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# Ovipositional Response of Seed Beetle Callosobruchus Maculatus (F.) Coleoptra: Chrysomelidae on Some Selected Varieties of Cowpea, Vigna Unguiculata (L.) Walp

**Augustine, A. M, Idoko, J. E, Adepoju A.O**

*Department of Crop, Soil and Pest Management, Federal University of Technology Akure, Nigeria*

## ABSTRACT

Ovipositional response of *C. maculatus* on ten varieties of cowpea was studied under ambient laboratory conditions in Akure, Nigeria. IT89K-288, IT97K-568-18, IT89K-391, IT96K-610, IT81D-994, IT98K-205, IT99K-573, IT97K-499-35, IT86D-719 and a well-known susceptible cowpea variety Ife Brown were obtained from International Institute of Tropical Agriculture (IITA) Ibadan. The assessment of their relative resistance was based on ovipositional responses and percentage pest tolerance. Result from the screening showed no significant differences ($p<0.05$) in the number of eggs laid among the ten cowpea varieties however IT97K-499-35 recorded more egg load while IT89KD-391 showed least egg load. Mean hatched eggs was significantly higher ($p<0.05$) in IT89D-941-1 and IT97K-499-35 while IT89KD-391 and IT97K-568-18 recorded least hatched eggs. The highest percentage pest tolerance was observed in IT97K-568-18 and IT89KD-391 while IT89D-941-1, IT97K-499-35, IT86D-719 and Ife Brown had low tolerance. Base on the findings of this study, it is recommended that IT89KD-391 and IT97K-568-18 which were more resistant when compared to Ife Brown be investigated upon by breeders to improve on their storability thereby consolidating on previously established varieties.

**Keywords:** Cowpea varieties, ovipositional responses and percentage pest tolerance.

## INTRODUCTION

Cowpea (*Vigna unguiculata (L.) Walp.)* is an important indigenous African grain legume providing millions of people in the tropics and subtropics with dietary protein, vitamins and mineral elements (Bressani, 1985; Rubatzky and Yamaguchi, 1997), and also income for farmers and traders (Langyintuo *et al*., 2005). Accounting for between 64% and 70% of the global annual production (7.56 million tonnes of dry seed or grain) Nigeria is the world's largest cowpea producer (Singh *et al*, 2002; FAO 2005). Harvested cowpea seeds are mainly stored for subsequent use as human food or trading product. Cooked cowpea seeds are either eaten plain or as a component of meals made from cereals, root crops or vegetables (Lambot, 2002).

Most of the pest management research on cowpea in West Africa has focused on developing and testing field and storage pest control technologies. Among these technologies are improved genetic material (pest and disease resistant and tolerant varieties), insecticide treatment and plant extract (Salifu, 2000). In the developed countries, conventional fumigation technology is currently being scrutinized for many reasons such as ozone depletion potential of methyl bromide and carcinogenic concerns with phosphine (Adedire, 2011). Furthermore serious problems of genetic resistance by insect species, pest resurgence, residual toxicity, photo-toxicity, vertebrate toxicity, widespread environmental hazards and increasing costs of application of the presently used synthetic pesticides have directed the need for easy to utilize, low cost and also compatible with other control tactics. (Zettler and Cuperus 1990; Glenn *et al*. 1994; Ewete *et al*. 1996; Guedes *et al*. 1997; Talukder and Howse 2000; Elhag 2000).

Several local and improved varieties of cowpea seeds exist in Nigeria with different levels of resistance to infestation by *C. maculatus* (Lale and Kolo, 1998, Maina *et al*., 2006). Although, the susceptibility to *C. maculatus* infestation of cowpea seeds of some local and improved varieties from

***Address for correspondence:***

akinara007.94@gmail.com

different parts of Nigeria have been assessed in the past (Osuji, 1976; Ofuya, 1987; Mbata, 1993; Pessu and Umeozor, 2004), such information for several local and improved varieties cultivated in the South Western Region of Nigeria remain scarce.

