

# Comparative Natural Resistance of Some Cowpea Varieties to *Callosobruchus Maculatus* (Fabricius)

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**Abstract** – The comparative natural resistance of six (6) cowpea varieties was investigated under ambient laboratory conditions in Ado-Ekiti, Nigeria. Treatment involved the measurement of 30grams of clean, uninfested cowpea seeds from the selected varieties into covered Petri dishes. Each measure of cowpea seeds in the covered Petri dishes was infested with 20 fresh emerged *Callosobruchus maculatus* adults (10 males and 10 females) and left for 4-7 days for the insects to mate and lay eggs; after which the old beetles were removed, for new ones to emerge. Number of holed seeds, emerged adult beetles and percentage weight loss from seeds taken after 40day of infestation, were used to measure the levels of seed resistance or susceptibility to *C. maculatus*. Of the six (6) cowpea varieties tested, Texas Cream exhibited the highest level of resistance to *C. maculatus*, with only 7 emerged adults and holed seeds respectively, and 4.30% weight loss from seeds; compared to Ife Brown which is the most susceptible, with 154 holed seeds, 155 newly emerged adults and 38.2% weight loss from seeds. All the tested varieties were significantly different ( $p < 0.05$ ) from the control and from each other in all parameters, except IT84S (2246) and IT81 (994) that bear the same Duncan Statistical letters of 'c', compared to other treatments and the control. None of the tested varieties however was able to completely prevent adult *C. maculatus* emergence from infested seeds. Breeding programmes to develop highly resistant varieties would go a long way in helping low income farmers and consumers.

**Keywords** – *Callosobruchus maculatus*, Resistance, Susceptibility, Infestation.

## I. INTRODUCTION

Cowpea *Vigna unguiculata* Linnaeus Walpers, is a tropical crop belonging to the order *Fabales*, family *Fabaceae*, sub-family *Faboideae*, tribe *Phaseoleae*, sub-tribe *Phaseolinae*, genus *Vigna* and species *unguiculata* (Verdcourt, 1999). The plant, which domestication is concentrated in West Africa, probably originated from the southernmost region of Africa (Padulosi and Ng, 1997). Today not less than 12.5million hectares of cowpea are cultivated worldwide; yielding well over 3million tones of beans annually (Singh et al., 1997).

Cowpea is one of the several species of the widely cultivated genus *Vigna*. It has been described as 'wonder' crop of Nigeria agriculture (Longe and Ofuya, 2009), is important from the standpoints of human and animal nutrition, soil improvement and protection, crop protection, internal trade and poverty alleviation. It is an important dietary staple in many countries of the tropics and the sub-tropical world. It is rich source of vegetable protein, minerals and vitamins (Longe, 2012).

People who consume cowpea have variously described it as giving protein, blood building, giving strength and being an adequate substitute for meat (Nnanyelugo et al., 1997). Some people relish the young leaves, which are eaten in salad while the immature pods or immature seeds are used as vegetable. The mature seed can be made into various local dishes, such as porridge, cakes and other snacks. The dry seeds can also be boiled with other food stuffs like yam, rice, maize, with condiments, to provide a sort of balanced diet for human consumption. As a staple food, it is eaten as in the form of dry seeds, green pods, green seeds, and tender green leaves. It is also utilized for fodder and as a quick-growing cover crop under a wide range of conditions. (Longe, 2013).

Cowpea as a field crop has the ability to fix nitrogen efficiently up to 40kgN/ha. It provides a high proportion of its own nitrogen requirements and also leaves a fixed nitrogen deposit of up to 60-70kg/ha in the soil for the succeeding crop. In spite of the great value of this important food crop, cowpea has faces so many constraints, particularly diseases and pests. The important pest of *Vigna unguiculata* during storage is the cowpea weevil *Callosobruchus maculatus* which belong to the family *Bruchidae* (Brisibe et al., 2011). It infests cowpea 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 (Longe, 2010). Infestations on stored grains may reach 50% within 3-4 months of storage (Dugje et al., 2009).

In Africa, cowpea growers have depended over the years on the use of conventional (synthetic) insecticides like phostoxin and primiphos methyl (actelic); which though are very effective for stored products protection, their use has several drawbacks like increasing costs, inconsistent supplies due to scarcity and hazards to human health and the environment, if carelessly and indiscriminately used; more so that most farmers in developing countries like Nigeria are poorly educated (Longe and Ofuya, 2010). And if cowpea seeds are to be stored for longer periods, then it is advisable to treat the seeds with recommended insecticides.

