Journal of Agricultural Science and Food Technology
Vol. 4 (4), pp. 64-70, June, 2018
ISSN: 2465-7522
Full Length Research Paper
http://pearlresearchjournals.org/journals/jasft/index.html

Morphometric Variations of Species of *Sitophilus zeamais* (Maize Weevil) in the Federal Capital Territory Abuja

Oyerinde A.A.[1*], Malann Y.D.[2], Bolorunduro I.E.[2], Solomon J.R.[2] and Lawal A.A.[1]

Accepted 21 June, 2018

[1]Department of Crop Protection, Faculty of Agriculture, University of Abuja, Abuja.
[2]Department of Biological Sciences, Faculty of Science, University of Abuja, Abuja.

ABSTRACT

Morphometric features were used to discriminate *Sitophilus zeamais* (L.) species in the Federal Capital Territory (FCT), Abuja, Nigeria into morphoclusters. Data obtained were analyzed with parametric statistical tools of mean, standard deviation and standard error. The morphometric features means of the maize weevil morphoclusters were presented in centroids, and also the simultaneous confidence intervals (95%) of means were expressed. In addition, the distribution and relation between them were subjected to two-step and hierarchical cluster analysis while the within a percentage of state of cluster were drawn into dendrogram plot. The results of this study classified maize weevil samples in the FCT into two races. Morphocluster 2 had the highest (56.0%) while morphocluster 1 had the lowest (44.0%) number of *Sitophilus zeamais*. The distribution by locations of *S. zeamais* in Area Councils in FCT based on morphometric features revealed that all *S. zeamais* samples obtained from Gwagwalada and Kuje Area Councils were of a single morphocluster while samples from Kwali Area Council were distributed within the two established morphocluters.

Keywords: Maize weevil, maize, Area Council, morphoclusters

*Corresponding author. Email:oyerindehyphae2002@gmail.com

INTRODUCTION

Sitophilus zeamais Linnaeus /Motschulsky is a pest of stored maize and cob maize prior to harvest. Infestations initiated in the standing crop may further develop in storage as the grain dries whether stored as cobs or bulk grain (Longstaff, 1981). It may also infest other cereals if the moisture content is moderate or high (Okonkwo and Okoye, 1996). Apart from the indirect effects, arising from the production of heat by the insects, the major effect of infestation by *Sitophilus* spp. is the damage to grain by feeding activities of the adults and the development of immature stages within the grain (Hussain et al., 1985). This not only reduces the grain quality but also produces a considerable amount of grain dust mixed with frass (Longstaff, 1981). Taxonomy of the *Sitophilus* group has been confusing, because of the difficulty of knowing the species to which it refers. The revisions in the Linnaeus original description of the smaller species and that Motschulsky's description of the larger species were valid. Both species were therefore placed in the genus *Sitophilus* with the specific names proposed by Linnaeus and Motschulsky. *S. zeamais* occurs throughout the warmer, more humid regions of the world, especially where maize is grown (Longstaff, 1981). It has also been recorded from Canada (Haque et al., 2000), Polynesia (Zimmerman, 1968), Argentina, Brazil, Burma, Cambodia, Greece, Japan, Morocco, Spain, Syria, Turkey, USA, USSR, Yugoslavia (Maceljski and Korunic, 1973). *S. zeamais* is widely distributed throughout

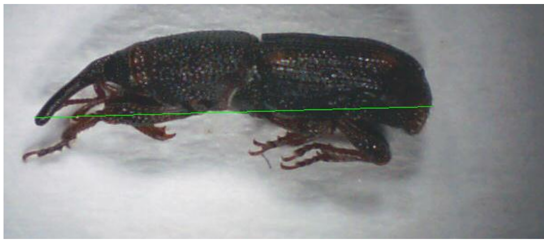
Plate 1. Body Length (BL).