Varietal resistance emerges as a potential option to minimize losses caused by *C. maculatus* during storage because it is easy to utilize, costs little and is compatible with other control tactics and most especially because cowpea is a crop of low economic return. The development of resistant cultivars is however still very limited, since few high-resistance sources have been identified (Singh *et al*., 1985; Dongre *et al*., 1996). This study was conducted in addition to efforts of crop researchers to minimize the indiscriminate use of synthetic chemicals and their effects. Oviposition decisions are crucial in the life cycle of bruchid beetles because they set the conditions in which an offspring must develop from egg to adult stage (Mitchell, 1990). Hence, the need to investigate on how oviposition can be reduced in *C. maculatus* through the use of resistant varieties by underscoring more highly resistant cowpeas aimed at consolidating on effort of previous researchers.

This study was therefore designed to access the ovipositional response of seed beetle *C. maculatus* in ten selected cowpea varieties available to farmers in South west part of Nigeria.

## MATERIALS AND METHODS

### Study Area

The study was carried out at the Pest Management Laboratory of the Department of Crop, Soil and Pest Management Technology, the Federal University of Technology, Akure Ondo State, located in the South-Western part of Nigeria and lies between latitude 50 45" and 80 15" North and longitude 40 30" and 60 East. The climate of the State is humid and hot, the rainy season is from April to October, with 1524 mm rainfall per year (approximately). The temperature varies under ambient conditions of 28 ± 2°C temperature and 70 ± 5% relative humidity.

### Collection and Preparation of Legume Seed Types

Seeds of ten cowpea varieties as listed in Tables 1 were collected from the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. Six varieties of the cowpea variety supplied from IITA were multiplied at the Teaching and Research Farm Obanla FUTA in order to obtain fresh seeds that will be sufficient for the evaluation. The legume seeds were first cleaned and disinfested by keeping them in a freezer at -5$^{0}$C for 7 days to kill all hidden infestations.

**Table1.** *Morphological characteristics of the ten cowpea varieties*

| Varieties | Seed Coat Texture | Colour |
|---|---|---|
| IT89K-288 | Rough | White |
| IT97K-568-18 | Smooth | Brown |
| IT89KD-391 | Rough | Brown |
| IT96D-610 | Smooth | Brown |
| IT81D-994 | Smooth | White |
| IT89D-941-1 | Smooth | White |
| IT99K-573 | Rough | White |
| IT97K-499-35 | Smooth | White |
| IT86D-719 | Smooth | White |
| Ife Brown | Smooth | Brown |

### Insect Culture

The initial culture of cowpea storage beetle, *Callosobruchus maculatus* used was obtained from cowpea grains already infested with bruchids from a market in Akure, Ondo State, Nigeria and was sub-cultured on a well-known susceptible cowpea variety Ife Brown which was purchased from International Institute of Tropical Agriculture IITA. Ife Brown cowpea seeds were first disinfested by deep-freezing for two weeks and acclimatized in the open laboratory conditions for 24hours before subsequent use. Bruchid cultures were established according to Beck and Blumer (2011). Cleaned cowpea seed 600g were set aside in a plastic container and infested with twenty adult bruchids (10 males and 10 females) for oviposition which was maintained at 28 ± 2°C and 70 ± 5% R.H. They were removed 5 days after introduction. The plastic container was then left undisturbed for twenty one days for adult emergence. Day old teneral adults that emerged from the container were used to infest cleaned disinfested legume seeds. Insect culture was maintained for subsequent assay.

### Ovipositional Response of C. Maculatus to Ten (10) Cowpea Varieties

This experiment was carried out adopting the procedure described by Lephale *et al.*, (2012) with little modifications made to it. Forty seeds from each variety were counted and put into petri dish of 90 x15mm. Pair of freshly (0-2 days old) emerged adults of *C. maculatus* (one male and one female) from laboratory culture were introduced into each petri dish containing the cowpea seeds, see in figure 3.2 below. The insects were left undisturbed in the dishes and arranged in the dark for 3 days at 28$^{o}$C and 75% RH, to allow for mating and oviposition before being removed. The total number of eggs laid after the death of the female (~14 days after infestation) were counted. Also the number of eggs per seed were counted and recorded. The experiment was laid in Completely Randomized Design (CRD) with three replicates. Data collected on number of egg laid, number of hatched eggs and unhatched eggs were subjected to analysis of variance, SPSS 16.0. Where necessary, data were transformed before analysis. Percentage data were arc-sine transformed and data based on count were square root transformed. Also, data on ovipositional response was analysed for percentage pest tolerance with the formular;

PPT (%) = ((Ti-Ds)/Ti)*100

Where PPT=Percentage pest tolerance, Ti=Total number of initial seeds, Ds=number of damaged seeds. Treatment means of the varietal parameters were separated by Tukey at 5% level of significant.

