

A survey of the damage caused by the *Callosobruchus maculatus* (F.) on different legume seeds sold in Njikoka Local Government Area, Anambra State, Nigeria

Umeanaeto P.U.¹, Ekesi O.N.¹, Irikannu K.C.¹, Onyebueke, A.C.² and Nzeukwu, C. I.¹

¹Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka Anambra State, Nigeria

²Department of Biology Education, Federal College of Education (Technical) Umunze, Anambra State, Nigeria

Abstract— *Callosobruchus maculatus* (F.) commonly called cowpea weevil is a major pest of stored leguminous seeds. The level of damage caused by *C. maculatus* (F.) on five different legumes on sale in Njikoka L.G.A., Anambra State was studied for a period of six weeks. The legume seeds were *Vigna unguiculata* var. brown (Brown cowpea) and *Vigna unguiculata* var. white (White cowpea), *Glycine max* (Soya beans), *Vigna subterranea* (Bambara nuts) and *Cajanus cajan* (Pigeon pea). They were purchased randomly from local traders at Orié-Agu market in Abagana, Anambra State. Clean seeds without infestation were selected for the study. One hundred grammes (100g) of each legume seeds were used. The weevils used for the study were reared in the laboratory. The F1 generation was used to infest the clean legume seeds. The weevils were introduced in different male to female ratios and containers covered with white muslin cloth to allow aeration. The experimental setup was left to stand on the laboratory bench while weight loss and emergence holes were observed at two week intervals for a period of six weeks. The treatments with the higher male to female ratios of weevils showed highest damage to legume seeds (15.08 ± 0.93). *V. unguiculata*-Cowpea (var. white) was the highest damaged seeds (13.88 ± 1.00), while *G. max*-soya beans were least damaged (2.24 ± 1.36). The damage done by the weevils on the different legume seeds were statistically significant ($P < 0.05$) using Analysis of Variance (ANOVA) and Post Hoc tests. Damaged seeds could lead to serious economic losses for both the farmers and the country. Early harvest, good storage practices and facilities to reduce the attack of these pests on legume seeds is recommended.

Keywords— Legumes, *Callosobruchus maculatus*, weevil, damage, Njikoka.

I. INTRODUCTION

Legumes (Family: Leguminosae) are valuable as a source of dietary proteins, vitamins and minerals. It has been consumed by humans since the earliest practice of agriculture in the developing countries of Africa, Asia and Latin America (Oluwafemi, 2012). It provides protein to rural as well as the urban dwellers as a substitute for the animal protein (Wakili, 2010). They are also a source of calcium, iron, thiamine and riboflavin. The major food

legumes cultivated in Nigeria are *Vigna unguiculata* (L.) (Cowpea), *Arachis hypogaea* (L.) (Groundnuts), *Cajanus cajan* (L.) (Pigeon pea), *Glycine max* (L.) (Soya bean), *Vigna subterranea* (L.) (Bambara nuts) and *Sphenostylis stenocarpa* (African yam bean).

Callosobruchus maculatus (F.) (Coleoptera: Bruchidae), also known as the cowpea weevil is a major pest of stored seeds of cowpea, pigeon pea and the African yam bean in tropics and subtropics (Yusuf *et al.*, 2019; Ofuya and Lale, 2001). It

is a field-to-store pest and ranked as the principal post-harvest pest of cowpea in the tropics because its attack starts in the field if the legumes are left unharvested especially cowpea. This soon spreads to the store after harvesting and storage (Caswel, 1981). It causes substantial quantitative and qualitative losses manifested by seed perforation and reductions in weight, market value and germination ability of seeds (Oluwafemi, 2012).

The weevil originated in Africa but is now widespread in the tropics and the subtropics. Adults are 2-4mm in length with brownish or black markings. They have a short lifespan of about 12 days and do not feed. Adult females lay about 100 eggs glued to the surface of the pods, and upon eclosion the larvae burrow into the seed where development takes place. There are two identified forms of this species; the active and sedentary forms. The active forms appear during periods of high infestations, they fly readily and are smaller and very active. These active flying forms under normal conditions in the West African Sahel region seem to have increased incidences during the rainy season from June to August due to increased moisture content in the seeds, while the sedentary forms may or may not be able to fly well enough (Ofuya, 2001; Ofuya and Lale, 2001).

