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Improving Local Varieties of Sweet Potato by Simple Recurrent Selection.

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ABSTRACT

The current experiment was carried out at Sedi Salem district, Kafr, El Shiekh, Egypt during three seasons of 2009, 2010 and 2011. This experiment aimed to improve the desirable characteristics of local varieties of sweet potato; Abees and Mabrooka which widely used in Egyptian cultivation by the methods of simple recurrent selection. One cycle of strong and healthy of sweet potato were cultivated on April, 15, 2009and the harvesting took place on Novamber,15,2009, during the season 150 plants were selected, and cultivated on November, 15,2009 to gave cuttings of November,15,2009to gave cutting of cycle (C_o) and the same system 2009 and 2010 to gave the cycle, (C_1) and (C_2), respectively. The experimental design was randomized complete block with three replications. The best plants of nursery were chosen in, April,15, 2008 to gave the original population by visual determined which was healthy and free of virus and mutations. The number of branches/plant, stem length cm, number of leaves/plant, average root weight, skin color, flesh color and root shape were measured for estimating. The expected improvement. It is evident that the phenotypic recurrent selection was found to be more effective in improving local varieties of sweet potato; Abees and Mabrouka skin for all the characters under study expect skin and flesh color and also stem length cm. It was found that the recurrent selection method gave significant increase in fifth leaf area (cm^2) dry matter%, yield/plant (g) and average root weight, than those obtained by original population of sweet potato. Also positive and significant correlation between average root weight and yield/plant (g) was clearing by simple recurrent selection. High estimates of PCV and GCV were obtained for the number of branches/plant, stem length cm, number of leaves/plant, average root weight, fifth leaf area (cm^2) dry matter %, yield/plant (g) and plant height indicated a good deal of variability in those characters signifying the effectiveness of selection of desirable types for improvement. High heritability assisted with high genetic advance as per cent of mean was observed for the number of branches/plant, stem length cm, number of leaves/plant, average root weight, fifth leaf area (cm^2) dry matter %, yield/plant (g) and plant height . Hence, simple selection based on phenotypic performance of these traits would be more effective. It is concluded that simple recurrent selection for studied characteristics was accompanied by slight loss variably making further progress possible.

Key words: Sweet Potato, recurrent selection, local varieties

Introduction

Sweet potato has long been a very important food crops through tropical and sub tropical regions of the world. Sweet potato is considered the six most important food crops in the world (Morrison *et al* 1993). Sweet potato tubers are a good source of vitamin c , carotene, carbohydrate, protein and some minerals. Sweet potato floor could be mixed with wheat floor in bread manufacturing and it's also a good row material for sweet industrial Cakes and biscuits, also foliage in terns of leaves and shoot contain high amount of vitamin A and B as well as protein, so it is used for animal feeding, sweet potato is used as a staple food vegetable (fresh roots, tender leaves and petioles) Chalfant *et al* 1990.The big problem in sweet potato there is not enough interest in Egypt about sweet potato improvement and also there is not enough cultivars of sweet potato in Egypt. Only two cultivars were used widely in Egypt; Abees and Mabrouka and there is not any breeding programs to improving them, vegetative propagation used only in sweet potato so that mutations and virus always attacks it, year after year.. The additive gene effects were identified in the inheritance of dry matter and β-carotene content (Chiona, 2009). The existence of positive correlation between traits implies that selection of one trait positively influences the other requiring simultaneous selection. While negative correlations between traits suggest that selection of one trait causes an obligatory decrease of the other trait. The absence of correlation indicates that each trait can be selected and improved independently (Acquaah, 2007).The genotypic variance and genotype by environment interaction, it was suggested that dry matter and starch content may be improved with a high selection efficiency in the earlier breeding stages (Grüneberg *et al*., 2005). For most of the traits studied, the additive component accounted for the major portion of the genetic variance and narrow-sense heritabilities on a

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plot basis were moderate to high (Jones, 1969a,b, 1977: Jones *et al*., 1969, 1978, 1979 : Jones and dukes, 1980). Estimates of phenotypic, genotypic and environmental correlations between traits indicated no serious impediments to selection for improved horticultural types through recurrent selection (Jones, 1970, 1971). Most of the important characters including yield are highly influenced by environment, since they are polygenically controlled (Amin and Singla, 2010). The possibility of improvement in any crop is dependent on the variability available in the crop, wider the genetic variability in the traits, better the chances of improvement through selection(Jindal *et al*., 2010). In sweet potato, the skin as well as the flesh contains carotenoids and anthocyanin pigments which determines its colour. The combination and intensity of these pigments vary to produce varying intensities of cream, yellow, orange, pink or purple skin and flesh colour. Attempts to demonstrate clear relationship between yield and morphological characteristics have been unsuccessful (Jones, 1966).Most of the morphological characters do not have any stable correlation with the root yield or yield components. Constantin (1965) and Hernandez *et al* (1965and1967) have reported skin colour as a quantitative character which was controlled by several genes in complementary action. High heritability for root shape and flesh colour was observed by Jones *et al* (1969and 1976) and Jones (1977and1988).Root yield is said to be a variable character and studies have indicated that heritability estimates for root yield was low indicating non additive genetic variance (Jones *et al*., 1969; Jones, 1977; Vimala, 1993; Vimala *et al*., 2011c;). This objective of the present work was to improving these cultivars sweet potato Abees and mabrooka by simple recurrent selection to become free from mutations and virus and also to gave high productivity and quality.

