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✓ **Morphometric Identification of Red Flour Beetle (*Tribolium Castaneum*, Herbst) of Bambara Groundnut (*Vigna subterranean* (L.) in Selected Area Council of Federal Capital Territory, Abuja**

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Abstract

The study was carried out in the selected Area Councils (ACs) of Federal Capital Territory, Abuja to determine the diversity of *Tribolium castaneum*. The four selected ACs for the study were Abaji, Bwari, Kuje and Kwali. Three markets were surveyed in each of the four ACs to get 1 kg measure of infested Bambara groundnut and three (3) insects (*Tribolium castaneum*) were selected randomly from each sampling unit and kept separately in a covered jar containing ethanol solution. The samples were taken to Insect Museum at the Department of Crop Protection, Faculty of Agriculture, Ahmadu Bello University, Zaria, Kaduna State for identification. MI scope was used to measure some features of the insects which were converted to millimeter (mm) and subjected to Analysis of variance (ANOVA), the means were separated



using Duncan Multiple Range Test (DMRT) at 5 % probability ($p=0.05$). Result obtained indicated that samples collected from Bwari AC had longer hind limb, shorter fore limb and smaller femur width of the features of *Tribolium castaneum* followed by Abaji AC having longer forelimb and shorter antennae. Only *Tribolium castaneum* species was identified in all the four ACs in FCT. Therefore, further study should be carried out on *Tribolium castaneum* in other markets and more Area councils of Abuja in searching for new species of this insect and information on the features variation observed should be used as a tool for insect taxonomist in bringing out new genus and/or species of *Tribolium castaneum*.

Key words: Bambara groundnut, *Tribolium castaneum*, Area councils, Market, species

Introduction

Bambara groundnut (*Vigna subterranean* (L.) Verdc.) is an underutilised African legume crop which is grown at low levels very extensively throughout sub-Saharan Africa (Okonkwo and Opara 2010; Bamshaiye *et al.*, 2011). Bambara groundnut with botanical name *Voandzeia subterranean* (L.) *thousars*, synonyms of *Vigna subterranean*, belongs to the plantae of the family of fabaceae and sub family of Faboidea (Bamshaiye *et al.*, 2011). It is a legume crop that is an important food source for rural households in sub-Saharan Africa. Studies had revealed the nutritional composition to be crude protein, moisture, crude fat, ash and total carbohydrate (Aremu *et al.*, 2006). It contains an appreciable amount of lysine and a minimum amount of trypsin and chymotrypsin (Olanipekun *et al.*, 2012).

Bambara groundnut is commonly called, beans, ground bean, earth pea and kaffir pea, depending on location and tradition. In Africa, it is commonly referred to as "Jugo beans" (South Africa), "Ntoyocibemba" (Republic of Zambia), "Gurjiya or Kwaruru" (Hausa, Nigeria), "Okpa" (Ibo, Nigeria), "Epa- Roro" (Yoruba, Nigeria) and "Nyimo beans" (Zimbabwe) (Bamshaiye *et al.*, 2011). It's cultivated in many semi-arid African countries such as Ghana, Nigeria and South Africa with a secondary cultivation centre in South East Asia namely Thailand, Indonesia and parts of Malaysia. Traditionally, it was cultivated in extreme, extreme, tropical environments by small-scale farmers without access to irrigation and/or fertilisers and with little guidance on improved practices (Mabhaudi *et al.*, 2013). Bambara groundnut is known to be drought tolerant, can grow in areas of high or low rainfall. It has been reported that this legume can produce yields where annual rainfall is below 500 mm and the optimum is between 900-1000 mm per year (Bamshaiye *et al.*, 2011).

The crop appears to be remarkably free from pests and diseases (Purseglove, 1992). This agrees with Doku (1995) who mentioned that the crop is relatively pest and disease free apart from weevil attack during storage. No serious pest or diseases are reported for this crop but damage is sometimes caused by leaf hoppers (*Hilda patruelis* and *Empoasca facialis*) (Isadeha, 2018).

