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THE PHYSIOLOGICAL BASIS OF VARIATION IN YIELD IN SOME SWEET POTATO LINES

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ABSTRACT *The physiological basis of variation in yield were studied among some sweet potato genotypes differ in foliage vigour and yield. The clonal lines used in this study were No. 9, 10, 19, 35, 106, 130, 131 and cultivar Mabrouka. This investigation was carried out at the Experimental Farm of Hort. Res. Station in El- Kanater El-Khayriya during two successive summer seasons, i.e. 1996 and 1997.*

Plant samples taken at 120 and 135 days after transplanting showed that stem dry weight at early stage presented the high portion of total plant dry weight. Also, genotypes which gave low tuber root weight at this stage showed relatively higher weights of other vegetative organs.

With few exceptions leaf area, leaf area index were not correlated with tuber root yield.

Significant differences were found between genotypes in some growth attributes such as relative growth rate (RGR), leaf area ratio (LAR), net assimilation rate (NAR) and crop growth rate (CGR). The results showed generally, that tuber root yield was positively correlated with RGR and NAR and negatively with LAR. However, CGR was significantly and positively correlated with tuber yield.

Also, tuber root chemical contents such as vitamin C, carotene, dry matter, carbohydrates, soluble sugar, non soluble sugar and starch significantly varied with genotypes. Also, non of these constituents were correlated with tuber root yield. However, genotype "19" which gave relatively low yield gave the highest values of carbohydrates, soluble sugars, non-soluble sugars and starch content.

Values obtained for the correlation coefficient between tuber yield and growth attributes, foliage and tuber characters showed that, number of tuber roots/plant, dry weight of tuber root at 135 days after planting, harvest index at 135 days after planting and crop growth rate during the period of 120 and 135 days after planting were significantly correlated with tuber root yield.

Key words: Sweet potato, Lines, Phsiological, Chemical, Corrlation coefficient.

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is consider the six most important food crop in the world (Morrison *et al.*, 1993). It is widely grown in many countries and produces a considerable yield under a wide range environments.

Tuberous roots are a good source of carbohydrate, protein, vitamin C, carotene and some minerals. Also, sweet potatoes are used to produce starch, alcohol, acetone, glucose, ... etc.

Because of the low yield under Egyptian conditions, many attempts were made to increase the yield either quantity and quality for exportation.

The continued interest in producing higher- yielding cultivars of many crops has stimulated interest in physiological factors contributing to final yield and in the possibilities of selecting for there factors in breeding programs. Researches have attempted to correlate yield in crops with various growth characteristics.

Previous reports (Agata, 1982; Bourke, 1984 and Chakrabarty & Goswami, 1993) indicated that net assimilation rate (NAR) leaf area, leaf area index (LAI), leaf area duration (LAD), crop growth rate (CGR), relative growth rate (RGR) were major factors affecting differences in growth rates among different plants within and between species. Watson (1952) concluded that varietal, fertilizer and seasonal effects on economic yield were highly positively correlated with variation in leaf area but little extent net assimilation rate.

Enyi (1977) showed that mean crop growth rate (CGR) and percentage of total dry matter diverted into the tubers of sweet potato were greater in the high- yielding cultivars and there was a positive and significant correlation between CGR and final total dry weight. Similar results were also obtained by Agata (1982) who indicated that tuberous root growth rate was more highly correlated with CGR and also NAR than with leaf area index (LAI). Moreover, potato tuber yield was very closely correlated with mean CGR, NAR, harvest index (HI) and also with leaf area ratio (LAR), max. LAI and mean tuber dry weight (Bourke, 1984). Ramanujam and Biradar (1987) revealed that specific leaf weight (SLW) also was significantly and positively correlated with tuber yield as well as with NAR and CGR in cassava.

Several investigators emphasized that these physiological parameters of growth measurements differed significantly among sweet potato genotypes during early and late phases of growth and between seasons. Mannan *et al.* (1992) and Naskar & Chowdhury (1994) showed that LAI, CGR, NAR and RGR increased with plant age to the maximum (60-120 days after planting) and decreased thereafter, however tuber, leaf and stem DM increased rapidly from 90 days after planting to the final harvest.

