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EVALUATION OF SOME SUGAR BEET VARIETIES PRODUCTIVITY PLANTED IN SILT CLAY SOIL AT KAFR EL-SHEIKH GOVERNORATE

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ABSTRACT

Experiments were carried out during 1998 / 1999 and 1999 / 2000 seasons to evaluate the productivity of seven different newly imported sugar beet varieties planted in silty clay soil at Sakha Agricultural Research Station , Agricultural Research Center , Kafr El-Sheikh Governorate . Growth , yield , yield components and root chemical contents of these varieties were monitored after 90 and 120 days from sowing and at harvest time as well . Varieties studied showed significant differences in their productivity in the experimental site , whereas , Farida var. was superior in root fresh weight . Moreover , growth of these varieties varied at vegetative sampling periods , these variation were remarkably during the first 90 days from sowing , later growth characters values did not show significant differences at 120 days from sowing . Farida var. showed superiorty in growth parameters and accordingly gave the highest root and sugar yield . On the other hand , Farida variety did not form the hugest above ground vegetative mass since Athospoly variety was superior in top fresh weight / plant (0.94 kg / plant) and accordingly reached the maximum in top yield (25.8 ton / fed.) with no significant differences with Farida var. (26.3 ton / fed.) . However , values of top yield (ton / fed.) between Farida and Athospoly did not differ significantly . Root fresh weights were varied significantly among the seven studied varieties , whereas , a percentage of 0 , - 2.94 , -18.63 , -17.65 , +19.61 , + 5.88 and +14.71 % deviation from the average fresh root weight / plant which was 1.02 kg were calculated for Lola , Kawemira , Top , Raspoly , Farida , Pamela and Athospoly respectively . Varieties studied could be classified according to its root and sugar yield in the experimental site to ; I- High productivity varieties which are , in descending order , Farida , Athospoly and Pamela , II- Intermediate productivity varieties which is Lola and III- Low productivity varieties which are , in descending order , Kawemira , Raspoly and Top

Keywords : Sugar-beet , Variety , Productivity , Soil-type , Growth , Yield , Chemical component .

INTRODUCTION

The Egyptian national plan proposes to expand sugar beet area to cover the increasing demand on sugar since sugar beet crop is highly adapted to grow even in poor and saline soils , in addition to its limited water requirements compared to sugar cane . Therefor , the crop becomes the second important crop for sugar production in Egypt . Crop productivity differed according to varieties since many articles declared that sugar beet varieties varied in growth parameters (Milford and Riley 1980 and Gaber *et al*

1991) , sucrose content and sucrose yield (Sanbuichi *et al.,* 1981 ,Tripathi *et al.,* 1986 , Abdel Aal and Dawwan 1991 , Zuffrano 1994 and El Sayed 1997) , purity of the juice and T.S.S. (Kamel *et al.,* 1981 and El Sayed 1997) , and accordingly in yield and yield component (Sanbuichi *et al.,* 1981 , Abdel-Hafeez *etal.,* 1984 , Badawy 1985 , El Sayed 1997) . It is documented that growth and development of different sugar beet varieties was attributed to the high rate of photosynthesis resulting from the exceptional proliferation of the leaves . It was concluded that improved varieties might be bred most readily by concentrating on increasing the net assimilation rate and reducing the above ground mass to the limit sufficient for producing high root and sugar yield (Minx 1976) .

In Egypt , sugar beet covers about 135,623 fed. in 2000 , meanwhile , the national plane proposed to expand this area to 200,000 fed. which consequently required sugar beet factories to be increased . Kafr El-Sheikh Governorate was selected for the current experiment since sugar beet cultivated area in this governorate covered 63.01% of the northern Egypt and 54.85 % of the whole country contributing with 47.70 % of the total productivity . Additionally , the greatest new cultivated expanding area was found at Kafr El-Sheikh , it reached 14.18 % of total cultivated area in the northern Egypt and 13.44 % of the total cultivated area in whole country , which rank this governorate as the first sugar beet production region in Egypt (Agricultural Statistics 2000) . Variation in soil type and fertility within the governorate should be considered . Most chemical and biological parameters of the soil fertility were varied according to fertilization , soil microorganism (Dabek *et al* 1996) , organic treatment (manure) , crop rotation (Lapa and Ivakhnenko 1995 and Dabek *et al.,* 1996) and soil texture (Granstedt *et al.,* 1997) . Also soil properties (i. e. soil aggregates , soil porosity) (Dabek *et al.,* 1996) , soil organic carbon , organic matter and total N were found to affect the growth and yield of sugar beet (Abou-Bakr and El-Maghraby 1994) .