Tanimu and Aliyu (1995) have also made similar observations that bambara groundnut is relatively free of the insect pests that plague other legumes, such as cowpea and peanut. Therefore, pesticides are hardly used by farmers when cultivating bambara groundnut. The most important fungal diseases are *Cercospora* leaf spot (*Cercospora spp.*), powdery mildew (*Erysiphe polygoni*) and Fusarium wilt



(*Fusarium oxysporum*) (Brinketal., 2006). According to Goli (1995) indry weather, pod attacks by termites have been consistently observed and root knot nematode (*Meloidogyne javanica*) also attacks the roots of the plant in sandy soils. Bambara groundnut (*Vigna subterranean* (L.) Verdc.) is often attacked by insect pest during storage, this result in high reduction of nutrient value of the crop seed (Bambara groundnut) under storage. Infested grain attracts low market value. Elevated levels of the genetic and environmental variance are often expressed in extreme habitat which alternate the beetle's development process, thus leading to inefficiency of adopted control measures. Provision of a sound background for Red Flour Beetles (*Tribolium castaneum*) species identification, enhance the establishment of higher taxonomic classification and for consideration on the beetles evolutionary development will go along way in reducing if not total prevention of resistant menace of various species to management strategies of *Tribolium castaneum*. The objective of this research therefore was to carry out the morphometric measurement of Red Flour Beetle and classify Red Flour Beetle (*Tribolium castaneum*) into different species.

MATERIALS AND METHODS

Study Area

Four (4) Area Councils of Federal Capital Territory, Abuja were selected for the study areas namely, Abaji, Bwari, Kwali and Kuje local government area

Sampling Techniques

Three (3) markets were surveyed in each of the four (4) Area Councils (ACs), 1 kg of infested bambara groundnut with *Tribolium castaneum* (Red Flour Beetle) was obtained and three (3) Beetle from each market were randomly selected from each measure and kept separately in a covered container, containing ethanol solution.

Classification Techniques

Three (3) Red Flour Beetle (*Tribolium castaneum*) from each of the three (3) locations (Market) were kept in different containers and labeled (for the different location at which they were obtained). The samples were identified and classified at the insect laboratory, (Insect Museum), of the Department of Crop Protection, Faculty of Agriculture Ahmadu Bello University (ABU), Zaria, Kaduna State for . Morphometric measurement was carried out using a Mi-Scope, where some features of the insect such as the Whole body length (WBL), Body width (BW), Hind limb (HL), Fore limb (FL), Head (H), Antennae (A), Tarsi (T), Width of femur (WF) and Femur (F) were measured. Afterward, the microscope was used to view and compare the collected insect with other Genus of *Tribolium castaneum* in the insect collection boxes present in the Muse

Data Analysis

The data collected were converted from pixel per length (P/L) to millimeter (mm), where 1 pixel = (25.4/96) mm and it was subjected to spread sheet format



using (Microsoft excel), after which the data were subjected to Analysis of variance (ANOVA), using Statistical Analysis Software (SAS) and the Mean separated using DMRT (Duncan Multiple Range Test).

RESULTS

Morphometric diversity of *Tribolium castaneum* in three (3) market of Bwari Area Council of Federal Capital Territory, Abuja.

Tribolium castaneum collected from Dutse Market had longer and significantly ($p=0.05$) hind limb than those collected from Mpape and Gwari Markets. The fore limb of the insect (*Tribolium castaneum*) collected at Gwari market was also shorter and significantly ($p=0.05$) than those of Dutse and Mpape Market. There was significant difference ($p=0.05$) between the width of femur of *Tribolium castaneum* from Dutse market and the width of femur from Gwari market.

Morphometric diversity of *Tribolium castaneum* in three (3) market of Kuje Area Council of Federal Capital Territory, Abuja.

There was no significant different in *Tribolium castaneum* from the three markets of Kuje Area Council. Kuje main markets had the highest body length and also had the highest body width. Kuje main market recorded the highest value for all the features compare to others except its fore limb, antenna and Tarsi

Morphometric diversity of *Tribolium castaneum* in three (3) market of Abaji Area Council of Federal Capital Territory, Abuja.

The fore limb of *Tribolium castaneum* collected from Rubochi market was longer significantly ($p=0.05$) than those from Yaba and Abaji main markets. The Antenna of the insect pest (*Tribolium castaneum*) collected at Abaji main market was also shorter significantly ($p=0.05$) than that of Yaba market. Other features measured were not significantly different from each other.

Morphometric diversity of *Tribolium castaneum* in three (3) market of Kwali Area Council of Federal Capital Territory, Abuja.

There was no significant differences in *Tribolium castaneum* collected from the three markets of Kwali Area Council. Kwali mini market had the longest hind limb and also had the longest Tarsi. Kwali main market recorded the highest value for all the features compare to others except its width of femur, but not significantly different from one another

Morphometric diversity of *Tribolium castaneum* in the Four (4) Area Council of Federal Capital Territory, Abuja.

