EVALUATION OF SOME SUGAR BEET VARIETIES UNDER THREE DIFFERENT LOCATIONS

Journal

J. Biol. Chem. Environ. Sci., 2018, Vol. 13(4): 243-264
http://biochemv.sci.eg

Hanan, y. Mohamed, Samar A.M. Helmy and S.M.I. Bachoosh

Sugar Crops Res.Inst.,Agric.Res.Center,Giza, Egypt.

ABSTRACT

Field experiment was carried out in three locations, Agricultural Research Stations in governorates of Ismailia (latitude of 30° 58′N and longitude of 32^o 26′E), Faiyum (latitude of 29^o18′ N and longitude of 30^o 35′E), and Alexandria (31° 21′N latitude and longitude of 29° 91′E), Egypt in 2016/2017 and 2017/2018 seasons. The present work included thirty six treatments, twelve sugar beet varieties (*Beta vulgaris,* L.) namely Beta 303, LP 1003, Beta 273, Pyramid, Sible, Beta 401, Beta 302, Univers, Nancy, Bairac, Oscar poly and LP 016 and three locations to evaluate them under Egyptian conditions and select the best in terms of suitability to environmental conditions and the extent of their superiority in yielding, technological traits and stability. The experiment was carried out in a randomized complete block design (RCBD) with three replications.

Results showed that Ismailia location surpassed the other two locations, producing roots with high content of sucrose% and less content of impurities compared with Faiyum and Alexandria.

Results indicated that varieties significantly differed in the studied traits except Quality index and impurities%. Pyramid variety exhibited the superiority over the other tested varieties which recorded the highest values of root yield (ton/fed.) Differences between Pyramid variety and Beta 273, LP 1003 and Beta 303 varieties did not reach significant level. With regard, in sugar yield Pyramid variety in 1st season and LP 1003 variety in 2^{nd} season surpassed the other varieties without significant difference with Beta 303.

Variety Beta 303 had the highest values of root yield at Ismailia location in the first season only 29.17 ton/fed while in second season Pyramid variety get the maximum root yield 28.89 ton/fed at same location. Meantime, Pyramid and Beta 302 varieties gave the highest values in sugar yield (4.52 and 4.64 ton/fed) at the same location in the first and second season, respectively.

The stability parameters b_i and S^2d for root and sugar yields revealed that, the varieties Pyramid, LP 1003 and LP 016 were stable in root yield. However Beta 303 variety was stable in sugar yield revealed near unity regression coefficient (b_i) and non-significant deviation from regression "S^2d" and it considered as a stable varieties to varying environments with a broad adaptability across the studied environments.

Key words: Locations, sugar beet, stability, varieties.

INTRODUCTION

Breeding for high yielding and stable cultivar has always been an important objective of all plant breeding programs. Yield is a complex character and sensitive to environmental changes. Plant breeder aimed to produce high yielding and stable varieties. Variety × environment interactions are often described as inconsistent differences among varieties from one environment to another especially when varieties are compared across series of environments. Hereby, the relative ranking of a variety, usually differ as a result of edaphic variation between locations and changes in the environmental circumstances. Thus, a large GxE interaction led to reduce any actual progress from selection reference. The analysis of variance procedure is useful for estimating the magnitude of GxE interaction, but fails to provide information on the contribution of individual variety to environment. To obtain reliable estimates concerning the response of individual varieties across a range of environments, several methods of stability analyses have been developed as adopted by **Eberhart and Russell (1966).**

In this connection, all sugar beet cultivars sown under Egyptian conditions are imported from global breeding sources. Therefore, evaluation of these varieties is required locally is very important to select the best ones, in terms of suitability to environmental conditions and extent of their superiority in yield and quality traits. Also, when varieties are compared in such environments (predictable and/or unpredictable), their, relative performance may be not the same. For example, one variety may have the highest yield in some environments and a second variety may excel in other. In this connection **Shalaby (2003)** showed that Kafr El-Sheikh location gave the highest average of root weight, sucrose%, root, sugar yields/fed, quality and extractability percentages. However, Dakahlia location gave the highest values of root length and alpha amino nitrogen percentage. On the other hand, under Faiyum location, the highest root diameter has been detected. Further, potassium and sodium root juice contents were insignificantly differed among locations. **Abd El-Aal** and **Mohamed (2005)** studied the interaction between variety and environment (GE) at 12 environments. They found that mean squares due to seasons, locations were highly significant for all the studied characters of ten sugar beet varieties. **Abd Elrahim, *et al.* (2005)** reported that high significant differences among varieties Del 937, Del 938, Del 939 in root yield/fed, sodium content, sucrose, sugar and quality percentages, while these differences in potassium, amino nitrogen contents, sugar recovery and sugar loss to molasses percentages were insignificant. Del 939 variety was superior compared to the other two varieties in root, top yields/fed and quality traits. **Aly (2006)** showed that beet varieties differed significantly. Marathon variety surpassed significantly the other varieties in root length, root diameter, root weight, root and sugar yields/fed. Kawemira variety had the highest mean values of sucrose, Quality index, extractable sugar and extractability percentages. The highest values of alpha amino nitrogen % and sodium % were produced from Del 936 variety, while Athos poly variety gave the maximum mean values of potassium % and sucrose loss to molasses. **Enan, *et al*. (2011)** revealed that the five tested sugar beet varieties differed significantly in their yield potential capacity. Cleopatra variety recorded the highest sucrose%, while Florima and Heracule varieties produced the highest root and sugar yields/fed due to the difference in their gene make-up, which plays an important role in plant structure and morphology. **Hozayn, *et al*. (2013)** recorded significant differences among the tested cultivars in all studied characters of sugar beet grown under newly reclaimed soil.

Further, **Hozayn, *et al.* (2014)** found that all sugar beet varieties showed diversity behavior with respect to sucrose %, fresh root and sugar yield/fed under the three locations. The highest root fresh weight/plant was produced by Monte Rose in sandy clay soil and DS-9004 and R-Hist in sandy soil. Similar trends were recorded for gross sugar yield. Moreover, Toro, DS-9007 and DS-9004 recorded the highest sucrose percentage in clay, sandy clay and sandy soil, respectively. **Aly, *et al.* (2015)** found that sugar beet varieties (Top, Sultan and Kawemira) significantly differed in root length, diameter and root fresh weight g/plant, as will as sucrose%, Quality index % and yields of root and sugar/fed. **Enan, *et al*. (2016)** indicated that the tested three beet varieties differed significantly in the studied traits. They added that Polat variety showed the superiority over the other two tested varieties and recorded the highest values of root diameter, fresh and top weights/plant in both seasons. Meanwhile, insignificant differences were found between Polat and Henrike varieties in root diameter and top fresh weight/plant in the 1st season; root fresh weight/plant in the second one. Moreover, insignificant differences among varieties were detected in their impact on gross and corrected sugar yields/fed.

