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## SHORT COMMUNICATION

# Morphological Evaluation of West African Okra, *Abelmoschus caillei* (A. Chev.) Stevels (Malvaceae) Fruits

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**ABSTRACT**

West African Okra (WAO) *Abelmoschus caillei* (A. Chev.) Stevels is common in traditional agricultural systems, where it is cultivated for its leaves, fruits, seeds, floral parts and stems. This study aims to conduct morphological evaluation of WAO fruits in order to investigate their diversity and contribute to conservation strategies. Using random stratified sampling method, WAO fruits were collected in Abudu, Ogan, Ologbo, Agenebode communities in Edo State and Koko, Agbor and Umunede communities in Delta State. Results showed that the highest mean and standard error values of pod length (cm) (10.98 ± 0.21) was recorded from Ogan and the least (7.46 ± 0.39) was obtained from Umunede. Highest mean and standard error of pod width (cm) were obtained from Ologbo (9.81 ± 0.59) while the least value was recorded from Agenebode (8.29 ± 0.43). WAO fruits collected from Ogan had the highest mean value for pod size index (10.35 ± 0.21) while the least value was recorded from Agenebode (8.10 ± 0.17). Results for number of ridges on WAO fruits suggest highest and least mean values were recorded from Ogan and Agenebode communities (8.90 ± 0.41 and 6.80 ± 0.20), respectively. The nature of fruit tip of WAO fruits collected from Abudu, Agbor, Agenebode, Ogan and Ologbo were 100% acute, Koko and Umunede are 80% acute and 20% obtuse. The fruit base of Okra from Abudu and Ogan is 100% flat. Agbor and Ologbo had 90% flat fruit base and 10% protruding fruit base. The nature of fruit base of both Agenebode and Umunede is 60% flat and 40% protruding, while that of Koko is 70% flat and 30% protruding. These results suggest morphological variations in WAO within the study area. The variation in traits may be a pointer to the differences in the genetic make-up of the accessions considered.

Keywords: Characterization, fruits, plant diversity and conservation, traditional agriculture system, West African Okra (*Abelmoschus caillei*)

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The genus *Abelmoschus* (Medik.) originated in South East Asia and have been an important cultivated vegetable in tropical and subtropical regions of the world (Schippers, 2000; Arapitsas, 2008; Aladele *et al.*, 2009; Osawaru *et al*., 2014).

Several species of Okra exist but in West Africa, two distinct species dominate; the common Okra (*Abelmoschus esculentus* (L.) Moench) and West African Okra [*Abelmoschus caillei* (A. Chev.) Stevel] also known as late Okra (Stevels, 1988; Siesmonsma & Hamon, 2004). *Abelmoschus esculentus* differ in several respects from *A. caillei*, but the width of the epicalyx segment offers the best discriminating characteristic (Udengwu, 1998; Osawaru *et al.*, 2011).

This study focuses on West African Okra (WAO), which is a garden variety in traditional agricultural system and is cultivated for its leaves, fruits, seeds, floral parts and stems (Osawaru & Ogwu, 2013). Studies by Charrier (1984), Siemonsma (1982), Siemonsma and Hamon (2004), Stevels (1988) and Hamon *et al.* (1991) points directly to West and Central Africa as the center of diversity of this crop plant. Schippers (2000) stated that the introduction of exotic varieties of the common Okra led to a much reduced production of indigenous Okra as genetic enhancement have not been made for *A. caillei*.

Local landraces are not at danger of genetic erosion at present although commercial growers tend to switch to commercial cultivars of *A.*

*esculentus*, whereas *A. caillei* is common in subsistence farming while significant amount of WAO germplasm is maintained by genebanks (Siemonsma & Hamon, 2004). Collection missions should be undertaken to improve gene bank collections for WAO while impacting on scientific studies and leveraging for the much needed genetic improvement. More so, the prevalence of A. *caillei* in homestead and cultivated fields is an indication of its richness as a genetic resource and a choice of local farmers (Osawaru & Ogwu, 2013). Therefore, this study aims to conduct morphological evaluation of WAO fruits collected from some communities in Edo and Delta States. This will sustainably contribute to conservation strategy of WAO.

