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EVALUATION OF SOME NEWLY INTRODUCED SUGAR BEET CULTIVARS UNDER EGYPTIAN NORTH-DELTA CONDITIONS:
II- QUALITY PARAMETERS

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ABSTRACT

This work was carried out to evaluate fourteen imported sugar beet cultivar under the farm conditions of at Abo Taha village, Belkas district, Dakahlia Governorate to determine their merit as possible candidates to be distributed to farmers. The work was carried out during 2008-2009 and 2009-2010 seasons at Belkas, Daqahlia region (latitude 31°15'0" N). Seven of the evaluated cultivars, namely Henrike, BTS 899, Beretta, Lagon, Lp15, Lp16, and Avantage belonged to monogerm type while another group of seven cultivars, namely; Monte Bianco, Monte Baldo, Monte Rosa, Swallow, Top, Capel, and Floima belonged to multi-germ type.

The main findings of this work could be summarized as follows:

1- The differences reported among mono-germ and multi-germ seed type were insignificant.
2- Differences due to the genetic makeup of the examined cultivars were significant for most determined traits.
3- Sugar recovery % of the superior cultivars M. Rosa, Swallow, and Top (multi-germ), in addition to the monogerm Henrike and Avantage was controlled mainly by their superiority in pol% and or quality index values. These cultivars were the most stable ones in both seasons.

In conclusion, it is evident that varietal differences control quality parameters that are of major interest from manufacturers' point of view. For such reason, it is evident that the high quality multi-germ cultivars M. Rosa, Swallow, and Top, in addition to the mono-germ Henrike and Avantage should be promoted for growing among farmers. However, root production which interferes significantly in determining total recovered sugar per feddan could cause some of these high quality cultivars to be out of the farming list.

INTRODUCTION

Sugar beet is the second major source for sugar production in Egypt. The Egyptian strategy adopts expanding beet farming and manufacturing as the main method to narrow the gap between sugar production and consumption. However, the quality of the grown beet plays a major role in the economical return of the manufacturers. High quality beet can reduce production costs and processing time in addition to reducing impurities and losses of sugar. The manufacturers' point of view of a perfect working condition is the one with improved quality parameters even with less beet tonnage. Since the whole farming system in Egypt depends on importing

seed from abroad as the conditions, it is essential to test and evaluate the cultivars that are imported before deciding on distributing it to farmers. One main factor is to determine whether the imported cultivars will perform well under the relatively warm weather of Egyptian terms of quality parameters. Works on evaluating beet cultivars for quality parameters are numerous all over the world.

Campbell and Kern (1982) evaluated ten sugar beet varieties at five locations in four years. They stated that most cultivars were not significantly different from each other for the influence of sucrose percentage, recoverable sucrose / ha and impurities. They added that higher root yield was associated with lower sucrose concentration.

Munzert *et al.* (1982) pointed out that the variance due to varieties were significant for sugar content, sugar beet yield and quality

Sako *et al.* (1982) evaluated four sugar beet varieties in two localities differing in soil type. They concluded that the percentage of K, Na, amino N and sugar percentage in molasses were least in the variety Monofort.

Al-Saad *et al.*(1984) evaluated four sugar beet cultivars and found that sugar content, non-reducing sugars, and total sugar contents did not significantly differed between sugar beet cultivars. This was in reverse of the findings of Obara *et al.* (1986) who evaluated four sugar beet varieties. They reported that the differences between varieties were significant for root yield, sugar content, amino N and un-refinable sugar content. However, Sorour *et al.* (1992) cultivated three multi-germ beet cultivars and found that cultivars revealed no significant differences in root length, T.S.S %, sucrose and juice purity%. In contrary,

Hassanin and Ramadan (1999) found that sugar beet variety RasPoly variety exceeded Deli 24 in sucrose%, T.S.S % and purity%. In addition, Abou- salama and El-Syaid (2000) found significant differences among varieties as maximum sugar yield (ton/fed.) was produced by Oscarpoly due to its high quality index values.

