Comparative analysis of damage sustained by unprotected cowpea varieties from the attack of *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae)

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ABSTRACT

Comparative analysis of damage sustained by unprotected cowpea varieties from the attack of *Callosobruchus maculatus* was carried out within six months.Three varieties of cowpea (Large White, Sokoto white and Drum) were collected from some major markets in Akure, Ondo State, Nigeria. Samples of each variety at collection were found to be free of insect attack and there was no holes in them. Under strict monitoring in the storage each variety exhibited 100% hole at various points. Under laboratory experiment, each variety was susceptible to *C. maculatus* attack, though with some varying degree of susceptibility. Cowpea (Sokoto white variety) appears to be most resistant to *C. maculatus* attack than the Large White and Drum cowpea varieties under prevailing ambient temperature and relative humidity. In Nigeria, C. *maculatus* is a cosmopolitan pest of stored seeds of cowpea, as such a need to give a comprehensive study on the resistance of cowpea to this pest.

Keywords: Cosmopolitan pest, *Callosobruchus maculatus,* cowpea, insect, storage.

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INTRODUCTION

Cowpea, *Vigna unguciulata* (L.) Walp, has been consumed by human since the earliest practice of agriculture in the developing countries of Asia, Latin American and Africa where it is a valuable source of proteins, mineral salts and vitamins (Singh *et al*., 2003). It occupies a prominent place in the diet of the Nigerian people, this is because it's cheap and readily available. It serves as an alternative source of animal protein as it is described as "poor man meat". Legume seeds are additionally a valuable source of calcium, iron, thiamine and riboflavin (Singh *et al*., 1997). The major food legumes cultivated in Nigeria are cowpeas, *Vigna unguiculata* (L.) Walp, groundnuts, Arachis *hypogaea* L., pigeon peas, *Cajanus cajans* (L.) Mill, Soyabean, *Glycine max* (L.) Merr, Bambara groundnut, *Vigna subterranean* (L.) Verdc and African yam bean, *Sphenotylis stenocarpa* Harms.

Pests of the genus, *Callosobruchus* are found to cause severe damage on stored seeds of most of these legumes. Cowpea has been known to have a longtime pest called *Callosobruchus maculatus* (Ofuya and Bamigbola, 1991). *C. maculatus* infects the cowpea before harvest and causes quantitative and qualitative losses to seeds in storage (Mbata, 1993., Shade *et al*., 1996). Infestation levels are very low at the time of harvest and during processing and may sometimes be undetectable (Hongnard *et al*., 1985). The cowpea weevil multiplies very fast in storage giving rise to a new generation every month (Ovedrago *et al.*, 1996).

Infestation on stored grains may reach 50% within 3-4 months of storage (Pascual-Villalobos and Ballesta-Acosta, 2003.).This pest is capable of

rendering unprotected grains unsuitable for food or seed with 2-4 months of storage (Secket *at al*., 1991; Wolfson *et al*., 1991). C. *maculatus* infestation of cowpea seeds starts with the females laying eggs on ripening cowpea pods in the field, the larvae burrow through the chorion of the egg directly into the pod wall, and then into the seed, where the larvae develop and pupate (Singh *et al*, 1997). Similarly, holes made on the pods by other insects becomes an easy pathway for beetles to enter and to lay their eggs directly on the seeds (Singh and Singh; 1992).

Many synthetic insecticides and fumigants have been reported as effective in the control of *C. maculatus* damage to cowpea seeds (Jackai and Adalla, 1997). Similarly, the use of plant extracts and other forms of plant materials has been reported to control C. *maculatus* effectively (Dawodu and Ofuya 2000; Ofuya and Dawodu, 2002; Olowo and Dawodu, 2009). The use of host plant resistance for the control of C. *maculatus* has been investigated by many workers and cowpea varieties with moderate resistance to the pest have been identified (Murdock *et. al*., 1997; Ofuya and Credland, 1995; Adeduntan and Ofuya, 1998; Lale and Kolo, 1998). Since infestation starts from the filed, ecological studies of *C. maculatus* need be carried out. Therefore, comparative analysis of damage sustained by unprotected cowpea varieties from the attack of *Callosobruchus maculatus* was carried out within six months in the laboratory.

