

The Damage Potential of Cowpea Beetle (*Callosobruchus maculatus*) on Stored Product in Damaturu Main Market, Yobe State, Nigeria

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Abstract

The weevils are one of the largest order of insects and their size range from minute to large and have two pairs of wings i.e forewings and hind wings. An investigation was carried out on the damage potential of *Callosobruchus maculatus* on stored beans in Damaturu main market Yobe State. Three Varieties of beans within Damaturu main market were obtained and subjected to 6 weeks Laboratory examination. The Varieties are White Beans, Red Beans and Brown Bean. During this research work, it was observed that Red Beans was infested first by the weevils, then followed by White Beans and Brown Beans. The rate of infestation and rapid multiplication of beans weevils are higher in Red Beans 40% than in White Beans 35% and Brown Beans 27%. The percentage weight loss was higher in Red beans than White beans and Brown beans respectively. The rate of viability Beans should be stored in a safe place where the larvae of the weevils (which affect the beans) will not come in contact with the beans. was less in White Beans 40% than in Brown Beans 50% and Red Beans 60% thus it was observed that *Callosobruchus maculatus* greatly affected storage quality. In conclusion, the bean weevil *Callosobruchus maculatus* appeared to have greatly affected the weight and the viability of the three beans varieties.

Keywords: Cowpea, Infestation, Viability, *Callosobruchus maculatus*, Multiplication

I. Introduction

The beans weevil belongs to the species of insects called *Callosobruchus maculatus* known as Tsutsan “wake” in Hausa which belongs to phylum arthropoda, class insecta and order coleoptera (Casewell, 2014). The weevils are one of the largest order of insects and their size range from minute to large and have two pairs of wings i.e forewings and hind wings. The mouth part is modified for biting and chewing. Many of them are phytophagous i.e. they feed on plant as their main source of food. They have large prothorax and their larvae are well developed and have head without legs during larval stages (Akinsoye, 2012). *Callosobruchus maculatus* is a serious pest of maize and beans. The weevil lay their eggs on the seeds in the field and may also lay eggs on the shelled steels during storage of agricultural products like Beans and Cereals (Akinsoye, 2012).

The larval that emerge dig in to the seed to complete their life cycle, by so doing, they leave undesirable roundish holes on the seeds. Adult that result from the larva will again lay eggs and the cycle is repeated while the seeds are in storage (Casewell, 2014). The control measure include fumigation of the stored beans with 0.5% Tindane dust Storing the seeds in air tight container for several month's will also give effective control of beans weevil (Casewell, 2014).

Callosobruchus maculatus begins its attack shortly before harvest and continues in store where it develops. This beetle is responsible for most of the losses which occur in stored bean seeds (Bangudu, 2015). Damage done of storage product taken place at different levels of storage including the producers levels, the trader and the central store levels with varying percentage (Egwuatu, 2016). All these damage affect the quality of the crops thus affecting its market value, taints the tests of the crops and also pose a threat to human health that is if these bruchids are eaten alongside with the food. Stored species of *Callosobruchus maculatus* through examination of insect holes and weighing of seeds infects the cowpea before harvest and causes quantitative and qualitative losses to seeds in storage (Mbata, 2013). Infestation levels are very low at the time of harvest and may sometimes be undetectable (Chaignard *et al.*, 2015).

The cowpea weevil multiplies very fast in storage giving rise to a new generation every month (Ouedrago *et al.*, 2016). Infestation on stored grains may reach 50% within 3-4 months of storage (Pascual-2013). Thus cowpea harvested and stored by these farmers becomes heavily infested with *Callosobruchus maculatus* a few months in storage resulting in economic losses to the farmer. It is therefore necessary to reduce losses by knowing the best time to harvest the crop so that fewer weevils would be carried into storage (Lale, 2012).

Bean beetles *Callosobruchus maculatus*, are agricultural pest insect of Africa and Asia. Females lay their eggs on the surface of beans (*family fabaceae*). Eggs are deposited (oviposition) singly and several days after oviposition, a beetle larva (maggot) burrows in to the bean larval growth and pupation occur inside the bean and are consequently difficult to observe. At 30°C pupation and emergence of an adult beetle occurs 25-30 days after an egg was deposited. Adults are mature 24-36 hours after emergence and they do not need to feed. Adults may live for 7-10 days during which time mating and oviposition occurs since larvae cannot move from the bean on which an egg was deposition the oviposition choice of a female determines the future food resources available to their offspring. The choice of prey bean is most critical choice a female makes for her offspring as it will influence their growth, survival and future reproduction (Mitchell,