Seven varieties newly introduced for sugar beet production were selected in simple experiment to evaluate its productivity under soil conditions of Kafr El-Sheikh Governorate rather than using a few varieties in factorial experiment . No literature was published about maximizing the productivity of these varieties under Egyptian condition , therefor , focusing in productivity of broad spectrum varieties and ranking them according to its production especially sugar yield was our target . Then , high yielding varieties will be selected for further investigation based on the results obtained from this experiment .

MATERIALS AND METHODS

Seed material

Seven different sugar beet varieties were submitted from Sugar Crops Research Institute , Agricultural Research Center , Giza , Egypt . These varieties were recently imported from Europe , they were Lola , Kawemira , Top , Pamela (Germany) , Farida , Athospoly (Netherlands) and Raspoly (Sweden) . Most of these varieties were used in Egyptian agriculture during 1994/1996 season and the others were used later .

Experimental protocol

Two field trails were conducted during 1998/1999 and 1999/2000 seasons at Sakha Agricultural Research Station , Agricultural Research Center , Kafr El-Sheikh Governorate . Soil analysis of the experimental site was determined , whereas , mechanical and chemical properties were tabulated in (Tables 1-A and 1-B) . Experimental soil was classified as a silt clay loam according to Piper (1950) . Soil analysis was carried out following Jackson (1973) . Seeds of used varieties were planted during the first week of November in both seasons . Varieties were arranged in Randomized Complete Block Design in four replicates . Nitrogen fertilizers was applied at a rate of 80 kg N/fed. in two equal portions , the first portion was added immediately after thinning and the second portion was added after 60 days from sowing . All other agronomic practices were followed as recommended in the experimental region .

Table (1-A) : Mechanical analysis of the soil at the experimental site .

Year	Sand %	Silt%	Clay%	Texture class
1998/1999	25.08	44.21	30.71	silt clay loam
1999/2000	23.97	43.47	32.56	silt clay loam

Table (1-B) : Chemical analysis of the soil at the experimental site .

Year	Cations (mq/L)				Anions (mq/L)				Ec mmhos /cm	pH	ppm available of	
	Ca++	Mg++	Na+	K+	Cl^-	SO_4^-	HCO^-	CO_3^-			P	N
1998/1999	0.18	0.08	0.15	0.18	0.20	0.12	0.28	0.00	1.02	7.96	21.3	39.5
1999/2000	0.25	0.02	0.25	0.03	0.17	0.14	0.33	0.00	1.11	7.91	20.1	36.3

Data recorded

Samples (3 plants / plot) of each replicate were taken after 90 and 120 days from sowing to estimate the following growth characters :

1- Root fresh weight (g).
2- Top fresh weight (g).
3- Root diameter (cm).
4- Root length (cm).
5- Leaf area (cm^2).
6- Root / top ratio .
7- Leaves total chlorophyll .

Chlorophyll content was determined in the field by using chlorophyll meter (SPAD 501) .

8- Total soluble solids (T.S.S.).

Total soluble solids were determined using hand refractometer according to A.O.A.C. (1995) .

9- Sucrose percentage (%).

A sample of 5 roots were collected , and its juice were extracted . Sucrose percentage was determined using sucarimeter according to the procedure outlined by A.O.A.C. (1995) .

After 210 days sugar beet plants of all varieties were harvested and the following parameters were determined :

1- Leaves total chlorophyll .

2- T.S.S. in root juice .
3- Sucrose (%) .
4- Purity (%).

Purity was calculated using the following formula ;

Purity = (Sucrose % / T.S.S.) x 100

5- Fiber (%).

Determination of crude fiber was carried out according to Weende method outlined in A.O.A.C. (1995) .

6- Root nitrogen content :

Nitrogen was determined in dried roots according to the improved Micro-Kjeldahl method (A.O.A.C. 1995) , then nitrogen percentage was calculated .

7- Root phosphorus content :

Phosphorus percentage was determined colormetrically using spectrophotometer according to (Olsen et al 1954) .

8- Root potassium and sodium content :

Potassium and sodium percentage were determined using flame photometer according to (Jackson 1973) .

9- Root fresh weight (kg / plant).
10- Top fresh weight (kg / plant).
11- Root / top ratio .
12- Root dry weight (g / plant) .
13- Top dry weight (g / plant) .
14- Root diameter (cm) .
15- Root length (cm) .
16- Leaf area (cm^2) .
17- Root yield (ton / fed.) .
18- Top yield (ton / fed.) .
19- Sucrose yield (ton / fed.) .