The aim of this investigation is to evaluate twelve sugar beet varieties under three locations (Agricultural Research Stations in governorates: Ismailia, Faiyum and Alexandria - Egypt) for yield and yield components along with technological traits. Also, both genotypic and phenotypic stability were investigated.

MATERIALS AND METHODS

Field experiment was carried out during 2016/2017 and 2017/2018 seasons under three different locations in the farms of existing Research Stations, Agric. Res. Center, Ismailia Governorate (latitude of 30° 58′N and longitude of 32^{o} 26′E), Faiyum Governorate (latitude of 29^{o}18′ N and longitude of 30^{o} 35′E), and Alexandria Governorate (31° 21′N latitude and longitude of 29° 91′E). The present work included thirty six treatments, which were the combinations of twelve imported sugar beet varieties (*Beta vulgaris, var. saccharifera* L.) namely Beta 303, LP 1003, Beta 273, Pyramid, Sible, Beta 401, Beta 302, Univers, Nancy, Bairac, Oscar poly and LP 016 to evaluate them under the three mentioned locations, to select the best ones in terms of suitability to environmental conditions and superiority in yielding, technological traits. The experiment for each location was carried out in a randomized complete block design (RCBD) with three replications. The plot area for each experimental site was 21 m^2 including 7 ridges of 5-m in length and 60-cm in width, with 20-cm hill spacing. Phosphorus fertilizer was applied in the form of calcium super phosphate (15 % P_2O_5) at the rate of 30 P_2O_5 kg/fed at seed bed preparation. Nitrogen fertilizer was applied as ammonium nitrate (33%) at rate of 80 kg N/fed in two equal doses after thinning and one month later. Potassium fertilizer was applied in the form of potassium sulphate (48% K_2O) at the rate of 48 kg K_2O/fed, which was added at the second dose of nitrogen. Other cultural practices were performed as recommended in each location. Sowing of sugar beet varieties took place during the 2nd week of October, while harvesting was done 7 months later in both seasons. Soil physical properties were analyzed using the procedure described by **Black**, ***et al*. (1981)**. Soil chemical analysis was determined according to the method described by **Jackson (1973)**. Physical and chemical analyses of the soil (the upper 30-cm) of the experimental site are given in **Table 1**. The monthly temperature (C^o) for each season and location are illustrated in **Table 2**.

Table 1: Soil physical and chemical properties of the experimental soil in each location

Seasons	Mechanical				Cations and anions (meq-l)							Available nutrients			E.C ds/m 25Co	PH Soil paste
	Sand %	Silt %	Clay %	Soil texture	Ca++	Mg++	Na+	K+	Cl^-	$So4^{-2}$	$HCO3^-$ meq/l	N (mg-l)	P (mg-l)	K (mg-l)		
El Ismailia																
2016/2017	15.96	28.29	55.75	Silty Clay	3.8	2.4	8.81	0.22	6.46	3.73	5.38	40.31	9.54	250.1	1.41	8.2
2017/2018	16.39	27.26	56.35		3.7	2.5	9.45	0.21	6.65	4.14	5.18	42.22	10.4	260.6	1.39	8.2
El Faiyum																
2016/2017	24.20	31.70	44.10	Silty Clay	4.89	2.53	15.34	0.38	8.21	12.23	2.71	39.21	8.82	234.20	3.19	8.0
2017/2018	23.87	30.59	45.54		4.22	2.31	14.95	0.42	8.75	11.89	2.52	40.15	9.63	240.28	3.11	8.0
Alexandria																
2016/2017	25.3	57.4	17.3	Sandy loam	2.09	3.06	5.24	0.18	7.08	4.62	0.15	38.90	10.3	175.2	0.90	7.8
2017/2018	24.91	54.97	20.12		2.03	2.97	4.95	0.19	7.11	4.51	0.17	38.4	11.15	183.0	0.82	7.9

Table 2: Monthly, maximum and minimum temperature (C^{o}) for each location

Location	Ismailia			Faiyum			Alexandria		
2016/2017 season									
Month	Max	Min	Aver	Max	Min	Aver	Max	Min	Aver
October	27.5	23.4	25.5	24.4	24.3	24.3	32.5	17.3	24.9
November	24.0	19.8	21.9	21.0	21.0	21.0	27.0	12.7	19.9
December	19.4	15.3	17.4	15.5	15.5	15.5	20.4	9.2	14.8
January	17.0	12.4	14.7	13.6	13.6	13.6	21.0	7.6	14.3
February	19.7	13.8	16.7	14.2	14.2	14.2	22.2	5.9	14.1
March	21.0	14.9	18.0	16.3	16.2	16.3	25.0	8.4	16.7
April	24.8	17.6	21.2	18.4	18.3	18.3	28.6	13.1	20.9
2017/2018 season									
Months	Max	Min	Aver	Max	Min	Aver	Max	Min	Aver
October	27.2	22.9	25.0	29.4	15.4	21.8	31.0	16.5	23.8
November	23.9	19.5	21.7	23.9	10.2	16.2	25.8	12.1	19.0
December	18.4	14.0	16.2	20.9	8.4	13.7	19.5	8.8	14.1
January	16.9	12.0	14.4	18.5	4.7	10.7	20.1	7.3	13.7
February	17.4	12.6	15.0	24.3	9.9	16.2	21.2	5.6	13.4
March	20.1	14.3	17.2	25.2	10.1	17.7	23.9	8.0	15.9
April	22.4	16.2	19.3	29.3	11.8	20.6	27.3	12.5	19.9

The recorded data:

At harvest, sample randomly (20 root) from each plot were uprooted randomly, topped and weighed to determine:

1. Root length and diameter (cm).

2. Root fresh weight/plant (kg).

3.Impurities of juice, *i.e.* Na and K (meq./100 g beet) were determined in the lead acetate extract of fresh macerated root tissue using "Flame photometry" method described by **Browen and Lilliand (1964)** while α-amino N was determined using "ninhydrin hydrindantin" method according to **Cooke and Scott (1993)**.

