EVALUATION OF GENETIC VARIABILITY FOR YIELD TRAITS AMONG SIX GENOTYPES OF NIGERIAN GARDEN EGG (*Solanum aethiopicum* L.) PLANTS

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ABSTRACT

A field experiment was conducted to evaluate the phenotypic and yield attributes of six garden egg (*Solanum aethiopicum* L.) accessions for the selection of desirable traits which could be used for the crop improvement. A randomized complete block design (RCBD) was used for the field experiment. Yield parameters such as number of fruits per plant, weight of fruits, number of seeds and weight of 100 seeds were investigated and scored using the standard procedures. Considerable variation in phenotypic traits such as fruit size, fruit shape, fruit surface, immature fruit colour and mature fruit colour were observed among the accessions. Fruit size ranges from small to medium, fruit surface from smooth to grooved and fruit colour ranges from red to brown. Significant variations (P<0.05) in yield attributes of the accessions were observed with accession NG/AO/06/12/193 having the highest fruit weight (13.33g) and number of seeds per fruit (273.80). The highest weight of 100 seeds (0.35g) was recorded in NHGB/09/138 and number of fruits per plant (87.00) in NHGB/09/100. The significant estimates of the phenotypic variations for all traits evaluated provide an indication that the selected accessions have an appreciable level of genetic variability. It was observed that there was a very high significant (P<0.01) correlation between the number of fruits per plant and number of seeds per fruit (-0.80) as well as number of fruits and weight of fruit (-0.75). Likewise coefficient of variation was significantly (P<0.01) high for weight of fruit and number of seeds per fruit (0.88). This observed variability for the yield parameters could play an important role in crop-breeding programme of the crop and will determine the limit of selection for yield improvement in the garden egg.

Keywords: Desirable traits, Variation, Selection, Improvement.

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INTRODUCTION.

Solanum L. is the largest genus of the family *Solanaceae* with over 2,000 (Bohs, 2011); members of the genus as varied morphologically as they are diverse in number and distribution eco-geographically. The genus includes perennial shrubs, vines, herbs or trees, with or without spines, glabrous or pubescent with unbranched or branched, often glandular hairs (Mueller *et al.* 2005). The common name "Eggplant" is ascribed to a group of vegetable encompassing three closely related cultivated species that belong to *Solanum* sub genus *Leptastemonum*: *Solanum melongena*, S. *aethiopicum* and S. *macrocarpon* (Daunay *et al.*, 2002.).

S. aethiopicum, commonly called the bitter tomato, Ethiopian eggplant, or nakati, is a fruiting plant mainly found in Asia and Tropical Africa; it is also known as Ethiopian nightshade (USDA, 2015). It is a shrub to perennial or annual herb, up to 200 cm tall, often much-branched; root system extending both vertically and laterally; branches and leaves with or without prickles and stellate hairs (PROTA, 2015). Leaves alternate, simple; stipules absent; petiole up to 11 cm long; blade broadly ovate, (6–)12–30 cm × (4–)7–21 cm, obtuse or cordate at base, acute to obtuse at apex, slightly to deeply lobed at margin, pinnately veined; upper leaves smaller, narrower, less lobed and often sub-opposite (PROTA, 2015).

In Nigeria, a large number of *S. aethiopicum* possibly indigenous, recognized by different sizes and shapes of their fruits, are widely grown. These tropical African crops are grown in the country for their nutritional, medicinal and economic values of the fruits and leaves. The fruits are consumed raw as snacks by both adult and children. In south-eastern Nigeria, the fruits of garden egg are served alongside with kolanuts (*Cola accuminata*) in ceremonies such as marriages, festivals, traditional title taking, meeting and others (Okafor, 1993). In most Igbo land, garden egg of 'Anara' as popularly called, is sliced and mixed Tapioca in the preparation of special native salad or dishes as "Nsisa", "Ugba" (Nwaorie and Agbaravoh, 2002). The fruits of some bitter species like *Solanum melongena* are cooked and used in the preparation of sauces for cocoyam and yam porridge (Onwuka, 2005). Onwuka (2005); Okafor (1993) and Maraizu (2007), stated that garden egg contains a lot of minerals, vitamins, carbohydrate and water which are essential for the maintenance of health and prevention of diseases. According to Chadha and Oluocha (2003), the crop has been recommended for tackling malnutrition in Africa, especially among women of childbearing age and children under 5 years old. Some medicinal properties attributed to the roots and fruits of the crops are carminative and sedative, thus, are used to treat colic and blood pressure (Grubben and Denton, 2004). The nutritional content of garden egg is comparable to that of tomatoes, but it has a lower content of vitamin C. This vegetable is also valued locally for its high iron content. It also offers gainful employment among rural households and its cultivation is not limited to any age or sex (Anuebunwa, 2007). Domesticated and wild relatives of garden egg have an important breeding trait that remains to be explored. In the field, garden egg itself shows a higher drought and heat tolerance than tomato or conventional eggplant. In Japan, cultivars of the Aculeatum group are used as rootstock for tomatoes. These important traits could be used for the breeding of garden egg but also for related crops such as eggplant or tomato.

