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Influence of Morphological Attributes of Cowpea Genotypes on Oviposition of Pulse Beetle (*Callasobruchus maculatus* F.)

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ABSTRACT

Background: Cowpea is an excellent host for *Callasobruchus maculatus* (F.). These beetles cause havoc in stored cowpea. They have the habit of cementing their eggs to the surface of the host seeds. Hence, the present study was aimed to the find the influence of morphological characters of cowpea varieties/genotypes on oviposition of the pulse beetle.

Methods: The ovipositional preference of *C. maculatus* on 14 cowpea varieties/genotypes was studied under the free choice condition and the data thus obtained were correlated with the morphological characters like seed shape, colour and texture.

Result: Each variety/genotype had a significant effect on egg laying by *C. maculatus*. Significantly least oviposition was noticed in GC 3 (35.33 eggs), having a rough testa texture and greater number of eggs were found on GC 1612 (117.33 eggs) having smooth texture. The pulse beetle preferred smooth textured seeds for egg laying irrespective of its shape and colour. This was again confirmed by one of the genotypes GC 1702, which belongs to the Holstein group based on the eye pattern of the cowpea, in this genotype the pulse beetle preferred to lay eggs on the smooth brown portion surrounding the hilum than the wrinkled white portion.

Key words: Cowpea, Oviposition preference, Pulse beetle, Seed colour, Testa texture.

INTRODUCTION

Cowpea is a leading crop cultivated across all the parts of the world. It fits well in various cropping systems like sole crop, mixed crop, intercrop and in Agroforestry combinations. Major cowpea growing states in India are Gujarat, West Bengal, Tamil Nadu, Andhra Pradesh, Kerala and Orissa (Patel *et al.* 2018). Due to its high protein content, drought tolerance, adaptable to different soil types and its ability to improve soil fertility, cowpea is getting more economic importance all over the country. Among the different causes that detains cowpea from realizing its yield potential, the bruchids has much importance (Augustine *et al.,* 2018). Oviposition is an ascendent behaviour exhibited by an insect for the continuation of its race and establishment of its population. The ovipositional preference of bruchid appears to be governed by several biotic and ecological factors (Kavitha *et al.,* 2018). Testa texture may act as a barrier and make it difficult for beetles to adhere their eggs to the seeds. This character of non-preference can be studied by the ovipositional preference of the pulse beetle. According to Gbaye and Holloway (2011), the seed physical characters such as colour, texture, size and hardness are associated with the resistance of some varieties of cowpea to *C. maculatus* and are indicated by decreased oviposition. Hence, the study of morphological characters of cowpea varieties/genotypes in relation to oviposition preference of pulse beetle under the free choice condition is important for the identification of the attributes that are involved in deterring oviposition by the pulse beetle.

MATERIALS AND METHODS

The studies were performed at Department of Entomology, C.P. College of Agriculture, S.D. Agricultural University, Sardarkrushinagar during 2019-20 with the following fourteen cowpea varieties/genotypes *viz.,* GC 3, GC 4, GC 5, GC 6, GC 1304, GC 1501, GC 1506, GC 1601, GC 1602, GC 1603, GC 1612, GC 1701, GC 1702 and GC 1710 collected from Pulses Research Station, S.D. Agricultural University, Sardarkrushinagar. Cowpea seeds infested with *C. maculatus* were also collected from the Pulses Research Station and mass cultured for 2-3 generations and the freshly emerged adults were used for the experimental studies.

Ovipositional preference of *C. maculatus* was studied by free choice technique using a circular galvanized tray measuring 35.5 cm diameter and 9.5 cm height. By fixing cardboard sheets of length 9.0 cm, height 2.5 cm and thickness 0.1 cm in a radial manner, fourteen equal compartments were made on a tray (Fig 1). Twenty-five gram of seeds from each of fourteen cowpea varieties/genotypes were randomly placed in these compartments. In the centre of the tray, a Petri dish (9.0 cm × 1.5 cm) was placed for releasing the pulse beetle. After releasing about two days

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old 5 pairs of adults in the Petri dish, the tray was covered with two-fold muslin cloth and held in position with the help of string and rubber bands. The adults were allowed to lay eggs on the grains of different varieties/genotypes freely on the basis of their ovipositional preference for a period of seven to eight days. After removing the adult beetles from test varieties/genotypes, the number of eggs laid on the surface of the seeds of each treatment was counted with the help of Illuminated Magnifier and the mean number of eggs laid were calculated for each variety/genotype.