4. Sucrose % (pol%) was polarimaterically determined according to the methods of **Le-Docte, (1927)**.

5. Sugar lost to molasses **(SLM %)** = 0.14 (K + Na) + 0.25 (α-amino-N) + 0.5, **Devillers (1988)**.

6. Extractable sugar% (sugar recovery) and extractability %were calculated as proposed by **Dexter *et al.* (1967).**

Extractable sugar % = sucrose% – (sugar loss in molasses % + 0.6).

Extractability % = (extractable sugar % / sucrose %) x100

7. Quality index (QI) = (Extractable sugar% ÷ sucrose %) × 100

8. Root yield (ton fed^{-1}): Weight per plot before taking samples was obtained and used to calculate root yield per fed.

9. Sugar yield (ton fed^{-1}) = root yield (ton) x Extracted sugar %.

Statistical analysis:

The collected data were statistically analyzed as shown by **Gomez and Gomez (1984).** Analysis of variance was computerized for each trait in each location and combined analysis for the three locations .Treatments means were compared using LSD test at 5% of probability. All statistical analysis was performed using analysis of variance technique of (MSTAT- c) computer software package.

The phenotypic stability parameters were estimates using model of **Eberhart and Russell (1966)**. The performance of individual variety is regressed on an environmental index (deviation of the mean of each trait at that environment from the overall mean of each trait of all environments). The analysis provides the linear regression coefficient "bi", (performance response index) and the deviation from regression mean square, S2d, (stability index).

RESULTS AND DISCUSSION

I.1. Effect on root characteristics and yield:

Results in **Table 3** indicated that root length (cm), diameter (cm), fresh weight (kg/plant) and yield (ton/fed) of sugar beet were significantly affected by locations in both seasons. Ismailia location gave the highest values of root length, diameter, fresh weight and yield, followed by Faiyum location, while, the lowest values of the above traits were obtained from Alexandria location. The variance in growth, quality index and root yield of sugar beet at the three locations may be attributed to differences in soil types and weather (temperatures) conditions among locations. These results coincide with those obtained by **Aly (2006)** and **Aly *et al*., (2015)**.

The obtained data in **Table 3** showed that the tested sugar beet varieties differed significantly in root length, diameter, fresh weight and root yield in both seasons with insignificant difference between Pyramid, Nancy and LP 016 varieties in root length. However, Beta 302 variety surpassed the other varieties with respect to root diameter. Beta 303 variety surpassed root fresh weight/plant and root yield/fed, in 1st season while Pyramids variety surpassed root fresh weight/plant and root yield/fed, in 2nd season compared the other varieties. Generally, the differences among some of varieties did not reach significant level. The variability among the evaluated varieties in the above-mentioned traits may be due to genetic structure. These results are in line with those obtained with **Aly (2006)** and **Enan *et al*., (2016)**.

Table 3: Root length, diameter (cm), root fresh weight (kg) and yield (ton/fed) of sugar beet as affected by locations and varieties in 2016/2017 and 2017/2018 seasons

Treatments	Root length (cm)		Root diameter (cm)		Root fresh weight (kg)		Root yield (ton/fed.)	
Season	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Locations								
Ismailia	30.50	29.37	11.33	11.02	1.113	1.002	28.06	27.97
Faiyum	28.54	28.23	10.50	10.04	0.952	0.907	26.99	26.24
Alexandria	27.86	28.16	9.74	9.88	0.842	0.871	25.98	25.72
LSD at 5%	1.550	1.020	0.930	0.670	0.160	0.080	1.220	1.320
Sugar beet varieties								
Beta 303	28.97	30.09	10.87	10.18	1.059	1.001	27.88	27.24
LP 1003	29.97	29.93	10.86	9.93	1.034	0.986	27.56	27.23
Beta 273	28.06	25.98	10.27	10.03	0.996	0.996	27.65	26.95
Pyramid	30.27	32.12	10.57	10.32	0.962	1.031	27.44	27.32
Sible	27.37	26.88	9.90	9.39	0.948	0.939	26.95	26.66
Beta 401	27.68	27.99	10.36	10.91	0.936	0.932	26.67	26.73
Beta 302	29.67	28.59	11.12	11.09	0.992	0.828	26.94	26.53
Univers	26.47	25.37	10.86	10.30	0.914	0.958	26.17	26.63
Nancy	31.46	32.68	10.49	11.00	1.009	0.799	27.00	25.98
Bairac	26.16	25.23	9.95	9.82	0.933	0.914	26.14	26.15
Oscar poly	29.27	27.89	10.00	10.41	0.863	0.817	26.55	25.89
LP 016	32.27	30.27	11.03	10.34	0.979	0.918	27.18	26.38
LSD at 5%	3.59	4.38	0.72	0.95	0.11	0.13	1.03	0.84

I.2. Effect on sucrose, quality and impurities:

Data in **Table (4)** indicated that sucrose % was significantly differed among locations in 1st season only. Ismailia Governorate was superior in producing roots with high sucrose % compared with in other locations. Similar results were reported by **Shalaby (2003)** and **Enan, *et al*. (2016)**

Data in **Table (4)** showed that sucrose % was significantly affected by the evaluated varieties in the 1st and 2nd seasons. The highest values of sucrose % were recorded by LP 016 and Univers varieties in the 1st and 2nd season, respectively (17.44 and 17.75%). Differences among Some of varieties were insignificant.

The obtained results in **Table (4)** cleared that insignificant effect have been observed on quality index in both seasons either among locations or varieties.

Further, data in **Table (4)** indicated that sodium (Na) and potassium (K) were insignificantly affected either among locations or varieties in the two seasons. Otherwise, α-amino-N was insignificantly affected among locations but it was significant among the evaluated varieties in both seasons. Pyramid attained the lowest values of α-amino-N (1.12 and 0.83 meq/100 g beet) compared the other varieties in the 1st and 2nd season, respectively.