## RESULTS

### Ovipositional Response of C. Maculatus Reared on Ten Different Cowpea Varieties

Figure 1 showed the mean number of eggs laid by *C. maculatus* reared on ten (10) cowpea varieties. There were no significant differences (P< 0.05) in the mean number of eggs laid on ten cowpea varieties. Though highest number of eggs laid was recorded on IT97K-499-35 (81.33) while the lowest was recorded on IT89KD-391 (39.00). There were significant differences in the mean number of hatched eggs on the ten cowpea varieties (figure 2). Highest mean number of hatched eggs was observed on IT89D-941-1 (57.33) and IT97-499-35 (55.33) while IT97K-568-18 (26.00) and IT89KD-391 was significantly lower (p<0.05) when compared to the control. Mean number of unhatched eggs was significantly higher (p<0.05) in IT97K-568-18 (27.67) and IT97K-499-35 (26.00) while IT89D-941-1 (7.00) gave the lowest (Figure 3). Percentage pest tolerance showed significant difference (p>0.05) among all the cowpea varieties with IT97K-568-18 (62.50) and IT89KD-391 (58.33) indicating the highest while IT89D-941-1 (16.67), IT86D-719 (17.50) and IT97K-499-35 showed the least pest tolerance to *C. maculatus* (Figure 4).

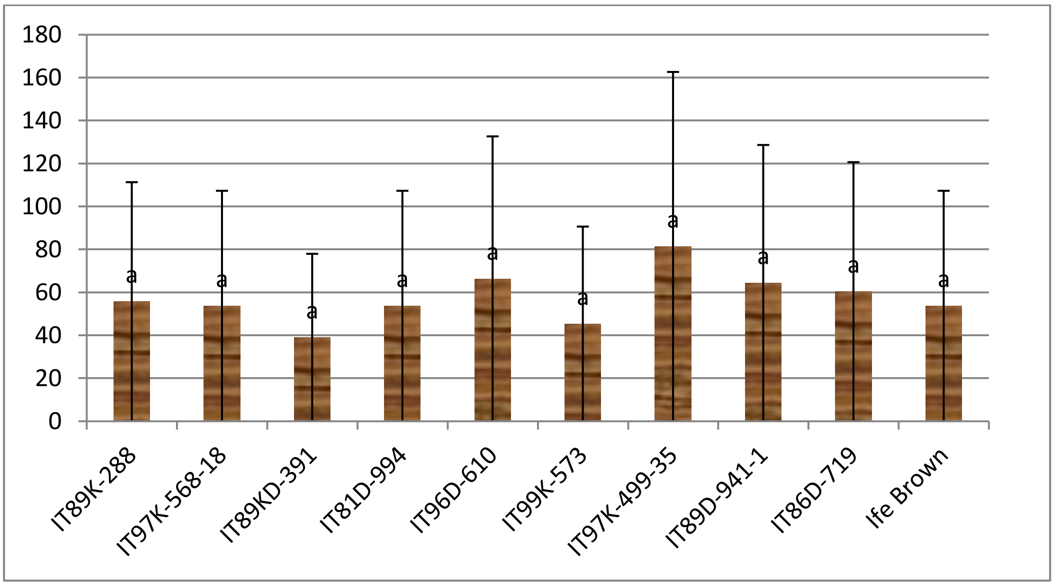


**Figure1.** *Number of eggs laid by C. maculatus reared on Different cowpea varieties*

*Means in each bar of the same colour bearing the same letter are not significantly different at the 5% level of probability by Tukey test.*