Seed shape (Kidney, Globose, Ovoid, Rhomboid and Crowder) was recorded by using the cowpea descriptors given by IBPGR (Anonymous, 1983). Seeds were categorized into two main seed colour *viz*., white and brown based on visual observation. Testa texture was examined under the stereo-binocular microscope and categorized as smooth, smooth to rough, rough-fine reticulation, rough to wrinkled, wrinkled and smooth and shiny by using the cowpea descriptors given by IBPGR (Anonymous, 1983). All the seed characters were arbitrarily quantified for the purpose of correlation analysis.

RESULTS AND DISCUSSION

The data presented in (Table 1) revealed that the mean number of eggs laid ranged from 35.33 to 117.33 eggs per 25g of seeds and none of the variety/genotype was completely free from oviposition. Significantly least oviposition was noticed in GC 3 (35.33 eggs), which was on par with GC 1702 (37.00 eggs), GC 1601 (37.33 eggs) and GC 1701 (39.33 eggs). However, it was closely followed by GC 1304, which recorded 46.33 eggs per 25 g seeds. The highest number of eggs was recorded on the variety GC 1612 (117.33). This genotype was more preferred by *C. maculatus* in free choice condition than the rest of cowpea varieties/genotypes.

This differential egg laying by the pulse beetle might be due to the differences in seed colour, shape as well as texture. A possible explanation for the lower oviposition registered for GC 3 (Table 1) was, it was the only one with rough testa among the tested varieties/genotypes. Augustine *et al.* (2018) also noticed that the variety GC 3 performed best in the antixenosis test for *C. chinensis* in storage and recorded the least number of eggs. Our results are also supported by Umadevi *et al.* (2018), who reported that the chickpea varieties/genotypes had a significant influence on the oviposition pulse beetle. They also found that female beetle preferred the varieties/genotypes with smooth texture over the varieties/genotypes with rough texture.

Observations showed that a maximum of nine varieties/genotypes (GC 3, GC 5, GC 1304, GC 1501, GC 1506, GC 1601, GC 1602, GC 1612 and GC 1702) had rhomboid shape while five varieties/genotypes (GC 4, GC 6, GC 1603, GC 1701 and GC 1710) had ovoid shape. Seven varieties/genotypes (GC 3, GC 4, GC 6, GC 1603, GC 1701, GC 1702 and GC 1710) were white and another seven varieties/genotypes (GC 5, GC 1304, GC 1501, GC 1506, GC 1601, GC 1602 and GC 1612) were brown in colour. As evident from Table 1, maximum of eight varieties/genotypes (GC 5, GC 6, GC 1304, GC 1501, GC 1506, GC 1601, GC 1602 and GC 1612) possessed smooth texture, followed by four (GC 4, GC 1603, GC 1702 and GC 1710) with wrinkled texture. One variety/genotype in each rough (GC 3) and rough to wrinkled (GC 1701).

Table 1: Effect of different cowpea varieties/genotypes on ovipositional preference of *C. maculatus*.

Genotype/ Variety	No. of eggs /25g seeds	Seed colour	Testa texture	Seed shape
GC 3	35.33	White (1)	Rough (2)	Rhomboid (1)
GC 4	48.33	White (1)	Wrinkled (4)	Ovoid (2)
GC 5	56.67	Brown (2)	Smooth (1)	Rhomboid (1)
GC 6	52.33	White (1)	Smooth (1)	Ovoid (2)
GC 1304	46.33	Brown (2)	Smooth (1)	Rhomboid (1)
GC 1501	67.00	Brown (2)	Smooth (1)	Rhomboid (1)
GC 1506	53.67	Brown (2)	Smooth (1)	Rhomboid (1)
GC 1601	37.33	Brown (2)	Smooth (1)	Rhomboid (1)
GC 1602	61.67	Brown (2)	Smooth (1)	Rhomboid (1)
GC 1603	60.67	White (1)	Wrinkled (4)	Ovoid (2)
GC 1612	117.33	Brown (2)	Smooth (1)	Rhomboid (1)
GC 1701	39.33	White (1)	Rough to wrinkle (3)	Ovoid (2)
GC 1702	37.00	White (1)	Wrinkled (4)	Rhomboid (1)
GC 1710	67.33	White (1)	Wrinkled (4)	Ovoid (2)
S. Em. ±	3.77	-	-	-
C. D. at 5%	10.91	-	-	-
C. V. %	11.69	-	-	-
Correlation coefficient (r) (N=42)	-	0.350*	-0.215	-0.078