Table 4: Sucrose%, quality index and impurities (meq/100 g beet) contents of sugar beet as affected by locations and varieties in 2016/2017 and 2017/2018 seasons

Treatment	Sucrose%		Quality index		Impurities (meq/100 g beet)					
					α-amino-N		Na		K	
Season	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Locations										
Ismailia	17.14	16.93	84.78	84.78	1.33	1.20	0.92	1.00	3.12	3.02
Faiyum	16.84	16.60	84.75	84.75	1.41	1.30	0.99	1.13	3.30	3.24
Alexandria	16.66	16.31	84.78	84.77	1.04	1.15	1.14	1.25	2.93	2.80
LSD at 5%	0.28	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Varieties										
Beta 303	16.78	16.83	84.76	84.74	1.29	1.25	1.10	1.36	3.24	3.21
LP 1003	16.98	17.74	84.78	84.78	1.17	1.39	0.83	1.05	3.26	3.00
Beta 273	16.76	17.16	84.76	84.80	1.27	0.91	1.04	1.15	3.22	2.97
Pyramid	17.00	15.59	84.78	84.79	1.12	0.83	1.06	0.92	3.12	2.81
Sible	16.70	17.74	84.77	84.75	1.30	1.36	1.13	1.35	2.99	3.26
Beta 401	16.55	16.70	84.78	84.78	1.21	1.04	1.00	1.05	2.92	3.05
Beta 302	16.47	15.44	84.77	84.75	1.29	1.10	1.00	0.86	2.95	3.12
Univers	16.66	17.75	84.75	84.79	1.46	1.41	0.99	1.09	3.13	2.86
Nancy	16.94	15.20	84.78	84.73	1.21	1.27	0.99	1.11	3.06	3.01
Bairac	17.24	17.64	84.77	84.77	1.32	1.21	0.99	1.31	3.13	3.03
Oscar poly	17.04	15.43	84.77	84.72	1.25	1.60	0.91	1.15	3.19	2.87
LP 016	17.44	16.05	84.78	84.75	1.19	1.21	1.13	1.10	3.14	3.06
LSD at 5%	0.57	1.53	NS	Ns	0.20	0.35	Ns	Ns	Ns	Ns

Further, data in **Table (4)** indicated that sodium (Na) and potassium (K) were insignificantly affected either among locations or varieties in the two seasons. Otherwise, α-amino-N was insignificantly affected among locations but it was significant among the evaluated varieties in both seasons. Pyramid attained the lowest values of α-amino-N (1.12 and 0.83 meq/100 g beet) compared the other varieties in the 1^{st} and 2^{nd} season, respectively.

I.3. Effect on sugar lost to molasses %, extractable sugar %, sugar extractability% and sugar yield ton/fed:

Analysis of variance in **Table (5)** indicated that locations exhibited significant effect on sugar lost to molasses, extractable sugar % (sugar recovery %) and sugar extractability% in first season only, Ismailia showed highest value for extractable sugar %, while, Alexandria had lower sugar lost to molasses than other locations. These results may be due to the low beet contents of impurities traits as mentioned before. The variation of juice quality among locations supported the role of agro-climatic conditions and will assisting in select the more suitable beet cultivars for different locations.

The data in **Table (5)** cleared that the tested varieties significantly differed in sugar lost to molasses, extractable sugar % and extractability% in both seasons. Pyramid variety exhibited the lowest values of sugar lost to molasses in both season (1.20 and 1.01%), respectively. Meantime, the highest values of extractability% were recorded by Pyramid and Beta 273 varieties in the 1^{st} and 2^{nd} season, respectively. (89.40 and 90.48%). These results may be due to the gene makeup. Similar results were reviewed by **Abd El-Aal and Mohamed (2005)** and **Hozayn *et al.* (2014).**

Results in **Table (5)** also indicated that sugar yield/fed of sugar beet were significantly affected by locations in both seasons. Ismailia location gave the highest values of sugar yield/fed, followed by Faiyum location, while the lowest values of the above traits was obtained from Alexandria location. The variance in quality and sugar yield at the three locations may be attributed to the differences in soil types and weather (temperatures) conditions among locations. These results coincided with those obtained by **Aly (2006)** and **Enan, *et al*. (2011).**

Results in **Table (5**) also indicated that sugar yield/fed of sugar beet were significantly affected by locations in both seasons. Ismailia location gave the highest values of sugar yield/fed, followed by Faiyum location, while the lowest values of the above traits was obtained from Alexandria location. The variance in quality and sugar yield at the three locations may be attributed to the differences in soil types and weather (temperatures) conditions among locations. These results coincided with those obtained by **Aly (2006)** and **Enan, *et al*. (2011).**

With regard to cultivar variance, data in **Table (5)** showed that the tested sugar beet varieties differed significantly in sugar yield/fed in both seasons. However, pyramid and L P1003 varieties surpassed the other varieties in sugar yield/fed, recording 4.24 and 4.30 ton/fed in the 1st and 2nd season, respectively. The variability among the evaluated varieties in the above-mentioned traits may be due to genetic structure. These results are in line with those obtained with **Aly (2006)** and **Enan *et al* (2016)**

Table 5: Sugar lost to molasses, extractable sugar, sugar extractability percentages and sugar yield (ton/fed) of sugar beet as affected by locations and varieties in 2016/2017 and 2017/2018 seasons

Treatment	Sugar lost to molasses%		Extractable sugar %		Sugar extractability %		Sugar yield (ton/fed)	
Season	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Locations								
Ismailia	1.30	1.23	15.24	15.10	88.93	89.16	4.28	4.23
Faiyum	1.40	1.34	14.84	14.65	88.13	88.20	4.01	3.85
Alexandria	1.13	1.22	14.94	14.49	89.64	88.81	3.88	3.73
LSD at 5%	0.15	Ns	0.18	Ns	0.89	Ns	0.23	0.28
Varieties								
Beta 303	1.32	1.35	14.86	14.89	88.56	88.44	4.08	4.07
LP 1003	1.22	1.34	15.16	15.84	89.32	89.07	4.14	4.30
Beta 273	1.30	1.03	14.86	15.54	88.67	90.48	4.01	4.17
Pyramid	1.20	1.01	15.19	13.98	89.40	89.70	4.24	3.81
Sible	1.30	1.44	14.80	15.71	88.61	88.52	4.05	4.18
Beta 401	1.20	1.16	14.75	14.94	89.10	89.52	4.01	4.03
Beta 302	1.26	1.19	14.62	13.65	88.73	88.10	3.92	3.67
Univers	1.41	1.34	14.65	15.80	87.89	89.00	3.86	4.14
Nancy	1.23	1.30	15.11	13.30	89.19	87.55	4.08	3.49
Bairac	1.31	1.28	15.33	15.76	88.93	89.27	4.02	4.12
Oscar poly	1.27	1.46	15.17	13.37	89.05	86.63	4.05	3.51
LP 016	1.26	1.25	15.58	14.20	89.34	88.39	4.22	3.71
LSD at 5%	0.12	0.37	0.57	1.45	0.74	1.37	0.22	0.47