Abd El-Fatah (2000) studied the performance of six sugar beet varieties (Alex, Universe, Kawemira, Pleno, Panther and Toro). He reported that Panther variety recorded the highest contents of impurities (α-amino-N, K and Na).The variety Kawemira had highest percentage of recoverable sugar. Similar trends were reported by Al-Labbody (2003) who indicated that differences among ten multi-germ varieties (Toro, Lados, Vital, Gloria, Pamela, Del937, Del938, Del939, Kawemira and Athos Poly) and five mono-germ varieties (Marathon, Rhopsodic, Tellus, Vital and Helis) with respect to sucrose% and purity % while T.S.S. % insignificantly differed in this respect .

Shalaby (2003) studied the performance of six sugar beet varieties (Del937, Del 938, Del 939, DesprezPoly and DemaPoly). He found that Del938 surpassed the other varieties in T.S.S., sucrose and purity % and K% in roots. Also, variety Del 939 surpassed the other varieties in α-N and Na in roots.

Abd El-Wahab *et al*. (2005) indicated that seasonal differences could influence the response of varieties. They added that studied cultivars did not differ significantly in root characteristics (length, diameter and weight) and

juice quality. T.S.S %, sucrose and purity % differed in the second season only.

Ali (2005) studied the performance of three sugar beet varieties (KWS-9422,Pamela, and Recolta Poly). He noticed that KWS-9422 variety had the highest value of total soluble solids percentage, whereas the variety Pamela had the highest values of sucrose and purity percentage. Similar differences were outlined by Amin , Gehan(2005) who stated that sugar beet cultivars differed in sucrose% total soluble solids%, purity, top yield, root and sugar yields.

Hoffmann (2005) reported that varieties differed in root quality and α-amino N. Also, Hoffmann and Marlander (2005) studied the effect of genotype and environment on the composition of soluble N in sugar beet to evaluate whether amino N reliably represents the total soluble N. Thay recorded the composition of total soluble N was more affected by environment than by genotype, whereby amino N was the only component which changed considerably, so that its percentage decreased from 37 to 22% with increasing total soluble N. It is concluded that amino N has a close and consistent relationship across environment and genotype.

Geweifel *et al.*(2006) reported that Baraca cv. showed better adaptation to the prevailing environmental conditions in Egypt and gave the highest sugar yield/ha, sucrose% and T.S.S.%. However, DemaPoly cultivar surpassed the other two cultivars in root and top yields. Similar differences among cultivars were reported by El-Hosary *et al.* (2007). They found that Monte Bianco variety recorded the highest value of total soluble solids% and potassium concentration in root, petioles and blades, while, Gloria variety produced the highest value of sucrose, purity percentage and boron concentration in roots, petioles and blades.

Gomma *et al*. (2007) studied the performance of three sugar beet varieties (Kawemira, Monte Bianco and Gloria). The results indicated that sugar beet variety Gloria surpassed the studied varieties with respect to its quality. Meanwhile; it recorded the highest sucrose and purity% and attained the lowest percent to sugar loss to molasses and impurities (K, Na and α-amino-N).

This work was carried out to evaluate the performance of seven Mono-germ and seven Multi-germ sugar beet cultivars for their quality parameters under north Delta conditions. The work is part of the research thesis of the first author for PhD degree.

MATERIALS AND METHODS

This work was carried out to evaluate fourteen imported sugar beet cultivar under the farm conditions of Belkas region to determine their merit as possible candidates to be distributed to farmers. The work is part of the research thesis of the first author for PhD degree The work was carried out during 2008-2009 and 2009-2010 season at Abo Taha village, Belkas district, Dakahlia Governorate (latitude 31°15'0" N). The experimental design was a Completely Randomized block design with seed type comprising two

treatments that were then nested to contain seven cultivars within each seed type.

Planting took place on ridges 50 cm wide and 3.5 meters long at a distance of 20 cm between hills. The cultivars were sown in six replicates experiment in plots 1/400 of the feddan (10.5 m^2). All cultivars were hand sown on October 20^{th} and 25^{th} in 2008-2009 and 2009-2010 seasons, respectively. Seedlings were thinned at the four leaf stage to one plant per hill. The planted field was maintained according to the recommendations of the Ministry of Agriculture. Calcium super phosphate was added at the rate of 15 kg P_2O_5/ feddan during soil preparation. Potassium fertilization was added in the form of potassium sulfate 48% at a rate of 24 kg K_2O /Feddan after thinning. Nitrogen was applied in the form of urea at a rate of 80kg/feddan applied at two equal doses after thinning and one month later. The source and type of the examined cultivars are given in table 1 while the soil analysis of the experimental site is shown in table 2.

