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RESPONSE OF SOME SUGAR BEET (*Beta vulgaris* L.) VARIETIES TO NITROGEN FERTILIZER IN SANDY RECLAIMED SOILS.

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ABSTRACT

Two field experiments were carried out at Kafr El-Hammam Research Station, Sharkia Governorate in 2008/2009 and 2009/2010 to study the effect of three nitrogen fertilizer levels (80, 100 and 120 kg N/fed.) on yield and quality of three multigerm sugar beet varieties, *i.e.* Gloria, Sultan and Desprez poly. Sugar beet varieties were planted by hand on the 1st week of November and harvest was after seven months in both seasons. A split plot design in four replications was used where varieties Gloria, Sultan and Desprez poly were allocated in the main plots while subplots were nitrogen fertilizer rates. The results showed that:

1- Both sugar beet varieties and nitrogen fertilizer levels were significantly affected on some growth characters [length, diameter (cm/plant) and fresh weight (g/plant) of roots], juice quality (total soluble solids, sucrose and purity percentages), yields [top, root and sugar yields (ton fed.$^{-1}$)] and some macronutrients % (nitrogen, phosphorus and potassium) in both seasons.

2- Sultan variety surpassed the other two varieties in root and sugar yields, and it recorded 38.77 and 35.96 (ton fed.$^{-1}$) , respectively for root yield and 6.33 and 5.29 (ton fed.$^{-1}$), respectively for sugar yield in the 1st and 2nd seasons.

3- Application of (120 kg N/fed.) surpassed the other nitrogen fertilizer levels in root and sugar yields, and recorded 39.97 and 37.26 (ton fed^{-1}), for root yield and 6.55 and 5.33 (ton fed.$^{-1}$), respectively for sugar yield in the 1st and 2nd seasons.

Under the conditions of this investigation, using the variety 'Sultan' fertilized with 100 kg N/fed. is recommended to obtain the maximum root and sugar yield tons fed^{-1} .

Key words: *Beta vulgaris L., nitrogen fertilizer, sandy reclaimed soils.*

1.INTRODUCTION

All sugar beet genotypes (*Beta vulgaris* L.) cultivated in Egypt are imported from foreign countries, so, it is preferable to evaluate them under Egyptian conditions especially under newly reclaimed soils to select the best suited ones. Sugar beet growth is largely influenced by the agronomic practices as crop stand and fertilization, especially in the newly reclaimed soils which are characterized by low contents of organic matter and nutrients, which ultimately affect root and sugar yields. Some sugar beet genotypes have been promoted as high sugar content genotypes and are adapted for early harvest. Aly (2000) and El-Geddawy *et al.* (2001) in Egypt, tested three sugar beet varieties Pleno, Kawemira and Lola. They found that Lola surpassed the other two varieties in TSS%, root and sugar yields. Badawi *et al.* (2002) and Osman *et al.* (2003) in Egypt evaluated some sugar beet cultivars *i.e.*, Top, Lola, Pleno and Kawemira. They found that, Kawemira was superior in sucrose%, root, top and sugar yields ton/fed. Shalaby (2003), Azzazy (2004) and Abd El-Aal and Amal (2005) indicated that two multigerm sugar beet varieties, Beta poly 4, Ras poly and two monogerm varieties, Toro and Hilx were differed significantly in root length, sucrose%, root and sugar yields. Also, they added that sugar beet variety 'Ras poly' surpassed the other varieties in root length, purity%, sucrose%, yields of root and sugar. Aly (2006), Azzazy *et al.* (2007) and El-Sheikh *et al.* (2009) showed that the evaluated sugar beet varieties varied significantly in root fresh weight, root and sugar yields, while root length and diameter as well as sucrose and

purity% did not differ significantly. Sugar beet variety KWS-9422 gave the highest root and sugar yields. Enan *et al.* (2009) found that sugar beet varieties *viz* Sumba, Pleno, Toro, Kawemira, Lola and Farida differed significantly in all the studied characters except TSS % in both seasons. In addition, insignificant differences were detected among varieties in sugar yield in the 1st season. Farida variety gave the highest value in root length, diameter and fresh weight and root yield. On the other hand, Lola variety came the second in sugar yield and quality parameters (TSS, sucrose and purity %) after Sumba. Several workers studied the effect of nitrogen fertilizer on sugar beet yield and quality. Shafika and Darwish (2001) revealed that sucrose and juice purity % were reduced linearly as N level was increased. On the contrary, total soluble solids (TSS %) was increased by increasing N level. Nemeat Alla (2004) stated that applying 20, 40 and 60 kg N/fed had no effect on sugar beet root length and increasing N level to 140 kg/fed. did not affect sucrose and TSS%. Abou Zeid and Osman (2005) and Aly *et al.* (2009) found that the highest sugar yield was obtained by adding 80 kg N /fed. While, insignificant differences were recorded on TSS, sucrose and purity% in both seasons. Pytlarzkozicka (2005) found that an increase of nitrogen rate from 90 to 180 kg N /ha caused a significant increase of average root mass, leaves and dry matter yields, potassium and nitrogen content in roots, but sugar content decreased. Abu El-Fotoh and Abou El-Magd (2006) found that the highest root yields (34.26 and 33.89 ton/fed.) were recorded when urea fertilizer was applied at 80 kg N/fed. in the 1st and 2nd seasons, respectively.