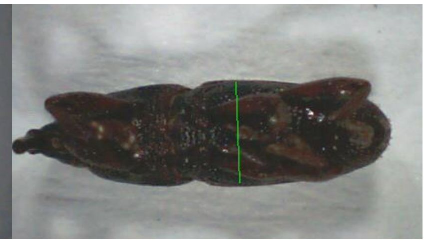
Plate 2. Body Width (BW).

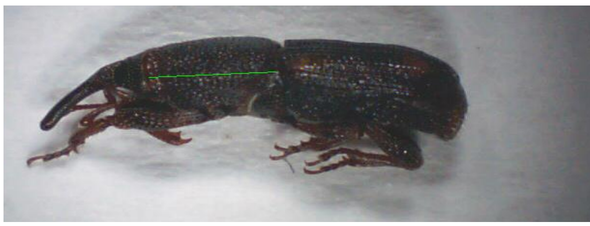
Plate 3. Thoracic Cavity Length (TCL).

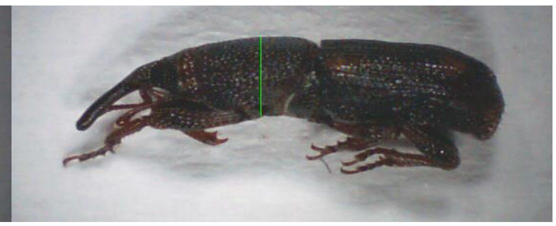
Plate 4. Thoracic Cavity Width TCW).

Growing areas of tropical countries, Nigeria inclusive (Haines, 1991; Okonkwo and Okoye, 1996; Haque et al., 2000).

Although, studies have been made on *S. zeamais* in Nigeria, there is no documentation on the variations morphometric features of *S. zeamais* in the country. This study aims at establishing morphometric variations of variants of *S. zeamais* in the Federal Capital Territory FCT, Abuja, Nigeria.

MATERIALS AND METHODS

Collection of samples

Random samples of 450 *Sitophilus zeamais* (maize weevil) were collected from five (5) different stores of maize in three (3) Area Councils of the FCT; namely: Gwagwalada, Kuje, and Kwali. The collections were sexed into males and females and stored separately in 70% ethanol in a small sampling bottle container labeled according to the sex and point of collection in the FCT.

Morphometric studies

Multivariate morphometric analysis was performed on one hundred and fifty (150) sexed female samples at fifty (50) samples of *S. zeamais* obtained from the three (3) Area Councils of the FCT at the Insect Museum of the Department of Crop Protection, Ahmadu Bello University, Zaira, Nigeria. All morphometric measurements were made with the aid of a calibrated hand held digitalized MiScope microscope with magnification range of 40-140x in millimeter (mm).

The following morphometric features i.e. Body length (BL), Body width (BW), Thoracic cavity length(TCL), Thoracic cavity width (TCW), Snout(Sn), Width of Head (WH), Length of Head (LH), Antenna length (AL), Fore leg (FL), Mid leg (ML), Hind leg (HL), Wing length (WL), Wing width (WW), Eye width (EW), Distance between the eye (DWE), Length of Abdomen(LA), and Width of Abdomen (WA) (Plates 1-16) were measured on each sample; measurement was carefully recorded and all the data collected were statistically analyzed.

Data analysis

Data obtained were analyzed with parametric statistical tools of mean, standard deviation and standard error. The morphometric features means of the maize weevil morphoclusters were presented in centroids, and also the simultaneous confidence intervals (95%) of means were expressed. In addition, the distribution and relation between them were subjected to two-step cluster analysis.

RESULTS

Two distinct races of *S. zeamais* were recorded (Table 1) based on the variation in morphometric features of maize


Plate 5. Snout (Sn)

Plate 6. Width of Head (WH).


Plate 7. Length of Head (LH).

Plate 8. Antenna Length (AL).


Plate 9. Fore Leg (FL).

Plate 10. Mid Leg (ML).


