Effect of Cowpea Seed Beetle (*Callosobruchus maculatus*) Infestation on Selected Landraces of Bambara Groundnut During Storage

Isma’ila Muhammad¹*, Nasiru Abdullahi², Abdulmalik Bala Shu’aiibu³ Ibrahim Musa⁴ Bawa Zakari Gambo⁵

¹Department of Botany, Faculty of Science, Gombe State University, PMB 127, Gombe, Nigeria.
²Department of Biological Sciences, Faculty of Science, Gombe State University PMB 127, Gombe, Nigeria.
³Department of Zoology, Faculty of Science, Gombe State University, PMB 127, Gombe, Nigeria.
⁴Department of Agronomy, Faculty of Agriculture, Federal University of Kashere, PMB 0182, Gombe, Nigeria.
⁵Department of Plant Science, Faculty of Science Modibbo Adama University, Yola, Nigeria.

*Corresponding author:
Dr. Isma’ila Muhammad,
Department of Botany,
Faculty of Science,
Gombe State University,
PMB 127,
Gombe,
Nigeria.

Email: ismuha@gsu.edu.ng

ABSTRACT

The study was carried out to assess the effect of *Callosobruchus maculatus* infestation on selected Bambara groundnut (*Vigna subterranea*) landraces in Gombe during storage to determine the Landrace(s) that are less susceptible to infestation caused by *C. maculatus* during storage. The trial was done in the Botany laboratory of Gombe State University, Gombe. Seeds were collected from five different Landraces, 40 grams each of healthy and *C. maculatus* infestation free seeds were infested with two males and three females. Completely Randomized Design (CRD) with three replicates was used to assess the effects of *C. maculatus* infestation on the selected landraces of Bambara groundnut during storage. The results of the analysis of variance displayed significant differences (p≤ 0.05) among the parameters studied. It indicated that the Mottled and Cream landraces are relatively less susceptible and witness lower damage from the bruchids attack 14.6 (36%) and 17 (46%), whereas Red and Black landraces are more susceptible 24 (61%) and 22 (57%) (recorded higher damage from the *C. maculatus* in terms of percentage weight loss recorded). These results showed the existence of variation among the different Bambara groundnut landraces used due to the infestation of *C. maculatus*. It can be observed from this study that the use of infestation free landraces at storage time may perhaps be a worthwhile and auspicious factor for integrated pest management especially on bruchids in Bambara groundnuts. Additionally, Mottle and Cream landraces might be employed as sources of resistance genes for the subsequent plant improvement program.

KEYWORDS

*Callosobruchus maculatus*
Bambara groundnut
Landraces
Oviposition
Infestation

INTRODUCTION

Bambara groundnut (*Vigna subterranea L. Thouars*) is an African indigenous legume crop that has been grown for centuries. Bambara groundnut is among the most commonly used grain in Nigeria, and help provide 14-24% of the protein requirements of most of the population [1]. The high contents of lysine and protein of this crop make it a natural supplement to essential diets for fruits, tubers, cereals, roots [2]. The entire plant is known for soil improvement because of nitrogen fixation [3]. Bambara groundnut can play a significant role as a source of protein. Seeds of this crop can make a complete food because it contains enough amounts of proteins, fats and carbohydrates. Averagely, Bambara groundnut seed is known to contain 17-24% protein, 54.5-69.3% carbohydrate and 5.3-7.8 fat [4]. Its seeds can be used as an important source of food and nutritional security due to their high nutritional contents and is an excellent source of iron, calcium, and fibre. Calcium is significant in aiding blood clotting. Based on records, red seeds of this crop are advantageous in regions where there is iron deficiency [4]. Bambara groundnut fatty acid composition of the oil is appropriate for edible purposes. It also contains thiamine, riboflavin, vitamins, carotene, and niacin but is very low in ascorbic acid content [5]. Brink *et al*., also mentioned that the dried leaves used for fodder can contain 16.7% crude protein, 31.9% crude fibre, 6.8% ash, and 1.7% fat. Bambara groundnut genotypes exhibit a wide range of genetic variations some of which include cream, brown, maroon and black with differences...
in the seed sizes, seed eyes and thickness of seed coats with some identified Bambara groundnut varieties comprising of; brown, red, black, white-eyed cream coloured, black-eyed cream coloured, cream coloured, strip-brown, and flecked/speckled/spotted, among others [6].