Statistical analysis :

All data collected were statistically analyzed following Snedecor and Cochran (1967) . For data comparison L.S.D. values were calculated .

RESULTS AND DISCUSSION

Growth parameters

Growth was monitored as samples were taken from the studied varieties after 90 and 120 days from sowing in both seasons, whereas , different growth parameters were determined . It is noticed that growth of these varieties varied significantly after 90 days except leaf area , however , 30 days later from the first sample (120 days from the sowing) differences between growth parameters did not reach the significant level except total clorophyll (Tables 2 and 3) . Data revealed that sugar beet varieties varied in growth during the first 90 days , sooner , plant vegetative mass of all studied varieties become similar and the gap between their growth has been narrowed . This phenomenon occurred because it seems that these varieties did not vary in vegetative mass especially after 120 days from sowing .

Farida var. was superior in growth parameters determined after 90 days from sowing if compared with the other varieties (Table 2) . Values of root fresh weight , top fresh weight , root diameter , root length and leaf area reached the greatest values of 177 g , 408 g , 4.4 cm , 19.1 cm and 220 cm^2 respectively , therefore , Farida variety showed the highest growth rate during the first period of growth (90 days) . On the other hand , Raspoly variety showed the lowest growth values , of 85 g , 266 g , 3.1 cm . 21.1 cm and 179 cm^2 for the same characters mentioned previously , respectively . Other varieties ranked in between during this period . After 120 days from sowing , although , Farida variety gave the heaviest root fresh weight , differences in values did not reach the significant level .

Table (2) : Growth characteristics of sugar beet varieties after 90 days from sowing (combind data of 1998/1999 and 1999 / 2000 seasons .

Varieties	Root fresh weight (g)	Top fresh weight (g)	Root diameter (cm)	Root length (cm)	Leaf Area (cm^2)	Root / top	Total chlor.
Lola	110	229	3.2	14.6	182	0.48	43.3
Kawemira	100	270	3.1	18.5	182	0.37	42.2
Top	97	301	3.5	15.5	196	0.32	39.6
Raspoly	85	226	3.1	21.1	179	0.38	38.3
Farida	177	408	4.4	19.1	220	0.43	36.4
Pamela	134	321	3.7	21.4	185	0.42	39.5
Athospoly	142	323	3.9	19.5	189	0.44	47.9
LSD 0.05	34.6	67.4	0.66	3.17	N.S.	0.08	6.16

Table (3) : Growth characteristics of sugar beet varieties after 120 days from sowing (combind data of 1998 / 1999 and 1999 / 2000 seasons).

Varieties	Root fresh weight (g)	Top fresh weight (g)	Root diameter (cm)	Root length (cm)	Leaf Area (cm^2)	Root / top	Total chlor.	T.S.S. %	Sucrose %
Lola	305	539	8.7	23.0	235	0.57	44.5	18.3	9.70
Kawemira	309	518	9.3	22.5	218	0.60	50.9	18.9	10.40
Top	286	480	8.1	22.5	215	0.60	47.8	16.8	9.90
Raspoly	231	498	7.7	22.8	216	0.46	45.1	18.0	9.10
Farida	400	668	9.4	24.2	250	0.60	52.5	17.8	10.30
Pamela	315	582	9.1	22.0	240	0.54	57.0	16.6	9.55
Athospoly	375	644	10.7	25.3	251	0.58	51.2	17.3	9.57
LSD 0.05	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	7.27	N.S.	N.S.

It is noticed that values measured of most growth characters were low in Raspoly and Top varieties and high in Pamela , Farida and Athospoly varieties . Total chlorophyll was measured as key to evaluate the capability of these varieties for producing dry matter , whereas , high chlorophyll content could be taken as a indication for the assimilation rate . The highest chlorophyll content were determined in Farida , Athospoly and Pamela , whereas , these varieties also gave the highest growth characters declaring the role of containing high chlorophyll concentration , that was true after 120 days from sowing (Table 3). High sugar content were detected in the same

varieties , however , data recorded of TSS and sugar percentage did not show any significance differences after 120 days from sowing .