Table 1. Source and type of the examined cultivars.

Cultivar	Country	Seed type
Monte Bianco	Germany	multi-germ
Monte Baldo	Germany	multi-germ
Monte Rosa	Germany	multi-germ
Swallow	Germany	multi-germ
Top	Germany	multi-germ
Capel	France	multi-germ
Florima	France	multi-germ
Henrike	Germany	mono-germ
BTS899	Germany	mono-germ
Beretta	Germany	mono-germ
Lp 15	France	mono-germ
Lp 16	France	mono-germ
Avantage	France	mono-germ
Lagon	France	mono-germ

Table 2: Mean values of some physical and chemical properties of the experimental site.

Variable	Value
Physical analysis	
Sand %	24.8
Silt %	32.8
Clay %	42.4
Texture class	Clay
Chemical analysis	
Soil reaction pH	7.8
EC (mmohs/cm)	4
Available N ppm	182.0
Available P ppm	6.79
Available K ppm	358.0
Soluble Cations (meq/L)	
Na+	27.21
K+	0.19

Temperature data recorded throughout the growing seasons are presented graphically in Fig. 1

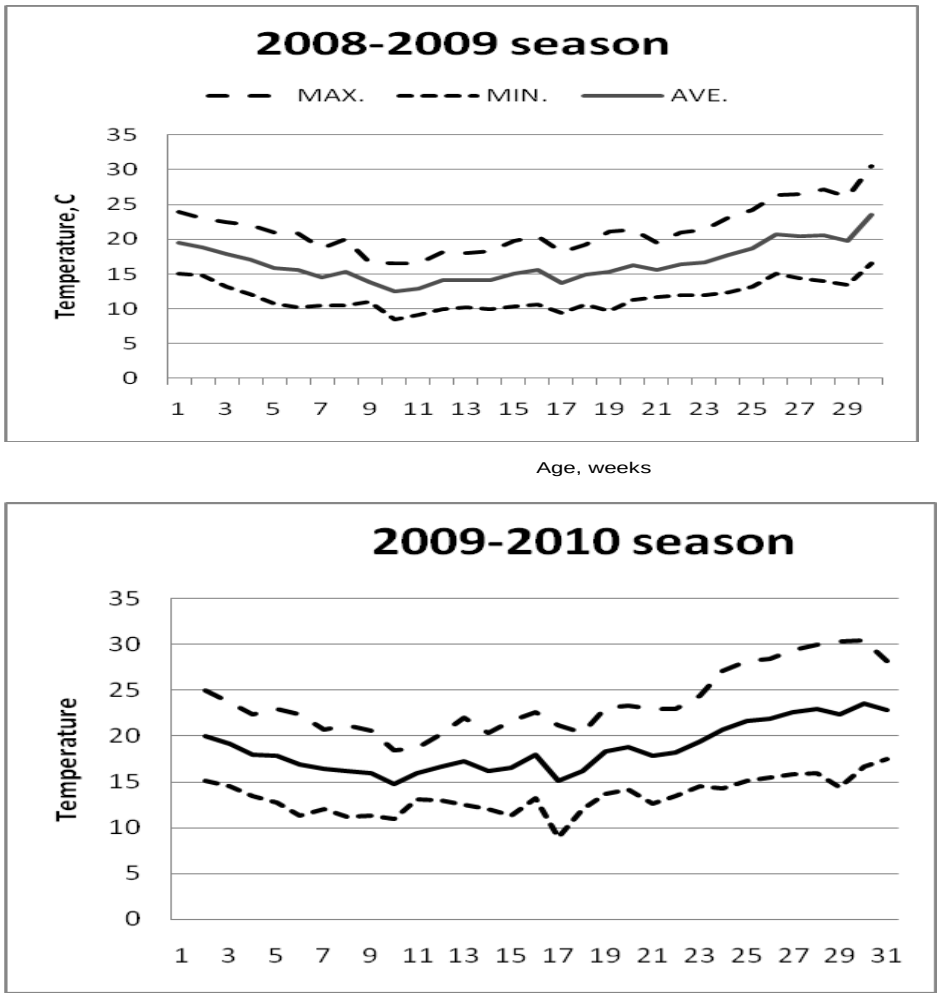

Fig. 1: Minimum, maximum and average weekly temperature recorded during the two experimental seasons.