2011). Although females can be induced to lay eggs (oviposit) on a wide range of beans species very few bean species result in normal development and the successful emergence of adults. Some bean species are very clearly toxic to *Callosobruchus maculatus* larvae (Joujen, 2017). The mature seeds are an important pulse, chiefly in Africa and are often ground in to paste of different kinds, such as bean powder used in preparation of bean cake popularly known as “Akara”, and “Moin-moin” in Yoruba land of Nigeria whereas the immature pods are eaten fresh, frozen canned (Kochhar, 2011). Attack from cowpea seed beetle, *Callosobruchus maculatus* has adversely affected the production of cowpea difficult. The Species, has drawn attention because it is widely distributed throughout the tropical and sub-tropical regions hence it has become tropicopolitans (Lale, 2012).

II. Varieties of Beans and Cultivation

Beans require only moderate amount of rainfall, if too heavy, the plant tends to be leafy and produce few leafs.

Under heavy rainfall, leaf disease tend to be very common, clay soil is best for the beans. Beans is best planted at the beginning of the raining season so that the seeds matures just as the raining season is over. Planting may be done in ridges or on flat land. While spacing with in the row 15-20cm. The seeds are down 3cm deep three to four seed cereals and placed in each hole (Caswell, 2014).

There are many varieties of beans found in Damaturu depending on the duration of the plant to mature. These include:

- i. White Bean
- ii. Red Bean
- iii. Brown Bean

The aim of this research is to determine the damage potential of Cowpea beetles (*Callosobruchus maculatus*) on stored product in Damaturu main market.

III. Methodology

Sample Collection

Three (3) varieties of uninfected beans were obtained from Damaturu main market and weevils were obtained from infested beans. This was conveyed to the laboratory for further analysis

The three (3) varieties of beans are:-

- i. Red beans variety
- ii. Brown beans variety
- iii. White beans variety

Experimental Procedure

Two hundred seed of beans for each of the varieties were infested with the weevils in different killing jar with the mouth of each jar tightly closed with muslin to allow air in the set up. This was kept in the laboratory for six weeks until the beans is moderately infested. During this periods of observation on the rate of infestation, the quantitative loss was carried out, the weevils were then removed using hand picking and counted. The infested and un-infested beans were separated and kept in a petri dish for further analysis.

Weight Loss Determination

The weight loss of the infested and un-infested was taken in a well-known weight of petri-dish. The percentage weight loss after infestation was calculated by the following formula

$$WL = \frac{\text{weight of examined beans}}{\text{weight of infested and uninfested beans}} \times 100$$
$$\text{Red Beans} = \frac{51.3}{42.5} \times 100 = 120.7$$
$$\text{Brown beans} = \frac{64.4}{57.6} \times 100 = 11.8$$
$$\text{White beans} = \frac{66.5}{58.2} \times 100 = 114.2$$

Determination of the Rate of Infestation

The number of the infested beans observed out of the total number of beans observed, experimental upon two hundred (200) beans seeds for each of the three (3) varieties were calculated as the rate of infestation of each variety are determined as follows

$$\text{Therefore} = \frac{NIB}{TEB}$$

Keys:-

NIB= Number of infested beans

TIB= Total number of experimental beans

$$\frac{NIB}{TEB} = \frac{\text{Number of infested beans}}{\text{Total number of experimental beans}} \times 100$$

Rate of infested of Red beans

$$NIB = \frac{164}{200} \times 100 = 82\%$$

Rate of infested of Brown beans

$$NIB = \frac{68}{200} \times 100 = 34\%$$

Rate of infested of White beans

$$NIB = \frac{128}{200} \times 100 = 64\%$$

Determination of Seed Viability Loss

Twenty (20) bean seeds of each varieties were tested for viability by placing it in three (3), petri dishes containing Socked water, these were kept in t laboratory for one week, those that germinated are viable and were calculated using the following formula

$$\text{Viability} = \frac{\text{seed that germinate}}{\text{Total number of tested beans}} \times 100 =$$

$$\text{Red Beans} = \frac{3}{20} \times 100 = 15\%$$

$$\text{Brown Beans} = \frac{2}{20} \times 100 = 10 \quad 10\%$$

$$\text{White beans} = \frac{1}{20} \times 100 = 5\%$$

RESULTS

Rate of infestation with *Callosobruchus maculatus* among the three varieties of beans. Explain and summerised the content of the table 1,2 % 3 in details, please.