Damage and weight loss on stored seeds is caused by the larva and the damage could be direct or indirect. Direct damage refers to the reduction in weight and seed viability while indirect damage refers to the economic loss and loss of goodwill. Factor that influence insect pest attack include climate condition of the store, proximity of source of infestation as well as interspecific and intraspecific competition. Types of storage facilities also play a major role in either protecting or exposing the crops to pest damage. The aim of this study is to ascertain the damage due to *C. maculatus* (F.) on different species of legume seeds sold at Njikoka L.G.A, Anambra State, Nigeria.

II. MATERIALS AND METHODS

Study Area

The study was carried out in Njikoka Local Government Area, Anambra state, Southeastern Nigeria. Njikoka lies within coordinates 6°10' N and 7°4' N with an estimated population of 148,394 (NPC/FRN, 2006). The study area experience two seasons in a year - the rainy season which lasts about 7 months (April to October) and the dry season lasting about 5 months (November to March) each year. The

area experiences harmattan - a short period of dry and dusty winds which occurs during the dry season. The L.G.A comprises six towns: Enugwu-Agidi, Enuwu-Ukwu, Nawfia, Abagana, Abba and Nimo. These towns all have markets that operate on a daily basis but each town has a specific traditional Igbo market day when the markets experience a very large turnout of both buyers and traders.

Procurement of the experimental seeds

This was a cross-sectional study. The legume seeds for the study were purchased from random sellers at Orie-Agu Abagana. The legume seeds used for the study were *V. unguiculata* var. brown (Brown cowpea) and *V. unguiculata* var. white (White cowpea), *G. max* (Soya beans), *V. subterranean* (Bambara nuts) and *C. cajan* (Pigeon pea). The seeds were properly picked to remove debris and plant remains. Damaged and immature seeds were removed to ensure that the used seeds had no damage or infection before use. The experiment was carried out in the laboratory of the Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka, Nigeria.

Procurement of insects used for the study

Cowpea seeds infested with *C. maculatus* (F.) were bought from Eke Awka market in Awka South L.G.A., Anambra State. The insects were harvested and cultured in a plastic jar. The jar was covered with white muslin cloth to allow proper aeration and also to prevent insect escape and kept under ambient temperature and relative humidity. The culture was left to develop as many weevils that were enough for the study.

Laboratory experiment

The experiment was carried out using the method described by Onyido *et al.* (2011).

Introduction of insects to the legumes

Two hundred grams (100g) of each of the different legume seeds were weighed into plastic containers. The containers were appropriately labelled with the names of the legumes and the amount of insects introduced. F1 generation weevils were used for the study. The weevils taken from the culture were used to infest the seeds in each container. Three categories of treatments were used in the ratio of 10 males:10 females, 15 males:10 females and 10 males:15 females. The containers were covered with white muslin cloth to enable aeration and prevent insect escape. Then these vials were left to stand on the laboratory bench with the controls. The

samples were observed at 2 weeks intervals for a period of six weeks. Already sterilized seeds without insect infestation were prepared as controls for each type of treatment under study.

Assessing grain damage

The seeds were weighed every two weeks during the experiment and after the experiment the weight losses were recorded. The seeds were also observed and the number of seed holes was determined by observing the emergence holes on individual seeds. Data on the final weight of the seeds (weight loss), nature of damage and the number of seeds with holes were recorded. The weight loss was determined by calculating the difference in the weight before and after the experiment.

Data Analysis

The weights before the experiment were compared with the weights after the experiments and the differences compared with Analysis of Variance (ANOVA) and Post Hoc tests using SPSS package.

III. RESULTS

The multiple comparisons of weight loss according to *C. maculatus* (F.) on the different legumes were calculated (Table 1). The weight loss levels were 15.08 ± 0.93 for *V. unguiculata* (var. white), 13.88 ± 1.00 for *V. unguiculata* (var. brown), 5.73 ± 2.60 for *C. cajan*, 2.24 ± 1.36 for *G. max* and 8.71 ± 4.74 for *V. subterranea*. This highest weight loss was found in *V. unguiculata* (var. white) while the least was observed in *G. max*. This was statistically significant ($P < 0.05$) using Analysis of Variance (ANOVA).