Harvest took place on the 22nd and 29th of May of 2009 and 2010 for the two seasons, respectively. At harvest, root fresh weight (kg), top fresh weight (kg), and root diameter were measured in samples of ten random plants. Yield (ton / feddan) was estimated on plot basis. A sample of 10 kg roots was collected from each plot and shipped to the quality laboratory of the Daqahlia Sugar Company to determine the quality parameters that was used to estimate gross sugar yield (ton/ feddan). Pol% (sucrose %), Potassium,

Sodium, Alpha amino nitrogen (meq/100g), and Alkalinity coefficient % were determined according to Reinefield *et al*. (1974). These parameters were used to estimate the following:

Quality index: = 100 [100 – (D/Pol)]

Where, D = 0.343 (k+Na) + 0.094 (α -amino N) + 0.29

Sugar loss % = 0.343 (K +Na) + 0.094 (α -amino N) - 0.31 .

Alkalinity coefficient (AC)%= (k+Na) / α -amino N

Theoretical sugar recovery%= Pol–0.029-0.343(K+Na) – 0.094 (α -amino N).

Where, Pol, K and Na refer to sucrose %, potassium and sodium in meq/100 g beet, respectively.

The collected data were subjected to statistical analysis. The model used separated the SS of the fourteen cultivars into contrasts of seed type, the nested each seed type to calculate the SS of mono- or multi- cultivars within its group. Significant means were compared using LSD at 5% probability level according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Pol %:

Data in Table 3 revealed that Pol % of the first season was generally higher than that of the second one. This could be attributed in part to the cool temperature recorded in the last stage before the harvest of the crop which enhanced sucrose accumulation in the roots (Fig. 1). Seed type and cultivars within multi-germ had insignificant effect on Pol % in the both seasons, while differences among cultivars and cultivars within mono-germ had a significant effect.

Data in Table 3 showed that M. rosa and Swallow cultivars produced the highest values of Pol % in both seasons, where, M. Bianco and Florima produced the lowest values. On the other hand, Henrike produced the highest value of Pol % in both seasons from mono-germ cultivars. Differences among cultivars in pol % were reported by several workers due to their genetic makeup and area of origin.

Potassium content (meq/100g):

Potassium plays a major role in the translocation of sucrose's in leaves to roots in sugar beet. But, when juice quality is concerned, excess K has a negative effect on the quality index. Table 3 indicates that root potassium contents of the first season were less than that of the second one. Seed type effect were insignificant in both seasons, however, differences within multi-germ, monogerm and among cultivars were significant in the two seasons.

Means in Table 3 showed that the lowest value of potassium content produced from M. Rosa cultivar in both seasons. Meanwhile, M. Biance and Capel gave the highest values of multi-germ cultivar. On the other hand, within the mon-germ group, Avantage cultivar gave the lowest value of K content while BTS 899 gave the highest value.

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Varietal differences in their chemical constituents were reported by Abd El-Fatah (2000), Shalaby (2003) and El-Hosary *et al.* (2007).

Sodium content (meq/100g) :

Sodium is an essential element for beet production although it has negative effects on sugar extraction in factories. The overall means in Table 3 indicates that sodium contents were higher in the second season than that of the first one. Seed types did not differ significantly in both seasons while the differences among cultivars and within multigerm and monogerm cultivars were significant in the two seasons.

Averages in Table 3 showed that the lowest value of Na content produced from M. Rosa cultivar in both seasons. Meanwhile, M. Bianco gave the highest value of Na content in the both seasons within the multi-germ group. On the other hand, Hemrike and Avantage cultivars produced the lowest values of Na content from mono-germ seeds. Similar finding were mentioned by Abd El-Fatah (2000) and Shalaby (2003)

Alfa -amino nitrogen (meq/100g)

Alpha amino nitrogen compounds are formed mainly in beet due to nitrogen level in soil, weather added as fertilizer or found naturally in field as residues from the previous crop.