II. Significant Interactions effect:

II.1. Root fresh and root yield:-

Data in **Table (6)** indicated that the interactions between varieties and locations affected significantly root fresh weight and root yield/fed, in both seasons. It was cleared that most of these varieties could grow successfully under the conditions of Ismailia to exhibit the highest values in root fresh weight and root yield/fed. These findings give evidence that, Ismailia agro-climatic conditions more suitable than Faiyum or Alexandria. However, Beta 303 variety surpassed the other varieties in root fresh weight (kg) at Ismailia location in 1st seasons (1.209 kg and 29.17 ton/fed, respectively while in 2nd season, Pyramid variety gave the maximum root fresh weight and root yield ton/fed. (1.190 kg and 28.89 ton/fed) at the same location (Ismailia). Meanwhile , at Alexandria location, Beta 303 variety surpassed the other variety in root fresh weight and root yield in 1st season (0.977 and 26.26 ton/fad) ,while universe variety was superior in the 2nd season (0.967 kg and 26.26 ton/ fad), respectively.

For Faiyum location, it is noticed that LP1003 variety recorded the highest values of the above mentioned traits (0.980 kg/plant and 27.27 ton/fed) in the 2nd season compared to the other varieties. These results may be attributes to the favorable agro-climatic conditions for varieties. Similar results were reviewed by **Al-Labbody (2003), Aly (2006)** and **Aly and Soha (2017)**

Table 6: Effect of the interaction between locations and varieties on root fresh weight (kg) and root yield (ton/fed.) of sugar beet in 2016/2017 and 2017/2018 seasons

Treatment	Root fresh weight (kg)						Root yield (ton/fed.)					
Season	1st			2nd			1st			2nd		
Varieties \ Locations	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Beta 303	1.209	0.995	0.972	1.143	0.975	0.886	29.17	27.32	27.16	28.62	27.18	25.92
LP 1003	1.152	0.986	0.964	1.112	0.980	0.867	28.64	27.18	26.87	28.67	27.27	25.76
Beta 273	1.128	1.007	0.855	1.081	0.968	0.938	29.05	27.72	26.17	28.32	26.46	26.08
Pyramid	1.017	0.993	0.877	1.190	1.036	0.868	27.94	27.77	26.62	28.89	27.22	25.85
Sible	1.049	0.985	0.810	1.117	0.919	0.781	27.87	27.09	25.90	28.38	26.74	24.86
Beta 401	1.013	0.969	0.825	1.042	0.850	0.904	27.12	26.86	26.02	27.96	26.50	25.72
Beta 302	1.138	0.985	0.852	0.739	0.869	0.876	28.09	27.75	24.98	27.38	26.63	25.57
Univers	1.121	0.843	0.779	1.049	0.858	0.967	27.67	26.40	24.45	28.06	25.57	26.26
Nancy	1.189	0.946	0.892	0.722	0.856	0.819	28.16	26.49	26.35	26.74	25.34	25.86
Bairac	1.156	0.894	0.749	0.951	0.833	0.959	27.91	26.20	24.31	27.15	25.18	26.11
Oscar poly	1.049	0.835	0.706	0.885	0.827	0.739	27.34	26.15	26.15	27.30	25.11	25.28
LP 016	1.129	0.982	0.825	0.993	0.912	0.849	27.73	26.98	26.82	28.16	25.62	25.36
LSD at 5%		0.013			0.141			0.25			0.43	

II.2. Sucrose% and sugar yield:-

Moreover, data in **Table (7)** revealed that the interactions between varieties and locations affected significantly sucrose percentage and sugar yield ton/fed, in both seasons.

Bairac and Univers varieties gave the highest values in sucrose%, recording 17.84% at Ismailia location and 18.86% at Faiyum location in first season and second season, respectively. Furthermore, Pyramid and Beta 302 varieties exhibited the highest sugar yield ton/fed recording 4.52 and 4.64 ton/fed at Ismailia location in first season and second season, respectively.

Table 7: Effect of the interaction between locations and varieties on sucrose% and sugar yield (ton/fed) of sugar beet in 2016/2017 and 2017/2018 seasons

Treatment	Sucrose%						Sugar yield (ton/fed)					
Season	1st			2nd			1st			2nd		
Varieties \ Locations	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Beta 303	17.12	16.87	16.35	17.36	16.14	17.00	4.22	4.06	3.97	4.47	3.98	3.77
LP 1003	16.81	17.30	16.83	17.20	17.73	18.43	4.18	4.14	4.10	4.37	4.33	4.19
Beta 273	17.53	16.21	16.55	16.99	16.73	17.77	4.22	3.95	3.87	4.33	3.91	4.26
Pyramid	17.43	17.49	16.08	16.23	15.50	15.04	4.52	4.32	3.87	4.13	3.77	3.53
Sible	17.08	16.57	16.46	17.19	18.44	17.60	4.38	3.92	3.85	4.34	4.35	3.87
Beta 401	16.67	16.70	16.27	17.82	16.85	15.43	4.24	3.99	3.79	4.51	3.95	3.64
Beta 302	16.40	16.65	16.37	17.90	14.37	14.06	4.04	4.10	3.62	4.64	3.25	3.13
Univers	17.00	16.11	16.86	16.12	18.86	18.27	4.23	3.65	3.69	3.83	4.27	4.30
Nancy	17.50	16.24	17.08	16.60	14.83	14.17	4.37	3.82	4.04	3.97	3.26	3.24
Bairac	17.84	17.25	16.64	16.33	18.20	18.40	4.44	4.00	3.60	3.90	4.08	4.37
Oscar poly	16.91	17.48	16.73	17.00	14.83	14.45	4.20	4.01	3.92	4.18	3.21	3.15
LP 016	17.42	17.16	17.73	16.44	16.66	15.06	4.28	4.11	4.26	4.04	3.79	3.30
LSD at 5%		0.30			0.92			0.12			0.26	

II.3. Sugar lost to molasses and extractable sugar%

With respect to the interactions between varieties and locations, data in **Table (8)** cleared that the interaction affected significantly sugar lost to molasses and extractable sugar percentages in both seasons.

