et al.* (2018) conducted Antixenosis experiment on Five black gram (*Vigna mungo* L.) accessions were evaluated for resistance against leaf caterpillar, *S. litura*. Under greenhouse condition among the accessions, also said that maximum mortality of larvae occurs in VBN 8 which have the maximum number of trichomes on both adaxial and abaxial leaf surfaces. De Queiroz *et al.* (2019) conducted experiment to evaluate antixenosis to *S. cosmioides* in soybean genotypes showed antixenosis mediated by leaf color and trichome density.

CONCLUSION

The research on the preferences and antixenosis responses of *S. litura* larvae towards different soybean germplasms provides valuable insights for both the scientific community and agricultural practitioners. The study highlights specific soybean germplasms vulnerable to infestation and those resistant against larval feeding. The results emphasize the importance of considering the preferences and feeding behaviours of pests when developing crop protection strategies. According to the key finding, JS21-72 found preferable for third instar larvae similarly DS-9421 found slightly antixenosis symptoms. This may be due to some plant secondary metabolites. This knowledge can guide future breeding programs aimed at developing resistant varieties and contribute to sustainable agriculture practices. The findings can assist farmers and crop managers in making informed decisions regarding pest management strategies, including the selection of suitable germplasms and implementation of targeted control measures. Overall, this study contributes to the understanding of *S. litura* larval preferences and the antixenosis responses of soybean germplasms, enhancing crop protection efforts and supporting the development of resilient soybean varieties.

REFERENCES

Agarwal, D.K., Billore, S.D., Sharma A.N., Dupare, B.U. and Srivastava, S.K. (2013). Soybean: Introduction, Improvement and Utilization in India-Problems and Prospects. *Agriculture Research*, 2(4): 293-300

Azmi, A. and Sharma, A. N. (2020). Nutritional indications of the tobacco caterpillar, *Spodoptera litura* on different soybean varieties. *J. Entomol. Zool. Stud.,* 8(1): 282-285.

Bayu, M. S. Y. I., Krisnawati, A. and Adie, M. M. (2018). Response of soybean genotypes against armyworm, *Spodoptera litura* based on no-choice test. *Earth Environ. Sci.,* 102(1): 12-33.

Beck, S. D. (1965). Resistance of plants to insects. *Annu. Rev. Entomol.*, 10(1): 207-232.

Biswas, C. G. (2013). Insect pest of soybean (*Glycine max* L.), their nature of damage and succession with the crop stages. *J. Asiat. Soc. Bangladesh Sci.,* 39(1): 1-8.

Boica Junior, A.L., De Souza, B.H.S., Costa, E.N., Ribeiro, Z.L. and Stout, M.J. (2015). Factors influencing Expression of Antixenosis in Soybean to *Anticarsia gemmatalis* and *Spodoptera Frugiperda* (Lepidoptera: Noctuidae). *Journal of Economic Entomology*, 108: 317-325.

De Queiroz, E.B., Da Silva, F.C., Borella Junior, C., Araújo, M.S., Hirose, E. and De Jesus, F.G. (2020). Antixenosis in soybean to *Spodoptera cosmioides* (Lepidoptera: Noctuidae) mediated by leaf color and trichome density. *Phytoparasitica*, 48: 813-821.

Gaur, N., Kohli, P., Devrani, A., KN, R. P. and Pandey, R. (2018). Laboratory studies an antibiosis and antixenotic effect of soybean [*Glycine max* (L.) Merrill.] Against *Spilaractia obliqua* (Walker). *J. Entomol. Zool. Stud.,* 6(2): 663-668.

Gowthish, K., Muthukumaran, N. and Selvanarayanan, V. (2018). Antixenosis resistance in black gram against leaf caterpillar *Spodoptera litura* fab. *Multilogic in Science*, 4(8): 63-65.

Harish, H., Patil, R.H. and Patil, P.V. (2009). Identification of resistant sources to major defoliator pests of soybean. *J. Agric. Sci*., 22(2): 215-219.

Howe, G. A. and Jander, G. (2008). Plant immunity to insect herbivores. *Annu. Rev. Plant Boil.,* 59(1): 41-66.

Kogan, M. and Ortman, E. F. (1978). Antixenosis a new term proposed to define Painter's "Non-Preference" modality of resistance. *Bulletin of the ESA*., 24(2): 175-176.

SOPA (2021). www.sopa.org. Soybean Processor Association of India, 8/10/2021

Sulistyo, A. and Inayati, A. (2016). Mechanisms of antixenosis, antibiosis and tolerance of fourteen soybean genotypes in response to whiteflies *(Bemisia tabaci)*. *Biodiversitas*, 17 (2): 447-453.

Tiwari, P. (2006). Plant Introductions in Soybean Achievements and Opportunities. *Indian J. Plant Gene Resources*, 19: 353-365.

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