Bambara groundnut is not attacked by pests and disease in any of its regions of production. Nevertheless, in most situations, it can be susceptible to several fungal diseases [1]. It has a low insect and pest susceptibility [7]. Bambara groundnut is vulnerable to infestation by bruchids which are fields to store pests. The level of infestation in storage is influenced by the type of storage structures employed and the variety of seeds used. The temperature of storage also influences infestation in local stores. Bambara groundnut and Cowpea are majorly infested by two species of Bruchidae; Callosobruchus maculatus and Callosobruchus subinnotatus, however, Callosobruchus maculates is particularly the most common species that attacked many legumes [8]. Callosobruchus maculates is a species of beetle generally recognized as cowpea weevil. The adult does not need food nor water and can spend their limited lifecycle of approximately 1 to 2 weeks mating and laying eggs on the seeds [9].

In spite of the significant rank of this crop in Gombe state and Nigeria as a whole, the supply of its seeds for consumption and planting is always restricted by bruchids (Callosobruchus maculatus) attack. Such attacks occur majorly during storage time. In view of the above, this research was conducted to determine the best landraces which are less susceptible to the attack of Callosobruchus maculates on selected Landraces of Bambara groundnut during storage and to determine which among the Landraces can exhibit minimal weight loss during storage.

MATERIALS AND METHODS

Experimental site
The experiment was led in the Botany Laboratory of the Biological Sciences Department, Gombe State University, Gombe Nigeria. Located at latitude 10º15’ N and longitude is 11º 10’ E. The altitude varied, from 466m to 767m. The mean temperature range of the study area is between 22ºC to 33ºC, whereas the relative humidity is around 72%.

Procurement and Sample Preparation
Clean (uninfected) seeds of selected Bambara groundnut Landraces used in this study were obtained from Gombe main Market, Kwami, Bujude of Kwami L.G.A Gombe State, the northeastern part of Nigeria, and the seed were refrigerated for 24 hours in order to disinfect the seeds for possible egg laid. Infested seeds were also procured which served as a stock culture.

Stock Culture
The culture of Callosobruchus maculates used in this study was sourced from the infested Bambara groundnut seeds. It was then kept and reared under relative humanity and temperature in the Laboratory (at Room temperature). It was then sieved to obtained newly emerged Callosobruchus maculates that were used for the experiment.

Experimental Design
The experiment was laid down in a Complete Randomized Design (CRD) and replicated three times, comprising five selected landraces of Bambara groundnut Figure 1, Black (Burobu), Read (Mai Bargo), Striped Black (Bidi), mottled (Giwa) and Cream (Benteli) respectively. 40 g of each of the landraces were placed in to 10 cm kiln jar, they were subsequently infected with two males and three females Callosobruchus maculates (2:3) and covered with fine mesh to prevent the insects from escaping throughout the study period.

Data Collection and Analysis
Each kiln jar was observed after every three days interval taking the records of eggs laid (Oviposition) for 9 days and the number of adults emerged after every four days interval starting from 36 days after infestation (DAI), 40 DAI, 44 DAI, and 48 DAI respectively. At the end of the experiment, the landraces of Bambara groundnut used in this study were assessed to determine the weight loss recorded during an infestation. Data collected were subjected to analysis of variance (ANOVA) using (SPSS 16.0). The results are expressed as Mean values (standard deviation), the difference between the treatments mean were evaluated using the least significant difference (LSD).

RESULTS AND DISCUSSION
The results of the analysis of variance showed significant (p<0.005) variation among all the traits studied and the landraces used in this study, the results indicated that oviposition observed from this study improved with the increase in time afterwards of infestation of Bambara groundnut landraces with bruchids (Table 1). It was equally observed during the sampling period that, fewer egg counts were recorded from the Mottled and, Cream landraces, which appears to be significantly different (p<0.005) among the several seed coat colours. It was also observed that Ovipositions on Red, black, and striped black landraces were not significantly (p<0.005) higher than those recorded on mottled and, Cream landraces, which appears to be significantly different (p<0.005) with fewer ovipositions observed.

Table 1. Effect of C. maculates on selected landraces of Bambara groundnut on Number of eggs Laid (oviposition count).