The study area comprises of Delta and Edo States (5.05˚N–6.15˚N and 4.00˚E–6.55˚E) Southern Nigeria. It is characterized mainly by low land relief with climatic condition typically wet and dry seasons (Osawaru & Ogwu, 2013).

The pressure on land for agricultural and non-agricultural purposes is high, though the main economic activities of the people are farming (Osawaru & Ogwu, 2013).

WAO accessions were collected during specific germplasm collection mission in seven communities. The communities are Abudu, Ogan, Ologbo and Agenebode in Edo state and Koko, Agbor and Umunede in Delta state. Random stratified sampling method was used to select germplasm holders from each community using methods outlined in Osawaru and Dania-Ogbe (2010); Osawaru and Ogwu (2014). Collection was identified using Charrier (1984). All collected germplasm were stored in the Plant Conservation Unit, University of Benin, Nigeria.

The morphological characters of the fruits were determined according to Charrier (1984), Hamon (1991) and Mahajan *et al.* (2000). Six characters were used to analyze the diversity (Table 1). For each character, ten measurements were made for each character.

Descriptive statistical analysis was used to enumerate the morphological characters as outlined in Ogbeibu (2005). Figure 1 shows the mean and standard error values of pod length, width of pod and pod size index of WAO.

The result suggests that the highest mean value of pod length (cm) 10.98 ± 0.21 was recorded from Ogan and the least was 7.46 ± 0.39 obtained from Umunede. Highest pod width (cm) was obtained from Ologbo (9.81 ± 0.59) while the least value was recorded from Agenebode (8.29 ± 0.43). WAO fruits collected from Ogan had the highest mean value of fruit pod size index (10.35 ± 0.21) while the least value was recorded from Agenebode (8.10 ± 0.17).

The mean and standard error of number of ridges on fruit of WAO are shown in Figure 2. The highest and least mean values were recorded from Ogan and Agenebode communities (8.9 ± 0.41 and 6.8 ± 0.20), respectively.

**Table 1.** Qualitative and quantitative characters used to evaluate the collected samples.

| Qualitative characters | Quantitative characters |
|---|---|
| **Nature of fruit tip** | **Pod length** |
| Flat acuminate = 1 | <7 cm : short = 1 |
| Acute = 2 | 8 – 15 cm : medium = 2 |
| Obtuse = 3 | >15 cm : long = 3 |
| **Nature of fruit base** | **Pod width** |
| Ringed or protrude = 1 | <2 cm : small = 1 |
| Ringless or flat = 2 | 3 – 4 cm : medium = 2 |
| Reniform or sunken = 3 | <5 cm : large = 3 |
| **Number of ridges on fruit** | **Pod size index** |
| None = 1 | 1 – 2 cm : small = 1 |
| 5 – 7 : few = 2 | 3 – 4 cm : medium = 2 |
| 8 – 10 : many = 3 | >5 cm : large = 3 |
| 11 and above = 4 | |