Yield and yield components

Although , the studied varieties did not vary significantly in growth rate after 120 days from sowing , the final productivity of these varieties varied significantly in most of the studied characters at harvest (Tables 4 and 5) . Farida variety which gave the highest yield compared to the other varieties as it was expected since this variety was promising during growth and other high yielding varieties i.e. (Athospoly and Pamela) had higher contents of chlorophyll since growth stage to the harvest time , however , these values did not show any significance differences at harvest . Also TSS , sucrose percentage and purity percentage of the root juice did not vary significantly between the studied varieties . Data of intake minerals did not show a trend compatible with the growth or yield trends (Table 4) . The adsorption of N , P , K and Na was less in the most yielded varieties . High yield of these varieties may be because of other factors affecting productivity rather than minerals adsorption , this point need more deeply investigation on mineral uptake and other factors affecting productivity such as photosynthesis , water relations and dry matter accumulation in sink (roots) , these factors are of very complicated relations .

Table (4) : Roots chemical components of different sugar beet varieties at harvest time (combined data of 1998/1999 and 1999/2000 seasons)

Varieties	Total chlor.	T.S.S.	Sucrose %	Purity %	Fiber %	N %	P %	K %	Na %
Lola	39.1	20.5	16.2	79.0	10.5	1.14	0.149	1.39	0.57
Kawemira	38.9	21.3	16.4	77.2	10.1	1.19	0.158	1.30	0.62
Top	38.7	21.0	16.4	78.1	10.3	1.11	0.124	1.15	0.48
Raspoly	38.7	20.8	16.0	77.8	10.5	0.92	0.106	1.11	0.62
Farida	41.5	20.4	16.8	82.3	10.9	1.04	0.121	1.03	0.55
Pamela	38.1	21.0	15.2	72.8	10.2	0.98	0.162	1.14	0.67
Athospoly	41.7	20.6	16.3	79.4	10.7	1.14	0.128	1.08	0.65
L.S.D. 0.05	N.S.	N.S.	N.S.	N.S.	0.45	0.07	0.004	0.08	0.05

Farida var. plants produced the biggest roots if compared to other studied varieties since parameters recorded on roots reached the highest values of 1.22 kg / plant , 281 g / plant , 12.4 cm and 29.6 cm for fresh root weight , dry root weight , root diameter and root length , respectively . On the other hand , Farida variety did not form the hugest above ground vegetative mass since Athospoly variety was superior in top fresh weight / plant (0.94 kg / plant) and accordingly reached the maximum in top yield (25.8 ton / fed.) with no significant differences with Farida var. (26.3 ton / fed.) . However , values of top yield (ton / fed.) between Farida and Athospoly did not differ significantly gaving both the highest values of top yield (ton / fed.) . Low productivity variety (Top and Raspoly) gave the lowest values of root fresh and dry weights , root dimensions (diameter and length) and also top fresh and dry weights . Root / top (sink / source ratio) revealed the capability of the vegetative mass of the studied varieties to produce dry matter through

photosynthesis process and to be accumulated in the roots (sink) . It is noticed that the high productivity varieties have the biggest ratio and vice versa since Farida , Pamela and Athospoly gave values of 1.33 , 1.34 and 1.25 while Top and Raspoly gave values of 1.18 and 1.16 , respectively . While , Lola and Kawemira gave higher values of 1.30 and 1.32 respectively , therefor , some varieties which produce high root / top ratio gave lower root yield . It is noticeable that correlation between root / top ratio and root yield (plant productivity) varied in the studied varieties . It was reported that the improved varieties might be bred most readily by concentrating on increasing the net assimilation rate and reducing the above ground mass to the limit sufficient for producing high root and sugar yield (Minx 1976) .

Table (5) : Yield and yield components of different sugar beet varieties at harvest time (combined data of 1998/1999 and 1999/2000 seasons)

Varieties	Root F.W.(kg/ plant)	Top F.W. (kg/ plant)	Root / top	Root D.W. (g/ plant)	Top D.W. (g/plant)	Root diam. (cm)	Root length (cm)	Leaf area (cm^2)	Root Yield (ton /fed.)	Top yield (ton /fed.)	Suc. yield (ton/ fed.)
Lola	1.02	0.79	1.30	261	103.4	11.7	27.1	233	28.56	22.1	4.63
Kawemira	0.99	0.75	1.32	231	90.4	11.7	26.7	220	27.72	21.0	4.54
Top	0.83	0.71	1.18	204	89.8	10.0	25.2	210	23.24	19.9	3.81
Raspoly	0.84	0.73	1.16	206	90.6	10.2	25.9	244	23.52	20.4	3.76
Farida	1.22	0.92	1.33	281	112.1	12.4	29.6	224	34.16	26.3	5.75
Pamela	1.08	0.81	1.34	263	108.5	12.0	27.5	233	30.24	22.7	4.59
Athospoly	1.17	0.94	1.25	271	121.9	12.2	28.4	261	32.76	25.8	5.35
L.S.D. 0.05	0.28	0.05	0.11	N.S.	22.0	0.92	2.4	1.49	1.62	1.49	0.56