Despite the numerous importance and beneficial breeding traits in the domesticated garden egg, these diverse advantageous traits have not been studied extensively by breeders and explore for the improvement of the crop. Information on the genetic variability and diversity of the crop is scanty and those available are not reliable. Consequently, the need to detect the genetic variabilities that exist in this plant has been severally stressed by many researchers as detecting these variabilities will enhance the success of the plant economic potentials. Mostafa *et al.* (2011), postulated that genetic diversity studies provides the understanding of genetic relationships among populations and hence directs assigning lines to specific heterogenous groups useable in identification of parents and hence choice selection for hybridization. Studies on genetic variability using agro-morphological and cytological characteristics in many crop species, even among the family *Solanaceae* have been variously attempted. Based on this background, this study is aimed at evaluating the yield attributes of some Nigerian garden egg (*Solanum aethiopicum*) genotypes.

MATERIALS AND METHODS

A total of six (6) accessions of *Solanum* species were obtained from National Agency for Conservation of Genetic Resources and Biotechnology (NACGRAB), Ibadan and also from Biological Garden of Federal University of Technology, Minna. Evaluation of the accessions for yield traits was carried out at the Experimental Garden Department of Biological sciences, Federal University of Technology, Minna. Prior to the planting, the seeds were tested for viability using the floatation method.

A total of fifty (50) seeds of each accession were planted in nursery trays to obtain seedlings. The seedlings were then transplanted into 12 litre capacity plastic experimental pots containing sandy-loamy soil, mixed with cow dung. Two seedlings were transplanted into each pot three weeks after seedling emergence. Each treatment (accession) was replicated five times with the pots arranged in a Randomized Complete Block Design (RCBD). The seedlings were watered once daily until maturity between 5.00-6.30 am using bore-hole water. Data were collected from ten (10) plants stand for each of the accession. Parameters measured were number of fruits per plant, weight of fruit, number of seeds per fruit and weight of hundred seeds. The data collected was analysed using analysis of variance (ANOVA) and Duncan Multiple Range Test (DMRT) was used to separate the means. All values were considered significant at $P = 0.05$. Genetic parameters estimates was estimated for genotypic variation (GV), phenotypic variation (PV), broad sense heritability (H^2), genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) and Genetic Advance (GA), following the methods of Singh and Chaundry (1985); Falconer and Mackay (1996). Pearson's correlation was used to determine the relationships among the parameters; correlation coefficients were considered significant at $P<0.01$ (highly significant) and $P<0.05$ (significant).

RESULTS

The results showed that there were variations in the visual traits (shape, colour, size and fruit) of the crop. There were great distinction in the shapes of the traits with the surface structures varied from smooth to grove. Information on the yield characters of each accession is presented in Figure 1 and Table 1. In term of sizes the fruit of the accessions varied from large in NG/AO/06/12/193 to small in MN/S/02/2015 (Figure 1). The yield parameters among the six different accessions of the *Solanum aethiopicum* also showed interesting variations Table 2. The results showed that MN/S2/2015 has the least weight (0.40g); this value was significantly the same ($P>0.05$) with NHGB/09/132, NHGB/09/100, NHGB/09/138 with the values of 0.69g, 0.77g and 1.47g respectively. However, the value is significantly different from all the other accessions. The highest weight (13.33g) is found in NG/AO/06/12/193 and the value is significantly different ($P<0.05$) from all other values (Table 2). The results also revealed that NHGB/09/100 has the smallest number of seeds (61.00); this value is significantly the same ($P>0.05$)with MN/S2/2015, NHGB/09/132, and NHGB/09/138 with their respective values 68.60, 82.60, and 92.80. The highest weight (273.80g) is found in NG/AO/06/12/193 and the value is significantly different (P<0.05) from all other values (Table 2). NHGB/09/100 has the smallest weight of seeds (0.19g); this value is significantly the same (P>0.05)with NHGB/09/132, MN/S2/2015 and NG/AO/06/12/193 with the values 0.21g, 0.27g and 0.30g respectively. The highest weight (0.35g) is found in NHGB/09/138 and the value was significantly different (P<0.05) from all other values (Table 2). NHGB/09/100 had the highest number of fruit per plant (87.00) and NG/AO/06/193 had the least (5.00); these values were significantly different from each other and from the values recorded from all the other accessions.