The aim of this investigation was to evaluate the effect of nitrogen fertilizer levels on yield and quality of some sugar beet cultivars under sandy reclaimed soils.

2. MATERIALS AND METHODS

Two field experiments were carried out at Kafr El-Hammam Research Station, Sharkia Governorate in 2008/2009 and 2009/2010 to study the effect of three mineral nitrogen fertilizer levels (80, 100 and 120 kg N/fed.) on yield and quality of three multigerm sugar beet varieties; Gloria, Sultan and Desprez poly. These varieties were planted by hand on the 1st week of November and harvested after seven months in both seasons. A split plot design with four replications was used. The varieties were allocated in the main plots, while, nitrogen fertilizer levels were distributed at random in subplots. Plot area was (21.60 m^2 1/194/fed.) including six rows of 60 cm width, 20 cm between hills and 6 m long. During seed bed preparation calcium super phosphate (15.5% P_2O_5) was applied at the rate of. 30 kg P_2O_5/fed. Nitrogen fertilizer levels (80, 100 and 120 kg N /fed.) were applied in the form of ammonium nitrate (33.5% N) at four equal doses. The 1st one was added after thinning and 15 days between the other doses. Potassium sulfate (48% K_2O) was added at the rate of 36 kg K_2O_5 /fed. after thinning. Soil samples were taken before sowing and were prepared for the determination of physical and chemical soil properties according to Page (1982) (Table 1).

The previous crop was maize in both seasons; thereafter seeds were sown and irrigated immediately. Other agricultural practices were done as recommended by Sugar Crops Research Institute.

2.1. Recorded data

Sugar beet plants of the two guarded rows were up-rooted, topped, weighed and a random sample of ten roots was taken from each sub-plot to determine: average root length and diameter (cm/ plant), average root fresh weight (g/plant), total soluble solids (T.S.S.%) which was determined by using Hand Refractometers, sucrose % was polarimetrically determined according to the methods of Le-Docte (1927), juice purity % which was determined according to the following equation : Juice purity % = (Sucrose% / total soluble solids%) x 100, top, root and sugar yields (ton fed^{-1}), Sugar yield (ton fed^{-1}) = root yield (ton

Table (1). Physical and chemical analyses of the experimental soil

Season	Mechanical analysis			Soil texture	E.C ds/m	Soil pH*	Organic matter%	$CaCO_3$
	Sand %	Silt %	Clay %					
2008/2009	64.00	23.00	13.00	Sandy	0.89	8.20	1.20	3.00
2009/2010	64.20	22.70	13.10	Sandy	0.87	8.00	1.30	2.98

Season	Soluble cations (meq/L)				Soluble anions (meq/L)				Available nutrients(ppm)		
	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{-}	HCO_3^{-}	Cl^{-}	SO_4^{-}	N	P	K
2008/2009	2.00	3.00	4.20	0.19	0.00	0.37	6.00	3.02	16.90	22.20	55.30
2009/2010	2.11	3.02	3.97	0.20	0.00	0.69	5.98	2.63	16.42	21.33	50.00

* Soil pH in 1:2.5 soil: water suspension

fed^{-1}) x (sucrose % / 100) and Macro elements *i.e.* nitrogen, phosphorus and potassium % were determined according to A.O.A.C. (1990).

Statistical analysis

Analysis of variance was made according to the method described by Snedecor and Cochran (1980). Least significant difference test (LSD) at 5% level of significance was used to compare means.

3. RESULTS AND DISCUSSION

3.1. Effect of sugar beet varieties

3.1.1. Effect on root growth characters

The results given in Table (2) revealed that the average of sugar beet root length and diameter (cm), as well as the average of root fresh weight (g/ plant) were significantly affected by the studied sugar beet cultivars in both seasons. Sultan variety surpassed the other two varieties in root dimension and root fresh weight followed by Disperz poly in both seasons.

These results are in harmony with those found by Al –Labbody (2003) and El-Geddawy *et al.* (2006). The difference among the three sugar beet varieties could be due to the variation in the gene make-up and their response to the environmental conditions.