To reduce the cost of buying these insecticides therefore and to prevent their hazard to human health, farmer needs to produce pest- free cowpea which will be of great advantage to farmer and increase the availability of food like cowpea because it's one of the important foods in Africa.

The discovery of resistant cowpea varieties therefore, will go a long way in assisting farmers in producing a pest-free crop and also reduce their cost of production, as less expense will be incurred in storage.

The objective of this study therefore, was to determine the natural resistance of some varieties of cowpea to *Callosobruchus maculatus*. The study specifically determined the number of damage seeds, adult emergence from seeds, final seed weight and the percentage weight loss infestation of *C. maculatus*.

## II. MATERIALS AND METHODS

### Experimental Site

The experiment will be conducted at the Crop, Soil and Environmental Sciences Laboratory of the Faculty of Agriculture, Ekiti State University, Ado- Ekiti.

### Cowpea Varieties

The cowpea varieties used are: Ife brown, Ife Bimpe, 227 White, IT81 (994), IT84S (2246) and Texas cream. The varieties were gotten from the International Institute of Tropical Agriculture (IITA), Ibadan. They were put in the freezer for two weeks to remove any possible infestation and were later left for a day to defrost and get used to the environment.

Table 1: Characteristics of cowpea varieties tested for resistance to *Callosobruchus maculatus*.

Varieties	Colour	Size	Texture	Eye Colour
227White	White	Small	Rough	Black
Texas Cream	Cream	Medium	Smooth	Cream
IT81 (994)	White	Medium	Rough	Black
IT84S(2246)	Brown	Large	Rough	Brown
Ife Bimpe	Brown	Medium	Rough	White
Ife Brown	Brown	Small	Rough	White

### Insect Culture

The cowpea storage beetle *Callosobruchus maculatus* that was used for this study was obtained from infested stock in the market and confirmed in a standard laboratory before use. The weevils were cultured on clean seeds of Ife brown cowpea variety in a container with net covering to prevent the escape of the weevils and also to give room for respiration.

### Description of Experimental Set-up

Thirty grams (30g) from each of the cowpea varieties were measured into Petri dishes in three (3) replicates and one control respectively. 20 fresh emerged adults of *C. maculatus* (10 males and 10 females) from the weevil culture were introduced into each of the Petri dishes with cowpea seeds, and left for 4-7 days for the insects to mate and lay eggs; after which the old beetles were removed, for new ones to emerge. The adult introduced were removed after 7 days, after which weevils were sieved out and discarded. By this time, eggs had been laid on the cowpea seeds and the eggs were counted.

### Data Collection

- After 40 days of infestation, the following data were taken:
- Total number of adult *C. maculatus* that emerged from seeds.
- Percentage weight loss in seeds.
- Number of damage seeds with holes.
- Final weight of cowpea of the infested seeds at the end of the experiment.

### Data Analysis

Analysis of variance was carried out on data collected; significant means were separated at 5% level of probability, using Duncan's Multiple Range Test (DMRT).

## III. RESULTS

Table 2 shows significant variation ( $p < 0.05$ ) among the different parameters and in comparison with the control in the sampled cowpea seeds, except between IT81 (994) and IT84S (2246) varieties. Texas Cream cowpea variety exhibited the highest level of tolerance or resistance to *C. maculatus* attack and development, by showing the least amount of damaged or holed seeds and adult weevil emergence of 7 respectively from seeds and the least percentage weight loss of 4.30 from infested seeds after the experiment (See table 2 for details).

Texas Cream is distantly followed by 227-White, with adult emergence and holed seeds value of 38, respectively and percentage weight loss from cowpea seeds of 13.7 after experiment. Ife Brown variety of cowpea exhibited the least natural resistant ability to *C. maculatus* infestation and development among the six (6) tested varieties; with mean adult emergence and holed seed values of 155 and 154 respectively and mean percentage weight loss from seeds of 38.2. It is also observed that the variety with the lowest percentage weight loss (Texas Cream), exhibited the lowest amount of holed seeds and adult emergence from the infested cowpea seeds and vice versa. This indicates a positive correlation between the parameters tested (viz: number of damaged or holed seeds, adult emergence and percentage weight loss from seeds).

Table 3 shows the rating of the six (6) cowpea varieties as indicated by the indices used in this experiment. The varieties were rated as highly resistant, moderately resistant and susceptible (non-resistant). Only Texas Cream is rated as resistant. 227-White, IT84S (2246) and IT81 (994) were rated as moderately resistant, while Ife Bimpe and Ife Brown were rated as susceptible. Ife Brown is the most susceptible. See table 3.

