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# Laboratory Investigation on Oviposition and Development of *Callosobruchus maculatus* (F.) on Four Varieties of Cowpea.

***Uddin II, R.O. and Adesiyun, A.A.**
Department of Crop Protection, University Of Ilorin, Ilorin, Nigeria.
*Corresponding author's e-mail: ruddinII@yahoo.com

## ABSTRACT

*Cowpea, one of the six major cultivated crop species of the family leguminosae distributed throughout the tropics is a cheap source of protein. It has about 20-25% protein content, containing about twice the protein content of most cereals and it is also rich in vitamins, minerals and low in fats. Even though cowpea is nutritionally important to many people, its cultivation is under treat from insect pests both in the field and storage but the most damaging pest of cowpea in storage is Callosobruchus maculatus.*

*The oviposition, growth and development of Callosobruchus maculatus (F.) (Coleoptera: Bruchidae) on four (two resistant and two susceptible) varieties of cowpea were investigated under laboratory conditions in the Department of Crop Protection, University of Ilorin. This was done to ascertain the resistance of the selected cowpea varieties to attack by C. maculatus. The experiment was laid out in a completely randomized design with five treatments namely Ife-brown, TVU-2027, Vita-7 and IT86D-535. Each treatment was replicated three times*

*More eggs were laid on Ife Brown when compared with TVU 2027. However, fewer eggs were laid on Vita-7 when compared with IT86D 535. C. maculatus developed best on the seeds of Ife brown followed by IT86D 535 and Vita 7. Few adult insects emerged from TVU 2027. Developmental period was longer in TVU 2027 than in Ife brown, IT86D 535 and Vita 7. The largest number of adult males and females were reared from Ife brown.*

*KEYWORDS: Cowpea varieties, Callosobruchus maculatus, oviposition and development.*

## INTRODUCTION

Cowpea, *Vigna unguiculata* (L.) Walp is an important grain legume in the tropical and sub tropical regions where a shortage of animal protein is often experienced (Apata and Ologhobo, 1997). Cowpea as well as other pea is excellent sources of dietary protein in animal nutrition (Igbasan and Guenter, 1997) especially where animal protein is in short supply and expensive. It provides 60 % of the dietary protein intake of most Nigerians (Oparaeke et al, 1998). It is one of the most widely grown leguminous crops in Africa,

with West Africa being the world's major producer with an area of 4.8 million hectares (Jackai and Daoust, 1986) and Nigeria being the largest African producer with 8 million tonnes (IITA, 2010).

The seeds of the crop can remain edible for several years if properly stored. The crop is attacked by insect pests at different stages of its growth as well as during storage. Yields could be low due to heavy infestation by insect pests. The infestation begins on the field and rapidly builds up during storage causing substantial damage and post harvest losses (Singh et al., 1990). Grain yield losses due to these pests range from 30 - 60 % incurred on cowpea stored for 3 6 months in Nigeria (Adedire and Ajayi, 2003). Insect infestation during storage markedly reduces the quality and viability and market value of the grains (Emeasor and Emosairue, 2002).

Control of stored products by insect pollution is primarily dependent upon continued application of liquid and gaseous insecticides (White and Leesch, 1995). Although it is efficient, the repeated use of insecticides for decades has disrupted the biological control system by natural enemies and led to outbreaks of insect pests, undesirable effects on non-target organisms and environmental and human health concerns (White and Leesch, 1995). Due to the dangers inherent in the use of chemicals, alternative control measures are being sought which would provide adequate protection for cowpea grains while protecting the environment and human health.

The wide range of legume seeds attacked in storage by *C. maculatus*, coupled with obvious differences of susceptibility has prompted researchers to try to discover which types of seeds are most likely to be attacked (Giga and Smith, 1987). This paper aims at evaluating some varieties and cultivars developed in Nigeria for resistance to *C. maculatus* as resistance from cowpea beetles forms one of the many ways in which the cowpea grains can be protected from *C. maculatus* without endangering the health of humans.

## MATERIALS AND METHODS

The experiment was carried out under ambient conditions in the laboratory of the Department of Crop Protection, University of Ilorin. Seeds used in the study were obtained from the International Institute of Tropical Agriculture. The study was done using a completely randomized design. Each treatment was replicated three times including an uninfected control for all the varieties.

The four cowpea varieties used for this study were Ife brown and Vita-7 (both susceptible varieties) and IT86D 535 and TVU 2027 (both resistant varieties). The seeds were placed in the refrigerator at $20^0$C prior to use in the experiment to kill or inhibit the development of any existing pest in the seed lot. One hundred whole seeds of each of the varieties were infested with ten newly (24 hours) emerged adults of *C. maculatus* in a ratio 3:3 (Male: Female). They were each placed in plastic specimen bottles (9.5 cm x 4.2 cm).

Each specimen bottle was covered with muslin cloth to enhance aeration and prevent

escape of the insects when disturbed. The insects were allowed seven days to oviposit and then removed and discarded. Ten seeds were selected randomly from each replicate on the $7^{th}$, $10^{th}$ $14^{th}$ $17^{th}$ and $20^{th}$ day after infestation. The seeds were examined for eggs/egg cases and the different developmental stages within the bean seeds. The mean number of eggs/empty egg cases and the different developmental stages were used to measure susceptibility of the four varieties of cowpea. Since the data collected had some zero values, 0.5 was added to all entries and subjected to square root transformation. The treatment means were compared using Least Significance Difference Test (LSD).