Table 1: Infestation rate with *Callosobruchus maculatus* among the three (3) varieties of beans examined.

Beans Variety	Number Examined	Number infested	Number Uninfested	Percentage Infested
Red Beans	200	164	36	82%
Brown Beans	200	68	132	34%
White Beans	200	128	72	64%

Table 2: Shows the percentage weight loss among three varieties of beans

Beans Variety	Initial Weight (g)	Final Weight	Weight Loss	Percentage Weight Loss
Red Beans	51.3g	42.5	8.8	17.1%
Brown Beans	64.4g	57.6	6.8	10.5%
White Beans	66.5g	58.2	8.3	12.4%

Table 3: Shows the viability of beans after infestation, it was observed among the three (3) varieties of beans that was examined.

Beans Variety	Number Tested	Number Germinated	Percentage Viability
Red Beans	20	3	15%
Brown Beans	290	2	10%
White Beans	20	1	5%

IV. Discussion

The infestation rate with, *Callosobruchus maculatus* among the three varieties of beans examined was observed for period of six (6) weeks in the laboratory. It was found that a higher infestation rate occurred in white beans and the least was found in Red beans and Brown beans. This shows that white beans variety was more resistant to *Callosobruchus maculatus* infestation than Red beans and Brown beans varieties

after being subjected to *Callosobruchus maculatus* infestation. Damage of beans seeds through the feeding habit and weight loss among the three varieties of beans was also investigated. As the weevils feed on the internal contents of the beans endosperm by boring holes on the beans. It was observed that among the three varieties of beans varied greatly. This finding is similar to the work of Ofuya (2011) who reported that most damage caused by larvae, which develop in the seed causing losses in weight, this was also agree with the report of Casewell, (2011) that cowpea seed beetle is a cosmopolitan pest of store products, especially cowpeas in a tropic and sub-tropic.

The range of holes found on white beans seed were from 1-5 per beans seed while in Red beans, the hole found were from 1-4 per beans seed and for Brown beans, they ranged from 1-2 holes per beans seed. This shows that the damage caused by the weevil with regard to the holes made in among the three varieties of beans is higher in white beans and least in Red beans and moderate in Browns beans varieties respectively.

The weight loss as a result of *Callosobruchus maculatus* was also investigated. It was observed that the percentage weight loss among the three varieties of beans varied greatly in Red beans. It was higher than white beans and brown beans. It was also observed that red beans loss more weight than brown beans and white beans. In this study, *Callosobruchus maculatus* greatly affect the stored product quality in Damaturu main market. Perhaps that is why according to Casewell (2011) reported that damage caused by stored Brunchid, especially *Callosobruchus maculatus*, it was also reported by Alebeek, (2016) that after six months in storage, 100% seed infestation and damage may be recorded.

This agree with the finding of Monti *et al.*, (2017) that every stage in the life cycle of the crop has at least a major insect pest, at the beginning of the growing season, leaves are being attack by Caterpillar called *Amsacta moorei*, beans flower are also attack by flower thrips known as *Megalura thrips* at the flowering stage and lastly the pod borer (*Maruca vitrata*) and the weevils *Callosobruchus maculatus* attacking the seed.

For the viability test analysis among the three varieties of beans, red beans germinated in higher proportion than brown beans and white beans. That is why according to Mbata, (2013) explained that 37% of cowpea and other leguminous crops are lost to pest during storage for a period of six (6) to eight (8) weeks in storage. This appeared to agree with the fact that red beans and brown beans which were more resistant to infestation, germinated better than white beans with a higher proportion of seed damage after infestation.

V. Conclusion

In conclusion, the bean weevil *Callosobruchus maculatus* appeared to have greatly affected the weight and the viability of the three beans varieties. The rate of infestation and multiplication of beans weevil was higher and rapidly in red beans than white beans and brown beans.

VI. Recommendations

Beans is a major source of protein for human being and commercially important especially in Nigeria. It is unfortunate that bean's weevil affect the quality through damage to the seeds and germination rate:

The following recommendation were made.

- i. Since the brown beans variety was found to be more resistant to infestation. It is advisable for farmers to adopt it for cultivation.
- ii. Red beans which was found to be higher infested and loosing much of its weight farmers are advised to treat their seeds properly when storing this variety of beans.
- iii. Beans should be stored in a safe place where the larvae of the weevils (which affect the beans) will not come in contact with the beans. These storage facilities should be airtight and preferable apply insecticide in the containers.

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