Original Research Article

IMPACT OF HYBRIDIZATION ON OKRA (*Abelmoschus esculentus)* NUTRIENT *ENRICHMENT*

ABSTRACT

Studies have shown that significant differences exist in the morphological, Phytochemical and nutrient characteristics among okra varieties. Plant breeders try to substitute the undesirable qualities in plants with desirable ones so that it will result in higher yield of crops of improved quality and this is achieved through the process of hybridization. In this study, hybridization was carried out on two varieties of okra namely: Clemson spineless and dwarf long green to raise F_1 so as to assess the expression of heterosis or improved vigour and the impact of hybridization on okra nutrient enrichment as shown in vitamin compositions (vitamin A, B_1, B_2, B_3 and C (fruits part) of the parental plants compared with the F_1 hybrid. This was done using standard methods. Results were analyzed using one way analysis of variance (ANOVA). Results showed that the parental and the F_1 plants contained varied quantities of all the investigated vitamins. Higher contents of Vitamins A, B_2 and C were recorded for the F_1 hybrid when compared with the parental plants. So, there was an expression of heterosis indicating that hybridization could greatly enriched vitamin nutrients in okra.

Moreover, F_1 generation combined the characters of Clemson Spineless and Dwarf long green varieties and also had additional improved genetic attributes. This can be seen in most nutrients being higher in the F_1 hybrid and also the reduced spines in the fruit of the F_1 hybrid as opposed to the prominent spines in dwarf long green parent.

Keywords: hybridization, okra varieties, Clemson spineless, dwarf long green, heterosis, vitamin composition, nutrient enrichment

INTRODUCTION

Abelmoschus esculentus L.(Moench), Okra, is an important vegetable in the family Malvaceae. It is a green fruit which is strictly used as a vegetable and is valued for its edible green seed pods containing round, white seeds (Jesus *et al*, 2008). It is an economically important vegetable crop cultivated in tropical, subtropical and warm temperate regions around the world (Vaughan and Geissler, 2009). The fruits are said to be shaped like a lady's fingers - one of its common names in British English. The flowers and upright plants give okra an ornamental value (Duzyaman, 1997).

Okra provides dietary fibres and distinct seed protein balanced in both lysine and tryptophan - amino acids (unlike the proteins of cereals and pulses) thus, referred as “a perfect villager’s vegetable (Camciuc *et al.*, 1998). Okra is an annual herb, 3 to 6 feet tall with a hibiscus-like flower, a deep branched taproot and succulent stem with scattered, stiff hairs. The pods of *Abelmoschus esculentus* have a unique flavour and texture and release slimy mucilage on cooking, which can be used to thicken sauces and add smoothness to soups. Its mature fruit and stems contain crude fibre, which is used in the paper industry. (Mabberley, 2008).

In the Eastern part of Nigeria, precisely Anambra, there are five varieties which are the most common. They are; Green emerald, Dwarf long green, the local long pod variety, perkins spineless and Clemson spineless. The two varieties which are the focus of this study are the Clemson spineless and the dwarf long green. The Clemson spineless is long, narrow and do not possess spines; while the dwarf long green variety is shorter, greater in diameter and possess spines. The Dwarf long green variety has a darker shade of green colour than the Clemson spineless (Van, 2005).

Vitamin is an organic compound and a vital nutrient that an organism requires in limited amounts. The body can only manufacture three vitamins D, K and Biotin a B vitamin. The rest must be obtained from dietary sources. Studies have shown that significant differences exist in the morphological, phytochemical, nutrient and anatomical characteristics among okra varieties (Van, 2005). Furthermore, the modern scientific method of crop improvement was necessitated by the present demands of modern man for good quality food crops; crops with good taste, crops that mature early, crops that contain most of the essential food nutrients and crops that can meet the immediate needs of man in terms of food and raw materials (Duzyaman, 2010; Ilodibia *et al*., 2014 and 2015). Plant breeders try to substitute the undesirable qualities in plants with desirable ones so that it will result in higher yield of crops of improved quality and this is achieved through the process of crossbreeding or hybridization. Hence, this research aimed at hybridizing two varieties of okra Clemson spineless and dwarf long green to produce a hybrid that might combine the qualities of the two varieties with the removal of their bad traits to meet the popular demands of the society. Such a hybrid of the two varieties is likely to be of better quality and demand than either of the two varieties. Accordingly, the problem and focus of the researcher is to hybridize the two common varieties found in Nigeria and compare the vitamin contents of the hybrid and the parental plants (Clemson spineless and the dwarf long green). It will cover the first filial generation in related qualities.

MATERIALS AND METHODS

Collection, identification of plant materials and study area

The seeds of the two varieties of *Abelmoschus esculentus* (Clemson spineless and the dwarf long green) used in this work were obtained between March – April 2016 and authenticated at the Agricultural development project (ADP), Kwata, Anambra state, Nigeria. The experiments were carried out at the Botany laboratory, Nnamdi Azikiwe University, Awka, Anambra state and Emery Biotechnology Laboratory, Ahia-Eke, situated in Umuahia, Abia State. The design of the study was pure experimentation of randomized complete block design.