The correlations among yield traits displayed high significant results for all the quantitative traits studied. Significantly negative correlation was recorded for the number of seeds per fruit with the number of fruits per plant (-0.80), so also weight of fruit is inversely correlated with number of fruits per plant (-0.75) and lastly weight of fruit is positvely and highly correlated with the number of seeds per fruit (-0.88) as shown in Table 3. This implies that as one parameter increases, the other decreases.

The results on genetic parameter revealed consistency in the environmental and genotypic variances. In all the characters studied, the genotypic variance was higher than the environmental variances. In addition, Genotypic Variance (GV) was higher than Environmental Variance (EV) for number of fruits per plant (1381.00), number of seeds per fruit (25477), weight per fruit (41.67) and weight of 100 seeds (0.01) (Table 4). However, the influence of the genotypic factors on the expression of other characters as indicated by the magnitude of the GV was quite evident. This indicates that a large proportion of the Phenotypic Variance (PV) was caused by genetic influences for those characters. Consequently, such character possess promising genetic variability; so, selection for them will be efficient and successes will be very high. The highest GV (25477) for number of seeds per fruit, this is followed by number of fruits per plant (1381.00), weight per fruit (41.67) and the least is the wight of 100 seeds (0.01). Phenotypic Variance (PV) was also highest in number of seeds per fruit (26828.5), followed by number of fruits per plant (1420.53), weight per fruit and the lowest was found in weight of 100 seeds (0.01). The values obtained for broad sense heritability for all the yield parameters indicate high values for all the parameters (Table 4), indicating possiblities for such character to be heritable.

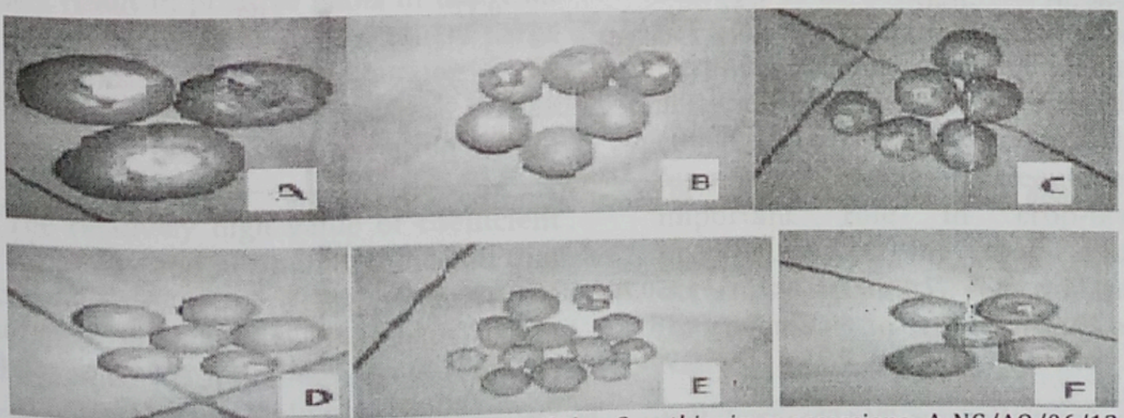

Plate 1: Variations in fruit shapes and sizes of the *S. aethiopicum* accessions; A NG/AO/06/12/193; B NHGB/09/100; C NHGB/09/128; D NHGB/09/132; E MN/S/02//2015; F NHGB/09/138

Table 1: Phenotypic Traits among Different Cultivars of *Solanum* Fruits

Accessions	Immature fruits colour	Mature fruits colour	Fruits surface	Fruits shape
NG/AO/06/12/193	Light green	Deep red	Grooved	Broader than long
NHGB/09/100	Light green with dark green stripes	Red	Smooth	Broader than long
NHGB/09/128	Light green with stripes	Deep red	Slightly grooved	Broader than long
NHGB/09/132	Light green	Light red	Smooth	Broad as long
NHGB/09/138	Very green	Brown	Grooved	Broader than long
MN/S2/2015	Yellow with green stripes	Red	Smooth	Broader than long

Table 2: Yield parameters characteritics of six assessions of Nigerian garden egg

Accessions	Weight of Fruits(g)	Number of Seeds/Fruit	Weight of 100 Seeds(g)	Numbers of Fruits/Plant
NG/A0/06/12/193	13.33±1.15[c]	273.80±30.57[c]	0.30±0.01[c]	5.00±0.58[a]
NHGB/09/100	0.77±0.08[a]	61.00±5.54[a]	0.19±0.01[a]	87.00±1.15[e]
NHGB/09/128	2.51±0.21[b]	120.80±14.37[b]	0.25±0.01[b]	30.00±4.04[b]
NHGB/09/132	0.69±0.07[a]	82.60±11.17[ab]	0.21±0.01[a]	46.00±6.93[c]
NHGB/09/138	1.47±0.2[ab]	92.80±14.94[ab]	0.35±0.02[d]	57.00±1.15[cd]
MN/S/02//2015	0.40±0.06[a]	68.60±10.06[a]	0.27±0.01[bc]	68.33±9.53[d]

Values are means ± SE of mean, values follow by different superscript alphabets are significantly different at (P<0.05).