Table 1: Weight loss according to legumes involved.

Legume seeds	Mean total weight loss (%)
<i>V. unguiculata</i> var. white (White cowpea)	21.33
<i>V. unguiculata</i> var. brown (Brown cowpea)	20.33
<i>C. cajan</i> (Pigeon pea)	8.39
<i>G. max</i> (Soya beans)	4.92
<i>V. subterranea</i> (Bambara nuts)	14.64

F = 48.563; df = 134; P = 0.000 ($P < 0.05$)

Comparisons of the damage according to the sex of weevils were 7.56 ± 0.81 for treatments with 10 males:10 females, 10.80 ± 1.03 for treatments with 15 males:10 females and 9.02 ± 0.91 for treatments with 10 males:15 females. Highest weight loss was recorded in treatment with 15 male:10 females and least in treatments with 10 males:10 females which was significant ($P < 0.05$) [Table 2].

Table 2: Weight loss in relation to the ratio of the Weevils used

Legumes seeds	10Males: 10Females	10Males: 15Females	15Males: 10Females
<i>V. unguiculata</i> var. white (White cowpea)	21.08	23.41	20.78
<i>V. unguiculata</i> var. brown (Brown cowpea)	16.75	24.65	21.65
<i>C. cajan</i> (Pigeon pea)	7.17	10.39	8.24
<i>G. max</i> (Soya beans)	3.45	5.78	4.09
<i>V. subterranea</i> (Bambara nuts)	12.92	17.23	15.89

F = 3.094; df = 134; P = 0.049 ($P < 0.05$)

Multiple comparisons of the emergence holes according to the sex of weevils were 22.30 ± 5.34 for treatments with 10 males:10 females, 29.47 ± 7.04 for treatments with 15 males:10 females and 26.03 ± 6.11 for treatments with 10 males:15 females (Table 3). The damage was highest in treatments with 15 male:10 females and least in treatments with 10 males:10 females, although the result was not significant ($P > 0.05$).

Table 3: Emergence holes in relation to sex of the weevils involved

Legume seeds	10Males: 10Females	10Males: 15Females	15Males: 10Females
<i>V. unguiculata</i> var. white (White cowpea)	67	103	72
<i>V. unguiculata</i> var. brown (Brown cowpea)	70	91	65

<i>C. cajan</i> (Pigeon pea)	21	59	27
<i>G. max</i> (Soya beans)	5	12	2
<i>V. subterranean</i> (Bambara nuts)	47	74	64

F= 0.034; df= 89; P= 0.717 (P > 0.05)

Comparisons of the damage according to duration of infestation of the weevils showed damage levels of 5.74 ± 0.60 at the second week, 8.39 ± 0.75 at the fourth week and 13.24 ± 1.04 at the sixth week. The damage by weight loss was highest at the sixth week and least at the second week (Table 4). The analysis of variance (ANOVA) was statistically significant (P<0.05).

Table 4: Percentage Weight loss in relation to duration of infestation.

Legume seeds	Week 2 % weight loss	Week 4 % weight loss	Week 6 % weight loss
<i>V. unguiculata</i> var. white (White cowpea)	11.09	15.17	21.33
<i>V. unguiculata</i> var. brown (Brown cowpea)	10.83	14.38	20.33
<i>C. cajan</i> (Pigeon pea)	3.64	5.69	8.39
<i>G. max</i> (Soya beans)	1.70	2.38	4.92
<i>V. subterranea</i> (Bambara nuts)	4.61	7.60	14.47

F= 21.570; df= 134; P= 0.000 (P < 0.05)

IV. DISCUSSION

The findings of this study has shown that *C. maculatus* (F.) is a major pest of stored legumes on sale in markets in the study area. The observation is in agreement with Yusuf *et al.* (2019) who noted that the storage of cowpea seeds over long periods is threatened by bean beetle infestation. In this study, the damage levels were greatest on *V. unguiculata* (var. white) and then on *V. unguiculata* (var. brown) while *G. max* was the least damaged. The observation agrees with the reports of Onyido *et al.* (2011) who also observed similar

damages on the legumes by the same pests in their study in Southeastern Nigeria. Also *C. maculatus* (F.) has been reported to attack and damage cowpea seeds exposed to infestation in Northern Nigeria (Musa *et al.*, 2013). The observed differences in the level of damage on these legume seeds could be related to the nature of the seeds as those with rough coats attracted more weevils than those with smooth seed coats. Cowpea supported the growth of the weevils because the reduced time for the larval growth facilitated more population growth. *Glycine max* showed reduced infestation due to the hard seed coats. There was a reduced infestation in treatments with *C. cajan* as well. This agreed with Janzen *et al.* (1976), who stated that the seeds are toxic to the bean weevils.

