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SUSCEPTIBILITY OF THREE VARIETIES OF COWPEA SEEDS TO INFESTATION BY *Callosobrancus maculatus* (F.) (Coleoptera: Bruchidae)

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ABSTRACT

Callosobrancus maculatus is a serious field pest of cowpea causing pre and post harvest damage reducing its economic value. Susceptibility test was carried out on three varieties of cowpea (IT89KD391, IT97-499.35, IT90K-82-2), infestation by *Callosobrancus maculatus* from April to August 2014.This was to determined whether IT89KD391, IT97-499.35 and IT90K-82-2, cowpea varieties can be resistant to insects attack in the store. A total of 20 *Callosobrancus maculatus* were introduced into 500g of each variety of cowpea seeds in kliner jars replicated three times. The result showed that none of the variety was completely resistant to attack by *C. maculatus*. Susceptibility test was determined by counting the number of insects pest on each of the varieties every month for six months. A total of 5680 (IT89KD391) insects pest were recorded as the most susceptible variety followed by 3331 (IT97K-499.35) and 1986 (IT90K-82-2) insects which appeared to be the most resistant. The size and texture of the seed do not modify resistance but the hard testa is most likely responsible for hardness and resistance. Higher moisture content of the seeds appeared to account for the susceptibility of the cowpea varieties used for this experiment. One way analysis of variance (ANOVA) showed no significant difference ($P>0.05$) between nutrition and insect infestation. It is hope that farmers and marketers will be educated on the economic importance of *C. macullatus* to continuously monitor their cowpea in store to avoid value lost.

Keywords: Susceptibility, Variety, Cowpea, Seeds, Infestation, *Callosobrancus maculatus*

INTRODUCTION

Cowpea is an important edible legume crop in many parts of the world especially in tropical and subtropical regions for human nutrition and animals. However, part of the seed production is lost due to insect attacks, mainly by the weevil *Callosobruchus maculatus* a major pest of stored cowpeas. It is used as human food due to its high protein content and also as livestock feed to make silage and hay (Singh, 1987; Diouf, 2011; Cruz *et al.*, 2016).

Nigeria is believe to be the largest producer and consumer of cowpea, accounting for about 45% of world's production and other African countries which account for about 65%. It is important to note that cowpea seed pods

and leaves are consumed fresh as green vegetables in some African countries (Lowenberg-DeBoer, 2008; Dugje et al., 2009). The other cowpea plant apart from the seeds serves as a nutritious fodder for livestock and a source of income when sold to farmers who use them as livestock feed. Vegetarian including people who cannot afford animal protein rely on it because of its nutritive value. Cowpea seeds are a rich source of minerals and vitamins. Cowpea is sometimes called "poor man's meat" or "vegetable meat" by researchers due to its high protein content. Cowpea seed contains 23.4% protein, 1.8% fat and 60.3% carbohydrates and a good source of vitamins and phosphorus (Ghaly and Alkoaik, 2010, Brisibe *et al.*, 2011, Ndung *et al.*, 2012,).

The production and storage of this important food crop, cowpea has faced so many constraints including insect pest as one of its major constraints. The major storage pest of cowpea is *Callosobruchus maculatus* which infests cowpea in the field before harvest, the higher the infestation levels before harvest, the greater the damage to the seeds in storage. This will result in higher weevil emergence causing a greater weight loss, larger number of holes and consequently loss of economic value. Infestations on stored grains may reach 50% within 3-4 months of storage (Redden and McGuire,1983; Jackai and Asante 2003; Dugje *et al.*, 2009; Baidoo *et al.*, 2010; Brisibe *et al.*, 2011,).

Callosobrachus maculatus is usually a cosmopolitan field-to-store pest ranked as the principal post-harvest pest of cowpea in the tropics. It causes substantial quantitative and qualitative losses manifested by seed perforation and reductions in weight, market value and germination inability of seeds (Messina, 1984; Fitzner *et al.*, 1985; Caswel, 1981; Oluwafemi, 2012).
Shollaronke (2003) reported a relationship between size and moisture content were that larger cowpea seeds were loose, soft with higher moisture content, hence susceptible to cowpea weevils. These researchers (Singh, 1997; Singh, 1999; Ojimelukwe, *et al.*, 1999) believed that Storage structures that maintain high levels of moisture in seeds are more prone to high levels of infestation.

It has been reported that high protein content of some cowpea varieties was responsible for high resistance to infestation by *C. maculatus*. In support of this statement Nwanze *et al.* (1975) reported that increase in protein content, sugar content contributed significantly to cowpea resistance to infestation by *C. maculatus*. Howevr, Okwor (2006), reported a negative relationship between high protein in cowpea and *C. maculatus* infestation and concluded that crude protein was independent of the *C. maculatus* infestation on the cowpea varieties.