Pyramid and Beta 401 varieties had the lowest value of sugar lost to molasses at Alexandria location in 1st and 2nd season (0.95 and 0.68%). Regarding extractable sugar percentages Bairac gave the highest extractable sugar (15.91%) at Ismailia location and 16.73% at Alexandria location in 1st and 2nd season, respectively compared with the other interactions. These results may be attributes the gene makeup over than environmental condition.

Table 8: Effect of the interaction between locations and varieties on sugar lost to molasses and extractable sugar percentages in 2016/2017 and 2017/2018 seasons

Treatment	Sugar lost to molasses%						Extractable sugar %					
Season	1st			2nd			1st			2nd		
Locations / Varieties	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Beta 303	1.42	1.41	1.14	1.27	0.91	1.86	15.10	14.87	14.61	15.49	14.63	14.54
LP 1003	1.20	1.46	0.99	1.19	1.27	1.57	15.00	15.24	15.24	15.40	15.86	16.27
Beta 273	1.39	1.37	1.14	0.90	1.36	0.82	15.55	14.24	14.81	15.49	14.77	16.35
Pyramid	1.34	1.34	0.95	1.20	1.05	0.78	15.49	15.55	14.53	14.43	13.85	13.66
Sible	1.42	1.50	0.99	1.28	1.58	1.45	15.06	14.47	14.87	15.31	16.26	15.55
Beta 401	1.25	1.26	1.10	1.48	1.33	0.68	14.82	14.85	14.57	15.75	14.92	14.15
Beta 302	1.20	1.28	1.29	0.78	1.57	1.21	14.60	14.77	14.48	16.52	12.20	12.25
Univers	1.38	1.68	1.18	1.20	1.54	1.29	15.02	13.83	15.08	14.32	16.72	16.37
Nancy	1.33	1.23	1.13	1.51	1.37	1.01	15.57	14.41	15.34	14.49	12.86	12.55
Bairac	1.33	1.38	1.22	1.36	1.41	1.08	15.91	15.28	14.82	14.37	16.19	16.73
Oscar poly	1.15	1.54	1.12	1.58	1.43	1.37	15.16	15.35	15.01	14.82	12.81	12.48
LP 016	1.19	1.33	1.25	1.02	1.28	1.46	15.63	15.23	15.88	14.82	14.78	13.01
LSD at 5%		0.20			0.38			0.39			0.99	

II.4. Quality index and extractable sugar%:-

Data in **Table (9)** cleared that the interaction between varieties and locations influenced significantly quality index and sugar extractability percentages.

In the first season, Pyramid and Sible varieties gave the highest quality index values (84.81 %) at Alexandria location, while in the second season; the highest value of this trait was recorded by Beta 273 (84.85).

For sugar extractability%, it was noticed that LP 1003 variety recorded the highest sugar extractability (90.55%) in first season at Alexandria location, while, in the 2nd season, the highest value of this trait was recorded by Beta 302 variety (92.28%) at Ismailia location compared to the other interactions.

Table 9: Effect of the interaction between locations and varieties on quality index and sugar extractability % of sugar beet in 2016/2017 and 2017/2018 seasons

Treatment	Quality index						Sugar extractability %					
Season	1st			2nd			1st			2nd		
Locations / Varieties	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Beta 303	84.76	84.75	84.76	84.76	84.77	84.70	88.19	88.10	89.39	89.22	90.61	85.49
LP 1003	84.78	84.76	84.81	84.80	84.78	84.77	89.29	88.12	90.55	89.58	89.37	88.26
Beta 273	84.77	84.75	84.76	84.82	84.73	84.85	88.68	87.87	89.46	91.11	88.27	92.07
Pyramid	84.76	84.77	84.81	84.79	84.76	84.83	88.91	88.93	90.37	88.89	89.37	90.83
Sible	84.77	84.72	84.81	84.77	84.74	84.75	88.16	87.32	90.35	89.04	88.19	88.33
Beta 401	84.76	84.79	84.79	84.75	84.76	84.84	88.91	88.88	89.51	88.34	88.54	91.67
Beta 302	84.78	84.76	84.77	84.87	84.66	84.72	89.04	88.68	88.46	92.28	84.90	87.13
Univers	84.77	84.70	84.80	84.80	84.76	84.80	88.37	85.85	89.45	88.84	88.52	89.65
Nancy	84.78	84.76	84.80	84.74	84.72	84.75	88.99	88.75	89.84	87.31	86.70	88.63
Bairac	84.78	84.77	84.77	84.75	84.77	84.80	89.18	88.53	89.08	87.99	88.91	90.90
Oscar poly	84.81	84.73	84.79	84.74	84.71	84.72	89.67	87.76	89.72	87.18	86.33	86.37
LP 016	84.80	84.76	84.77	84.78	84.78	84.70	89.74	88.75	89.55	90.15	88.70	86.32
LSD at 5%		0.04			0.06			1.28			2.37	

III. Stability analysis:

Twelve varieties from sugar beet were evaluated under six environments (Three locations and two years) for phenotypic stability according to **Eberhart and Russell (1966).**

Pooled analysis of variance:

Eberhart and Russell (1966) model of stability analysis was used for the assessment of environmental influence, varieties and varieties x environmental interaction for root and sugar yields (ton/fed.). When the varieties x environment interactions was significant for the traits, then partitioning of total sum of squares due to varieties x environment interactions into predictable and unpredictable source of variations. Pooled analysis of variance **Table (10)** revealed that the mean squares among the varieties were highly significant for root yield (ton/fed.) only. Highly significant variation for environments (root yield (ton/fed.) only) and environment linear were observed for root and sugar yields (ton/fed.), suggesting that root and sugar yields (ton/fed.) in sugar beet are highly influenced by changing in the environments. Varieties (G) × environment (E) interactions (linear) component of variation of stability were insignificant for the studied traits, revealing the no differential response of the studied varieties, to various location used.

Table 10: Pooled analysis of variance for stability analysis of root and sugar yields (ton/fed.) in sugar beet at three locations in 2016/2017 and 2017/2018 seasons.

