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Effect of Physical Characteristics and Phenolic contents on Jassid and Pod Borer of Cowpea

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SP conceived the project and supervised the study. SKS and BG conducted field observations and laboratory studies. SD made the genotypes available and conducted the biochemical analysis. AK helped in statistical analysis and interpretation of data with SK. SP wrote the article with the help of RM and NL.

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ABSTRACT

Host-plant resistance to insect pest damage is the most economically and environmentally sound method of pest management in cowpea. The present study was taken up with seventeen cowpea genotypes to investigate the influence of physical characteristics and phenolic contents conferring pest resistance. Different biophysical parameters, viz. vine length, number of pods/plant, pod length, individual pod weight, yield/plant, days to flowering, days to first harvest and the biochemical parameter like total phenol content of green leaves were studied in relation to the expression of reaction towards jassid (*Empoasca kerri* Pruthi) and spotted pod borer (*Maruca vitrata* Fab.). Pest infestation varied significantly amongst different cowpea genotypes. The mean jassid infestation was the minimum in Lafa Sohini 7 (0.54 jassid/leaf) as against the maximum in the variety Kashi Kanchan (3.00 jassid/leaf). Two varieties namely Pusa Fulguni Gold and UV-5 (0.00 larva/plant) were found completely free from spotted pod borer infestation as against the maximum infestation in the variety Ankur Gomoti (1.19 larva/plant) flowed by Bidhan Barboti 1 (1.18 larva/plant). The cowpea genotypes varied significantly in different biophysical characteristics and phenolic contents. Correlation studies of these parameters with jassid and pod borer infestation revealed that the number of pods per plant was found to be positively and significantly correlated (r = 0.495) with the jassid population as well as pod borer per plant (r = 0.486). The pod borer infestation was found to register significant negative correlation with the days to flowering (r = -0.556) and days to first harvest (r = -0.553). The jassid as well as the pod borer infestation was found to have negative association with the phenol content (mg/g of fresh leaf) but the association was not statistically significant.

1. INTRODUCTION

Cowpea, *Vigna unguiculata*, (L.) (Walp.) is one of the most important legume crops cultivated by many resource-poor farmers in many countries of tropical Africa, Asia and South America [1]. It can be used as a green bean (snake bean), a pulse (black-eye peas) or as a fodder, forage and cover crop. Degri *et al.*[2] reported that cowpea is nutritionally consisted of protein (23%), fats (1.3%), fibre (1.8%), carbohydrate (67%) and water (8-9%). The protein in cowpea seed is rich in the amino acids such as lysine and tryptophan compared to other legumes; hence, cowpea seed is valued as a nutritional supplement to cereals as well as a protein source. Insect pests are one of the major biotic stresses in cowpea growing regions in both developing and developed countries [3]. The avoidable losses in yield have been recorded in the range of 66 to 100 per cent in cowpea [4]. Synthetic insecticides are the widely followed means of controlling the pest complex of cowpea. However, the health risks and environmental pollution potentially caused by the unscrupulous use of pesticides, demand for skilled application which rarely be expected by resource-limited farmers. Therefore, it is important to lay emphasis on an integrated comprehensive approach to combat this pest menace. Host-plant resistance to insect pest damage is the most economically and environmentally sound method of pest management for both large scale and subsistence cowpea production. This approach is less

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labor intensive and more secure compared to other methods, thus very appropriate for resource-limited farmers. Due to these merits, developing varieties with sustainable resistance to these insect pests and other biotic stresses is a major goal of national and international cowpea breeding programs. Different biophysical as well as biochemical parameters of the plants play a vital role by influencing the infestation of various insect pests. Number and length of trichomes, pod wall thickness, angle between the pods and pod width played a vital role in conferring tolerance to mungbean cultivars against pod borer, *Maruca vitrata* [5]. Jackai [6] studied the influence of different plant characters on the field infestation of pod borer and found that early maturity, small size of flower and greater flower bud formation could be the reasons for lower infestation of pod borer. On the otherhand, Jayappa [7] found none of the plant characters like plant type, flower colour, pod colour, pod position, pod shape and days taken to pod maturity to be accountable for imparting resistance reaction to pod borer. Amongst the biochemical parameters, total phenol content was found to have significant negative correlation with jassid incidence [8]. Hence, the present study was undertaken with different available genotypes of cowpea to understand the role of different plant characters and phenol content in imparting tolerance reaction against jassid and pod borer.