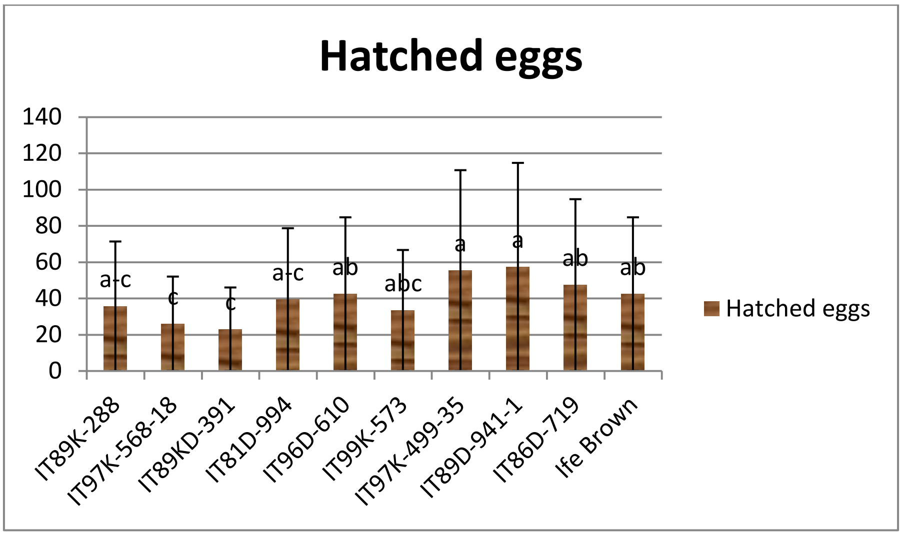


**Figure2.** *Hatched eggs laid by C. maculatus reared on Different cowpea varieties.*
*Means in each bar of the same colour bearing the same letter are not significantly different at the 5% level of probability by Tukey test.*

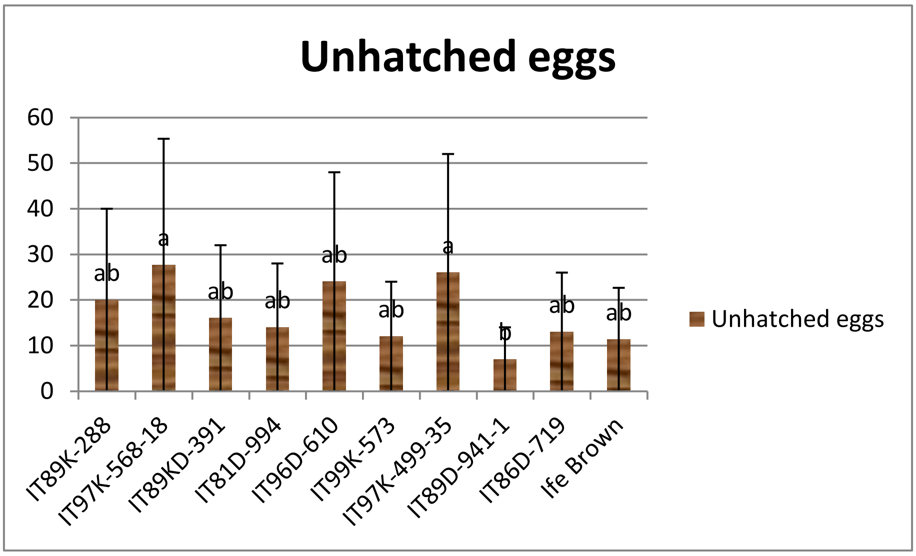


**Figure3.** *Unhatched eggs laid by C. maculatus reared on Different cowpea varieties*
*Means in each bar of the same colour bearing the same letter are not significantly different at the 5% level of probability by Tukey test.*