SOV	d.f	Root yield (ton/fed)	Sugar yield (ton/fed)
Varieties (G)	11	4.19**	0.36
Environments (E)	60	3.92**	0.37
E (linear)	1	184.87**	8.58**
GxE (linear)	11	0.37	0.44
Pooled Deviation	48	0.96**	0.19
Beta 303	4	0.61	0.04
LP 1003	4	0.57	0.04
Beta 273	4	0.22	0.12
Pyramid	4	0.75	0.11
Sible	4	0.77	0.15
Beta 401	4	0.37	0.06
Beta 302	4	1.54*	0.29
Univers	4	1.82*	0.34
Nancy	4	1.29	0.25
Bairac	4	1.92*	0.35
Oscar poly	4	0.64	0.21
LP 016	4	1.00	0.27
Average Error	132	0.56	0.55

The obtained results showed highly significant variation for pooled deviation with concern to root yield (ton/fed.) trait, explaining that the major component of differences for stability in root yield may be due to deviation from the linear function. These results are in agreement with the finding of **Liovic and Kristek (2000), EL-Refaey *et al*., (2012), Aly and Soha (2017)** and **Okasha and Mubarak (2018).**

Phenotypic stability parameters

The mean performance coupled with the regression coefficient values provides as useful parameter for studying the adaptation of varieties. As suggested by **Eberhart and Russell (1966)**, the varieties with regression coefficient (bi) equal or close to 1.0 and minimum deviation from regression mean square ($S^2d=0$) were considered to be stable (adaptable to all environments); a variety with a regression coefficient significantly greater than one and small deviation mean square was considered as unstable, (adaptable to high-yielding environments); and a variety with a regression coefficient significantly lower than one and a small deviation mean square was considered as unstable (adaptable to low-yielding environments).

The stability parameters b_i and S^2d **(Table, 11)** for root yield (ton/fed) showed that the bi varieties ranged from 0.73 to 1.21. The deviation mean square "S^2d" ranged from 0.22 to 1.92 for this trait. The varieties Pyramid, LP 1003 and LP 016 revealed near unity regression coefficient (b_i) and non-significant deviation from regression "S^2d" and were considered as stable varieties with a broad adaptability across the studied environments. The varieties Beta 273 showed significant regression coefficient and more than unity and it was considered as unstable with adaptability normal conditions. On the other side, the Nancy and Oscar-poly showed regression coefficient less than unity and it were considered as unstable with adaptability stress environments.

Among varieties the linear regression coefficient (b_i) and "S^2d" for sugar yield (ton/fed) ranged from -0.27 to 2.28 and 0.04 to 0.35, respectively, **Table (11).** One variety Beta 303 showed regression coefficient near unity and non-significant deviation from regression "S^2d" and it was considered as stable varieties with a broad adaptability across the studied environments. The varieties Beta 302, Oscar-poly and Nancy showed significant regression coefficient and more than unity and it were considered as unstable with adaptability to normal conditions. On the other side, the LP 1003, Bairac and Beta 273 showed regression coefficient less than unity and it considered as unstable with adaptability to stress environments.

Table 11: Phenotypic and genotypic stability parameters for root and sugar yields/fed under six environments in sugar beet.

Varieties	Root yield (ton/fed)			Sugar yield (ton/fed)		
	Mean	b_i	S^2d	Mean	b_i	S^2d
Beta 303	27.56	1.08	0.61	4.08	1.01	0.04
LP 1003	27.40	1.03	0.57	4.22	0.12	0.04
Beta 273	27.30	1.21*	0.22	4.09	0.39	0.12
Pyramid	27.38	0.95	0.75	4.02	1.49	0.11
Sible	26.81	1.19	0.77	4.12	0.77	0.15
Beta 401	26.70	0.73*	0.37	4.02	1.32	0.06
Beta 302	26.73	1.06	1.54*	3.80	2.28**	0.29
Univers	26.40	1.12	1.82*	4.00	-0.27*	0.34
Nancy	26.49	0.75	1.29	3.78	1.68**	0.25
Bairac	26.14	1.07	1.92*	4.07	0.15	0.35
Oscar poly	26.22	0.85	0.64	3.78	1.88*	0.21
LP 016	26.78	0.98	1.00	3.96	1.17	0.27
Mean	26.83			3.99		
LSD (0.05)	0.82			0.20		

REFERENCES

Abd El-Aal, A.M. and Amal Z.A. Mohamed (2005). Genotype x Environment interaction and stability analysis for yield and quality of some sugar beet varieties. Annals of Agric. Sci. Moshtohor 43 (2): 527-544,

Abd Elrahim, H.M., A.M. Abou-Salama, E.A. Teama and S.F. Abo-Elwafa (2005). Effect of planting and harvesting dates on yield and quality of sugar beet varieties in middle Egypt. International conf. On political Economic and Technological challenges for sugar and its integrated industried in the Arab Region, the middle east, Africa and the European union. P4/1-2 Alexandria, Egypt.

Al-Labbody, A.H. (2003). Evaluation of some multigerm and monongerm sugar beet varieties under Faiyum Governorate conditions. Ph.D Thesis. Fac. of Agric., Al-Azhar University, Egypt.

Aly, E.F. (2006) Effect of environmental conditions on productivity and quality of some sugar beet varieties. Ph. D. Thesis. Fac. of Agric. Benha. University , Egypt.

Aly, E.F.A. and Soha, R.A. Khalil (2017). Yield, Quality and Stability Evaluation of Some Sugar beet Varieties in Relation to Locations and Sowing dates. J. Plant Production, Mansoura Univ., Vol. **8** (5): 611– 616.

Aly, E.F.A; S.A.A.M. Enan and A.I. Badr (2015). Response of sugar beet varieties to soil drench of compost tea and nitrogen fertilization in sandy soil. J. Agric.Res.Kafr El-Sheikh Univ.41(4):1322-1338.

Black, **C**.**A**; **D**.**D. Evans, L**.**E**. **Ensminger, G**.**L**. **Whiteand and F**.**E**. **Clark (1981)**.Methods of Soil Analysis. Part 2. Pp. 1-100. Agron.Inc. Madison. WI., USA.

Browen, J.D. and D. Lilliand (1964). Rapid determination of potassium and sodium in plant materials and soil extracts by flame photometric. Proc. Amer. Soc. Hort. Sci., 48:341-346.

Cooke, D.A. **and R. K. Scott (1993)**. The sugar beet crop. Chapman and Hall London, pp.262-265.

Devillers, P. (1988). Prevision du sucre melasse. Sucrerie francases. 129, 190-200. (C.F. The Sugar Beet Crop Book, 575-576, 1st Edition published by Chapman and Hall, Univ. Press, Cambridge, UK.) .