## RESULTS

The mean number of eggs/empty egg cases, larvae, pupae and $F_1$ progeny of *C. maculatus* which emerged from different cowpea varieties are shown in Table 1.

**Table 1: Developmental Stages of *C. maculatus* on Different Cowpea Varieties.**

| Varieties | Mean no. of eggs/ 10 seeds | Mean no. of larvae/10 seeds | Mean no. of pupae/10 seeds | Mean no. of $F_1$ progeny |
|---|---|---|---|---|
| Ife brown | 58.3 | 9.7 | 6.3 | 51.0 |
| Vita 7 | 16.7 | 3.0 | 3.0 | 8.7 |
| IT86D-535 | 43.3 | 11.7 | 10.0 | 21.0 |
| TVU 2027 | 18.3 | 6.7 | 0.3 | 2.3 |
| LSD | 55.8 | 15.1 | 13.2 | 54.5 |

There was no significant difference in the mean number of eggs laid recorded for the 4 varieties suggesting that all the varieties are equally susceptible to oviposition by *C. maculatus*. The level of infestation was higher in the susceptible like Ife brown than the resistant variety such as TVU 2027.

The mean number of larvae observed was higher in IT86D-535 than in Ife-brown. A striking observation made was that the resistant variety IT86D-535 had the highest mean number of larvae when compared to the susceptible variety, Vita-7 which had the lowest mean number of larvae. There was however no significant differences in the mean numbers of larvae observed between the 4 varieties, suggesting that they were all equally susceptible to attack by *C. maculatu*s (Table 1).

In the 4 varieties studied, infestation was lowest for TVU 2027 and highest for IT86D-535. Pupae observed increased in the order TVU 2027, Vita-7, Ife-brown and IT86D-535. There were no significant differences between the mean numbers of pupae observed

for all the varieties studied (Table 1). Adult emergence was highest in the susceptible variety with Ife-brown having the highest number of emerging adults while it was lowest in the resistant variety with TVU 2027 having the lowest number of adult insects emerging. These differences were however not statistically significant at $P < 0.05$ (Table 1). The proportion of males to females which emerged from the 4 varieties did not appear to depart significantly from a ratio 1:1 (Table 2)

**Table 2: Sex Ratio of the $F_1$ Progeny of *C. Maculatus* Developing on Different Cowpea Varieties.**

| Varieties | Mean no of $F_1$ progeny | M: F |
|---|---|---|
| Ife brown | 51.0 | 1:1.10 |
| Vita 7 | 8.7 | 1:0.63 |
| IT86D-535 | 21.0 | 1:1.42 |
| TVU 2027 | 2.3 | 1:1.33 |

## DISCUSSION

In this study, Ife-brown and IT86D-535 were found to be quite susceptible to *C. maculatus*, while Vita-7 and TVU 2027 showed very low susceptibility. This agrees with the work of Mbata (1993) who reported that TVU 2027 is consistently less susceptible to attack by *C. maculatus* and *C. subinnotatus*. Vita-7 was least susceptible to larval damage. The inability of the insect to develop on Vita-7 may be because their seed coat could not be penetrated by the larvae. Jensen (1977) found that the hardness and chemistry of the seed coat may be important as a barrier to entry of *C. maculatus*.

The oviposition, growth and development of the insect was found to be generally more favourable on Ife-brown than TVU 2027 in terms of mean number of eggs laid, mean number of larvae observed, mean number of pupae observed and total mean number of adult insects which emerged. IT86D-535 also proved to be more suitable for the insect than Vita-7 in terms of mean number of eggs laid, mean number of larvae observed, mean number of pupae observed and total mean number of adult insects which emerged. However, Ife-brown which is a susceptible variety was generally more susceptible than IT86D-535, Vita-7 and TVU 2027. Differences in susceptibility to attack and damage by *C. maculatus* between the 4 varieties have been related to ovipositional preferences of the insect for some type of cowpea seeds (Ofuya and Bamigbola, 1991). Oviposition is affected by the plumpness or wrinkling of the seed coat and perhaps by the size and hardness of the seed as well as odour (Howe and Currie, 1964). Ovipositional preference

showed Ife-brown to be the most suitable to the insect followed by IT86D-535, TVU 2027 and Vita-7. However, seed size may have played an important role in the susceptibility of cowpea to *C. maculatus*. This is noticed in TVU 2027 which has large sized seeds. It showed the lowest mean number of pupae observed and the overall number of adult insects which emerged when compared with the other varieties.

Many workers (Giga and Smith, 1987; Ofuya and Bamigbola, 1991) have suggested that differences in the suitability of legumes for growth and development of *C. maculatus* may be attributable to the nutritional value of the seed.

Although Ofuya and Bamigbola (1991) found that the sex ratio among the adults of *C. maculatus* may be influenced by the kind of legume on which it is reared, the 4 varieties used in this study didn't seem to affect the sex ratio as there was a balance of the sexes.

Gatehouse *et al*, (1979) found that an elevated level of trypsin inhibitor could cause antibiosis to the larvae of *C. maculatus*, hence imparting a form of resistance to the cowpea.

## CONCLUSION

In this study, though all the varieties tested showed varying degrees of susceptibility, there was no significant difference at $P< 0.05$ for all the parameters evaluated. This is an indication that none of the four cowpea varieties studied is superior to others in terms of resistance to *C. maculatus.*

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