Significant differences were found among some new sweet potato varieties in their tuber contents of carotene, vit. C, N, P. K, total protein as well as sugar and starch (Shalaby *et al.*, 1993b; Liao *et al.*, 1994).

The aim of this investigation is to develop some new lines, also to study the physiological and chemical basis of variance in yield for the tested lines.

MATERIALS AND METHODS

This experiment aimed to study the physiological basis of variation in yield, the clonal lines used in this study were No. 3, 9, 10, 19, 35, 37, 106, 130, 131 and "Mabrouka". These genotypes were selected on the light of their performance during the evaluation studies previously planting. This investigation was carried out at the Experimental Farm of Horticulture Research Station in El-Kanater El-Khairyia during two successive summer seasons: *i.e.*, 1996 and 1997.

Two plant samples (consisted of 3 plants from each experimental unit) were taken for studying growth analysis and yield components. The first and second samples were taken at 120 and 135 days after transplanting, in both seasons.

In each samples the whole plants were taken including stems, leaves, tuber roots as well as lateral roots. Attention was paid to obtain both roots as complete as possible. Each plant organs were separated and the following measurements were determined.

a- Physiological studies :

1- Fresh weight of different plant organs: *i.e.*, stems, leaves, tuber roots and lateral roots.

2- Dry weight of different plant organs: *i.e.*, leaves, tuber, roots and lateral roots were determined by drying in an oven at 70°C for 3 days (until constant weight).

3- Proportion of dry matter allocated to various plant organs.

4- Leaf area and its related parameters.

b- Chemical analysis :

The following plant chemical properties were determined :

1- Chlorophyll and carotene content : at 110 days after transplanting the fifth leaf from the top was used for these determination using the colorimetric methods described in the A.O.A.C. (1965). The concentration of chlorophyll "a" and "b' and carotenoids in the leaf were calculated as follows (Wettstein, 1957) :

Chl. "a" = $9.784 \times E_{662} - 0.99 \times E_{644}$ = measured in mg/L

Chl. "b" = $21.426 \times E_{644} - 4.65 \times E_{662}$ = measured in mg/L

Car. = $4695 \times E_{440} - 0.286$ (Chl. a + Chl. b) = measured in mg/L

Where :

Chl. "a", Chl. "b" and Car. : Concentration of chlorophyll "a", chlorophyll "b", and carotenoids, respectively. E : optical density at the indicated wave length.

2- Total carbohydrate content in leaves, was determined according to method described by Smith *et al.* (1956). The value was multiplied by 0.94 to obtain the percentage of soluble sugars contents as mentioned by the A.O.A.C. (1970). Total carbohydrates were determined colourimetrically as g. glucose per 100 g dry weight according to Smith *et al.* (1956). After extracting the soluble sugars, starch was determined in the residue left on the filter paper, according to A.O.A.C. (1970).

3- Vit. C. content in roots : was determined according to A.O.A.C. (1970).

4- Tuber root chemical contents.

5- Correlation coefficient between tuber root yield and the other traits of sweet potato.

Statistical Analysis :

All data obtained during both seasons of every experiment were subjected to statistical analysis according to Snedecor and Cochran (1972). Mean values represented the various investigated genotypes were compared by the Duncan multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

1- Tuber root weight, number and average weight of tuber :

The effect of genotypes on tuber roots weight (yield) and number as well as average tuber weight were listed in Table (1). Significant differences were found among genotypes in such yield and its component, at harvesting. It is obvious that genotype "37" gave the highest yield, followed by 10, 131, 106 and 35 in descending order. On the other hand, "Mabrouka" cultivar gave an intermediate yield.

Table (1) : Effect of sweet potato genotypes on tuber root weight/plant (kg), number of tuber roots/plant and averge weight of tuber root (kg) "average of the 1996 and 1997 seasons".

Characters / Genotypes	Tuber root weight/ plant (kg)	No. of tuber roots/plant	Average weight of tuber root (kg)
3	0.574 f*	2.300 g	0.259 b
9	0.678 e	3.150 f	0.215 c
10	1.333 b	5.000 c	0.274 a
19	0.599 f	3.667 e	0.163 e
35	0.822 d	4.800 d	0.171 d
37	1.464 a	8.150 a	0.180 d
106	0.842 c	4.983 c	0.169 d
130	-	-	-
131	0.907 c	5.163 b	0.176 d
Mabrouka	0.644 e	3.067 f	0.210 c

* Means within a column followed by different letters are significantly different at the 0.05 level.