Materials and experimental procedure

Seeds of two varieties of okra (Clemson spineless and dwarf long green (Fig. 1), twenty (20) black polythene bags, weighing balance, a pair of forceps, aluminium foil, animal manure and loam soil. After the seeds were obtained, a viability test was carried out on them. This was done by soaking a handful of each variety in a beaker containing distilled water for approximately 3 minutes. The seeds that floated on the surface of the soil were discarded while those that sank to the bottom of the beaker were sown in a transparent glass jar containing loamy soil. After a few days, germination occurred proving the seeds to be viable. A total of twenty black polythene bags were obtained, perforated and filled with 5kg of loamy soil each. Ten of the polythene bags were labeled ‘Clemson spineless’ while the other ten were labeled ‘Dwarf long green’ which are the two varieties to be studied. The seeds of each variety were broadcast accordingly on the soil surface (five seeds per bag). At different stages, the seedlings were pruned to two seedlings per bag when they were 12cm high. Flowering of the dwarf long green variety started at eight weeks while that of the Clemson spineless variety started at nine weeks. It was at this stage that the crossing or hybridization was done. Artificial crossing was adopted because okra is a self-pollinating crop. This involved the removal of anthers with a pair of forceps from the dwarf long green variety thus using it as a female parent before it dehisces and covering it with a study bag (foil) to avoid natural crossing by insects. This was followed by the collection and transference of ripe pollen grains from the Clemson spineless (male parent) to the stigma of the emasculated plant (dwarf long green). This pollination process was followed by fertilization and subsequent production of fruits (the F_1 hybrid). This procedure is as outlined by Ilodibia *et al*. (2014).

Vitamin nutrient analysis

Dried fruits of two varieties of okra (Clemson spineless, Dwarf long green) and the F_1 hybrid were ground into fine (100-mesh screen) powder with a dry mill and then examined for the following vitamins (A, B1, B2, B3 and C) using the standard methods described by AOAC (2005).

STATISTICAL ANALYSIS

Data obtained was statistically analyzed using one way analysis of variance (ANOVA). The Duncan’s multiple range test was used to test the difference among treatments at 0.05% level. Results were presented in Mean± Standard Error.

RESULTS AND DISCUSSION

Results of the study were shown in Table 1 and Figures 1-4.

Results showed that the parental and the F_1 plants contained varied quantities of all the investigated vitamins except B3 which was absent in F_1 (Table 1). This conforms to the report of Velu *et al*. (2011) and Ilodibia *et al*. (2015), that several hundred wheat accessions showed four to five fold variability for grain Fe and Zn concentrations and the two species of pepper (*Capsicum frutescens* and *C. annuum*) and F1 hybrid all contained different nutrient compositions respectively. The fruit of the dwarf long green variety contained higher quantities of Vitamins B_1 and B_3 when compared with the fruit of the Clemson spineless variety and the F_1 hybrid.

Higher contents of Vitamins A, B_2 and C were recorded for the F_1 fruit when compared with the fruits of parental plants. Vitamin A: 8.75 ± 0.00, 9.40 ±0.00 and 9.75 ± 0.00 for clemson spineless, dwarf long green and F_1hybrid respectively (Table 1, Fig. 1)**.** Vitamin B**:** 0.45±0.00, 0.35±0.00 and 0.50±00 for clemson spineless, dwarf long green and F_1 hybrid respectively (Table 1)**.** Vitamin C:

18.80±0.14, 17.53±0.11 and 19.20±0.10 for clemson spineless, dwarf long green and F_1hybrid respectively (Table 1)**.** This is in line with the report of Allard (1960) that the progeny of hybridization will combine many of the qualities of both parents thus producing a crop which is superior to some extent to either of the parents. Again, Nwakile (1994) reported that when the male pollen of a plant is manually transferred, into the female stigma of another plant which may be of a different variety, species or even genera, a hybrid with improved characters is produced. Also, with that of Ilodibia *et al*. (2014 and 2015), who reported that F1 generation combined the characters of both parents and other improved attributes.

Furthermore, the F_1 generation combined the characters of both the Clemson spineless and Dwarf long green varieties, although the characters of the Dwarf long green dominated that of the Clemson spineless variety. This can be seen in the reduced number of spines possessed by the F_1 hybrid as opposed to the Clemson spineless which has no spines. This agrees with what Mendel (1866) pointed out that when two plants with pair of contracting characters are hybridized, one of the characters would often appear in the offspring while the other remain masked. The character that appeared in the offspring he called dominant character while the character that did not appear he called recessive character. Vitamin A provides healthy skin, good eye sight, a powerful antioxidant that protects against cancer and heart disease and enhances the immune system. Vitamin B1 provides healthy heart and nervous system, optimizes metabolism and brain formation. Vitamin B2 helps in the formation of antibodies and red blood cells, facilitates carbohydrate, fat and protein metabolism, aids against stress and fatigue. Vitamin C is an anti-stress vitamin, protects the cells from toxic wastes and is the most powerful and effective of all the antioxidants, reduces infections, allergies, asthma and common cold.