The head of *Tribolium castaneum* collected from Bwari Area Council was smaller significantly ($p=0.05$) than those of other Area Councils. The whole body length of *Tribolium castaneum* collected from Bwari Area Council has no significant difference from Abaji Area Council, but showed significant difference ($p=0.05$) compare to Kuje and Kwali Local Area Councils. Other features were not significant different from one another



Discussion

The diversity in the features of *Tribolium castaneum* measured were evident, because there were variations. The *Tribolium castaneum* in Kuje main market had the longest whole body length (100.91 mm) and the widest body width (31.35 mm) while the *Tribolium castaneum* in Abaji main market had the shortest Antenna (12.03 mm) at Abaji Area council. Kwali mini market recorded the longest hind limb (40.21 mm) and the longest Antenna (17.17 mm) of *Tribolium castaneum* in Kwali Area council while the longest fore limb (35.65 mm) was recorded in Rubochi market at Abaji Area council. The biggest Head (16.89 mm) of *Tribolium castaneum* was recorded in Abaji main market of Abaji Area council. The longest Tarsi (10.56 mm) of *Tribolium castaneum* was gotten from Chukuku market of Kuje Area council.

Dutse Market recorded the widest width of femur (6.59 mm) of *Tribolium castaneum* in Bwari Area council. The longest femur (19.14 mm) of *Tribolium castaneum* was gotten from Kuje main market of Kuje Area council.

In Bwari Area council, the *Tribolium castaneum* in Gwari market had the shortest whole body length (81.82 mm) compare to other market. Gwari market recorded almost all the shortest value for all the features measured in *Tribolium castaneum* except the Head (11.39 mm), Antenna (13.62 mm) and Tarsi (6.95 mm).

Dutse market in Bwari Area council had the smallest Head (10.55 mm) of *Tribolium castaneum* while Kuje main market in Kuje Area council had the shortest Tarsi (5.77 mm) of *Tribolium castaneum*.

Conclusion

Based on the findings from this study, there was significant difference ($p=0.05$) among the features of *Tribolium castaneum* measured. However, in spite of these differences, no new species of *T. castaneum* was discovered.

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Table 1: Morphometric diversity of *Tribolium castaneum* in three (3) market of Bwari Area Council of Federal Capital Territory, Abuja.

BWARI AC	WBL	BW	HL	FL	H	A	T	F	F
Mpape Market	89.41 ^{ab}	27.15 ^a	33.19 ^b	31.76 ^{ab}	14.86 ^{abc}	13.90 ^{bc}	7.86 ^a	5.49 ^{ab}	14.14 ^{ab}
Dutse Market	88.76 ^{ab}	29.98 ^a	46.94 ^a	33.43 ^{ab}	10.55 ^c	16.14 ^{ab}	10.49 ^a	6.59 ^a	16.63 ^{ab}
Gwari Market	81.82 ^b	27.06 ^a	32.89 ^b	23.51 ^c	11.39 ^{bc}	13.62 ^{bc}	6.95 ^a	4.09 ^c	11.99 ^b
+SE	2.66	1.57	2.20	1.89	1.59	1.26	1.57	1.01	1.88

Mean with the same letter (s) on the same column are not significantly different by Duncan's Multiple Range Test (DMRT) at (p=0.05)

KEYS: Whole Body Length (WBL), Body Width (BW), Hind Limb (HL), Fore Limb (FL), Head (H), Antenna (A), Tarsi (T), Width of Femur (WF), Femur (F).

Table 2: Morphometric diversity of *Tribolium castaneum* in three (3) market of Kuje Area Council of Federal Capital Territory, Abuja.

Kuje AC	WBL	BW	HL	FL	H	A	T	WF	F
Kuje Main Market	100.91 ^a	31.35 ^a	37.58 ^b	28.94 ^{abc}	15.76 ^{ab}	15.88 ^{ab}	5.77 ^a	5.24 ^{abc}	19.14 ^a
Forest Market	93.45 ^{ab}	29.67 ^a	37.32 ^b	29.78 ^{abc}	13.98 ^{abc}	14.56 ^{abc}	8.09 ^a	5.10 ^{abc}	16.78 ^{ab}
Chukuku Market	91.69 ^{ab}	29.59 ^a	37.19 ^b	29.36 ^{abc}	15.73 ^{ab}	16.49 ^{ab}	10.56 ^a	5.16 ^{abc}	13.04 ^{ab}



+SE	2.66	1.57	2.20	1.89	1.59	1.26	1.57	1.01	1.88
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Mean with the same letter (s) on the same column are not significantly different by Duncan's Multiple Range Test (DMRT) at (p=0.05)

KEYS: Whole Body Length (WBL), Body Width (BW), Hind Limb (HL), Fore Limb (FL), Head (H), Antenna (A), Tarsi (T), Width of Femur (WF), Femur (F)

Table 3: Morphometric diversity of *Tribolium castaneum* in three (3) market of Abaji Area Council of Federal Capital Territory, Abuja.