Table 2: Comparative effect of *C. maculatus* on different varieties of stored cowpea seeds

Cowpea Variety	Initial Seed Weight	Final Seed Weight	%Weight Loss in Seeds	Mean number of Damage (holed) Seeds	Mean Adult Emergence from Seeds
Texas Cream	30a	28.7a	4.30a	7a	7a
227 White	30a	25.9b	13.7b	38b	38b
IT81 (994)	30a	23.9c	20.3c	48c	47c

IT84S (2246)	30a	24.4c	18.7c	47c	45c
Ife Bimpe	30a	21.9d	27.0d	70d	71d
Ife Brown	30a	18.5e	38.2e	156e	155e
Control	30a	0.00f	0.00f	0.00f	0.00f

Mean in each column having the same letters are not significantly different at 5% level of probability by Duncan Multiple Range Test (DMRT).

Table 3: Performance rating of tested cowpea varieties

Variety	Level of resistance to <i>C. maculatus</i>
227-White	Moderately resistant
Texas Cream	Highly resistant
IT81 (994)	Moderately resistant
IT84S (2246)	Moderately resistant
Ife Bimpe	Susceptible
Ife Brown	Susceptible

#### IV. DISCUSSIONS

Resistance to insect pest is a potentially valuable means of pest control, either as a sole control measure or as part of other control measures. According to Obalofin (2014) an important component of crop protection and improvement in the world over, is the development of pest resistant crop varieties. Keneni et al., (2011), observed that the use of resistant varieties against storage insect pests, when successful, has a number of comparative advantages over other control measures, particularly the use of chemical insecticides. Other researchers have also shown that seed resistance is a valuable tool against *C. maculatus* attack.

Results of the present study indicated that the cowpea varieties tested exhibit various degrees of resistance and susceptibility to adult *C. maculatus* attack. This supports the findings of Oke and Olajire (2012), which says that the cowpea varieties they studied exhibited some levels of resistance and susceptibility to *C. maculatus*.

From the results obtained in this study, Texas Cream was found to be most resistant to *C. maculatus* among the six (6) varieties tested; in terms of seed damage (holed seeds), adult emergence and weight loss from infested cowpea seeds. This was distantly followed by the 227-W variety. IT84S (2246) and IT81 (994) were found to be moderately resistant to the weevil attack. Ife Brown and Ife Bimpe varieties were found to be susceptible to the weevil (*C. maculatus*) infestation. Ife Brown cowpea variety was the most susceptible to the attack.

The study further revealed that the cowpea variety with the lowest adult emergence (Texas Cream), also recorded the lowest amount of holed or damaged seeds and percentage weight loss from infested seeds and vice versa. In other words, increasing population of emerged adults causes more extensive damage to infested seeds and vice versa. This agrees with previous findings which reveal that the number of emerging adults determines the extent of seeds damage; and seeds that permit more rapid and higher levels of adult emergence will be more extensively damaged (Singh et al., 1999).

The very low number of emerged *C. maculatus* adults in some of some the tested cowpea seeds, particularly Texas Cream, might suggest the presence in the varieties of some

active ingredients in the cotyledons which may be toxic to the feeding larva of the weevil during development, leading to their death and eventual non-emergence of adults from them. Janzen (1997) had earlier reported the presence of some biochemical substances in the cotyledon of certain varieties of grain legumes. These bio-chemicals probably confer antibiosis on the tested varieties, and this may explain in part of the significantly lower number of adults that emerged from the affected cowpea varieties.

Finally, Tanzubil, 1997 observed that cowpea stored without a means of controlling *C. maculatus* during storage, can record up to 30% reduction in weight due to seed damage by the weevil. The need therefore to look for varieties that are resistant to *C. maculatus* in storage becomes important.

#### V. CONCLUSION

Result from the study indicated that cowpea varieties can resist insect infestation to some extent even without the application of chemical insecticides.

Of the six cowpea varieties studied, Ife Brown was the most susceptible to adult *C. maculatus* attack followed by Ife Bimpe, hence, would not be suitable for longer storage except insecticides are applied.

This study rated Texas Cream variety highest in natural resistant to *C. maculatus* attack than the other five varieties because of its low population of adult weevil emergence, low weight loss and number of damaged or holed seeds.

Texas Cream therefore is suitable for recommendation to farmers because of it observed natural pest resistant ability. Where Texas Cream is not readily available, 227 white should be used. Breeding of Texas Cream with susceptible variety like Ife Brown or Ife Bimpe will help in improving their natural resistant ability.

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