2. MATERIALS AND METHODS

2.1 ***Site and season of experiment***

The field experiment was carried out during the summer season of 2015 with seventeen cowpea genotypes at the farm of Uttar Banga Krishi Viswavidyalaya (North Bengal Agriculture University), Pundibari, Cooch Behar ($89^0$23'53" E longitude and $26^0$19'86" N latitude, situated in sub-Himalayan West Bengal in the north-eastern part of India) in sub-tropical prehumid type of climate with high annual rainfall (higher than 3000 mm), high relative humidity (avg. max. & min. of 95 & 65%, respectively) and moderate temp. (avg. max. & min. of 31 and 11^0C, respectively).

2.2 ***Experimental details***

The experiment was laid out in randomized block design (RBD) with two replications. The genotypes were sown in plots of 2.5 m x 2.0 m with a spacing of 45 cm x 20 cm. The crop was raised under normal recommended agronomical practices. The crop was kept free from insecticides to allow natural multiplication of pest population.

2.3 ***Study of plant characters***

Seven plant parameters, viz. vine length (cm), number of pods/plant, pod length (cm), individual pod weight (g), yield/plant (g), days to flowering (days) and days to first harvest (days) were recorded for studying their role in imparting resistance reaction against major insect pests. For this purpose, ten plants per replication were tagged. The data on vine length was recorded when the plants were full grown at 60 days after sowing (DAS). Total number of pods per plant and yield per plant were recorded throughout the life period of crop till maturity from the tagged plants. Days required for flowering and to first harvest were also recorded for each tagged plant. For studying the pod length and pod weight twenty pods per replication were randomly selected.

2.4 ***Biochemical analysis***

The total phenol content of the green leaves was measured for studying the role of the biochemical parameter in expression of resistance reaction amongst the genotypes. The total phenol content of leaf was estimated using Folin–Ciocalteau reagent (FC reagent) by following method of Malick and Singh [9]. Fresh healthy leaves from tagged plants were collected for each genotype and analyzed for total phenol in leaf. Total phenol was determined in catechol equivalent after comparing with the standard curve prepared from distilled catechol. Total phenol was expressed as mg/g fresh wt. of tissue.

2.5 ***Analysis of data***

Observations on pest infestation were recorded weekly from ten randomly selected plants from each replication. The jassid population was counted from three trifoliate leaves selected at random from three different strata on each plant. Each selected plant was thoroughly examined for the presence of spotted pod borer larvae and the total number of caterpillars encountered in each plant was counted. The data on pest infestation was subjected to square root transformation and then analyzed using GenStat Version H.1.0.1504 (VSN International Ltd., Oxford, UK) and OPSTAT statistical package. The weekly pest infestation on different genotypes was pooled over the entire crop life stages to get a mean value of infestation for each pest. The relationship between pest infestation and various plant characters of cowpea was assessed through correlation studies.

3. RESULTS AND DISCUSSION

3.1 ***Jassid infestation on different cowpea varieties***

The jassid infestation varied significantly amongst different cowpea varieties at the time of incidence period of this pest. The jassid population varied significantly on all dates of observation except in the 22^{nd} standard week. The seasons' mean jassid infestation was the minimum in Lafa Sohini 7 (0.54 jassid/leaf) as against the maximum in the variety Kashi Kanchan (3.00 jassid/leaf) (Fig. 1).