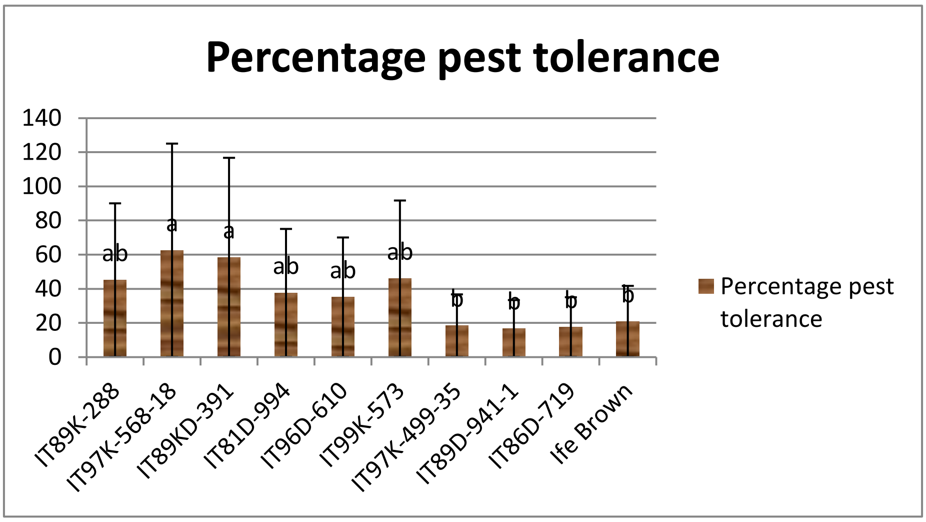


**Figure4.** *Percentage pest tolerance to C. maculatus reared on Different cowpea varieties*
*Means in each bar of the same colour bearing the same letter are not significantly different at the 5% level of probability by Tukey test.*

## DISCUSSION

Varietal resistance emerges as a potential option to minimize losses caused by *C. maculatus* during storage because it is easy to utilize, costs little and is compatible with other control tactics and most especially because cowpea is a crop of low economic return. The development of resistant cultivars is however still very limited, since few high-resistance sources have been identified (Singh *et al*., 1985; Dongre *et al*., 1996). Therefore this present study have further provided fact and figures that could assist in screening and underscoring more highly resistant legumes thereby consolidating on effort of previous researchers.

Results on the screening of cowpea varieties showed slight variations in oviposition by the female *Callosobruchus maculatus.* All the cowpea varieties in this study showed no significant difference ($P<0.05$) in mean number of eggs but number of hatched eggs indicated that IT89KD-391(23.00), IT97K-568-18(26.00), IT99K-573(33.33) and IT89K-288(35.67) cowpea varieties were moderately resistant to bruchid infestation. The majority of the cowpea varieties showed higher mean number of egg and similar result was obtained in the number of hatched eggs which is indicative of their susceptibility to *C. maculatus*. Some researchers in the course of evaluating cowpea varieties obtained similar result (Oke and Olajire, 2012), on levels of resistance and susceptibility to *Callosobruchus maculatus*. The highest resistant variety IT89KD-391 had been reported to be unanimously resistant to only bruchid infestation (Norris, 1996). Thomas and Waage (1995) asserted that varietal resistance is an important part of sustainable pest management strategy which is particularly effective in reducing post-harvest losses by *C. maculatus*. Variability in grain characteristics has been found useful in the selection of cultivars for insect resistance. Studies have identified some cowpea grain physical characteristics to be associated with bruchid resistance (Kitch *et al*., 1991, 1992). Scanning electron microscopy further revealed that solid and compressed subepidermal sclereids were found in resistant accessions of cowpea while longitudinal ridges of subepidermal sclereids were found in susceptible materials (Ramirez, *et al.,* 2015). Since seed properties including seed testa colour, mass, size and moisture content generally do influence the susceptibility of cowpea seeds and other cereals grains to *C. maculatus* in storage (Lale and Kolo, 1998; Maina and Lale, 2005; Maina and Dlamini, 2009), the above observed differences were very likely to be due to variations in the composition or levels of chemical substances that either deter or stimulate bruchid oviposition and/or feeding in these seeds (Gatehouse *et al.*, 1979).

## CONCLUSION

The results of this study have shown that among the legume seed type, IT97K-568-18, IT89KD-391 and *Mucuna pruriens*, *Sphenostylis stenocarpa* were resistant to infestation by *C. maculatus*. Therefore they could be included in the use of varietal resistance for the management of *C. maculatus.* Control measures base on the use of resistant varieties are ongoing pest management programme that needs to be sustained over time. It is therefore recommended that further investigations be carried out on *Mucuna pruriens* to identify the gene responsible for its resistant trait to *C. maculatus.* On identification the gene could now be introgressed into cowpea varieties to consolidate previously established resistant varieties.

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