Number of tuber produced per plant almost followed the same trend of tuber weight/plant. Genotype 37 gave the highest number of tuber roots. Genotypes 131, 10, 106 and 35 gave also higher tuber number. These results suggested a highly positive correlation between yield and tuber number/plant, as shown in Table (1). Bouwkamp and Hassan (1988) in their study on source - sink relationships in sweet potato indicated that sink strength could be estimated roughly by storage root number/plant. Depend on this conclusion of Bouwkamp and Hassan, the genotypes which gave high yield in this study, showed relatively high sink strength. Thus, results (Tables 1) enforce the previous general consensus that sink strength is more important than source potential (total above-ground vine weight) in determining yield in sweet potato (Wilson, 1977).

Average weight of tuber root, however, showed somewhat different trend, than that of tuber weight and number (Table 1). Genotypes 10, 3, 9 and "Mabrouka" gave the highest average of tuber weight, this may suggested that plant yield mainly depend on tuber number and to lesser extent tuber average weight.

Marked differences in tuber yield, tuber number and average weight of tuber were found between sweet potato cultivars elsewhere (Bertoli *et al.*, 1994 and El-Shimi, 1996). Also, the relatively high weight of tuber in cultivar "Mabrouka" was also mentioned by El-Shimi (1996) and El-Denary (1998).

2- Dry weight of the entire plant and various plant organs :

The effect of genotype on dry weight of different plant organs and entire plant were listed in Table (2). Significant differences were found among genotypes in such dry weight, at 120 and 135 days after transplanting. After 120 days, genotypes 106, 10 and 130 gave the highest dry weight of the entire plant, whereas genotypes 3, 19 and 35 had the lowest weight. Other genotypes showed intermediate values of pant dry weight.

Regarding tuber root dry weight, genotype 10 gave the highest weight. Genotypes 131, 3 and "Mabrouka", however gave lower values. It is obvious also that genotypes 130 failed in producing tuber root (Table 2). With few exceptions, genotypes which gave lowest dry weight of tuber roots gave the highest dry weight of lateral roots. Genotypes 130 and "Mabrouka" which showed the lowest values of tuber root dry weight had, however, the highest weight of other vegetative organs; *i.e.*, lateral roots, stems and leaves (Table 2). This means that assimilates which did not accumulate in tuber root was used in building up other vegetative organs particularly lateral roots and stems and for lesser extent leaves. At this stage of growth, the dry weight of entire plant was mostly depended on stem dry weight. Table (2) also shows taht genotypes 131 and 9 gave the highest dry weight of leaves, whereas genotypes 3 gave the lowest weight.

Table (2): Effect of sweet patato genotypes on dry weight of various plant organs taken in 2 sampling date.

1st sample (taken at 120 days after transplanting) (average of the 1996 and 1997 seasons)

Characters / Genotypes	Dry weight of plant organs / plant (g)				
	Roots (g)		Stems (g)	Leaves (g)	Entire Plant (g)
	Tuber	Lateral			
3	27.908^{g*}	4.303^{f}	41.235^{i}	30.823^{i}	103.867^{h}
9	57.918^{c}	12.839^{d}	68.430^{g}	68.376^{b}	207.563^{d}
10	119.300^{a}	12.215^{d}	93.889^{d}	47.409^{e}	272.813^{a}
19	33.520^{f}	5.160^{f}	27.170^{i}	23.751^{j}	89.607^{g}
35	47.614^{e}	8.195^{e}	44.868^{h}	32.688^{h}	133.365^{f}
37	51.309^{d}	12.039^{d}	87.099^{e}	55.259^{d}	205.706^{d}
106	89.757^{b}	14.827^{e}	129.150^{c}	39.403^{g}	273.137^{a}
130	0.000^{i}	22.599^{a}	174.378^{a}	59.484^{c}	256.461^{b}
131	28.771^{g}	12.107^{d}	82.347^{f}	70.561^{a}	193.786^{e}
"Mabrouka"	18.486^{h}	20.500^{b}	156.913^{b}	42.140^{f}	238.039^{c}

