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Heritability, Genetic Advance and Character Association in Six Yield Related Characters of *Solanum anguivi*

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ABSTRACT

The objective of this study was to assess eighteen accessions of *Solanum anguivi* collected from various diverse sources for broad-sense heritability, genetic advance and character of association in yield related traits. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. High estimates of broad sense heritability was observed in plant height at maturity (76.67), number of branches per plant (83.9), total number of fruits per plant (85.5), total weight of fruits per plant (86.96) suggesting additive gene effect in these characters. Number of branches per plant, total number of fruits per plant, total weight of fruits per plant combining high estimates of heritability and genetic advance is an indication of crop improvement through mass selection. Positive and significant phenotypic and genotypic correlation was observed between number of branches and total number of fruits per plant (0.67, 0.74) and total weight of fruits per plant (0.61, 0.67) suggested that selection for fruit yield on the basis of these traits will be effective. Meanwhile, significant and negative phenotypic and genotypic correlation between number of fruits per plant and fruit length (-0.30, -0.41) suggested that selection for fruit yield on the basis of these traits will not lead to increases in fruit yield.

Key words: Accession, additive gene effect, *Solanum anguivi*, genetic advance

INTRODUCTION

Solanum anguivi is a semi-cultivated non-tuberous *Solanum* sp. which is widely distributed in Africa (Schipper, 2000; Bukenya-Ziraba, 2004). The species has attained considerable importance in the South Eastern geographical zone of Nigeria. In this area, the edible immature fruits are consumed and used extensively in cultural ceremonies and traditional medicine, contributing to the sustainable production and demand for the crop. *Solanum anguivi* is polymorphic and exhibit diverse morphological characteristics including genetic variation in yield and fruit form (Schipper, 2000). The fruits are usually bitter, small in size with green color like the Asian pea eggplant *Solanum torvum* (Schippers, 2004). However, some Nigerian local cultivars have medium to big fruits with variable colors (e.g., white, cream colors) and slightly sweet taste which can be introduced into different varieties. Genetic improvement of *S. anguivi* with increases in the yield and quality of fruit characteristics will further enhance the social value of the crop and the contribution to poverty alleviation and better nutrition in the zone. But, so far, not much has been achieved with the breeding of the crop and information in this area is scanty and not readily available. Bukenya-Ziraba (2004) reported that *S. anguivi* has a potential use as a genitor in breeding for disease resistance in *Solanum aethiopicum*. He further suggested that traits such as plant habit, earliness, fruit quality and yield should be considered during selection and breeding.

In order to achieve rapid genetic improvement of the crop, the available population pool can be exploited for genetically desirable traits which can be selected and combined in various forms to produce improved varieties. Determination of heritability estimates, using different methods has been reported by various authors including (Wray and Visscher, 2008; Obilana and Fakorede, 1981; Johnson *et al*., 1955). The value of heritability estimates is enhanced when used together with the selection differential or genetic advance. Combined high heritability estimate and genetic advance is an indication that variation is attributable to high degree of additive effect and selection would prove useful (Panse, 1957). Heritability estimates for yield-components in different crops have been reported in other breeding programmes e.g., tomato (Foolad *et al*., 2006); peanut (Ekvised *et al*., 2006) and in exotic and local eggplant (Islam and Uddin, 2009). Information on the amount and direction of association between yield and yield related characteristics is important for rapid progress in selection and genetic improvement of a crop (Binodh *et al*., 2008). This will indicate the interrelationship between two or more plant characters and yield, providing suitable means for indirect selection for yield. The characters associated in a significant and positive direction with the fruit yield and other desirable traits including the quantity and fruit size are important for the development of improved and more acceptable varieties of *S. anguivi*.

This study is aimed at determination of traits with appreciable level of heritability estimates, genetic advance and which are in positive association with the fruit yield of *Solanum anguivi*.