* Significant at 5 per cent level, 'r' (0.05) > 2.021 Significant

Correlation analysis between the number of eggs laid by *C. maculatus* and various morphological characters (Table 1) reveal that the number of eggs laid had a significant positive relationship with seed colour (r = 0.350*) and a negative relationship with testa texture (r = -0.215) and no relation to seed shape (r =-0.078). Augustine *et al.* (2018) also observed a negative and nonsignificant correlation while correlating seed colour and seed shape with the number of eggs laid. The results showed that the pulse beetle preferred brown testa and smooth texture more than the white and other testa textures, respectively. But it is important to notice from the (Table 1) that all the brown coloured varieties/ genotypes have smooth testa texture and on the other hand the variety GC 6 with white and smooth testa is well preferred by these beetles. Hence, similar to seed shape, seed colour also had no influence on the oviposition by the pulse beetle. Fawki *et al*. (2012) also found that the smooth surface was preferred by the female pulse beetle for oviposition. Similar results were also recorded by Sharma and Thakur (2014) who worked with cowpea, soybean and chickpea genotypes and found that the cowpea and soybean genotypes have smooth testa and they are highly preferred for egg laying by the pulse beetle than the chickpea genotypes with rough testa. Tripathi *et al.* (2013) observed that the colour and shape of cowpea seeds had no influence on the susceptibility of cowpea accessions to the pulse beetle.

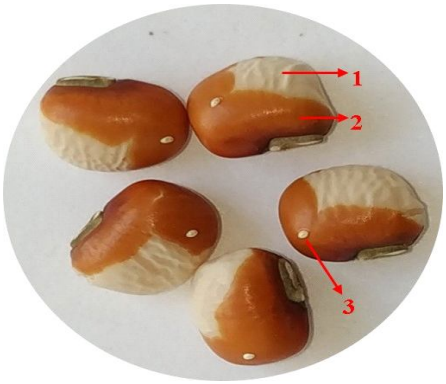
Response of *C. maculatus* to the genotype GC 1702

The above results are again confirmed by one of the genotypes GC 1702, which belongs to the Holstein group (eye encircles the back of the hilum in a narrow ring, widens at the sides and then extends margin of the eye is very distinct) based on the eye pattern of the cowpea specified in the cowpea descriptors given by IBPGR in 1983. In this genotype, the eye encircling the back of the hilum is brown with smooth texture, but the remaining portions are white



(1. Circular galvanized tray 2. Cardboard 3. Adults released at centre of the tray 4. Genotypes/Varieties).

Fig 1: Experimental setup to study the ovipositional preference of pulse beetle under free choice condition.



(1. White and wrinkled surface 2. Brown and smooth surface 3. Pulse beetle preferred the smooth brown colour portion surrounding the hilum for egg laying).

Fig 2: Response of *C. maculatus* to the cowpea genotype GC 1702

with wrinkled texture. The pulse beetle preferred the smooth brown portion surrounding the hilum for egg laying than the wrinkled white portion (Fig 2).

CONCLUSION

The differential egg laying by the beetle was due to the differences in testa texture. The adult female pulse beetle prefers to lay eggs on the cowpea grain with smooth textured testa. Colour and shape of the cowpea had no influence on the oviposition by the beetle. Hence, in resistance breeding, focus must be given to those seeds with rough and wrinkled texture to reduce the egg laying by the pulse beetle.

Conflicts of interest

The authors have no conflicts of interest to declare

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