2nd sample (taken at 135 days after transplanting) (average of the 1996 and 1997 seasons)

Characters / Genotypes	Dry weight of plant organs / plant (g)				
	Roots (g)		Stems (g)	Leaves (g)	Entire Plant (g)
	Tuber	Lateral			
3	76.118^{d*}	5.964^{g}	63.614^{i}	47.832^{f}	193.330^{i}
9	70.871^{d}	9.318^{e}	124380^{f}	81.806^{c}	386.375^{h}
10	223.142^{a}	7.310^{f}	103.060^{h}	55.287^{e}	388.799^{c}
19	51.001^{e}	3.878^{h}	44.907^{j}	45.996^{g}	145.782^{j}
35	149.807^{b}	8.710^{e}	116.050^{g}	45.030^{h}	319.597^{f}
37	124.751^{c}	11.695^{d}	152.726^{d}	119.245^{a}	408.417^{b}
106	171.156^{b}	19.080^{e}	196.42^{b}	47.494^{f}	434.150^{a}
130	0.000^{f}	23.731^{a}	193.840^{c}	81.948^{c}	299.519^{g}
131	91.982^{c}	18.328^{c}	139.740^{e}	88.380^{b}	338.430^{e}
"Mabrouka"	47.979^{d}	20.99^{b}	221.757^{a}	73.669^{d}	364.395^{d}

* Means within a column followed by different letters are significantly different at the 0.05 level.

At 135 days after transplanting, the dry weight of all plant organs distinctly increase than those determined after 120 days, but these augmentation in dry weight, as expected, were not similar among different genotypes. Genotype 106 still had the highest dry weight of entire plant, whereas genotype 37 showed the second highest value of entire plant dry weight (Table 2). Genotypes 10, "Mabrouka" and 131 also gave high dry weight of entire plant. At this stage, the increasing in plant dry weight of these genotypes was mainly due to the increase in tuber weight (as in genotypes 106, 10, 35 and 37), stem weight (as in genotypes 37, 106, 131 and "Mabrouka") or for lesser extent leaves (as in genotype 106).

It is obvious from Table (2) that genotype 130 completely failed in producing tuber roots, however, the amount of dry matter accumulated in other vegetative organs was not high after 135 days, as was expected, compared with some other genotypes produced tuber root.

3- Proportion of dry matter allocated to various plant organs :

At 120 days after transplanting, the genotypes differ significantly in the proportion of dry matter allocated to different organs. The range of percentage of dry matter allocated to tuber roots, lateral roots, stems and leaves were : 0 to 47.60, 4.14 to 8.81, 25.37 to 67.99 and 14.41 to 36.41, respectively, in all studied genotypes. These results confirm our early observation, that at this stage the entire plant dry weight was mainly depended on stem dry weight, since percent of dry matter allocated to stem reached up to 68 % and showed the higher range.

At 135 days after transplanting, it is obvious from Tables (2 & 3) that dry weight and dry matter allocated to tuber root, values increased than those observed at 120 days, in most genotypes. So, the percentage of dry matter allocated to other vegetative organs such as to lateral roots (in all genotypes), stems (in most genotypes) and leaves (in most genotypes) decreased.

Results presented in Tables (2 & 3) showed that percentage of dry matter allocated to tuber roots and its dry weight in both samples were higher in genotypes 10, 35, 37 and 106. Results presented in Table (1) showed that the highest yield of tuber roots were obtained by genotype 37 followed by 10, 131 and 35 genotypes. This may suggest that some genotypes which showed a tendency to produce early tuber root and devoted relatively high dry matter proportion to them, can produce high yield at harvesting (October). These findings reinforces the conclusion obtained by Chowdhury and Ravi (1991) who mentioned that high-yielding genotypes generally initiated storage root formation earlier and also partitioned more photosynthate to storage roots than low-yielding genotypes in sweet potato.

On the other hand, genotype 106 gave also relatively high values of both dry weight of tuber root and proportion of dry matter devoted to them early in

Table (3): Effect of sweet patato genotypes on the proportion of dry matter allocated to various plant organs taken in 2 sampling date.