MATERIALS AND METHODS

The experiment was carried out at the horticultural unit of Babcock University Ilishan Remo, Ogun State during the rainy season through the dry season in 2009. The experimental site is located in the rain forest agro-ecological vegetation at latitude 6°43 E and longitude 6°5 N of the equator in the South-Western Nigeria. A total of eighteen accessions collected from various sources including home gardens, farmers' plots, private collections and market places were used in the study (Table 1). The seeds were sown in plastic trays in the nursery in March and the seedlings were transplanted 5-6 weeks after sowing on the field. The seedlings were planted on raised beds in two rows per bed with spacing of 30 cm between plants within each row and 50 cm between rows. Before planting, poultry organic manure was incorporated into the beds at the rate of 20t per h. The eighteen accessions were each planted in 2.0×4.0 m plot and replicated four times in Randomized Complete Block Design (RCBD). Data was collected on agronomic characters including:

- Plant height (cm)
- Mean fruit yield (g)
- Number of branches per plant
- Number of fruit set per plant`
- Fruit length (cm)
- Fruit width (cm)

Table 1: List of accessions with some agronomic characteristics

Accession	Description
BU 1	Moderate height, profuse branching, big white fruits
BU 2	Moderate height, profuse branching small white fruits
BU 3	Tall, moderate branching big green fruits
BU 4	Tall, profuse branching small green fruits
BU 5	Tall, profuse branching big white fruits
BU 6	Moderately, branching with big white fruits
BU 7	Medium height, low branching with big white fruits
BU 8	Medium height average branching with big green fruits
BU 9	Poor branching with big green fruits
BU 10	Medium height poor branching with white fruits
BU 11	Medium height low branching large white fruits
BU 12	Short, poor branching and small green fruits
BU 13	Moderate height low branching and white fruits
BU 14	Short plant, poor branching and small green fruits
BU 15	Medium height, poor branching and fruiting
BU 16	Short plant poor branching and fruits
BU 17	Profuse branching, medium height, white and green fruits
BU 18	Medium height poor branching big and small white fruits

Data analysis: Data collected on the quantitative characters were analyzed using SAS Microsoft windows 8.0 (SAS, 1999), employing the method outlined by Steel and Terrie (1980). The yield and yield component was used to determine the genotypic and phenotypic variances according to Prasad *et al.* (1981). The variance components was used to compute the Genotypic Coefficient of Variability (GCV), Phenotypic Coefficient of Variability (PCV), broad sense heritability and expected genetic advance, according to the methods of Burton (1952), Johnson *et al.* (1955) and Kumar *et al.* (1985). Estimates of genotypic and phenotypic correlation coefficients among the characters were obtained using the formula of Miller *et al.* (1958).

RESULTS/DISCUSSION

The mean square obtained from analysis of variance showed significant differences ($p\geq 0.01$ Table 2) for plant height at maturity, branches per plant, total number of fruits per plant, total fruit weight per plant and fruit width, whereas fruit length was not significantly different ($p\geq 0.01$ Table 2) among the accessions. This suggested sufficient amount of variation among the accessions (Ibrahim and Hussein, 2006). This agrees with the report of Dar and Sharma (2011), Kitila *et al.* (2011), Singh *et al.* (2011), Gandhi *et al.* (2001) and Mostofa *et al.* (2002).

Generally, the values of PCV are slightly higher than that of GCV. This agrees with the report of Jalata *et al.* (2011) in barley. The difference can be accounted for by environmental influence. PCV ranged from (11.62) for fruit width to (58.17) for total fruit weight (Table 3). Similarly GCV ranged from (9.45) for fruit width to (54.25) total weight of fruits per plant. High PCV and GCV values which was observed in total fruit weight and number of branches per plant, suggested that these characters account for the highest variation in *S. anguivi*. This also agrees with the report of Aragaw *et al.* (2011), Kitila *et al.* (2011), Kotal *et al.* (2010), Ibrahim and Hussein (2006) and Vijay and Manohar (1990). Phenotypic and genotypic variance is highest in total weight of fruits per plant (3219.01 and 2799.39) and least in fruit width (0.03 and 0.02), respectively. The estimates of broad sense heritability among the characters varied from moderate to high. For plant

Table 2: Mean squares of six fruit and yield related characters of eighteen Solanum anguivi accessions in Ilishan-Remo Nigeria during rainy-dry season

Source of variation	Df	Plant height at maturity	Branches per plant	Total No. of fruits	Total fruit weight	Fruit width (cm)	Fruit length
Block	3	163.7	3.2	68.56	437.6	0.05	0.11
Variety	17	1100.1**	159.8**	3128.8**	12876.0**	0.11**	0.04
Error	51	256.7	25.7	452.8	1678.5	0.04	0.07
CV (%)		18.3	29.9	42.7	40.0	13.50	19.90