It is known that both farmers and marketers have constantly and indiscriminately misused insecticides to control storage insects on cowpea due to its high protein content and market value. Such indiscriminate applications have always caused sudden deaths, blindness, and skin irritation due to inappropriate used of storage chemicals. The use of chemical insecticides to

control insect has serious disadvantages such as the development of resistant strains and recycle of toxin leading to increase in cost of production and sale (Ofuya ,Idoko and Akintewe, 2008).

There is usually an increasing demand from grain buyers and consumers toward zero-tolerance to contamination by insects in grains and grain products. This usually forces the farmers and marketers to indiscriminately overdose cowpea with chemicals to prevent infestation to maintain quality and value. The way forward is to encourage plant breeders to produce pest resistant cultivars. It is therefore, important to screen varieties of cowpea sold in our markets to determine whether some varieties are resistant against *C. maculatus*. It has been reported that an efficient method for controlling seed infestation is the use of insect resistant cultivars (Cruz *et al.*, 2016).

The major objective of the current study is to determine if different cowpea cultivars have resistance to weevil infestation. The aim of this research is to determine whether moisture, size, texture and nutrient composition in the different cowpea varieties prevent the development of *Callosobruchus maculatus*.

MATERIALS AND METHODS

Study Area and sample collection

This study was conducted in Keffi LGA of Nasarawa State. Keffi is located on Latitude 7°55 and 8°00N and Longitude 6°00E (Akwa, *et al.*, 2007). The three cowpea seeds IT89KD391, IT97K-499.35 and IT90K-82-2 were bought from Keffi market randomly selected from different sellers. All the three samples were taken to the laboratory, Department of Zoology, Nasarawa State University for the experiment. The three varieties were all identified as IT89KD391, IT97K-499.35 and IT90K-82-2 by International Institute of Tropical Agriculture, Kubwa office, Abuja.

Morphological Description

The three varieties of cowpea were described morphologically using the seed size. Tenuninfected seeds were randomly picked and measured using venire caliper. These measurements were lengthwise in millimeters (mm) to determine size range. The seeds were also described morphological as either smooth, rough or wrinkle as stated by(Ebong,1970).

Moisture and Nutritional Analysis

The moisture content of the three varieties of the cowpea seeds were determined before and after the infestation with *Callosobrahcus maculatus*. Similarly the nutrient content of the three cowpea varieties IT89KD391, IT97K-499.35 and IT90K-82-2 were determined before and after the infestation by proximate analysis.

Experimental design

The three varieties of cowpea used for this experiment were carefully selected to avoid picking infested seeds. The method of Wahedi *et al.* (2013) was adopted with some modifications. The cowpea varieties were further disinfected using aluminium phosphate in an air tight container to eliminate any form of pre-infestation by the insect pest

(*C. maculatus*). A relapse period was allowed before the insects were introduced. About 500g of each variety was introduced into kliner jar. Each treatment was replicated three times including a control for each variety. Twenty adult C. *maculates* were carefully introduce into each kliner jar except the control. Each kliner jar was covered with a mesh net of size 30mm and allowed to stand for six months from April to August at room temperature. The number of insects in each jar was counted after every two weeks and presented as the mean. Each kliner jar was over turn unto a fine white cloth spread on a wide table and care should be taken to ensure that no insect escape and the content carefully return into kliner jar. The result was subjected to one way analysis of variance (ANOVA).

RESULTS

The physical morphology of the three cowpea varieties (IT89KD391, IT97K-499.35 and IT90K-82-2) and the texture is shown in table 1. The IT89KD391 (3.70-4.50 mm) were bigger in size, followed by IT97K-499.35(3.20-3.70 mm) and IT90K-82-2 (3.01-3.50 mm) was least in size. All the three varieties were rough.

Table 2 susceptibility of the three varieties of cowpea to infestation by *Callosobrachus maculatus* after six months. It was observed that IT89KD391 (10.15) had higher moisture, followed by IT97K-499.35 (9.65) and least in IT90K-82-2 (9.50). The total number of insects pest in the three varieties was not the same. The highest mean number of insects pest recorded on the three varieties of cowpea were as follow, 1894 (IT89KD391), 1110 (IT97K-499.35), 662 (1990K-82-2). All the varieties showed increased in moisture content after the infestation. It showed that the higher the moisture content, the higher the susceptibility of the cowpea variety and the higher number of insects pest. Higher moisture probably made the seeds very soft. One way analysis of variance (ANOVA) showed no significant difference ($P>0.05$) between nutrition and insect infestation.

The proximate analysis of the nutrient content of the three varieties of cowpea before and after the infestation was carried out. It was observed that IT89KD391 variety had the highest crude protein and lipid, IT97K-499.35 highest in ash and calcium, while IT90K-82-2 highest in crude fibre and phosphorus. The three varieties showed high protein content which is characteristics of the cowpea seeds (Table 3).