1st sample (taken at 120 days after transplanting) (average of the 1996 and 1997 seasons)

Characters / Genotypes	proportion of dry matter allocated to various organs %			
	Roots (g)		Stems (g)	Leaves (g)
	Tuber	Lateral		
3	26.867^{f*}	4.143^{d}	39.699^{bc}	29.975^{c}
9	27.903^{e}	6.185^{b}	32.968^{c}	32.942^{b}
10	43.729^{b}	4.477^{d}	34.889^{c}	17.377^{i}
19	47.624^{a}	4.818^{cd}	25.371^{d}	22.178^{g}
35	35.702^{c}	6.144^{b}	33.643^{c}	24.510^{e}
37	20.146^{g}	6.983^{b}	42.341^{b}	26.259^{d}
106	32.861^{d}	5.428^{bc}	47.283^{b}	14.426^{j}
130	0.000^{j}	8.811^{a}	67.993^{a}	23.194^{f}
131	27.179^{f}	6.247^{b}	42.493^{b}	36.411^{a}
"Mabrouka"	12.166^{i}	8.648^{a}	65.919^{a}	17.702^{h}

2nd sample (taken at 135 days after transplanting) (average of the 1996 and 1997 seasons)

Characters / Genotypes	proportion of dry matter allocated to various organs %			
	Roots (g)		Stems (g)	Leaves (g)
	Tuber	Lateral		
3	39.372^{c*}	3.084^{d}	32.416^{f}	24.741d
9	24.747^{h}	3.253^{d}	43.432^{d}	28.566b
10	57.392^{a}	1.801^{f}	26.507^{g}	14.219g
19	26.129^{g}	3.022^{de}	37.999^{f}	35.848a
35	46.873^{b}	2.752^{e}	36.311^{e}	14.089f
37	37.545^{e}	2.863^{de}	37.394^{e}	21.196e
106	38.545^{d}	4.394^{c}	45.242^{c}	10.939h
130	0.000^{j}	7.923^{a}	64.717^{a}	27.359c
131	27.179^{f}	5.415^{b}	41.290^{cd}	26.114d
"Mabrouka"	12.166^{i}	5.760^{b}	60.856^{b}	21.216e

* Means within a column followed by different letters are significantly different at the 0.05 level.

the growing season (at 120 and 135 days after transplanting); however, at harvesting, this genotype gave relatively low yield. In this respect, Bouwkamp and Hassan (1988) mentioned that partitioning rate change during the growing season and differ among cultivars and group of cultivars. They added that cultivars showing strong root sink effects are generally low-yielding. Thus, it could be concluded that the main differences among cultivars were due to the differential effects of root number (root sink strength) on yield and rate of partitioning. In some cultivars, the relatively stronger root sink effects on partitioning resulted in reduced vine (leaves) grolater in the season and that yield may have been reduced due to less photosynthetic capacity. In other cultivars had high but not strong effects of root number (sink strength) on partitioning, vine growth continued and yield were higher even through the harvest index was lower.

4- Leaf area and its related parameters :

Results presented in Table (4) showed the effect of different sweet potato genotypes on leaf area/plant (LA), leaf area index (LAI) and leaf area duration (LAD), till 135 days after transplanting.

As indicated in the table, all mentioned leaf- related parameters, were highly significantly affected by the genotypes. Genotype 130, which did not produce tuber roots, gave the highest values of LA, LAI and the *2nd* highest value of LAD. Genotypes 131, 9, "Mabrouka", 37 and 10 produced high values of such parameters. On the other hand, 106, 3 and 19 genotypes gave lower values.

Table (4) : Effect of sweet potato genotypes on leaf area/plant (LA) and leaf area index (LAI) taken at 135 days after transplanting and leaf area duration (LAD) taken during period of 120-135 days after transplanting "average of the 1996 and 1997 seasons".

Characters / Genotypes	(LA) / plant (m^2)	(LAI) (m^2)	(LAD) m^2/week
3	1.644 h*	3.29 i	2.69 i
9	3.120 c	6.24 c	5.76 f
10	2.191 f	4.38 f	4.12 f
19	1.691 gh	3.38 h	2.56 j
35	1.752 g	3.52 g	3.15 g
37	2.881 e	5.76 e	4.95 d
106	1.641 h	3.28 i	3.02 h
130	3.523 a	7.18 a	5.97 b
131	3.305 b	6.61 b	6.16 a
Mabrouka	2.969 d	5.94 d	4.54 e

* Means within a column followed by different letters are significantly different at the 0.05 level.