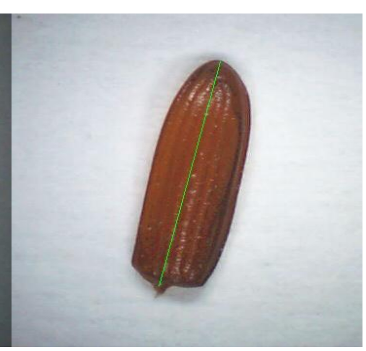

Plate 11. Wing Width (WW).

Plate 12. Wing Length (WL).

Plate 13. Eye Width (EW)

Plate 14. Distance Between the Eye (DWE)

Plate 15. Length of Abdomen (LA)

Plate 16. Width of Abdomen (WA)

Table 1. Morphometric features based distribution of *Sitophilus zeamais* in area councils of the Federal Capital Territory (FCT) Abuja.

Morphoclusters	No	% of Combined	% of Total
1	66	44.0%	44.0%
2	84	56.0%	56.0%
Combined	150	100.0%	100.0%
Total	150		100.0%

weevil samples collected from different Area Councils of the FCT. Maize weevils collected from Gwagwalada (1), Kwali (2) and Kuje (3) Area Councils of the Federal Capital Territory shows that morphocluster 2 had the highest (56.0%) while morphocluster 1 had the lowest (44.0%) number of S. zeamais. The distribution by locations of *S. zeamais* in Area Councils in FCT based on morphometric features (Figure 1) revealed that all *S. zeamais* samples obtained from Area Councils 1 (Gwagwalada) and 3 (Kuje) were of a single morphocluster while samples from Area Council 2 (Kwali) were distributed within the two established morphocluters. The centroid of the two morphoclusters *S. zeamais* in the three Area Councils of the FCT based on variation of morphometric features (Table 2) indicated that morphocluster 1 recorded the highest mean value for BL (3.74 mm), TCW (1.07 mm), WH (0.67 mm), LH, WL (2.31 mm), WW (0.83 mm), EW (0.26), DBE (0.27 mm) and LA (2.37 mm) while morphocluster 2 had higher mean values in the other measured variables. Correlationis one of the most common and most useful statistics, where a single number is used to describe the