TABLE 1: Size and texture of the three varieties of cowpea seeds

Cowpea variety	Size range (mm)	Texture
IT89KD391	3.40-4.50	Rough
IT97K-499.35	3.20-3.70	Rough
IT90K-82-2	3.01-3.50	Rough

Table 2: Susceptibility of the three varieties of cowpea infestated by *Callosobrachus maculatus*

Variety	Moisture content		Weight(g) Cowpea	No. insect pest	Replicates			Total	Mean
	Initial	After			1	2	3		
IT89KD391	10.15	27.90	500	20	560	1382	2100	5680	1893
IT97K-499.35	9.65	26.05	500	20	472	1224	1635	3331	1110
IT90K-82-2	9.50	21.95	500	20	291	738	957	1986	662

Table 3: Proximate analysis showing the nutrient content of the three varieties of cowpea before and after infestation by *Callosobrchus maculatus*

Vareity	Inscts Pop.(mean)	Crude protein		Crude fiber		Lipid (fat)		Ash		Calcium		Phosphorus	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
IT89KD391	1893	37.69	37.79	4.85	3.72	1.22	3.33	3.95	5.77	0.17	1.00	0.05	0.60
IT97K-499.35	1110	25.37	43.62	3.76	6.80	0.77	2.22	3.98	7.00	1.33	0.22	0.45	0.11
IT90K-82-2	662	30.59	36.19	7.62	1.22	0.83	2.10	3.43	6.49	0.28	0.04	0.03	0.01

DISCUSSION

The result of this research showed that none of the three varieties of cowpea was completely resistant to infestation by *C. maculatus* (table 2). This supports the findings of Oke and Olajire, (2012), who reported that the cowpea varieties they studied exhibited some levels of resistance and susceptibility to *Callosobruchus maculatus*, a major storage insect pest of cowpea in the world. From the results obtained IT90K-82-2 was found to be more resistant to *C. maculatus* followed by IT97K499.35 and least resistance was observed in IT89KD391 variety. Resistant varieties had least number of adult *C. maculatus* population. It has been reported by researchers that factors that made some cowpea varieties resistant to *C. maculatus* attack is indicated by their low population over time (Redden and McGuire1983, Jackai and Asante 2003).

The study revealed that cowpea variety with highest population of adult insects pest emergence recorded extensive damage with many holes. Therefore, the higher the rate of susceptibility the more the population of adult insects causing extensive damage of cowpea seeds. This finding correlated with (Singh *et al.*, 1985) who reported that the number of emerging adult determines the extent of damage.

The three varieties were examined and describe morphologically. They were all showing rough texture and did not contribute to resistance to *C.maculatus* infestation. It has been reported that smooth cowpea texture may play a vital role in insect pest infestation. The current finding did not support the findings of Nwanze *et al.* (1975) who reported that *C. maculatus* prefers smooth-coated and well-filled seeds to their rough and wrinkled counterparts for oviposition. Akintola and Oyegoke (2004) indicated that seed coat texture plays significant role in inducing ovipositional response.

The size and moisture were observed to exhibit a relationship. The size range appeared to have influenced the infestation of the cowpea varieties by *C. maculatus*. It was observed that the biggest contain higher moisture; therefore, suffered higher infestation by *C. maculatus* weevil but the smaller size with lower moisture suffered least infestation. This is in agreement with the report of Shollaronke (2003) whose findings showed relationship between size and moisture content and concluded that cowpea with larger seeds were loose, soft with higher moisture content, hence susceptible to cowpea weevils. These researchers (Singh, 1997 and 1999; Ojimelukwe, *et al.*, 1999) believed that Storage structures that maintain high

levels of moisture in seeds are more prone to high levels of infestation.

The proximate analysis carried out on the three varieties of cowpea showed a high among of protein. Nwanze *et al.* (1975) reported that increase in protein content, sugar content contributed significantly to cowpea resistance to infestation by *C. maculatus.* While high protein content lead to resistance to infestation by *C. maculatus* in some cowpea varieties, this is not in agreement with this research work. Therefore, no relationship was established between increase in protein content and insects pest infestation. One way analysis of variance (ANOVA) showed no showed no significant difference ($P>0.05$) between nutrition and insects pest infestation. This means nutritional content of the cowpea did not offer any resistance against *C. maculatus* infestation.

CONCLUSION

In conclusion, it is important that we constantly screen our cowpea seeds cultivars in the market to determine varieties that are resistant to insect pest infestation. This will help farmers and sellers store such resistant cultivar for a longer time and safer for human consumption. This is the only way our ever increasing population can be protected from the effects of indiscriminate application of pesticides to protect the cowpea seeds from *C. maculatus* infestation. Farmers should always be educated to cultivate only the resistant varieties, thus reducing food poison associated with indiscriminate application of chemicals to protect the cowpea. Plant breeders should be encouraged to develop cultivars that show resistance to insects attack both in the field and store.

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