It is clear from results found in Table (4) that leaf related parameters LA, LAI and LAD were not correlated, in general, with tuber yield (Table 1).

However, individually, among those genotypes which gave high yield, genotype 131 (which gave the *3rd* highest yield) gave the highest value of LAD and the *2nd* highest LA and LAI values. Genotypes 37, 10 and 35 which gave also high yield, showed, on the other hand, low LA, LAI and LAD values (Tables 1 & 4). These results seem to be in accordance with those of Agata (1982) and Zrust and Ceple (1991). They all concluded that such leaf-related parameters were either associated with yield in some genotypes or not associated in the others.

5- Leaf chlorophyll and carotene contents :

Sweet potato genotypes were found to be significantly different regard to chlorophyll a, b and carotene contents in the *5th* leaf taken at 110 days after transplanting (Table 5).

Table (5) : Effect of sweet potato genotypes on chlorophyll a, b and carotene contents in the *6th* leaf taken at 110 days after transplanting and carbohydrates % in leaves taken at 135 days after transplanting "average of the 1996 and 1997 seasons".

Characters Genotypes	Chl. a mg/100 g f.w.	Chl. b mg/100 g f.w.	Carotene mg/100 g f.w.	Carbohydrates in leaves %
3	21.093 f*	15.630 e	9.377 e	30.733 d
9	30.940 a	19.990 d	11.680 d	38.000 c
10	61.447 a	26.923 b	12.990 b	70.000 a
19	26.257 d	27.080 b	8.880 e	29.833 e
35	19.777 g	7.363 f	8.340 f	29.667 e
37	30.973 a	28.600 a	12.167 c	41.000 b
106	29.080 c	26.713 b	12.773 b	9.667 g
130	29.737 b	20.143 d	12.357 c	37.833 c
131	28.570 c	25.737 c	15.073 a	30.333 e
Mabrouka	24.457 e	16.097 e	6.290 g	27.167 f

* Means within a column followed by different letters are significantly different at the 0.05 level.

The highest values of chlorophyll a, b and carotene were, respectively, recorded to genotypes 10, 37 and 131.

Among those genotypes produced high yield, genotype 37 (which gave the highest yield) had the *2nd* highest, the highest and the *4th* highest contents of chlorophyll a, b and carotene, respectively. Also, genotype 10 (which gave the *2nd* highest yield) had the highest, the *3rd* highest and the *2nd* highest contents of chlorophyll a, b and carotene, respectively. This may suggest the importance of high photosynthetic pigments in determining yield, in some genotypes. Somewhat, similar results obtained by Radwan *et al.* (1979) on tomato, who found that cv. "Money Maker" which produced the highest yield had also the highest chlorophyll a, b and carotene contents in leaves.

On the other hand, genotype 35 (which gave the *4th* highest yield and highest value of NAR) had the lowest chlorophyll a, b and low of carotene contents. This finding suggested that there were no correlation between yield or dry matter accumulation and leaf photosynthetic pigments contents in some genotypes. These findings agree with those obtained by Radwan *et al.* (1979) on tomato.

Generally, data presented in Table (5) showed a positive but not significant correlation between sweet potato yield and leaf chlorophyll and carotene contents.

6- Tuber root chemical contents :

Data presented in Table (6) showed the effect of sweet potato genotypes on some chemical contents of tuber root.

No significant differences were observed between the genotypes regarding vitamin C content, in tuber root.

Regarding carotene content, genotype 106 followed by 10 gave the highest carotene content values. On the other hand, genotypes "Mabrouka" and 3 gave the lowest values. It is well known that carotene content affected flesh colour of tuber root; *i.e.* high carotene contents gave yellow or orange flesh colour, whereas low contents gave white flesh.

Regarding to dry matter percentage in tuber roots at harvesting, data presented in Table (6) showed that sweet potato genotypes significantly differed in this trait. Genotype 3 had the highest dry matter content in tuber root at harvesting. Also, genotypes 35 and 131 had high dry matter content. Genotypes 9 and 106, however gave the lowest dry matter content in tuber roots. The differences in dry matter content in tuber roots among sweet potato genotypes were also found elsewhere Liu *et al.* (1985), Iwama *et al.* (1990), Abd El-Salam (1993), El-Shimi (1996) and El-Denary (1998).