Data in Table 3 showed that Monte rosa cultivar gave the lowest value of Alpha amino nitrogen in both seasons, while Monte bianco gave the highest value. On the other hand, Avantage cultivar from mono-germ cultivar gave the lowest value of alpha amino nitrogen compounds. This might be due to varietals genetic makeup. Seed type affect were insignificant in the first season only, also, there were insignificant effect among cultivars and within cultivars. These findings are in harmony with those of Obara et al. (1986), Abd El-Fatah (2000), Shalaby (2003), Al-Labbody (2003), Shalaby (2003, and Hoffmann (2005)

Alkail Compounds (AC) %:

Alkail compounds affect the industrial process of beet sugar. Data in Table 4 showed that none of the tested parameters showed significant differences in both seasons. The multigerm cultivar Monte Bosa cultivar produced the lowest value of alkail compounds in the both seasons. On the other hand, LP15 and Avantage cultivars produced the lowest values of alkail compounds for mongerm group.

Quality index:

The values recorded for quality index of the fist season was higher than that of the second one due to the increase of Pol% used to calculate that parameter. In addition, K, Na, and Alpha amino N values that are used to calculate quality index were less in the first season. Differences among and within cultivars were significant effect on quality index. Seed type had insignificant effect in both seasons. Means in Table 4 showed that M. Rosa, and Swallow produced the highest value of quality index in the both seasons within the multi-germ group. This is partially due to the low values of sodium and potassium contents of these particular cultivars. Meanwhile, Monte Bianco gave the lowest value in both seasons. On the other hand, Henrike and Avantage cultivars produced the highest values from mono-germ cultivars because of the low NA and K values.

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The cultivar BTS 899 produced the lowest value of quality index. Differences in quality index due to varietal makeup were reported by Abou-Salama and El-Syiad (2000) and El-Hosary (2007).

Sugar loss %:

Sugar loss of the first season was less than that of the second one. This could be attributed to the high value of quality index of this season. Seed type had insignificant effect in both seasons. Differences among and within cultivars had significant effect on sugar loss % in both seasons.

Means in table 4 showed that M. Rosa cultivar produced the lowest value of sugar loss % in both seasons. While, Monte Bianco produced the highest value of sugar loss %. This is due to high contents of sodium, potassium content and alpha amino nitrogen compounds.

Theoretical sugar recovery %:

The estimated sugar recovery % of the first season was higher than that of the second season. This could be attributed mainly to the high quality index value of the first season. Differences among and within cultivars were significant in both season, while seed type had insignificant effect on sugar recovery % in the both seasons and only in the first season cultivars within mono-germ.

Means in Table 4 showed that Monte Rosa, Swallow, and Top cultivars produced the highest values in both seasons. The cultivar Monte Bianco produced the lowest value of sugar recovery % because of its low quality index in the group multi-germ. M. Rosa, swallow, and Capel were the highest in this group for sugar recovery partially due to the high quality index and pol %. On the other hand, Avantage and Henrike cultivars produced the highest values in both seasons due to high quality index and pol%. Meanwhile, BTS 899 produced the lowest value of sugar recovery % from mono-germ cultivar.

In conclusion, it is evident that varietal differences control quality parameters that are of major interest from manufacturers' point of view. For such reason, it is evident that the high quality mult-germ cultivars M. Rosa, Swallow, and Top, in addition to the monogerm Henrike and Avantage should be promoted for growing among farmers. However, root production which interferes significantly in determining total recovered sugar per feddan could cause some of these high quality cultivars to be out of the farming list.

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تقييم بعض اصناف بنجر السسكر الستوردة حديثا تحت ظروف شمال الدلتا المصرية:

2- صفات الجودة

توفيق نصر القماش[1] ، محمد محمد عبد القادر [1] ، مصطفى عبدالجواد فرج [2] ، المهدى عبد المطلب طعيمة [3]، و عادل مصطفى ابوسلامه[3]