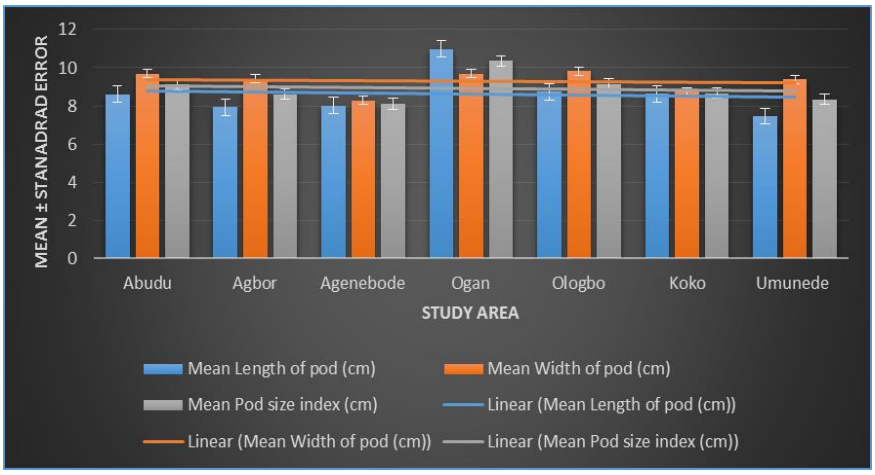


**Figure 1.** Mean and standard error of pod length (cm), width of pod (cm) and pod size index of WAO fruits.

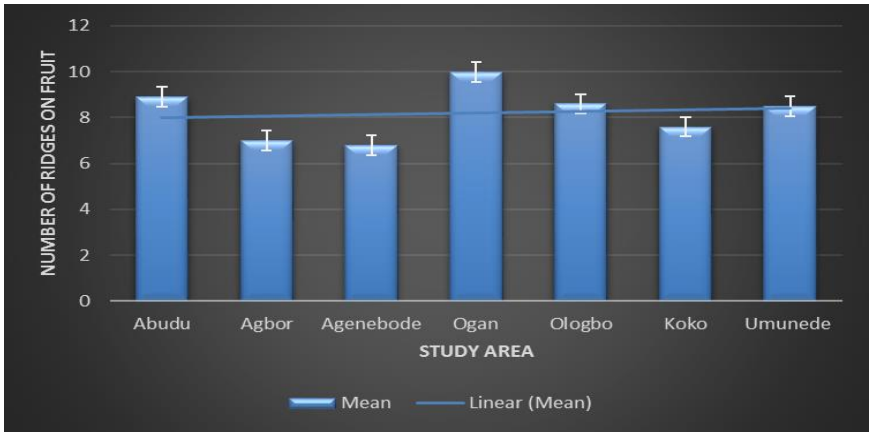


**Figure 2.** Mean and standard error of number of ridges on WAO fruits.

Figure 3 shows the percentage of nature of fruit tip of WAO fruits. The result suggest that the fruit tips of WAO from Abudu, Agbor, Agenebode, Ogan and Ologbo are 100% acute, Koko and Umunede are 80% acute and 20% obtuse.

Figure 4 shows the percentage of the nature of fruit base of WAO fruits. The fruit base of Okra from Abudu and Ogan is 100% flat. Agbor and Ologbo have 90% flat fruit base and 10% protruding fruit base. The nature of fruit base of both Agenebode and Umunede is 60% flat and 40% protruding, while that of Koko is 70% flat and 30% protruding.

Morphological evaluation of WAO fruits were conducted in order to enhance knowledge about their diversity and contribute to conservation strategies. Bates (1968), Siemonsma (1982), Stevels (1988), Hamon (1988) and Osawaru *et al.* (2013) have shown that fruit characters including nature of fruit tip, nature of base, number of ridges on fruits, fruit length, fruit width and pod size index are useful taxonomically to improve and support Okra classification. Variations were observed in these fruit characters of the WAO studied.

Varied results were obtained for pod length and width, which is in line with the reports of Osawaru *et al.* (2013). Pod size index is a relationship between length and width of fruit and shows the relative size of the fruit. High index indicates large fruits, Akoroda (1986) reported that pod size index of fruit as low as 3.0 are considered small pods. Results suggest that the accessions studied have pod size index greater than 3.0 (>5 cm) and considered as large, which is in accordance with the reports of Stevels (1988) and Osawaru *et al.* (2013). Chheda and Fatokun (1982), Hamon *et al.* (1991) noted that large fruits are found in West African Okra. The size of seeds and its number per fruit is determined by the pod size (Akoroda, 1986).