The dry matter contents in tuber roots among different cultivars showed that there was no correlation between this trait and tuber yield.

Data of total carbohydrate percentage in tuber root of sweet potato genotypes were presented in Table (6). Significant differences were found between genotypes in this character. Genotypes 19, 35 and 3 gave the highest carbohydrate in tuber roots, whereas genotypes 10 and 131 gave the lowest values. Other genotypes showed intermediate values of carbohydrate content in tuber roots.

Data presented in Table (6) revealed no significant correlation between tuber carbohydrate content and tuber yield.

Soluble sugar percentage in tuber roots of sweet potato genotypes were presented in Table (6). Significant differences were found between genotypes in this trait. Genotype 35 gave the highest value of sugar percentage, followed by genotypes 19 and 3. On the other hand, genotypes 131 gave the

Table (6) : Effect of sweet potato genotypes on some tuber root chemical contents (average of the 1996 and 1997 seasons).

Characters / Genotypes	Vitamin C content mg/ 100 g f.w.	Carotene content mg/ 100 g f.q.	Dry matter %	Carbohydrates in tuber roots %	Soluble sugar in tuber roots %	Non soluble sugar in tuber roots %	Starch in tuber roots %
3	27.93* a	2.292 f	35.62	37.000 c	19.333 c	17.667 d	16.607 a
9	26.310 a	4.958 d	24.43	26.000 e	17.167 d	8.833 f	8.307 b
10	22.340 a	6.106 b	29.10	14.167 g	6.167 g	8.000 g	7.520 b
19	27.920 a	4.339 e	25.16	53.167 a	31.167 b	22.000 a	20.680 a
35	46.085 a	5.443 c	30.83	38.000 b	32.333 a	5.667 h	10.340 b
37	32.610 a	4.626 d	27.78	18.167 f	4.333 h	13.833 e	10.653 b
106	15.065 a	6.525 a	23.70	34.167 f	15.000 e	18.833 c	17.703 a
130	-	-	-	-	-	-	-
131	18.620 a	5.541 c	30.80	10.333 h	2.000 i	8.333 f	7.833 b
Mabrouka	31.650 a	2.304 f	24.58	26.267 e	2.267 f	19.000 b	17.860

*** Means within a column followed by different letters are significantly different at the 0.05 level.**

lowest value. It is well known that soluble sugar content is responsible for sweetness in tuber root.

Likewise, non soluble sugar content in tuber roots varied between genotypes (Table 6), where genotypes 19 and 35 had the highest and lowest content, respectively. Similarly, Babu (1994) and El-Shimi (1996) found significant differences in total sugars content in tuber roots between studied sweet potato genotypes.

It could be concluded from results of sugar content in tuber roots and those of tuber yield that there was no correlation between the two characters (Table 7).

Starch percentage in tuber roots were recorded in Table (6). The studied genotypes varied in starch content in tuber roots. It is obvious from these results that genotypes could classified into two groups; *i.e.*, high starch content group such as 3, 19, 106 and "Mabrouka" and low starch content groups such as 9, 10, 35, 37 and 131 genotypes.

Several investigators (Lee *et al.*, 1985; Liao *et al.*, 1985 and El-Shimi, 1996) found significant differences between sweet potato genotypes regarding tuber roots starch content.

Again, it seem that there was no correlation between tuber starch content and tuber yield.

7- Correlation coefficient between tuber yield and the other studied traits of sweet potato :

Values obtained for the correlation coefficient between tuber yield and some growth attributes, foliage and tuber characters are listed in Table (7).

Table (7) : Correlation coefficient between yield/plant (kg) and some plant characters of sweet potato.

Characters	"r" value
Number of tuber roots/plant	0.930**
Average weight of tuber roots	0.122
Dry weight of ruber roots at *2nd* sample	0.800**
Leaf area/plant at *2nd* sample	-0.176
Leaf area index at *2nd* sample	-0.192
Harvest index at *2nd* sample	0.766**
Chlorophyll a (at 110 days)	0.281
Chlorophyll b (at 110 days)	0.507
Relative growth rate	0.528
Leaf area ratio	-0.377
Net assimilation rate	0.510
Crop growth rate	0.676*
Leaf area duration	-0.074
Carbohydrate in leaves	0.384
Carbohydrate in tuber root	0.003
Plant dry weight at 2^{nd} sample	0.518

* Significant at P 5 % level of probability.