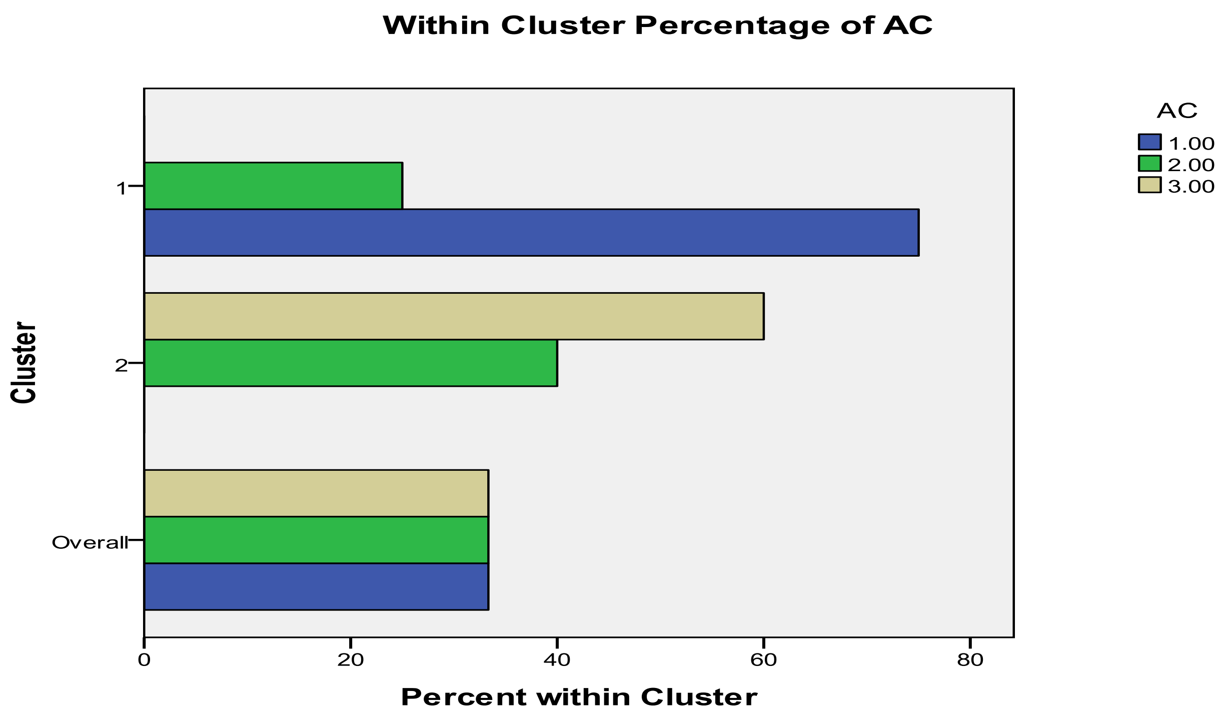

Figure 1: Within Cluster Percentage of *S. zeamais* based on morphometric features in the area Council (AC) of FCT.Key 1: Gwagwalada Area Council, 2 Kwali Area Council, 3 Kuje Area Council

degree of relationship between two variables. Table 3 shows the relationship between the morphometric features of the two established morphoclusters.

DISCUSSION

Results obtained from this study revealed that maize weevil samples collcted from some town in the FCT formed two different morphoclusters. Also, differences existed between the morphoclusters that existed in the Territory. S. zeamais has been found to be amongst the most important pests of maize in a number of studies; in South Carolina, USA, (Arbogast and Throne, 1997), in Kentucky (Sedlacek et al., 1998) and in steel silos in Taiwan (Peng, 1998), and in central Italy (Trematerra et al., 1999). Insect pests infesting stored pearl millet and their damage potential were assessed in northeastern Nigeria by Lale and Yusuf (2000). *S. zeamais* caused 0.6% damage. The two morphoclusters established based on morphometric features in the FCT showed that morphocluster 1 had the highest number of *S. zeamais* within the two Area Councils where morphocluster 2 is lower than morphocluster 1 based on morphometric features. These show that the *S. zeamais* in FCT are linked based on their structural difference which might be as a result of geographical distribution across the FCT with reference to earlier reports (Coombs et al., 1977; Longstaff, 1981; Arbogast and Throne, 1997; Peng, 1998). The finding also conforms to the earlier measured morphometric features of morphocluster 2 as a variant of *S. zeamais* (Babu, 1997; Meikle et al., 1999; Hidayat et al., 2000; Lale and Yusuf, 2000). However, the number of body segmentation observed in the *S. zeamais* samples based on the taxonomic techniques were the same; as the established morphoclusters corroborate with the established differences in *S. zeamais* in India (Babu, 1997) and Southern Nigeria (Lale and Yusuf, 2000). The use of multivariate morphometric features in classification of *S. zeamais* found in FCT gave a number of morphoclusters. This implied that this technique can be used by taxonomist for the grouping of maize weevil into morphoclusters in the territory. Despite the variations that were established with the number of morphoclusters of *S. zeamais* in the FCT, it is of note that the different morphoclusters of maize weevil were with varying and interrelated morphometric features. This is probably due to the variation in the ecology of the Area Councils and

Table 2. Centroids of *Sitophilus zeamais* based mophometric features in the FCT.

