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**Relative susceptibility of four varieties of cowpea
(*Vigna unguiculata* L. Walp) to infestation and damage
by *Callosobruchus maculatus* (f.) (Coleoptera:
Bruchidae)**

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ABSTRACT: The susceptibility of four different varieties of cowpea namely IT97K-1069-9, IT98K-1092-1, Danila and Ife-brown to *Callosobruchus maculatus* was evaluated in the laboratory in an effort to identify resistant varieties. Twenty (20) grams each of the four different cowpea variety seeds were weighed into 150ml plastic containers and infested with ten (10) newly emerged adults of *C. maculatus* in a ratio 1:1 (5 males: 5 females). The experiment was conducted using a completely randomized design. There were three replicates per treatment. Data was collected on oviposition, number of larvae, number of pupae and the F1 progeny emergence at 7, 10, 14, 17 and 20 days after infestation. The result showed that IT98K-1092-1 was the least susceptible of the four varieties and it is significantly different from Ife-brown which was the most susceptible variety at $P < 0.05$. IT98K-1092-1 had the least number of eggs larvae, pupae and adults when compared to the other cowpea varieties evaluated.

Keywords: Cowpea, *Callosobruchus maculatus*, Susceptibility, Resistance

Introduction

Cowpea *Vigna unguiculata* is a staple food of Nigeria and tropical African countries (Olakojo et al., 2007). Annually the global grain production of cowpea is approximately 4.9 million tons (FAO, 2008). IITA (2010) reported that more than 5.4 million tons of dried cowpeas are produced worldwide with Africa producing nearly 5.2 million tons.

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Nigeria is the largest producer and consumer accounting for 61% of production in Africa and 58% worldwide (IITA, 2010). All parts of the crop are useful as all are rich in nutrient and fibre. It contains about 23-25% protein and 50-67% carbohydrate (Quinn, 1997) and therefore has a tremendous potential to contribute to the alleviation of malnutrition among resource poor farmers. In Africa, humans consume the young leaves, immature pods, immature seeds and matured dried seeds (IITA, 2010). The stems, leaves and vines serve as animal feed and are often stored for use during the dry season. Apart from food and feed to humans and animals, cowpea is used for soil improvement and weed control (Hector and Smith, 2002).

In Nigeria, the production trend of cowpea shows a significant improvement with about 441% increase in area planted and 410% increase in yield from 1961-1995 (Ortiz, 1998). The use of cowpea as a dual purpose crop, providing both grain and fodder, is attractive in mixed crop/livestock systems where land and feed are becoming increasingly scarce (Tarawali et al, 1997) especially in the dry season. Cowpea is susceptible to attack by pests and diseases at all stages of its growth. These infestations by these pests begin on the field and rapidly build up during storage causing substantial damage and post-harvest losses (Singh et al. 1990) The major causes of low yields are insect pests, diseases, parasitic weeds, drought and low soil fertility. Insect pests constitute the major constraints to cowpea cultivation (Singh et al, 1990. Karungi et al, 2000). A major pest of economic importance to leguminous grains such as cowpea and lentils is *Callosobruchus maculatus* (F.), a bruchid that infests cowpea both in the field and in storage (Mulatu and Gebremedhin, 2000; Park et al, 2003). *Callosobruchus maculatus* is a serious problem of field and stored cowpea seeds. They are the most common and widespread insect pest in storage. Post harvest losses are highly variable but losses can be over 90% (Elwell, 1995).

Control of stored products 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 several decades has disrupted the biological control system by natural enemies and led to outbreaks of insect pests and development of resistance, 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 such as environmental pollution, toxicity to mammals, hazard to users and consumers, alternative control measures are constantly being sought.

Resistance which is an inherent ability of the crop to resist or tolerate infestation by insect pests with minimal damage is one of the promising methods to combat insect pest attack. Several improved varieties of cowpea have been developed over the years but complete resistance to *C. maculatus* has not been ascertained. This study is to evaluate the resistance of three (3) improved varieties of cowpea to infestation by *C. maculatus*.

Materials and Methods

Three improved cowpea seed varieties (IT97K-1069-9, IT98K-1092-1 and Danila) obtained from the International Institute of Tropical Agriculture (IITA) and a susceptible variety (Ife-brown) obtained from the National Seed Council were used for the study. Adult *C. maculatus* used for the experiment were obtained from a culture maintained in the laboratory of the Department of Crop Protection, University of Ilorin at ambient temperature. Prior to the commencement of the experiment, the cowpea seeds were sterilized by placing them in the oven at 54°C for 30 minutes to kill all existing stages of the insect. The seeds were then allowed to cool down, stored in polythene bags and then kept in the freezer to prevent reinfestation of the seeds.