Abaji AC	WBL	BW	HL	FL	H	A	T	WF	F
Abaji Main Market	96.94 ^a	28.29 ^a	34.59 ^b	27.78 ^{bc}	16.89 ^a	12.03 ^c	8.10 ^a	5.26 ^{abc}	14.98 ^{ab}
Yaba Market	92.20 ^{ab}	30.22 ^a	37.15 ^b	27.37 ^{bc}	15.02 ^{abc}	15.35 ^{ab}	9.03 ^a	6.11 ^{ab}	14.24 ^{ab}
Rubochi Market	87.81 ^{ab}	28.27 ^a	38.17 ^b	35.65 ^a	14.46 ^{abc}	14.47 ^{abc}	8.74 ^a	4.62 ^{abc}	13.00 ^{ab}

+SE	2.66	1.57	2.20	1.89	1.59	1.26	1.57	1.01	1.88
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Mean with the same letter (s) on the same column are not significantly different by Duncan's Multiple Range Test (DMRT) at (p=0.05)

KEYS: Whole Body Length (WBL), Body Width (BW), Hind Limb (HL), Fore Limb (FL), Head (H), Antenna (A), Tarsi (T), Width of Femur (WF), Femur (F).

Table 4: Morphometric diversity of *Tribolium castaneum* in three (3) market of Kwali Area Council of Federal Capital Territory, Abuja.

Kwali AC	WBL	BW	HL	FL	H	A	T	WF	F
Yongoji Market	94.20 ^{ab}	29.63 ^a	36.02 ^b	31.39 ^{ab}	15.49 ^{ab}	14.99 ^{abc}	9.52 ^a	5.28 ^{abc}	14.02 ^{ab}
Kwali Mini Market	97.51 ^{ab}	30.31 ^a	40.21 ^{ab}	31.47 ^{ab}	16.24 ^{ab}	17.17 ^a	10.26 ^a	4.56 ^{bc}	15.42 ^{ab}
Kwali Main Market	92.09 ^{ab}	28.86 ^a	36.12 ^b	30.75 ^{ab}	15.73 ^{ab}	15.16 ^{ab}	9.24 ^a	4.46 ^{bc}	13.91 ^{ab}

+SE	2.66	1.57	2.20	1.89	1.59	1.26	1.57	1.01	1.88
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Mean with the same letter (s) on the same column are not significantly different by Duncan's Multiple Range Test (DMRT) at (p=0.05)

KEYS: Whole Body Length (WBL), Body Width (BW), Hind Limb (HL), Fore Limb (FL), Head (H), Antenna (A), Tarsi (T), Width of Femur (WF), Femur (F).

Table 4.5: Morphometric diversity of *Tribolium castaneum* in Four (4) Area Councils of Federal Capital Territory, Abuja.

Treatment	WBL	BW	HL	FL	H	A	T	WF	F
Bwari AC	86.67 ^b	28.06 ^a	37.68 ^a	29.57 ^a	12.27 ^b	14.55 ^a	8.44 ^a	5.39 ^a	14.25 ^a
Kuje AC	95.35 ^a	30.20 ^a	37.36 ^b	29.36 ^a	15.16 ^a	15.64 ^a	8.14 ^a	5.17 ^a	16.32 ^a
Abaji AC	92.32 ^{ab}	28.93 ^a	36.64 ^a	30.27 ^a	15.46 ^a	13.95 ^a	8.62 ^a	5.33 ^a	14.07 ^a
Kwali AC	94.60 ^a	29.59 ^a	37.45 ^a	31.20 ^a	15.82 ^a	15.78 ^a	9.67 ^a	4.77 ^a	14.45 ^a
±SE	7.98	2.48	4.85	3.58	2.55	1.59	2.47	1.02	3.54

Mean with the same letter (s) on the same column are not significantly different by Duncan's Multiple Range Test (DMRT) at (p = 0.05)

KEYS: Whole Body Length (WBL), Body Width (BW), Hind Limb (HL), Fore Limb (FL), Head (H), Antenna (A), Tarsi (T), Width of Femur (WF), Femur (F).