Table 3: Pearson's linear correlation of some yield parameters of different accessions of *S. aethiopicum*

PARAMETERS	Number of Fruits/Plant	Number of Seeds/fruit	Weight of fruits (g)	Weight of 100 Seeds (G)
Number of Fruits/Plant	1.00			
Number of seeds/fruit	-0.80**	1.00		
Weight of fruits (g)	-0.75**	0.88**	1.00	
Weight of 100 seeds (g)	-0.40	0.42	0.37	1.00

** Correlation is significant at the 0.01 level (2- tailed)

Table 4: Estimation of genetic parameters of some yield attributes of some selected eggplant accessions

Yield Traits	Means	GV	PV	EV	BSH	GCV	PCV	GA
Number of Fruit/Plant	48.866	1381.00	1420.53	39.53	0.97	76.05	77.13	154.46
No of Seeds/Fruit	116.6	25477	26828.5	1350.70	0.88	86.47	92.04	167.36
Weight/Fruit	3.1967	41.67	42.85	1.18	0.97	201.94	204.77	410.23
Weight of 100 Seeds	0.2611	0.01	0.01	0.00	1.00	28.84	28.84	59.41

GV= Genetic Variance, PV= Phenotypic Variance, EV= Environmental Variance, GCV= Genotypic Coefficient of Variation, PCV= Phenotypic Coefficient of Variation, GA= Genetic Advancement.

DISCUSSION

The wide range of morphological variability observed among the six accessions for the quantitative and qualitative parameters revealed the importance of these traits in selection breeding; similar ascertion had been made by Ihtizaz *et al.* (2015) in *Solanum melongena* and Boyaci *et al.* (2015) in *S insanum*. Variations in fruit characters such as shape and sizes observed among the accessions is in agreement with the work of Tindall (1976), who said a wide range of variations was observed in fruit shape, fruit size, immature fruit and mature fruit colour and fruit surface. The stripping observed in some fruit with two or more colours is also line with the work of Chinedu *et al.* (2011) who observed the same colour variations among eggplant, this is an indication that such character might be due to genetic factors rather than environmental factors. Such fruit colour character often influence consumers' preferences in selecting eggplant.

Both positive and negative correlations observed in this research is in conformity with the work of Kubie (2013) on *S. aethiopicum* and Ihtizaz *et al.*, (2015) in *S. melongena*. Kubie (2013), opined that if a negative correlation exists, then selection pressure for either one of these traits will result in positive gains in that trait but negative gains in the other. Large variations observed among the eggplants within the accessions are an indication of plausible variation within the accessions.

The relatively high value of coefficient variability and heritabiliy indicated that the characters were highly under the control of genes. The result is in agreement with the findings of Mittal *et al.*, (1996) and Mohanty (2003) who also made similar ascertion. The high value of broad sense heritability for weight of 100 seeds observed is an indication that about 100% of the variation for this trait was genetically determined and could be transfered to the next generation. Similar results was reported by Srivastava *et al.*, (1998); Mohanty (2003) and Singh and Mandhar (2004). All the traits examined in this study showed a wide range of genetic variability among the evaluated accessions (Vijah and Manohar, 1990). The variations obtained among the genotypic coefficient of variation for most of the characters shows that the genetic advances for selection of a character depends on the amount of genetic variability of such characters. Similar assertion have been drawn by Elsadig *et al.*, (2013). High values of heritability estimates recorded for most traits indicate that these traits possessed wide range of genetic variability that could be explore for the improvement of the crop through mass selection (Elsadig *et al.*, 2013; Mostofa *et al.*, 2002). Both high GCV and PCV as well as Genetic Advance have also been reported by Kubie (2013) in *S. aethiopicum*. High heritability coupled with high genetic advance (GA) for number of fruit per plant, weight of fruit and number of seeds per fruit in this study is an indication of additive gene effects of such traits; this statement is in corroboration with the report of Mostofa *et al.* (2002). Jalal and Ahmad (2012), emphasized the importance of heritability and genetic advance as selection parameters. It is therefore concluded that the observed variability for the yield parameters could play an important role in crop-breeding programme of the crop and will determine the limit of selection for yield improvement in the garden egg in Nigeria.

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