The experiment was conducted using a completely randomized design. There were 3 replicates per variety. Twenty (20) grams of whole seeds per each variety were weighed and put in a 150 ml transparent plastic container. 10 (ten) newly emerged adults of *C. maculatus* were obtained from the culture using a putter and introduced into each replicate in a ratio 1:1 (5 males: 5 females). Each container was securely covered with muslin cloth held in place with rubber bands to allow for aeration and to prevent the insects from escaping. After seven days, all insects were removed from each sample and discarded. Ten (10) seeds randomly selected from each replicate were observed for the eggs and other developmental stages of *C. maculatus*. The seeds were discarded after observation.

The procedure was repeated on the 10th, 14th, 17th and 20th day after infestation with the total number of eggs, larvae and pupae recorded for each of the days sampling was done. The F1 progeny emergence was counted from the day of first emergence until there were no more insects emerging. The insects counted were removed and discarded to prevent overlaps. The data collected were subjected to analysis of variance and there were significant differences; the means were compared using the New Duncan Multiple Range Test.

Results and Discussion

The total number of eggs was used to measure susceptibility to *C. maculatus*. The 4 varieties showed varying degrees of susceptibility with IT97K-1069-9 having the highest number of eggs laid after 7 days of infestation and IT98K-1092-1 having the least eggs laid for the same period. On day 7, there was no significant difference between all varieties tested but there was a significant difference between IT98K-1092-1 and Danila on day 10. Danila had the highest mean number of eggs laid on the 7th, 10th and 14th day after infestation while Ife-brown had the highest mean number of eggs laid on the 17th and 20th day after infestation. However, there was no significant difference between the two varieties (Table 1). Danila had a higher mean larval emergence than Ife-brown on the 10th, 14th and 20th day after infestation while Ife-brown had a higher mean larval emergence on day 17. There was no significant

difference between the two varieties at $P < 0.05$. Danila was significantly different from IT97K-1069-9 and IT98K-1092-1 on the 10th, 14th and 17th day after infestation.

Table 1: Effect of varietal difference on oviposition

Variety	Days After Infestation				
	7 th	10 th	14 th	17 th	20 th
IT97K-1069-9	2.27	1.56	1.46	0.99	1.22
IT98K-1092-1	1.26	1.35	1.44	1.38	1.26
Danila	2.34	2.59	2.51	1.95	1.17
Ife-brown	1.81	2.51	2.11	2.03	1.56
S.E.	0.56	0.49	0.32	0.40	0.29
L.S.D.	1.38	1.21	0.79	0.98	0.73

Table 2: Larval development on the four different cowpea varieties

Variety	Days After Infestation			
	10 th	14 th	17 th	20 th
IT97K-1069-9	0.70	1.22	0.87	0.87
IT98K-1092-1	0.70	0.87	1.35	1.35
Danila	1.34	1.83	1.68	1.68
Ife-brown	0.87	1.55	1.95	1.48
S.E.	0.12	0.25	0.35	0.44
L.S.D.	0.30	0.61	0.86	1.09

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Table 3: Effect of varietal difference on pupal development

Variety	Days After Infestation	
	17 th	20 th
IT97K-1069-9	0.70	0.87
IT98K-1092-1	0.70	1.17
Danila	1.04	1.05
Ife-brown	0.87	0.99
S.E.	0.20	0.36
L.S.D.	0.48	0.89

Table 4: Influence of different cowpea varieties on F1 progeny emergence

Variety	Days After Infestation								
	20 th	21 st	22 nd	23 rd	24 th	25 th	26 th	27 th	28 th
IT97K-1069-9	0.70	0.99	1.22	1.91	2.32	1.34	0.87	0.70	0.70
IT98K-1092-1	0.87	0.70	0.87	2.66	2.22	0.81	0.70	0.70	0.70
Danila	0.70	1.61	1.93	2.95	2.73	2.66	1.55	0.70	0.70
Ife-brown	0.87	1.89	3.45	3.81	3.84	3.43	1.58	1.04	0.70
S.E	0.18	0.48	0.32	0.71	0.47	0.24	0.15	0.12	0.00
L.S.D	0.45	1.19	0.80	1.75	1.15	0.61	0.37	0.29	0.00

There was no significant difference among the 4 varieties on the 20th day after infestation (Table 2). As expected, Danila had the highest mean number of pupae (Table 3) followed by Ife-brown on the 17th day after infestation. However, IT98K-1092-1 had the highest mean number of pupae for the 20th day after infestation, though there was no significant difference between all the varieties tested for pupae emergence at $P < 0.05$. The F1 progeny showed Ife-brown having the mean highest number of adult emergence and IT97-1069-9 having the least mean number of adult emergence (Table 4). Ife-brown was significantly different from the other varieties on day 22, 25 and 27 after infestation, while IT97K-1069-9, IT98K-1092-1 and