Materials and Methods

The current experiment was carried out at Sedi Sulem district, Kafr, El Shiekh Egypt During three successive seasons 2008,2009 and 2010. Orginal cutting of sweet potato were transplanted on april 15, 2008 at the private farm at Sedi Salem kafr El Shaiekh province: 150 plants were selected for good/ planty which was very healthy, free of virus and mutations and the cuttings were cultivated at Novamber 2009to gave cuttings of cycle (C_0) and the same work in 2010 and 2011 to gave (C_1) and (C_2) respectively. Data were taken for this characters , No. of branches/ plant, stem length, No of leaves, plant ,fifth leaf area cm^2,dry matter %, yield plant (g), no roots/plant, average root weight skin color, flesh colour and root shape were measured for estimating the expected improving . The obtained data were statically analyzed according to Snendecor and Cochran (1967).

Statistical analysis:

The mean values of each character under the study were computed and subjected to analysis of variance following the procedures described by Gomez and Gomez (1984) using MSTAT computer software. The genotypic (GCV) and phenotypic (PCV) coefficients of variation were estimated according to the procedure outlined by Johnson *et al*. (1955):

$\sigma_p^2 = \sigma^2_g + \sigma^2_e, \sigma^2_g = MS_g\text{-}MS_e/r$

Where, σ_p^2 = Phenotypic variance,

σ^2_g = Genotypic variance,

σ^2_e = Environmental variance (error mean square).

$$PCV = \frac{\sqrt{\sigma^2 p}}{\bar{x}} \times 100$$

where, = grand mean . Broad $GCV = \frac{\sqrt{\sigma^2 g}}{\bar{x}} \times 100$ sense heritability and the genetic advance expected under selection, assuming the selection intensity of 5% were calculated as suggested by Allard (1960):

$$H^2 = \frac{\sigma_g^2}{\sigma_p^2} \times 100$$

Where,

H^2 = Heritability in broad sense (in percentage).

$G_s = (K)\ \sigma_A\ (H^2)$

Where,

G_s= Expected genetic advance,

K = Selection differential (1.4 at 5% selection intensity),

σ_A = Phenotypic standard deviation.

Results and Discussion

1- Vegetative characteristics:

1.1- No of branches:

Data concerning number of branches /plant table1 showed that the number of branches /plant were 20,19.8 and 19.1 in the C_1, C_2 and C_3 in Mabrouka variety and it were 27,28.7 and 29.2 in Abees variety respectively. This means refer to that simple recurrent selection improved number of branches/plant in Abees cv. While it not improved in Mabrouka cv.

2.1- Stem length / plant:

The values of stem length in mabrouka cv were 186.0,189.9and 183.2 while it were 191,195.7 and 191.6 in C_1,C_2 and C_3 respectively .This results indicied that simple recurrent selection not affected in stem length/plant cm in sweet potato also simple recurrent selection not affected in skin root colour or flesh root colour of sweet potato, where ever in all cycles, Mabrouka and Abees varieties had dark purple in skin colour while Abees cv have orange flish colours and Mabrouka cv have white flesh colour. Also root shape not affected by simple recurrent selection and not differed in Mabrouka and Abees varieties in all cycles and root shape were elliptic in the two cultivars.

Table 1: Mean performances of two sweet potato cultivars Mabrouka and Abees for number of branch / plant, stem length cm^2, No of leave/plant fifth leaf area cm^2 and dry matter %.

Genotypes	No of branche /plant			Stem length cm			No of leaves plant			Fifth leaf area cm_2			Dry matter%		
	C_1	C_2	C_3	C_1	C_2	C_3	C_1	C_2	C_3	C_1	C_2	C_3	C_1	C_2	C_3
Mabrouka	20.0	19.8	19.1	186.0	189.6	183.2	399.0	389.6	399.6	24.5	24.7	25.1	25.0%	26.0%	27.0%
Abees	27.0	28.7	29.2	191.0	195.7	191.6	205.0	195.7	211.5	20.1	20.8	20.9	30.1%	31.4%	31.9%

The results in the three cycles in the first tables referred to there's no significant variation in most vegetative characters and the recurrent selection not affected on these character, while it was very affected on the yield and its components, data in table (2) C_1, C_2 and C_3.