The treatments with higher male to female ratios showed more weight loss and more emergence holes than treatments with lower or equal male to female ratios. This may be as a result of the habit of the female weevils that mate several times with several males and this can lead to deposition of more eggs. The emergence holes increased with increasing duration of infestation and the time of infestation increased with increasing eggs deposition and more weevils were produced which emerged after developing.

V. CONCLUSION

This study has shown the level of damage caused by the cowpea weevil, *C. maculatus* (F.) on different legumes seeds on sale in the study area. The study also revealed that cowpea (*V. unguiculata*, var. white and var. brown) has highest infestation levels. These seeds when damaged caused weight loss and also loss in viability and market value. Damaged seeds could also lead to serious economic losses for both the farmers and the country. Therefore, it is important to maintain good storage practices and facilities to reduce attack of these pests on legume seeds. Also inexpensive, safe and effective pesticides should be employed to destroy already infested legume seeds.

REFERENCES

- [1] Caswel, G.H. (1981). Damage to stored cowpea in the northern part of Nigeria. *Samaru J. Agricultural. Research* 5:4-5.
- [2] Janzen, D.B., Juster, H.B. & Liener, I.E. (1976). Insecticidal action of the phyto hemagglutinin in black beans on a bruchid beetle. *Science* 192:795-796.

- [3] Musa, A.K., Odunayo, A. & Adeyeye, O. E (2013). Effects of Initial Infestation Levels of *Callosobruchus maculatus* (F.) (Coleoptera: Chrysomelidae) on Cowpea and Use of *Nicotiana tabacum* L. Aqueous Extract as Grain Protectant. *Global Journal of Biology, Agriculture & Health Sciences* 2(3):209-212
- [4] NPC/FRN, (2006). Population Census of Nigeria, Federal Republic of Nigeria. Population distribution in Local Government Areas by Sex and Number of Households. Legal Notices on publication of the details of the breakdown of the National and State Provisional population census totals. *Official Gazette*, 94(24).
- [5] Ofuya, T.I. & Lale, N.E.S. (2001). *Pests of stored cereals and pulses in Nigeria: biology, ecology and control*. Dave Collins Publications, Akure, Nigeria 174 p.
- [6] Ofuya, T.I. (2001). Pests of stored cereals and pulses in Nigeria: In Ofuya T.I & Laye N.E.S eds., *Biology, Ecology and Control of Insects Pests of Stored Food Legumes*. Dave Collins Publications, Akure, Nigeria. pp 24-25.
- [7] Oluwafemi, A.R. (2012). Comparative effects of three plant powders and pirimiphos-methyl against the infestation of *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) in cowpea seeds. *SOAJ of Entomological Studies* 1(2):108-117.
- [8] Onyido, A. E., Zeibe, C.C., Okonkwo, N.J., Ezubgo-Nwobi, I.K., Egbuche, C.M., Udemezue, O.I. & Eneanya C.I. (2011). Damage caused by the bean bruchid, *Callosobruchus maculatus* (Fabricius) on different legume seeds on sale at Awka and Onitsha markets, Anambra state, South Eastern Nigeria. *African Research Review* 5:116-123
- [9] Wakili, A.M (2010). Economic analysis of cowpea production in Nigeria. *Russian Journal of Agricultural and Socio-Economic Sciences*, 1(13) 60-64.
- [10] Yusuf, S. Y., Musa, A. K., Adebayo, A. G. & Lawal, M. T (2019). Suppression of damaging effects of *Callosobruchus maculatus* (F.) (Coleoptera: Chrysomelidae) by plant powders. *Agrosearch*, 19(1): 1-12