3.2 ***Spotted pod borer infestation on different cowpea varieties***

The spotted pod borer infestation also differed significantly amongst different cowpea varieties. Two varieties namely Pusa Fulguni Gold and UV-5 (0.00 larva/plant) were completely free from spotted pod borer infestation as against the maximum infestation in the variety Ankur Gomoti (1.19 larva/plant) flowed by

Bidhan Barbati 1 (1.18 larva/plant) based on the mean of infestation level (Fig. 2). The varieties Pusa Fulguni Gold and UV-5 escaped the spotted pod borer infestation probably due to late flowering nature.

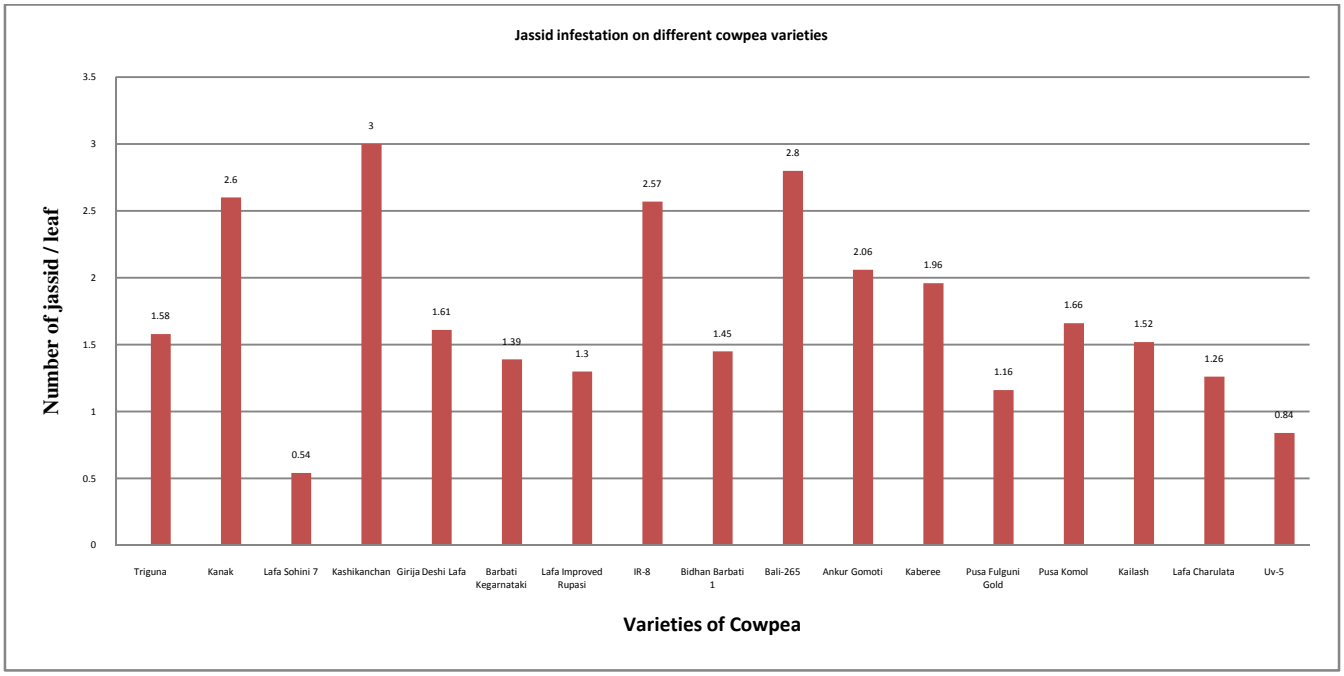

Fig 1. Jassid infestation on different cowpea varieties

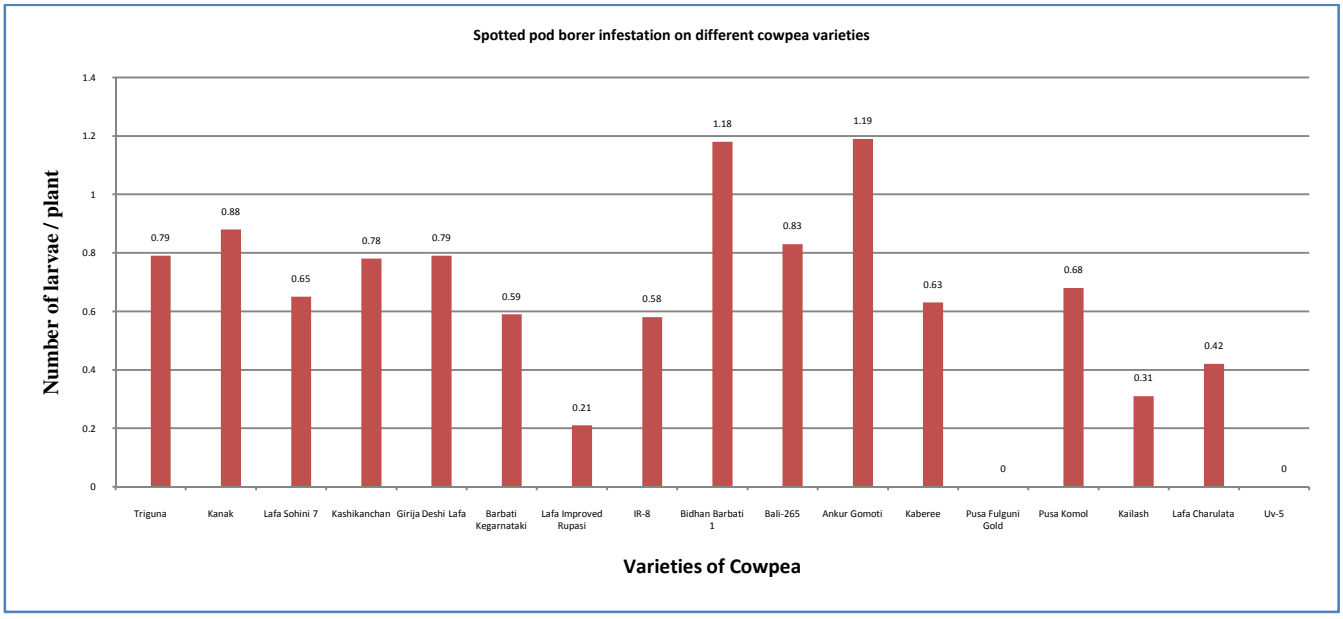

Fig 2. Spotted pod borer infestation on different cowpea varieties

Several screening methods to identify genotypes with resistance to major cowpea insect pests have been developed [10]. A good number of screening programs have been undertaken by a number of workers all over the world like [11], [12], [13], [14] etc. However, despite of the evaluation of many cowpeas accessions, plants with high levels of resistance to most of the major insect pests have not yet been released to farmers. Nevertheless though, Singh [15] reported the identification of accessions with a satisfying level of resistance to aphids and moderate level of resistance to flower thrips, pod bugs and pod borer. In the present study the varieties Pusa Fulguni Gold and Uv-5 completely escaped the spotted pod borer infestation. But that is probably due to the

ecological resistance/pseudo-resistance. Ecological resistance is resistance related to favorable environmental conditions at a given location at a particular time. Here the resistance is mainly due to host evasion where the susceptible stage of the host did not coincide with the period of higher pest population. Pusa Fulguni Gold and Uv-5 also showed moderate level of resistance to jassid infestation (Fig. 1). In addition to these two varieties Lafa Sohini-7 also exhibited considerable level of resistance to jassid infestation. So these varieties can be exploited for future breeding purpose. The varieties namely Lafa Improved Rupasi and Kailash look promising for future exploitation as it manifested significant level of tolerance to spotted pod borer infestation (Fig. 2). Kumar *et al*. [16] while conducting an experimental trial with 15 cowpea genotypes, also found some genotypes (viz., KCP-6, Pusa Komal and RGC-5) to be infested less by pod borer as against more infestation in the genotypes KCP-1, RGC-2 and RGC-4.