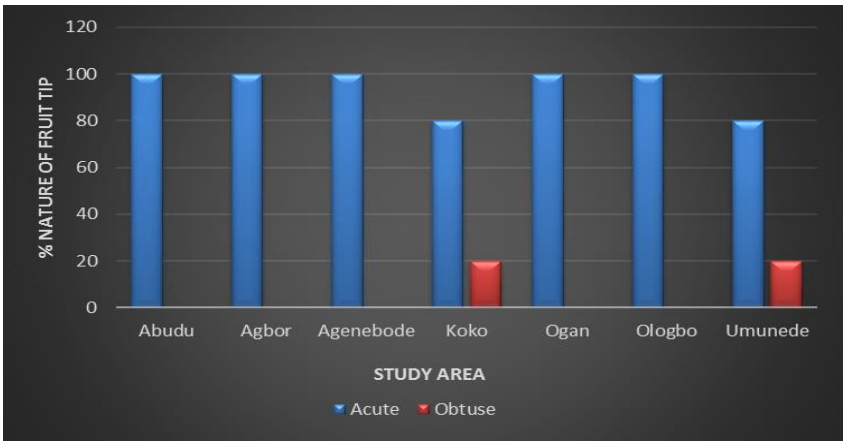


**Figure 3.** Nature of fruit tip of WAO fruits.

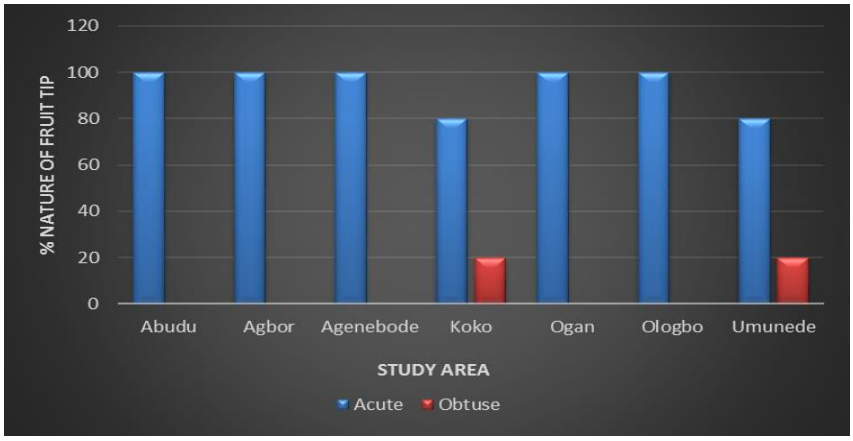


**Figure 4.** Nature of fruit base of WAO fruits.

Ridges on fruit aid the dispersal of seeds and also makes the removal of seeds during threshing easier. The mean number of ridges on fruits from the study area are approximately seven or more and may be considered as many. The number of ridges on fruit is not dependent on fruit size. The seeds of fruit with ridge running down the whole length would be removed easily. While the fruit with ridge running two third of the fruit length hold their seeds intact and thus prevent the shattering of seeds and infestation by rodents (Osawaru *et al.*, 2013).

Furthermore, the result from the present study suggest the existence of obtuse and acute fruit tips. Osawaru *et al.* (2013) reported that among the 53 accessions of WAO collected from Southwestern Nigeria, 47% had acute tip and 53% had obtuse tip. The nature of fruit base was also either flat/ringless or protruding.

Accession from both Agenebode and Umunede have 60% flat/ringless fruit base diversity based on phenotypic and morphological characters usually varies with environments and evaluation of traits requires growing the plants to full maturity prior to identification (Adeoluwa & Kehinde, 2011).

In conclusion, the morphological examination of WAO fruits suggest variations, which could be a pointer to differences in the genetic make-up of the accessions considered.

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## REFERENCES


Adeoluwa, O.O. & Kehinde, O.B. (2011). Genetic variability studies in West African okra (*Abelmoschus caillei)*. *Agriculture and Biology Journal of North America*, 2(10): 1326-1335.

Akoroda, M.O. (1986). Relationships of plantable okra seed and edible fruit production. *Journal of Horticultural Science*, 61(2): 233-238.

Aladele, S.E. (2009). Morphological distinctiveness and metroglyph analysis of fifty accessions of West African Okra [*Abelmoschus caillei* (A. Chev.) Stevels]. *Journal of Plant Breeding and Crop Science*, 1(7): 273-280.

Arapitsas, P. (2008). Identification and quantification of polyphenolic compounds from okra seeds and skins. *Journal of Food and Chemistry*, 101: 1041-1045.

Bates, D.M. (1968). Notes on the cultivated Malvaceae – *Abelmoschus*. *Baileya*, 16: 99-112.

Charrier, A. (1984). *Genetic resources; Abelmoschus (Okra).* Rome, Italy: International Board for Plant Genetic Resources, (IBPGR). P 61.

Chheda, H.R. & Fatokun, C.A. (1982). Numerical analysis of variation patterns in okra (*Abelmoschus esculentus* L. Moench). *Botanical Gazzettte*, 143: 253-261.