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نفذ هذا البحث لتقييم اربعة عشر صنف بنجر سكر مستورد تحت الظروف الحقلية لمنطقة بلقاس لتحديد جدواها من حيث احتمالات التوسع فى زراعتها بالمنطقة. نفذ البحث خلال موسمى 2008-2009 و 2009 – 2010 بمنطقة بلقاس محافظة الدقهلية (خط عرض 31 درجة 15 دقيقة شمالا). قيمت سبعه اصناف من مجموعه وحيدة الاجنة هى Henrike, BTS 899, Beretta, Lagon, Lp15, Lp16, and Avantage بالاضافة إلى سبعة أخرى تنتمى للمجموعة متعددة الاجنة و هى Monte Bianco, Monte Baldo, Monte Rosa , Swallow, Top, Capel, and Floima . زرعت جميع الاصناف يدويا فى 20 و 25 اكتوبر 2008و 2009 على التوالى و نفذت عليها توصيات وزارة الزراعة. تم الحصاد فى 22 و 29 مايو من عامى 2009 و 2010 على الترتيب. حللت صفات الجودة بمعامل الجودة عقب الحصاد بمعامل شركة الدقهلية للسكر.

و كانت اهم النتائج كما يلى:

١ - لم توجد فروق معنوية فى صفات الجودة مابين الثمار متعددة أو وحيدة الاجنة .

٢ - اختلفت معظم صفات الجودة بصورة معنوية نتيجة للفروق الوراثية بين الاصناف.

٣ - كان معدل استخلاص السكر % مرتفعا بصورة معنوية للاصناف متعددة الاجنة , Monte Rosa , Swallow, Top و الصنفين وحيدى الاجنة Henrike and Avantage راجعا بصورة اساسية ألى ارتفاع صفة نسبة السكروز و / أو دليل الجودة لتلك الاصناف.

و كاستنتاج عام يتضح أن الفروق الصنفية تتحكم فى صفات الجودة التى تشكل الاهتمام الرئيسى لمصنعى سكر البنجر. و لهذا فأن من الواضح ان الاصناف عديدة الاجنة , Monte Rosa, Swallow, Top و الصنفين وحيدى الاجنة Henrike and Avantage هم المرشحون للتوسع فى توزيعهم على المزارعين بتلك المنطقة للحصول على منتج عالى الجودة. ويجب الاشارة أن محصول الجذور الذى يؤثر بصورة رئيسية على ناتج السكر النهائى للفدان يمكن أن يغير من أفضلية قبول هذه الاصناف المتميزة من حيث الجودة لدى الزراع و المصنعون.

قام بتحكيم البحث

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Table 3: Means of pol%, K, Na, and alpha amino nitrogen of fourteen sugar beet cultivars in 2008-2009 and 2009-2010 seasons.

Seed type	Cultivars	Pol %		Mean	K		Mean	Na		Mean	Alph amino N		Mean
		2008 -2009	2009-2010		2008 -2009	2009-2010		2008 -2009	2009-2010		2008 -2009	2009-2010	
Multi-germ	M.bianco	16.470	15.427	15.949	5.427	5.600	5.514	1.902	1.968	1.935	4.157	4.302	4.229
	M.baldo	17.310	16.167	16.739	4.612	4.855	4.734	1.815	1.868	1.842	4.063	4.293	4.178
	M.rosa	18.113	16.397	17.255	4.473	4.628	4.551	1.600	1.665	1.633	3.792	4.132	3.962
	Swallow	18.497	16.195	17.346	4.590	4.787	4.689	1.768	1.826	1.797	3.850	4.282	4.066
	Top	17.710	16.649	17.180	4.758	4.927	4.843	1.818	1.900	1.859	4.080	4.200	4.140
	Capel	17.245	15.643	16.444	5.220	5.273	5.247	1.857	1.873	1.865	4.125	4.208	4.167
	Florima	16.602	15.787	16.195	4.917	4.935	4.926	1.780	1.903	1.842	4.022	4.133	4.078
	Mean	17.421	16.038	16.729	4.857	5.001	4.929	1.791	1.858	1.825	4.01	4.22	4.117
Mono-germ	Henrike	17.575	16.445	17.010	4.348	4.923	4.636	1.542	1.621	1.582	3.767	4.180	3.974
	BTS 899	16.263	15.658	15.961	5.318	5.470	5.394	1.873	1.951	1.912	4.145	4.238	4.192
	Beretta	17.300	15.728	16.514	4.843	4.880	4.862	1.810	1.888	1.849	3.912	4.173	4.043
	Lagon	17.328	16.150	16.739	4.623	4.775	4.699	1.788	1.815	1.802	4.003	4.082	4.043
	Lp15	17.352	16.177	16.765	4.465	4.615	4.540	1.845	1.906	1.876	4.088	4.167	4.128
	Lp16	16.807	16.222	16.515	5.137	5.205	5.171	1.843	1.878	1.861	4.070	4.110	4.090
	Avantage	17.425	15.942	16.684	4.412	4.632	4.522	1.655	1.694	1.675	3.778	4.037	3.908
	Mean	17.150	16.046	16.598	4.735	4.928	4.832	1.765	1.822	1.794	3.966	4.141	4.054
Grand mean		17.286	16.042	16.664	4.796	4.965	4.881	1.778	1.840	1.809	3.989	4.181	4.086