3.3 *Morphological and biochemical characters of cowpea varieties*

The various morphological and biochemical characters of cowpea varieties have been studied which make it explicit that the varieties of cowpea varied significantly in the various morphological and biochemical characters. The vine length varied from 32.64 cm in the variety Uv-5 to 96.65 cm in the variety Girija Deshi Lafa. Number of pods per plant ranged from 11.17 (Uv-5) to 31.07 (Triguna). The variety Girija Deshi Lafa produced the longest pods (45.40 cm) as against the shortest in the variety Pusa Fulguni Gold (20.65 cm). Similarly, the yield/plant was recorded the highest for the variety Kashi Kanchan (274.00 g). The variety Kaberee (37.13 days) was the earliest to flower as against the latest in the variety Pusa Fulguni Gold (53.67 days). Similarly, the variety Kaberee (45.17 days) took the minimum days to first harvest whereas, the variety Pusa Fulguni Gold (61.67 days) took the maximum. The phenol content varied from Ankur Gomoti (0.105 mg/g of leaf) to Pusa Komal (0.387mg/g of leaf). Earlier reports also confirms that significant differences existed among the varieties tested in all the growth characters measured [17].

3.4 *Correlation of morphological and biochemical characters of cowpea with jassid and spotted pod borer infestation*

The perusal of the Table 1 reveals that the number of pods per plant was found to be positively and significantly correlated with the jassid population (r= 0.495) as well as pod borer per plant (r= 0.486). The pod borer infestation was found to register significant negative correlation with the days to flowering (r= -0.556) and days to first harvest noticed (r= -0.553). The jassid as well as the pod borer infestation were found to have negative association with the phenol content (mg/g of fresh leaf) but the association was not statistically significant.

Table 1. Correlation of morphological and biochemical characters of cowpea with jassid and spotted pod borer infestation

Pests	Morphological Characters							Biochemical character
	VL	NP	PL	PW	PY	DF	DH	Phenol content
Jassid	-0.166	0.495*	-0.254	-0.147	0.338	-0.350	-0.300	-0.145
Pod borer	-0.006	0.486*	-0.022	0.026	0.357	-0.556*	-0.553*	-0.056

* Significant at 5% level(r = ± 0.482)
** Significant at 1% level(r = ± 0.606)
VL-vine length; NP- number of pod/plant; PL-individual pod length; PW-individual pod weight; PY- yield /plant; DF- days to flowering; DH- days to 1st harvest

The vine length, individual pod length, individual pod weight and individual plant yield failed to show any significant association with both the jassid and spotted pod borer infestation (Table 1). Earlier, Anusha [17] also failed to observe any significant association between the morphological characters of cowpea genotypes with flower and pod damage by pod borer. In the present study, the pod borer infestation was found to register significant negative correlation with the days to flowering (r= -0.556) and days to first harvest noticed (r= -0.553). Anusha [18] found significant positive correlation between pod borer infestation and days taken for 50 per cent flowering and maturity, which is in contradiction with the current findings. The jassid as well as the pod borer infestation were found to have negative association with the phenol content (mg/g of fresh leaf) but the association was not statistically significant. Earlier, Singh and Singh [19] observed that the pod borer infestation recorded strong negative association with the phenol content in flowers and immature pods.

4. CONCLUSION

The cowpea varieties showed differential reactions to jassid as well as spotted pod borer infestation under field conditions. The biophysical and biochemical properties of the cowpea varieties studied exhibited limited influence on the expression of resistance reaction to major pests.

5. ACKNOWLEDGMENTS

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6. AUTHORS CONTRIBUTIONS

SP conceived the project and supervised the study. SKS and BG conducted field observations and laboratory studies. SD made the genotypes available and conducted the biochemical analysis. AK helped in statistical analysis and interpretation of data with SK. SP wrote the article with the help of RM and NL.

7. CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of the article.

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