** Significant at P 1 % level of probability.

Significant positive correlation were found between tuber yield at harvesting and each of number of tuber roots/plant, dry weight of tuber roots at 135 days after planting, harvest index at 135 days after planting and crop growth rate during period of 120 and 135 days after planting.

These characters which significantly correlated with yield are useful to the plant breeder who may wish to incorporate them in his breeding programme for the production of a high yielding cultivar.

No other significant correlation were found between tuber yield and other characters.

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دراسة الأسس الفسيولوجية والكيماوية لاختلاف المحصول في بعض سلالات البطاطا

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الملخص العربي

تمت دراسة الأسس الفسيولوجية بين التراكيب الوراثية لسلالات البطاطا والتى تختلف عن بعضها فـى الشـكل الظاهرى والمحصول. أستخدمت فى هذه الدراسة السلالات رقم ٩، ١٠، ١٩، ٣٥، ٣٧، ١٠٦، ١٣٠، ١٣١ والصـنف الشـائع فـى الـزراعة "مبروكة". أجرى هذا البحث فى محطة بحوث البساتين بالقناطر الخيرية خلال الموسم الصيفى لعامى ١٩٩٦ و ١٩٩٧.

وأخذت عينات من النباتات بعد ١٢٠، ١٣٥ يوم من الشتل .. وأظهرت النتائج أن الوزن الجاف للسـاق فى المرحلة المبكرة أسهمت فى زيادة المادة الجافة لنبات ككل. أيضا التراكيب الوراثية والتى أعطـت جذور صغيرة ذات وزن منخفض فى هذه المرحلة أعطت على الجانب الاخر أوزانا مرتفعة فى النموات والأعضاء الخضرية فيما بعد.

لاترتـبط مسـاحة الورقة ودليل مساحة الورقة ودوام مساحة الورقة خلال النمو بمحصول جذور الدرنات إلا مع بعض الإستثناءات.

وجـدت إختلافات جوهرية فى التراكيب الوراثية تحت الدراسة فى قوة النمو الخضرى، مثل معدل الـنمو النسبى (RGR)، نسبة مساحة الورقة (LAR) والسرعة النسبية للتمثيل (NAR) وسرعة نمو المحصـول (CTGR). أظهـرت النـتائج بصفة عامة أن محصول درنات الجذر ارتبطت إيجابيا بمعدل النمو النسبى (RGR)، ومقدار الكفاءة التمثيلية (NAR) وإرتباطا سلبيا بنسبة مساحة الورقة (LAR). بيـنما الإرتـباط بيـن محصول الدرنات وهذه الصفة لم يكن معنوياً وعلى أية حال فـإن سرعة نمو المحصول (CTGR) إرتبطت معنويا وإيجابيا بمحصول الدرنات.

إختلفـت التراكيـب الوراثية جوهريا فى المحتوى الكيميائى للدرنات مثل فيتامين C والكاروتين والمادة الجافة والكربوهيدرات والسكريات الذائبة وغير الذائبة والنشا. أيضا فإن هذه الصفات لم ترتبط بمحصـول الدرنات. وعلى أية حال فإن التركيب الوراثى رقم ١٩ والذى أعطى محصول منخفض نسبيا

أعطى فى نفس الوقت قيم مرتفعة فى المواد الكربوهيدراتية والسكريات الذائبة وغير الذائبة والمحتوى من النشا.

القيم التى تم الحصول عليها لمعامل الإرتباط بين محصول الدرنات والنمو الخضرى والعرش وصفات الدرنات أوضحت أن عدد الدرنات للنبات والمادة الجافة للدرنات بعد ١٣٥ يوما من الزراعة وكذلك دليل المحصول بعد هذه المدة من الزراعة، وسرعة نمو المحصول أثناء الفترة بين ١٢٠ و ١٣٥ يوما من الزراعة إرتبطت جوهريا بمحصول الدرنات.