2- Yield and its components:

Referred to table 2 in C_1,C_2 and C_3 found that colour and root shape not affected by simple recurrent selection these characters were fixed in all cycles. On the other hand, recurrent selection affected in root yield/ plant (g),root numbers/plant and average root weight (g). Mabrouka cv gave 455.581 and 597 (g) in C_1, C_2 and C_3 respectively these means decided that recurrent selection increased yield/plant (g) the same result had to Abees cv with means 405,460and 473 (g) in C_1,C_2 and C_3 respectively. Mabrouka cv gave number of roots /plant in C_1, C_2 and C_3 in 3.4,3.3 and 3.4 respectively while Abees cv gave 3.7,3.8 and 4.0 in C_1,C_2 and C_3 respectively these means referred to recurrent selection affected in No .of roots/plant. Average root weight (g) affected directly in the root yield /plant and yield/fedan. The values of average root weight (g)in two sweet potato cultivars Mabrouka and abees. Mabrouka cv were 138.0,176 and 175.0g in C_1,C_2 and C_3 respectively this means reported that recurrent selection is very important to improve root yield in sweet potato. The same results which were recorded in Abees cultivars, showed that average root weight were 109,121,118.9 in C_1,C_2 and C_3 respectively .The increase value in C_2 and C_3 over than C_1 10.5 g these means and these increase reported that recurrent selection was success full methods to improve sweet potato and also you can say to all propagated crops. Vimala *et al* (2011) showed that the selection of a number of superior hybrid clones for yield and other attributes would provide a large gene pool for the recombination from which the promising variety of considerable value could be generated. The carotenoid rich clones also indicates the possibility of significantly improving the nutritive value by making more acceptable products to the consumers whereas storage roots with high dry matter and starch content are more suitable for secondary processed foods. Sweet potato exhibits hexasomic or tetra-disomic inheritance (Kumagai *et al*., 1990). A wide range of variation exists among the sweet potato cultivars for the morphological as well as root characters Most of the important characters including yield are highly influenced by environment, since they are polygenically controlled (Amin and Singla, 2010).

Table 2: Mean performances of two sweet potato cultivars Mabrouka and Abees for root yield /plant, No. of roots /plant ,average root weight (g), skin colour, flesh and root shap.

Genotypes	yield /plant (g)			No of roots/plant			average root weight(g)			skin root colour			Flesh root colour			Root shape		
	C_1	C_2	C_3	C_1	C_2	C_3	C_1	C_2	C_3	C_1	C_2	C_3	C_1	C_2	C_3	C_1	C_2	C_3
Mabrouka	455.0g	581.7 g	597.0g	3.4	3.3	3.4	138.0g	176.0g	175.0g	Durk purple	Durk purple	Durk purple	White	white	White	Elliptical	Elliptical	Elliptical
Abees	405.0g	460.0g	473.0g	3.7	3.8	4.0	109.0g	121.0g	118.0g	Durk purple	Durk purple	Durk purple	Orange	Orange	Orange	Elliptical	Elliptical	Elliptical

The possibility of improvement in any crop is dependent on the variability available in the crop, wider the genetic variability in the traits, better the chances of improvement through selection (Jindal et al., 2010). In sweet potato, the skin as well as the flesh contains carotenoids and anthocyanin pigments which determines its colour. The combination and intensity of these pigments vary to produce varying intensities of cream, yellow, orange, pink or purple skin and flesh colour. Attempts to demonstrate clear relationship between yield and morphological characteristics have been unsuccessful (Jones, 1966) Earlier reports showed that extensive studies have been made on the inheritance of various characters of sweet potato (Poole, 1952) while Harmon (1960) have demonstrated the quantitative inheritance of morphological characters such as leaf type, stem colour and vine length and found that deeply leaf type was dominant and several genes influence the degree and pattern of purple colouration in stem. In another study, from the reciprocally intercrossed 19 sweet potato parents selected for early blooming varieties, wide variation was recorded for all the character studied (Jones, 1966).

- *Genetic Variability, Heritability and Genetic Advance:*

The analysis of variances revealed significant differences among the genotypes for all the characters (Table 3). The coefficients of genotypic and phenotypic variations, heritability estimates and expected genetic advance are shown in Tables (3 and 4). The highest genotypic and phenotypic coefficients of variations were observed for No. of branches/ plant, stem length, No of leaves/ plant, fifth leaf area ($cm^{2)}$,dry matter (%), No of roots/plant, average root weight and yield plant (g) . In the present investigation the difference between GCV and PCV were low in the characters of No. of branches/ plant, stem lengthcm^2, No of leaves plant, fifth leaf area (cm^2,dry matter %, No of roots/plant, average root weight and yield/ plant (g) indicating less environmental influence on these characters . hence this trait provide practically average chance for selection .