LSD. 0.05								
Seed type	Ns	Ns	Ns	Ns	Ns	Ns	Ns	*
Cultivars within multi	Ns	Ns	** 0.512	*0.581	**0.134	**0.134	Ns	Ns
Cultivars within mono	**0.997	**0.670	**0.512	*0.581	**0.134	**0.134	Ns	Ns
Among cultivars	**0.997	*0.670	**0.512	*0.581	**0.134	**0.134	Ns	Ns

Table 4: Means of Alkail compounds, quality index, sugar loss and recovery percentages of fourteen sugar beet cultivars in 2008-2009 and 2009-2010 seasons.

Seed type	Cultivars	Alkail compounds		Mean	Quality index		Mean	Sugar loss%		Mean	Sugar recovery %		Mean
		2008 -2009	2009-2010		2008 -2009	2009-2010		2008 -2009	2009-2010		2008 -2009	2009-2010	
Multi-germ	M.bianco	1.757	1.765	1.761	80.522	78.569	79.546	3.197	3.290	3.244	14.349	13.235	13.792
	M.baldo	1.589	1.568	1.578	83.285	81.434	82.360	2.876	3.000	2.938	15.488	14.264	14.876
	M.rosa	1.600	1.533	1.566	84.918	82.627	83.773	2.730	2.848	2.789	16.387	14.616	15.502
	Swallow	1.667	1.551	1.609	84.695	81.758	83.227	2.833	2.950	2.892	16.678	14.340	15.509
	Top	1.612	1.627	1.619	83.405	81.865	82.635	2.929	3.018	2.974	15.838	14.710	15.274
	Capel	1.717	1.707	1.712	81.882	79.879	80.881	3.105	3.145	3.125	15.205	13.580	14.393
	Florima	1.680	1.652	1.666	82.124	80.842	81.483	2.965	3.021	2.993	14.683	13.833	14.258
	Mean	1.660	1.629	1.644	82.976	80.996	81.986	2.948	3.039	2.993	15.518	14.083	14.800
Mono-germ	Henrike	1.565	1.585	1.575	84.829	82.061	83.445	2.664	2.944	2.804	15.909	14.576	15.243
	BTS 899	1.736	1.740	1.738	80.558	79.419	79.989	3.146	3.223	3.185	14.186	13.529	13.858
	Beretta	1.710	1.614	1.662	82.924	80.909	81.917	2.940	2.996	2.968	15.386	13.810	14.598
	Lagon	1.606	1.622	1.614	83.433	81.768	82.601	2.866	2.944	2.905	15.505	14.264	14.885
	Lp15	1.544	1.559	1.551	83.637	81.988	82.813	2.839	2.909	2.874	15.572	14.341	14.957
	Lp16	1.726	1.726	1.726	81.732	80.812	81.272	3.067	3.110	3.089	14.795	14.174	14.485
	Avantage	1.619	1.594	1.606	84.346	81.962	83.154	2.726	2.875	2.801	15.699	14.116	14.908
	Mean	1.644	1.634	1.638	83.066	81.274	82.170	2.893	3.000	2.946	15.293	14.116	14.704
Grand mean		1.652	1.632	1.641	83.021	81.135	82.078	2.920	3.020	2.970	15.406	14.099	14.752

LSD. 0.05								
Seed type	Ns	Ns	Ns	Ns	NS	NS	NS	Ns
Cultivars within multi	Ns	Ns	**1.1688	*1.658	**0.204	*0.226	*1.047	Ns
Cultivars within mono	Ns	Ns	**1.1688	**1.658	**0.204	**0.226	**1.047	**0.722
Among cultivars	Ns	Ns	**1.1688	**1.658	**0.204	**0.226	**1.047	**0.722