MATERIAL AND METHODS

Two different markets in Akure were surveyed for the three most popularly sold cowpea varieties. These markets are "Oja-Oba and Oja Isinkan", in Akure, Ondo Stae, Nigeria. Three varieties (Large white, Sokoto white and Drum) were selected for sampling. The sampling was carried out between January and June, 2010. At each market day each sample weighed 1 kg of the various cowpeas was purchased from the trader every first Friday of each month.

The samples of each variety were mixed together and the samples were placed in plastic containers with tightly fitted lids and taken to the laboratory. 1000 cowpea seeds were drawn from each cowpea and the number of cowpea seeds with holes and those without holes were counted. The samples of each variety was observed every month and immediately after each collection. The numbers of seed with holes and the number of adult bruchid emerging from the seeds were recorded.

Data on temperature and relative humidity in the laboratory were collected during the whole period (January – June, 2010). Correlation/comparative analysis was carried out on temperature and humidity data, percentage holed seeds and number of adult bruchid emerging from the seeds at various times.

RESULTS AND DISCUSSION

During the period when sampling of cowpea seeds were carried out in the two markets, adult bruchid were not found to have infested the seeds sampled. However, the percentage holed seeds were highest during rthe last two

months (May and June) with 18.9% and 20.1% respectively (Table 1). Highest number of adult *C. maculatus* and holed cowpea seeds were recorded in the month of February while the highest number of adult *C. maculatus* and 100% holed cowpea seeds was recorded in the month of March.

During market sampling, adult *C. maculatus* was not found on Sokoto White cowpea seeds but percentage holed seeds was highest in the month of January (Table 2). One month after sampling, the highest number of *C. maculatus* was found to have emerged from the sample in the Month of May, but the highest percentage of holed seeds was recorded in January (18.8%).

Two months after sampling, the highest number of *C. maculatus* emerged from the May sample while the highest percentage holed was also recorded in May with 48.3%.

The January and April samples consistently had relatively low number of *C. maculatus* emerging from the seed and percentage holed seeds.

During market sampling, adult C. *maculatus* was not found on Drum cowpea seeds but the percentage holed seeds was highest in March sample with 32.6% (Table 3). One month after sampling, the highest number of *C. maculatus* was found to have emerged from the sample in the month of May but percentage holed seeds was highest in the April sample with 28.7%. Two months after sampling, the highest number of C. *maculatus* emerged from the May sample and the highest percentage holed was also recorded in April with 59.7%.

Table 1: Infestation and damage to Cowpea (Large White variety) by C. *maculatus* for six months consecutively

Month	At sampling		One month after sampling		Two months after sampling	
	No of C. *maculatus*	% of holed seeds	No of C. *maculatus*	% of holed seeds	No of C. *maculatus*	% of holed seeds
January	0	2.4	8	3.9	50	25.2
February	0	14.6	950	43.7	205	56.3
March	0	9.9	435	38.4	1685	100
April	0	6.5	82	20.6	95	80.2
May	0	18.9	112	20.4	160	36.7
June	0	20.1	59	25.7	65	28.9

Table 2: Infestation and Damage to Cowpea (Sokoto White) by C. *maculatus* for six months consecutively

Month	At sampling		One month after sampling		Two months after sampling	
	No of C. *maculatus*	% of holed seeds	No of C. *maculatus*	% of holed seeds	No of C. *maculatus*	% of holed seeds
January	0	8.5	16	18.8	23	10.3
February	0	6.8	68	13.0	29	15.9
March	0	7.9	31	12.2	68	18.1
April	0	4.1	29	6.1	7	8.2
May	0	7.9	212	58.6	185	48.3
June	0	6.2	56	9.7	31	12.9

Table 3: Infestation and damage to Cowpea (Drum variety) by C. *maculatus* for six months consecutively

Month	At sampling		One month after sampling		Two months after sampling	
	No of *C.maculatus*	% of holed seeds	No of *C.* maculatus	% of holed seeds	No of C. maculatus	% of holed seeds
January	0	3.6	6	20.6	72	42.6
February	0	14.7	7	18.1	9	18.5
March	0	32.6	9	23.8	6	38.1
April	0	8.7	16	28.7	1	59.7
May	0	18.5	281	27.8	420	15.0
June	0	11.2	3	15.0	13	16.1

Table 4: Mean ambient temperature and relative humidity for six months consecutively

Month	Temperature	Relative Humidity
January	26^0C	83%
February	26.5^0C	87%
March	28^0C	86%
April	30^0C	90%
May	29^0C	90%
June	27^0C	91%

Table 5**: C**orrelation matrix for various parameters taken within six month during the assessment of cowpea damage (Drum variety).