Morphoclusters	BL		BW		TCL		TCW		SN		WH		LH		AL		FL		ML		HL		WL		WW		EW		DBE		LA		WA	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	3.74	.48	1.12	.05	.72	.09	1.07	.04	.72	.05	.67	.11	.51	.13	.55	.12	1.01	.26	1.10	.26	1.31	.21	2.31	.11	.83	.20	.26	.04	.27	.07	2.37	.36	1.01	.12
2	3.73	.23	.99	.30	1.06	.07	.97	.30	.71	.11	.41	.07	.29	.05	.65	.09	1.49	.15	1.60	.11	1.73	.12	1.45	.12	.62	.06	.17	.03	.23	.05	1.96	.08	1.06	.01
Combined	3.74	.36	1.05	.23	.91	.19	1.01	.23	.72	.09	.53	.16	.38	.14	.61	.12	1.28	.31	1.38	.32	1.54	.26	1.83	.45	.71	.18	.19	.04	.25	.06	2.14	.32	1.04	.08

Key: Body Length (**BL**), Body Width (**BW**), Thoracic Cavity Length (**TCL**), Thoracic Cavity Width (**TCW**), Snout (**Sn**), Width of Head (**WH**), Length of Head (**LH**), Antenna Length (**AL**), Fore Leg (**FL**), Mid Leg (**ML**), Hind Leg (**HL**), Wing Length (**WL**), Wing Width (**WW**), Eye Width (**EW**), Distance Between the Eye (**DWE**), Length of Abdomen (**LA**), Width of Abdomen (**WA**)

Table 3. Correlation of maize weevil Morphometric Features in FCT.

	BL	BW	TCL	TCW	SN	WH	LH	AL	FL	ML	HL	WL	WW	EW	DBE	LA	WA
BL	1																
BW	.032	1															
TCL	.322	-.303	1														
TCW	.057	.991**	-.240	1													
SN	.619**	-.119	.193	-.119	1												
WH	.420*	.277	-.565**	.201	.475*	1											
LH	.613**	.296	-.504**	.251	.363	.908**	1										
AL	.361	.153	.470*	.159	-.102	-.154	.027	1									
FL	.526**	-.223	.947**	-.165	.354	-.352	-.279	.468*	1								
ML	.529**	-.203	.938**	-.139	.329	-.414*	-.304	.541**	.974**	1							
HL	.488**	-.191	.875**	-.118	.293	-.472*	-.336	.544**	.884**	.962**	1						
WL	-.032	.364	-.909**	.282	-.030	.814**	.765**	-.252	-.794**	-.814**	-.804**	1					
WW	.709**	.312	-.351	.278	.277	.795**	.956**	.245	-.112	-.117	-.140	.636**	1				
EW	.540**	.155	-.129	.088	.632**	.865**	.727**	.015	.088	-.021	-.160	.473*	.654**	1			
DBE	.472*	.231	-.098	.191	.545**	.628**	.579**	.365	.013	.015	.043	.367	.560**	.630**	1		
LA	.493**	.122	-.504**	.126	.279	.561**	.720**	-.373	-.304	-.285	-.248	.522**	.678**	.271	.055	1	
WA	.699**	-.062	.469*	.026	.185	-.137	.193	.370	.606**	.637**	.634**	-.353	.364	.000	-.013	.336	1

Correlation is significant at the 0.01 level, *Correlation is significant at the 0.05 level. **Key: Body Length (**BL**), Body Width (**BW**), Thoracic Cavity Length (**TCL**), Thoracic Cavity Width (**TCW**), Snout (**Sn**), Width of Head (**WH**), Length of Head (**LH**), Antenna Length (**AL**), Fore Leg (**FL**), Mid Leg (**ML**), Hind Leg (**HL**), Wing Length (**WL**), Wing Width (**WW**), Eye Width (**EW**), Distance Between the Eye (**DWE**), Length of Abdomen (**LA**), Width of Abdomen (**WA**).

also the ability of the morphoclusters to swarm over some kilometers of land.

Conclusion

Based on the result of these findings, it can be concluded that the morphoclusters of *S. zeamais* in the FCT have related morphometric tendencies. So, it can be appropriately recommended that farmers in this territory can always interact to share practical ideas on how to develop sustainable management of *S. zeamais* under maize growing areas.