Table 1: Mean Percent Vitamin compositions of the fruit of Clemson spineless, Dwarf long green and F_1hybrid (%).

Parameters	Clemson spineless (F)	Dwarf long green (F)	F_1 Fruit	p-value
Vit. A (UI/100g)	8.75±0.00^{a}	9.40±0.00^{b}	9.75±0.00^{c}	0.01
Vit. B_1 (mg/100g)	0.45±0.00^{b}	0.35±0.00^{a}	0.50±0.00^{c}	0.05
Vit. B_3 (mg/100g)	0.88±0.00^{b}	1.04±0.00^{c}	0.10±0.00^{a}	0.00
Vit. C (mg/100g)	18.80±0.14^{b}	17.53±0.11^{a}	19.20±0.10^{c}	0.00

Results are in Mean ±Std.
The same letter in a column is not significantly different by Duncan's multiple range test at ($p<0.05$)
F: fruit

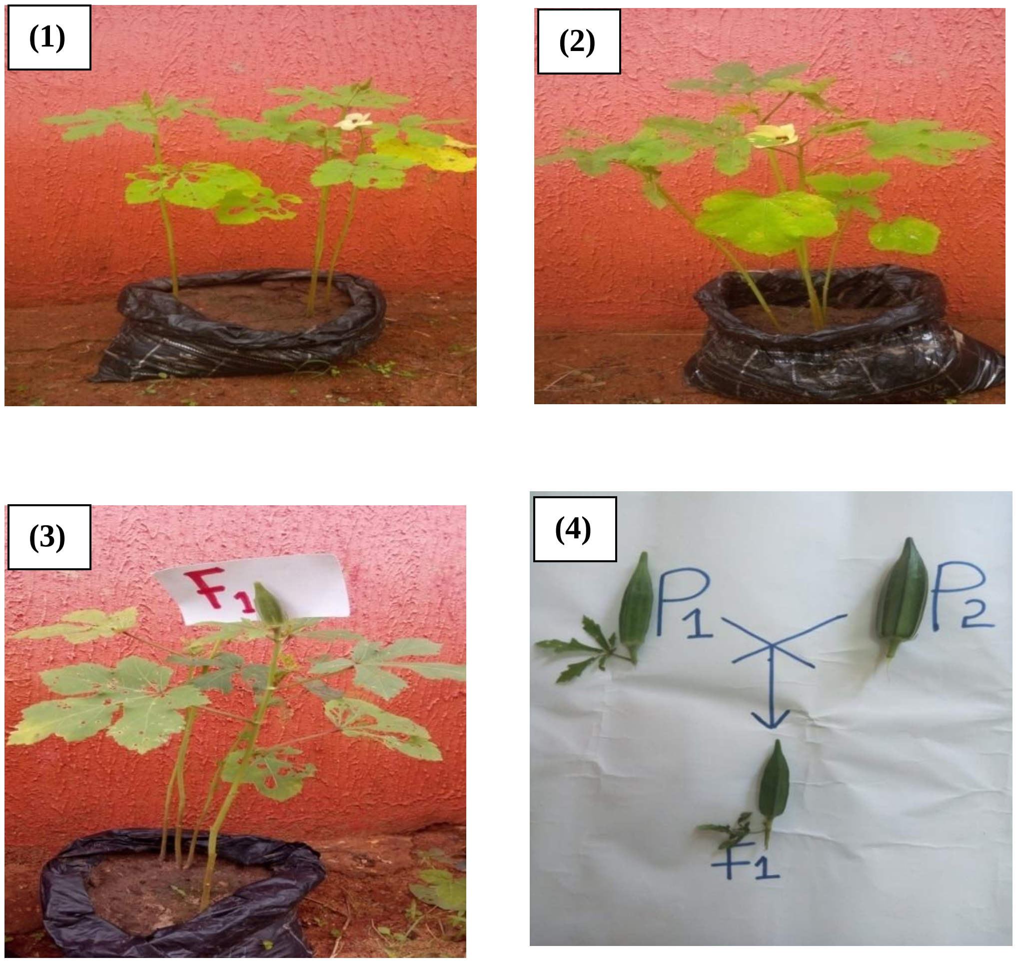

Fig. (1) The parental variety P_1 (Clemson spineless) (2) Parental variety P_2 (Dwarf long green) (3) F_1 hybrid and (4) Fruits of parents compared with the fruit of the F_1 hybrid.

Conflict of Interests: Authors have declared that no competing interests exist.

CONCLUSION

Results of this study showed that the F_1 generation combined the characters of Clemson Spineless and Dwarf long green varieties and also had additional improved genetic attributes. This can be seen in most nutrients being higher in the F_1 hybrid and also the reduced spines in the fruit of the F1 hybrid as opposed to the prominent spines in dwarf long green parent. Thus hybridization could greatly enriched vitamin nutrients in okra.

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