Parameters	% Holed seed at 1 month	No of brouchid at 1 month	No of bruchid at 2 months	% Holed seeds at 2 months	Monthly mean temp	Monthly mean R/H
Monthly mean temperature	0.60	0.46	0.38	0.48	1	
Monthly mean relative humidity	0.19	0.17	0.69	0.17		1

Table 6: Correlation matrix for various parameters taken within six month during cowpea damage assessment (Large White variety).

Parameters	% holed seed at 1 month	No of bruchid at 1 month	No of bruchid at 2 months	% holed seeds at 2 months	Monthly mean temperature	Monthly mean relative humidity
Monthly mean temperature	0.29	0.02	0.17	0.36		1
Monthly mean relative humidity	0.12	0.06	0.34	0.39	0.34	

Table 7**:** Correlation matrix for various parameters taken between January and June 2010 during damage assessment on Sokoto white variety

Parameters	% Holed seed at 1 month	No of brouchid at 1 month	No of brouchid at 2 months	% Holed seeds at 2 months	Monthly mean temperature	Monthly mean relative humidity
Monthly mean temperature	0.44	0.05	0.33	0.30		1
Monthly mean relative humidity	0.28	0.54	0.54		1	

For large white and Sokoto white, there were no significant relationship between temperature or relative humidity and any of the damage parameters assessed. For the drum cowpea, there were similarly no significant relationship between temperature or relative humidity and any of the damage parameters assessed except between temperature and percentage holed seeds at one month after sampling ($r=0.60$; $P<0.05$), and relative humidity and number of adult bruchids that emerge from seeds two months after sampling ($r=0.69$; $P<0.05$).

Callosobruchus maculatus has always being regarded as a major pest of stored cowpea seeds in Nigeria (Adedutan and Ofuya, 1998; Lale and Kolo, 1998). Evidence of adult exit holes on cowpea seed and presence of adult bruchids were observed in all the three cowpea varieties. Damage to cowpea in terms of holed seeds at sampling range from 2.4% in Drum cowpea in the Month of January to 8.5% in Sokoto White cowpea in the same Month. When such cowpeas were further stored for two Months, 100% damage may be recorded. Singh (1977) had earlier reported that frequently after cowpea has been stored for 3 - 5 months 100% damage to seed may be recorded in Nigeria. The observation that *C. maculatus* may be able to cause 100% holes in stored cowpea seeds at certain times and in some varieties shows that it is still a major pest in contemporary times. The three varieties of cowpea sampled were not equally susceptible to bruchid damage. Over all the Sokoto white appears more resistant to C. *maculatus* damage than the Drum and Large white varieties. For example, two months after storage i.e the month of March 2010, 20% of the stored cowpea seeds of Sokoto white had been holed by *C. maculatus* where as it was 100% and 38.1% for Large white and Drum cowpea varieties respectively.

The absence of *C. maculatus* at sampling may be due to the fact that traders on a daily bases remove the insects from cowpea seeds before displaying them for sale in order for their products to be more attractive but those recorded a month after storage could be traced to eggs laid on cowpea seeds in the stores or on pods in the field just before harvest. Two months after cowpea seeds are stored greater number of infested seeds were recorded. This may be due to uninterrupted multiplication carried on by the first generation of C.*maculatus* that were hatched in the first month of storage after harvest as a result of field infestation by bruchids which is usually 5% of less (Ezueh, 1995).

C. maculatus, a cosmopolitan pest of cowpea in storage, have been found to begin its infestation from the field. It may be suggested that the adoption of improved cowpea resistant to bruchids by farmers may reduce damage both in the field and at storage. Research at IITA has developed insect resistant varieties which could replace local varieties (Jackai and Adalla, 1997). Since the more the holes on cowpea seeds, the less the price it attracts in markets (Mordock *et al.*, 1997).

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