REFERENCES

Arbogast RT, Throne, JE (1997). Insect infestation of farm-stored maize in South Carolina: towards characterization of a habitat. Journal of Stored Products Research, 33(3):187-198.

Babu BS (1997). Detection of insect pests of quarantine significance in screening of seeds of germplasms under an exchange programme during 1989-1995 in India. Journal of Entomological Research, 21(3):295-297.

Coombs CW, Billings CJ, Porter JE (1977). The effect of yellow split-peas (*Pisium sativum* L.) and other pulses on the productivity of certain strains of *Sitophilus oryzae* (L.) (Col. Curculionidae) and the ability of other strains to breed thereon. Journal of Stored Products Research, 13(2):53-58.

Haines CP (1991). Insects and Arachnids of Tropical Stored Products: Their Biology and Identification (A Training Manual), 2nd edition. Chatham, UK:Natural Resources Institute.

Haque MA, Nakakita H, Ikenaga H, Sota N (2000). Development-inhibiting activity of some tropical plants against *Sitophilus zeamais* Motschulsky (Coleoptera: Curculionidae). Journal of Stored Products Research, 36(3):281-287; 21.

Hidayat P, Phillips TW, Ffrench-Constant RH (1996). Molecular and morphological characters discriminate *Sitophilus oryzae* and *S. zeamais* (Coleoptera: Curculionidae) and confirm reproductive isolation. Annals of the Entomological Society of America, 89(5):645-652.

Hussain I, Bin, Haines CP, Pranata RI (1985). Susceptibility of paddy and milled rice to attack by *Sitophilus oryzae* (Linnaeus) and *Sitophilus zeamais* Motschulsky. In*:* Proceedings of the 6th Annual Workshop on Grain Post-Harvest Technology (Maintaining Good Grain Quality), Puncak Pass, Bogor, Indonesia, 3-6 May 1983, 147-156.

Lale NES, Yusuf BA (2000). Insect pests infesting stored pearl millet Pennisetum glaucum (L.) R. Br. in northeastern Nigeria and their damage potential. Cereal Research Communications, 28(1/2):181-186.

Longstaff BC (1981). Biology of the grain pest species of the genus *Sitophilus* (Coleoptera: Curculionidae): A critical review. Protection Ecology, 2: 83-130.

Maceljski M, Korunic Z (1973). Contribution to the morphology and ecology of *Sitophilus zeamais* Motsch. in Yugolsavia. Journal of Stored Products Research, 9: 225-234.

Meikle WG, Holst N, Markham RH (1999). Population simulation model of *Sitophilus zeamais* (Coleoptera: Curculionidae) in grains stores in West Africa. Environmental Entomology, 28(5): 836-844.

Okonkwo EU, Okoye WI (1996). The efficacy of four seed powders and the essential oils as protectants of cowpea and maize grains against infestation by *Callosobruchus maculatus* (Fabricius) (Coleoptera: Bruchidae) and *Sitophilus zeamais* (Motschulsky) (Coleoptera: Curculionidae) in Nigeria. International Journal of Pest Management, 42(3):143-146.

Peng W (1998). Insects in domestic corn and sorghum stored in steel silos in Taiwan. Plant Protection Bulletin (Taipei), 40(4):309-314.

Sedlacek JD, Weston PA, Price BD, Rattlingourd PL (1998). Survey of insect pests in shelled corn stored on-farm in Kentucky. Journal of Entomological Science, 33(2):171-179.

Trematerra P, Sciarretta A, Mancini M (1999). Insect pests in traditional cereal warehouses. *[Infestazioni da insetti in depositi tradizionali di cereali.]* Tecnica Molitoria, 50(9):980-989.

Zimmerman EC (1968). Rhynchophorinae of Southeastern Polynesia. Pacific Insects, 10(1): 47-77.