Dexter, S.T., M.G. Frankes and F.W. Snyder (1967). A rapid and practical method of determining extractable white sugar as may be applied to the evaluation of agronomic practices and grower deliveries in the sugar beet industry. J. Am. Soc. Sugar Beet Technol. 14: 433-454.

Eberhart, S.A. and W. A. Russel (1966). Stability parameters for comparing varieties. Crop Sci., 6: 36–40.

EL-Refaey, R.A., E.H. El-Seidy; I.H.EL-Geddawy and H.M.EL-Sayed (2012). Phenotypic and genotypic stability for some sugar beet varieties. Proc. 13th international Conf. Agron., Fac.of Agric., Benha Univ., Egypt, 9 – 10, September, 317 – 331.

Enan, S.A.A.M.; A. M. Abd El-Aal and N.M.E. Shalaby (2011). Yield and quality of some sugar beet varieties as affected by sowing date and harvest age. Faiyum J. Agric. Res. & Dev., **25** (2): 51-65.

Enan, S.A.A.M.; E.F.A.Aly and A.I. Badr (2016). Effect of humic acid and potassium on yield and quality of some sugar beet varieties in sandy soil. J. Plant Production, Mansoura Univ., Vol. **7** (2):289- 297.

Gomez and Gomez (1984) Statistical Procedures for Agricultural Research A Wiley-Inter-Science publication, John Wiley and Sons, New York.

Hozayn M., A.M. Korayem, E.F. El-Hashash, A.A. Abd El-Monem, E.M. Abd El-Lateef, M.S. Hassanein and T.A. Elwa (2014). Evaluation of Ten Exotic Sugar Beet Varieties under Different Locations in Egypt. *Middle East j. Agric. Res., 3(4): 1145-1154, 2014*

Hozayn, M.; A. A. Abd El-Monem and A. A. Bakery (2013). Screening of some exotic sugar beet cultivars grown under newly reclaimed sandy soil for yield and sugar quality traits. J. Appl. Sci. Res., **9** (3): 2213-2222.

Jackson, **M**. **I**. **(1973)**. Soil Chemical Analysis.Prentice Hall Inc. Englewood cliffs, N. J., U.S.A.

Le-Docte, A. (1927). Commercial determination of sugar beet in the beet roots using Sachs Le-Docte process. Int. Sugar J., 29: 488-492.

Liovic, I. and A. Kristek (2000).Stability of agronomic traits in sugar beet hybrids .Rostlinna-Vyroba. 2000; 46(4): 169-175.

Okasha, S.A. and M.H. Mubarak (2018). Genotype x Environment interactions and stability analysis for root yield and quality traits in sugar beet (Beta vulgaris L.). Egypt. J. Plant Breed. 22(3):469–486

Shalaby, N.M. (2003). Effect of environmental conditions on the behaviour of different varieties of sugar beet root yield and quality. Ph. D thesis Fac. Of Agric. Al-Azhar University. Egypt.

Shalaby, N.M.S.; I.E El-Beially; A.H.S.Al-Labbody and S.H.M. Abd-El- Haleem (2007). Studies on stability of sugar beet varieties under old and new reclaimed lands. Pakistan. J. Biotechnol., **4** (1-2): 73 -91.

تقييم بعض أصناف بنجر السكر تحت ثلاثة مواقع مختلفة

حنان يوسف محمد ، سمر عبد العاطي محمد حلمى ، سعيد مصطفي إبراهيم بقوش

معهد بحوث المحاصيل السكرية – مركز البحوث الزراعية - جيزة - مصر

أقيمت تجربة حقلية في ثلاثة مناطق مختلفة بمحافظات الاسماعيلية (عند دائرة عرض 30 18° وخط طول 32 30 30 °) والفيوم (عند دائرة عرض 29 18° وخط طول 30 25 °) والإسكندرية (عند دائرة عرض 29 55° وخط طول 31 212 °) بمصر خلال موسمي 2017/2016 و 2018/2017 لدراسة سلوك ومدي ثبات الصفات المحصولية في أثنى عشر صنفاً من بنجر السكر هما: (بيتا 303 ، Lp 1003 ، بيتا 273 ، بيراميد ، سبل ، بيتا 401 ، بيتا 302 ، يونيفرس ، نانسي بيراك ، أوسكار بولي ، Lp16 . لاختيار الأفضل من حيث ملائمتهم للظروف البيئية ومدي تفوقها في المحصول والصفات التكنولوجية . أجريت التجربة في تصميم القطاعات الكاملة العشوائية في ثلاثة مكررات ، تم إجراء التحليل الإحصائى لكل منطقة منفرده ثم التحليل التجميعى للمناطق معا وكذلك تحليل الثبات المظهري للأصناف لاستبيان أفضلهم ثباتاً عبر بيئات هذه الدراسة.

كانت البيانات المتحصل عليها كالأتي:

1. اختلفت المواقع فيما بينها معنوياً حيث تفوق موقع محافظة الإسماعيلية علي الموقعين الآخرين ، حيث أنتج أعلى حاصل من الجذور ذات محتوي عالي من السكروز % وأقل محتوي من الشوائب.

2. تفوق الصنف بيراميد في حاصل الجذور/فدان بدون اختلافات معنوية بينة وبين الأصناف (بيتا 273) ، (Lp1003) وكذلك الصنف (بيتا 303) ، أما فيما يخص حاصل السكر/فدان فقد تفوق الصنف بيراميد في الموسم الأول ، في حين حقق الصنفLp 1003 تفوقا ملحوظا في حاصل السكر الموسم الثاني .

3. أشار التفاعل بين المواقع والأصناف إلي أن جذور الصنف بيتا 303 سجلت أعلي القيم من حاصل الجذور/ فدان في موقع محافظة الإسماعيلية في الموسم الأول ، حيث سجل 17و29 طناً ، بينما سجل الصنف بيراميد أعلي القيم في الموسم الثاني ، حيث سجل 89 و 28 طناً من الجذور في نفس الموقع. من ناحية أخري سجلت الأصناف بيتا 302 وبيراميد أعلي القيم في حاصل السكر/ فدان (64و4 و 52و4 طناً من السكر علي الترتيب) في نقس الموقع في الموسمين.

كما أوضحت النتائج أن الأصناف بيراميد وLp 1003 وكذلك Lp 016 كانت الأكثر ثباتا وقيمة في حاصل الجذور ، كذلك اظهر الصنف بيتا 303 ثباتاً وقيمة في حاصل السكر/ فدان