Danila were not significantly different on the 20th, 21th, 27th and 28th day after infestation (Table 4). IT97K-1069-9 and IT98K-1092-1 both had low mean number of F1 emergence when compared with the other varieties. Though they were not significantly different from each other at $P < 0.05$, they were significantly different from Ife-brown which had the highest F1 progeny emergence. All the varieties evaluated showed varying degrees of susceptibility to *C. maculatus* infestation. In this study, Ife-brown and Danila were quite susceptible to infestation by *C. maculatus*, while IT98K-1092-1 and IT97K-1069-9 were not readily susceptible to infestation. IT98K-1092-1 was the least susceptible to oviposition, with IT97K-1069-9 showing the least susceptibility to F1 progeny emergence

The oviposition growth and development of *C. maculatus* was found to be generally more favourable on Ife-brown than on the other varieties tested. Howe and Currie (1964) opined that 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 the odour. Ife-brown which is small in size possesses a smooth seed coat which might have reduced the ability to oviposit by the insect, but the seed coat of Ife-brown is of the same nature as that of IT97K-1096-9 which had a higher susceptibility to oviposition by the insect than Ife-brown. This suggests that another factor might be responsible for ovipositional preference. Ofuya and Bamigbola (1990) 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. This might imply that the resistant varieties were not as nutritious as the susceptible varieties for the oviposition, growth and development of *C. maculatus*.

Conclusion

IT97K-1096-9 can be used in the management of the bruchid beetle. It can be stored for a longer period when compared to Ife-brown. The inherited genetic make-up of IT97K-1096-9 has played an important role in the reduction of susceptibility and this could be incorporated in integrated pest management of *C. maculatus*. IT97K-1096-9 could also be used as parent lines for improvement of local as well as improved varieties in Nigeria.

References

- Elwell (1995). Physical methods for insect control in stored grain ecosystem. New York, pp 353-407.
- FAO (2008): Cowpea production in Africa. Pp 1-2.
- Hector V, Smith J (2002): Cowpea; cooperative extension services. University of Hawai at Marwa, SA-GM-6.
- Howe RW, Currie JE (1964). Some laboratory observations on the rates of development, mortality and oviposition of several species of Bruchidae breeding in stored pulse. *Bulletin of Entomological Research*. 55:437-477.
- IITA (2010): Research to nourish Africa. Cowpea (*Vigna unguiculata*). Pp 1-2.
- Karungi J, Adipala E, Ogenga Latingo MW, Kyamnywa (2000): Pest management of cowpea Part Quantifying the effects of cowpea field pests on grain yields in eastern Uganda. *Crop Protection* 19: 343-347.
- Mulatu B, Gebremedhin T (2000): Oviposition-deterrent and toxic effects of various botanicals on the Adzuki bean beetle, *Callosobruchus chinensis* L. *Insect Science and its Application* 20 (1):33-38.
- Ofuya TI, Bamigbola KA (1990). Damage potential, growth and development of the seed beetle, *Callosobruchus maculatus* (Fabricius) (Coleoptera: Bruchidae) on some tropical legumes. *Tropical Agriculture (Trinidad)*, 68: 33pp.
- Olakojo SA, Ayanwale O, Obasemola VI (2007): Laboratory screening of seeds of some cowpea cultivars (*Vigna unguiculata*) for tolerance to cowpea beetles (*Callosobruchus maculatus*) in hot humid environment. *American-crusian J. Agric & Environ. Sci.*; 2 (5): 528-533.
- Ortiz R (1998): Cowpeas from Nigeria: A silent food revolution. *Outlook on Agriculture* 27 (2): 125-128.
- Park C, Kim SI, Ahn YJ (2003). Insecticidal activity of asarones identified in *Acorus gramineus* rhizome against three coleopteran stored-product insects. *J. Stored Prod. Res.*, 39: 333-342.
- Quinn FM (1997): Introduction In: Advances in cowpea research. Co-publication of International Institute of Tropical Agriculture (IITA) and Japan International Centre for Agricultural Sciences (JIRCAS), eds., Singh BB, Mohan-Raj DR, Dashiell KE, and LEN Jackai (eds.) IITA, Ibadan, Nigeria. Pp. 4-14.
- Singh S, Singal SK, Verma AN (1990): Evaluation of some edible oils as protectants of chickenpea seeds, *Cicer arietinum* L. against pulse beetle, *Callosobruchus chinensis* (L.) by preferential feeding method. In: Proc. 5th Intl. Working Conf. Stored Prod. Protec. (Bordeaux, France, 1990) Fleurat-Lessard F, and P Ducom (eds.).pp 1715-1724.
- Tarawali S, Singh BB, Peters M, Blade SF (1997): Cowpea haulms as fodder. In: Advances in cowpea research, edited by Singh, B.B., Mohan-Raj, D.R., Dashiell, K.E. and Jackai, L.E.N. International Institute of Tropical Agriculture (IITA) and Japan International Research Centre for Agricultural Sciences (JIRCAS) co-publication, IITA, Ibadan, Nigeria. pp 313-325.
- White NDG, Leesch (1995). Effect of Chlorpyrifosmethyl on oat ecosystems in farm jars. *J. Econ. Entomol.* 64: 960-969.

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