Table 3: Genetic parameters for No. of branches/ plant, stem length, No. of leaves plant, fifth leaf area cm^2,dry matter %, some characteristics in sweet potato genotypes.

Source of variance	No of branches/plant			Stem length cm			No of leaves /plant			Fifth leaf area cm^2			Dry matter%		
	C1	C2	C3	C1	C2	C3	C1	C2	C3	C1	C2	C3	C1	C2	C3
VPh	24.5	42.13	51.05	12.5	18.6	35.26	18818.0	18682.4	17690.8	9.8	8.54	11.52	8.4	130.5	14.56
VG	23.3	41.8	51.04	11.3	18.4	34.65	188.70	18681.2	17690.7	9.6	8.43	11.41	8..3	110.9	14.44
H%	95.2	99.2	99.9	90.67	98.9	98.26	99.9	99.9	99.9	98.3	99.67	99.0	98.8	91.5	99.17
GA	653.1	901.4	999.28	448.7	597.14	816.85	14185.8	19116.6	18606.3	43.08	408.14	470.42	400.88	461.9	529.77
PCV	210.6	27.004	14.58	1.9	3.1	4.33	45.43	79.75	76.09	14.0	6.12	7.12	5.3	13.1	7.12
GCV	20.50	26.69	14.53	1.7	3.009	4.29	45.40	79.94	76.08	13.8	6.008	7.08	5.2	**12.5**	7.009

The heritable fraction of the variation provides the base to the plant breeder for selection on the basis of phenotypic performance. Heritability estimates in broad sense were more than 90% for the characters of No. of branches/ plant, stem length, No of leaves plant, fifth leaf area cm^2,dry matter %, average root weight and yield plant (g) and more than 60% were observed in No of roots/plant . The heritability estimates were more than98% for No of leaves plant. These findings are in agreement with the works of Alam *et al.* (1998) and Hossain *et al.* (2000) who investigated high GCV and PCV for vine length, number of storage root per plant, individual root weight and storage root fresh yield per plant. Jones *et al.* (1986) suggested that in sweet potato, a heritability estimates above 60% are quite adequate for good selection advance and estimates as low as 40% by variancecovariance analysis could be considered favorable provided that the selection techniques have enough precision. Thus, although the heritability value recorded on storage root dry yield *perse* was the second from the least, it can be considered as favorable to achieve satisfactory progress by selection.

Table 4: Genetic parameters for No. of roots / plant, average root weight (g) and yield characteristics in sweet potato genotypes.

Source of variance	No of roots / plant			Average root weight (g)			Yield /plant (g)		
	C1	C2	C3	C1	C2	C3	C1	C2	C3
VPh	0.045	0.125	0.180	420.5	1512.5	1624.5	1800.0	7320.1	7688.0
VG	0.028	0.108	0.160	413.3	1484.0	1623.8	1774.0	7318.1	7672.8
H%	62.9	86.66	88.0	98.2	98.1	99.9	98.5	99.96	99.8
GA	18.64	42.89	52.56	2820.1	5341.2	5637.4	5883.9	11930.4	12250.8
PCV	5.9	1.87	2.2	16.6	31.9	33.3	9.7	37.48	37.9
GCV	4.7	1.74	2.007	16.4	31.6	33.2	9.6	37.47	37.7

The genetic advance was also equally high as compared to heritability for the characters mentioned. So, all the characters with high heritability were equally effective for selection. No. of branches/ plant, stem length, No of leaves plant, fifth leaf area cm^2,dry matter %, average root weight and yield plant (g) had high heritability values, and hence these characters are very much important to be considered by a breeder for selection. In addition, the characters like number of leaves per plant and yield had high genetic advance along with high heritability. Therefore, these three characters are much more important for selection with a view to developing high yielding varieties. Number of compound leaves per plant had heritability estimate of 99.9 with low genetic advance in percent of mean. So, this character may not be considered important. Likewise, No of roots/plant had also low genetic advance (18.64 %) which is considered less effective for selection. Panse (1957) suggested that effective selection may be done for the characters having high heritability accompanied by high genetic advance which is due to the additive gene effect. He also reported that low heritability accompanied with genetic advance is due to non-additive gene effects for the particular character and would offer less scope for selection because of the influence of environment. Desai and Jaimini (1997) also reported that tuber yield, number of stem, number of leaves, maturity, shoot fresh weight, number of tubers and average tuber weight had high genotypic coefficients of variation, high heritability and high genetic advance irrespective of environments. T. Alam *et al*. (1998) and Hossain *et al*. (2000) also found high genotypic coefficients of variation coupled with high heritability and genetic advance for the traits vine length, number of roots per plant and individual root weight.

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