Root fresh weights were varied significantly among the seven studied varieties , whereas , a percentage of 0 , - 2.94 , -18.63 , -17.65 , +19.61 , + 5.88 and +14.71 % deviation from the average fresh root weight / plant which was 1.02 kg were calculated for Lola , Kawemira , Top , Raspoly , Farida , Pamela and Athospoly respectively . Also data of total sucrose yield (ton / fed.) showed the same trend , whereas , values of deviation percentage from the average sucrose yield (4.63 ton / fed.) were 0 , -1.94 , -17.71 , -18.79 , +24.19 , - 0.86 and + 15.55 % for the previously mentioned varieties respectively . It is noticeable that the highest root and sucrose yields were obtained from Farida var. . Based on the percentages calculated above , these varieties could be classified into three groups which were I- High productivity varieties ranked in descendingly order as Farida , Athospoly and Pamela , II- Intermediate productivity variety which is Lola and III- Low productivity varieties ranked in descendingly order as Kawemira , Raspoly and Top .

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تقييم إنتاجية بعض أصناف بنجر السكر فى تربة سلتية طينية بمحافظة كفر الشيخ

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أقيمت تجربتين حقليتين خلال عامى ١٩٩٨ / ١٩٩٩ و ١٩٩٩ / ٢٠٠٠ لتقييم إنتاجية سبعة أصناف أستوردت حديثاً من بنجر السكر فى تربة سلتية طينية بمحطة بحوث سخا - مركز البحوث الزراعية - محافظة كفر الشيخ . تمت دراسة صفات النمو والمحصول ومكونات المحصول والتركيب الكيماوى لجذور هذة الأصناف بعد ٩٠ ، ١٢٠ يوم من الزراعة وكذلك عند الحصاد . أظهرت الأصناف المدروسة إختلافات معنوية فى إنتاجيتها فى منطقة إقامة التجربة حيث أظهر الصنف Farida تفوقا فى الوزن الغض للجذر ، هذا بالإضافة إلى أن هذة الأصناف أختلفت فى نموها الخضرى فى فترات تقدير القياسات الخضرية . هذة الإختلافات كانت معنوية فى فترة النمو المبكرة عند عمر ٩٠ يوم من الزراعة إلا أنة بعد تلك الفترة لم تظهر الإختلافات فى قياسات النمو الخضرى أى معنوية عند عمر ١٢٠ يوم . أظهر الصنف Farida تفوقاً فى صفات النمو الخضرى عن باقى الأصناف وبالتالى تفوق محصول الجذور والسكر لهذا الصنف . ومن جهة أخرى فإن هذا الصنف لم يعطى أعلى نمو خضرى فوق سطح التربة حيث أظهر الصنف Athospoly تفوقا فى المجموع الخضرى أعلى سطح التربة (٠,٤٩ كجم / نبات) ولهذا أعطى أعلى محصول للمجموع الخضرى فوق سطح التربة (٢٥,٨ طن / فدان) وبدون فرق معنوى مع الصنف Farida (٢٦,٣ طن / فدان) . مهما يكن فإن قيم المجموع الخضرى فوق سطح التربة لصنفى Athospoly و Farida لم تظهر خلاف معنوى. أختلفت أوزان الجذر الغض للأصناف السبعة تحت الدراسة حيث كانت قيم الإختلاف لهذة الأصناف عن المتوسط العام لوزن الجذر الغض (١,٠٢ كجم / نبات) هى ٠,٠ ، -٢,٩٤ ، -١٨,٦٣ ، -١٧,٦٥ ، +١٩,٦١ ، +٥,٨٨ ، +١٤,٧١ لأصناف Lola و Kawemira و Top و Raspoly و Farida و Pamela و Athospoly على الترتيب . يمكن تقسيم الأصناف المشتملة عليها هذة الدراسة تبعاً لكمية محصول الجذور ومحصول السكر إلى : ١- أصناف عالية الإنتاجية وهى بالترتيب التنازلى Farida و Athospoly و Pamela ٢- أصناف متوسطة الإنتاجية ويتبعها صنف Lola ٣- أصناف منخفظة الإنتاجية وهى بالترتيب التنازلى Kawemira و Raspoly و Top .