Hamon, S. (1988). Organisation évolutive dugenre Abelmoschus (Gombo): Co-adaptation et évolution de deux espèces de gombo cultivées en Afrique de l'ouest A. esculentus et A. *caillei*. Edit. ORSTOM, T.D.M. 46. P 191.

Hamon, S. (1991). Potential and limitations of standardized descriptors for the genus *Abelmoschus* (Okra). In: *IBPGR. Crop Network Series 5; Report on an International Workshop on Okra Genetic Resources.* IBPGR, Rome. Pp 95-103.

Hamon, S.A., Charrier, A., & Koechin, J. (1991). Potential contributions to okra breeding through the study of their genetic resources. *International Crop Network Series 5; Report on an International Workshop on Okra Genetic Resources*. IBPGR, Rome. Pp 77-883.

Mahajan, R.K., Sapra, R.L., Srivastava, U., Singh, M., & Sharma, G.D. (2000). *Minimal descriptors (for characterization and evaluation) of agri-horticultural crops (Part I)*. National Bureau of Plant Genetic Resources Pusa Campus, New Delhi, 110012, India. P 249.

Ogbeibu, A.E. (2005). *Biostatistics*. Benin City: Mindex Publishing Company Limited. P 246.

Osawaru, M.E., Dania-Ogbe, F.M., Chime, A.O., & Ogwu, M.C. (2011). Epidermal morphology of West African Okra *Abelmoschus caillei* (A. Chev.) Stevels from South Western Nigeria. *Science World Journal*, 6(3): 15-23.

Osawaru, M.E., Ogwu, M.C., & Dania-Ogbe, F.M. (2013). Morphological assessment of the genetic variability among 53 accessions of West African Okra [*Abelmoschus caillei* (A. Chev.) Stevels] from South Western Nigeria. *Nigerian Journal of Basic and Applied Science*, 21(3): 227-238.

Osawaru, M.E. & Dania-Ogbe, F.M. (2010). Ethnobotanical studies of West African okra, [*Abelmoschus caillei* (*A. Chev*) *Stevels*] from some tribes of south western Nigeria. *Science World Journal*, 5(1): 36-42.

Osawaru M.E. & Ogwu, M.C. (2014). Ethnobotany and germplasm collection of two genera of cocoyam (*Colocasia* [Schott] and *Xanthosoma* [Schott], Araceae) in Edo State Nigeria. *Science Technology and Arts Research Journal*, 3(3): 23-28.

Osawaru, M.E. & Ogwu, M.C. (2013). Collecting West African okra [*Abelmoschus Caillei* (A. Chev.) Stevel] germplasm from traditional agriculture in parts of south western Nigeria. *The Bioscientist*, 1(2):171-181.

Osawaru, M.E., Ogwu, M.C., Braimah, L., & Chime, A.O. (2014). Evaluation of two okra species [*Abelmoschus esculentus* (L.) Moench and *Abelmoschus caillei* (A. Chev.) Stevels] exposed to crude oil contaminated soil in Auchi, Edo State, Nigeria. *African Journal of Biotechnology*, 13(9): 1009-1018.

Schippers, R.R. (2000). *African indigenous vegetables: an overview of the cultivated species.* Chathan, United Kingdom: Natural Resources Institute/ACP-EU Technical Centre for Agricultural and Rural Cooperation. P214.

Siemonsma, J.S. & Hamon, S. (2004). *Abelmoschus caillei* (A.Chev.) Stevels [Internet] record from protabase. In Grubben, G.J.H. & Denton, O.A. (Eds.). *PROTA (Plant Resources of Tropical Africa/Resources végétales de l'Afriquetropicale)*. Wageningen, Netherlands. [*http://database.prota.org/search.html*]

Siemonsma, J.S. (1982). West African okra: morphological and cytogenetical indications for the existence of natural amphidiploid of *Abelmoschus esculentus* (L) Moench and *A. manihot* (L.) Medikus. *Euphytica*, 31: 241-252.

Stevels, J.C.M. (1988). A new combination of *Abelmoschus* (Malvaceae) in west and central Africa. *Adasonia*, 2: 137-144.

Udengwu, O.S. (1998). Photoperiodic response of early and late okra types *Abelmoschus esculentus* and application to accelerated gene transfer. *Nigeria Journal of Botany*, 11: 151-160.