<table>
<thead>
<tr>
<th>Landraces</th>
<th>Number of eggs laid (Oviposition count)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3DAI</td>
</tr>
<tr>
<td>Black (Burobu)</td>
<td>26.0±4.6</td>
</tr>
<tr>
<td>Mottled (Giwa)</td>
<td>9.3±1.5</td>
</tr>
<tr>
<td>Red (Mai Bargo)</td>
<td>28.0±6.6</td>
</tr>
<tr>
<td>Striped Black</td>
<td>25.3±2.5</td>
</tr>
<tr>
<td>Cream (Benteli)</td>
<td>17.3±1.5</td>
</tr>
</tbody>
</table>

Note: DAI Days After Infestation
Similarly, the results on the effect of *Callosobruchus maculatus* infestation on the Bambara groundnut landraces based on the emergence of adult count showed significant variation (p<0.005), similarly, there was highly significant variation among the landraces used and between the weeks observed during this study. The result indicated that mottled landrace exhibited the lowest mean value recorded (Table 2). The trend of the results obtained based on the response of the landraces to infestation by *Callosobruchus maculatus* showed Red, Black and Striped Black to be the landraces with the highest mean number of adult emergence count after infestation with *Callosobruchus maculatus*.

Table 2. Response of *C. maculatus* on selected landraces of Bambara groundnut based on adult count Emergence.

<table>
<thead>
<tr>
<th>Landraces</th>
<th>Adult emergence count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cream (Benteli)</td>
<td>36DAI 40DAI 44DAI 48DAI</td>
</tr>
<tr>
<td>Black (burobu)</td>
<td>21.0±3.0$^a$ 20.3±4.0$^b$ 22.7±4.7$^c$ 20.3±2.5$^d$</td>
</tr>
<tr>
<td>Mottled (Giwa)</td>
<td>7.3±2.0$^a$ 11.7±0.7$^b$ 12.0±3.0$^c$ 13.7±2.1$^d$</td>
</tr>
<tr>
<td>Red (Mai bargo)</td>
<td>22.7±5.5$^a$ 26.3±4.2$^b$ 24.7±3.5$^c$ 21.3±2.5$^d$</td>
</tr>
<tr>
<td>Striped Black (Bidi)</td>
<td>19.7±1.5$^a$ 17.7±1.5c 19.3±1.5$^b$ 15.3±6.7$^a$</td>
</tr>
<tr>
<td>Cream (Benteli)</td>
<td>12.0±1.0$^a$ 15.7±0.4$^b$ 11.3±3.5$^c$ 13.0±3.8$^d$</td>
</tr>
</tbody>
</table>

Note: DAI Days After Infestation

This condition of the darker surfaces can also elucidate the higher adult emergence recorded between these Red, and black-coated landraces used in this study. The reaction of *C. maculatus* to prefer the seed-coat colour of Bambara groundnut in this study is supported with the reports by many researchers like [11][14] they maintained that, insects have a preference for colours. Nevertheless, records especially on the effects of seed damage on oviposition and survival of *C. maculatus* are somewhat inconsistent. For example, [15] in their experiments on twenty-two cowpea varieties (five less susceptible, four moderately susceptible, and thirteen most susceptible) with and without seed coat, and on ten Bambara groundnut varieties respectively stated that seed coat had no importance in protecting cowpea and Bambara groundnut seeds from attack by *C. maculatus*. They suggested that the growth and development of *C. maculatus* in cowpea and Bambara groundnut depends on the nutritional contents of the seeds. The choice for Red, Black and Striped Black landraces to other landraces by the bruchids therefore, suggests that those landraces used in this study could have varied in their nutritional compositions.

**CONCLUSION**

The experiment was led to determine the effect of *C. maculatus* infestation on selected landraces of Bambara groundnut during storage. The results showed that Red, Black, and Striped Black are more susceptible, while Mottled and Cream landraces are less susceptible to *Callosobruchus maculatus* attack. The study concludes that despite other characteristics of seeds such as size, nutritional value and chemical composition are recognized to affect their resistance to insect attacks, however, attributes like variability among landraces and coat colour can still contribute to the susceptibility of grains to storage pests. It was also concluded from this study that *C. maculatus* have the potentials to attack all the Bambara groundnut landraces, nonetheless, some landraces such as Mottled and Cream landraces are less susceptible than the other landraces (Red, Black, and Striped Black) used in this study. These findings will serve as an advisory report for Bambara groundnut farmers, industry and marketers knowing that Mottled and Cream Landraces are vulnerable than the other landraces used.

**REFERENCES**