**Significant at 1% (p≥0.01) level of probability

Table 3: General mean, estimate of phenotypic and genotypic variance, phenotypic and genotypic coefficient of variability, broad sense heritability and genetic advance expressed for eighteen Solanum anguivi accessions

Characters	Grand mean	Phenotypic variance	Genotypic variance	Phenotypic coefficient of variability	Genotypic coefficient of variability	Heritability	Genetic advance %
Plant height	87.44	275.03	210.87	18.97	16.61	76.67	29.96
No. of branches	16.97	39.94	33.51	37.24	34.11	83.90	64.36
Total No. of fruits	49.84	782.19	669.00	56.11	51.90	85.53	98.87
Total weight of fruits	97.5357	3219.01	2799.39	58.17	54.25	86.96	104.21
Fruits width	1.408	0.03	0.02	11.62	9.45	66.15	15.83

height at maturity (76.67), number of branches per plant (83.9), total number of fruits per plant (85.5), total weight of fruits per plant (86.96) and fruit width (66.15). This indicates that these characters are under the influence of additive gene effect and therefore suggests that any selection in *S. anguivi* based on the phenotype of these characters will be effective in fruit yield. This agrees with the report of Parthiban *et al.* (2011) and Nwangburuka (2010). High genetic advance was also recorded in number of branches (64.36), total number of fruits per plant (98.87) and total fruit weight per plant (104.21). However, heritability estimate alone is not enough to produce a high genetic gain (Ibrahim and Hussein, 2006). Thus traits like number of branches per plant, total number of fruits per plant, total weight of fruits per plant combining both high genetic advance and high estimates of heritability is a more reliable indicator of additive gene action and therefore, their improvement can be achieved through mass selection (Randhawa and Sharma, 1972; Ibrahim and Hussein, 2006). Plant height at maturity and fruit width withmoderate estimates of heritability and genetic advance suggested that these traits may be under the control of non-additive gene action and environmental effect (Subramayan *et al.*, 1995). The phenotypic and genotypic correlation coefficient indicated that plant height at maturity was positively and significantly correlated with number of branches per plant (0.55, 0.56), total number of fruits per plant (0.64, 0.69) and total weight of fruits per plant (0.54, 0.60) (Table 4). Similarly, positive and significant phenotypic and genotypic correlation was observed between number of branches and total number of fruits per plant (0.67, 0.74); total weight of seed per plant (0.61, 0.67). There was also significant positive phenotypic and genotypic correlation between total number of fruits per plant and total weight of fruits per plant (0.96, 1.01); fruit width (0.39, 0.54). This was suggested that selection for fruit yield on the basis of these traits will yield reliable result. However, significant and negative correlation at Phenotypic and genotypic level between total number of fruits per plant and fruit length (-0.30, -0.41), total fruit weight and fruit length (-0.30, -0.48) suggested that selection directed towards fruit yield based on fruit length

Table 4: Phenotypic, genotypic and environmental correlation coefficient among five characters of Solanum in Ilishan-Remo

Character	No. of branches	Total No. of fruits	Total weight of fruits	Fruits width	Fruit length
Plant height					
Phen cor	0.55**	0.64**	0.54**	0.03ns	-0.34**
Gen cor	0.56**	0.69**	0.60**	0.00ns	0.32**
No of branches					
Phen cor		0.67**	0.61**	0.13ns	-0.01ns
Gen cor		0.74**	0.67**	0.19ns	-0.06ns
Total No. of fruits					
Phen cor			0.96**	0.39**	-0.33**
Gen cor			1.01**	0.54**	-0.41**
Total fruits weight					
Phen cor				0.48**	-0.30**
Gen cor				0.62**	-0.48**
Fruits width					
Phen cor					-0.01ns
Gen cor					-0.25*

**Significant at 1% ($p \geq 0.01$) level of probability. ns: Not significant

will not produce any significant improvement. This agrees with the report of Malik *et al.* (2000) and Gondane *et al.* (1995).

CONCLUSIONS

This study concludes that number of branches per plant, total number of fruits per plant and fruit width with high heritability and genetic advance should be taken into consideration in selection for fruit improvement in *Solanum anguivi*. It further concludes that variability *S. anguivi* is accounted for by the fruit weight and branching characteristics.

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