3.1.2. Effect on juice quality

The results given in Table (2) indicate that the differences among sugar beet cultivars in sucrose, total soluble solid and purity % were significant in the two seasons, except the difference between Gloria and Disperz poly varieties in purity% in the1st season and between Sultan and Gloria varieties in sucrose and purity % in the 2nd season. Sultan recorded the highest values (16.49 and 14.70 %) of sucrose in the 1st and 2nd seasons, respectively and the highest value (21.48 %) of T.S.S in the 1st season and of purity (79.05%) in the 2nd season, whereas Desprez poly variety was superior over the other two varieties in purity (81.63 %) in the 1st season and in T.S.S (19.87 %) in the 2nd season. This finding is in line with that found by El-Geddawy *et al.* (2006) who found that Sultan variety recorded the highest sucrose % compared with the other varieties in both seasons.

3.1.3. Effect on Macro-nutrients composition of beet root

The results in Table (3) reveal that the evaluated verieties differed significantly in their macro nutrient contents in both seasons, except the difference between Sultan and Desprez poly varieties in P% in the 1st season and in K% in the 2nd season. Sultan recorded the highest values of N% and P% in the 1st season. While in the 2nd season Desprez poly variety gave the highest value of N% as well as Gloria variety recorded the highest P% and K%.

3.1.4. Effect on yields of top, root and sugar (tons fed^{-1}.)

The data in Table (3) show a significant difference among the tested sugar beet cultivars in top, root and sugar yields in both seasons, except the difference between Sultan and Desprez poly varieties in root and sugar yields in both seasons and in top yield in the 1st season only; where differences did not reach to the significant level. Sultan overpassed the other two varieties for top, root and sugar yields. The same trend was found by Al-Labbody (2003) and El- Geddawy *et. al.* (2006). They reported that top, root and sugar yields showed a marked variation among varieties. Sultan was superior than the other varieties in root and sugar yields.

3.2. Effect of nitrogen fertilizer levels

3.2.1. Effect on root growth characters

The data in Table (4) show that N- fertilizer levels had significant effect on averages root length, diameter and root fresh weight, in both seasons. The highest values of root length, diameter and fresh weight were obtained from 120 kg N/fed. in the two seasons. Whereas, the lowest values were obtained from applying 80 kg N/fed. in both seasons, with insignificant differences between 80 and 100 kg N/fed. for root length in the1st season only. Raising N levels from 80 to 100 and from 100 to 120 kg N/fed. increased root fresh weight by 20.45 and 25.44 g/plant, respectively in the 1st season, corresponding to 44.11 and 45.11 g/plant, respectively in the 2nd season (Table, 4). The increase in root dimension could be due to stimulation effect of nitrogen on building up new cells, cell division and cell enlargement and also to the role of nitrogen in encouraging plant uptake of the other elements and activate accumulation of carbohydrates, which in turn enhanced root fresh weight per plant (Zeinab *et al.*, 2000). These results are in line with those of Ibrahim *et al.* (2005), El- Sheref (2006), Nemeat Alla *et al.* (2007), El- Geddawy *et al.* (2008) and El-Sarag (2009).

3.2.2. Effect on juice quality

Increasing N-level from 80 to 120 kg N/fed. significantly increased T.S.S % from 20.32 to20.82 %, in the 1st season and from 19.32 to 19.48%, in the 2nd season, respectively.

Sucrose % was also increased by increasing N-level from 80 to 120 kg N/fed. with insignificant differences between 100 and 120 kg N/fed. in both

Table (2): Effect of sugar beet varieties on some root growth characters and juice quality % at harvest in 2008/2009 and 2009/2010 seasons.

2008/2009						
Characters	Root growth characters			Juice quality %		
Sugar beet varieties	Length (cm/plant)	Diameter (cm/plant)	Fresh weight (g/plant)	Total soluble solids	Sucrose	Purity
Gloria	35.49	15.69	1176.67	19.59	15.51	79.41
Sultan	38.22	18.32	1373.78	21.48	16.49	75.31
Desprez poly	36.90	17.09	1281.22	20.57	16.06	81.63
LSD 5%	0.90	0.85	90.10	0.65	0.15	2.30
2009/2010						
Gloria	31.47	14.30	1072.22	19.21	14.54	76.82
Sultan	34.02	16.85	1263.56	18.78	14.70	79.05
Desprez poly	33.06	15.89	1191.22	19.87	13.96	70.56
LSD 5%	0.66	0.55	52.50	0.13	0.20	3.00

Table (3):Effect of sugar beet varieties on top, root and sugar yields (ton fed^{-1}) and macro element % in roots at harvest in 2008/2009 and 2009/2010 seasons.

2008/2009						
Characters	Macro elements %			Yields (ton fed^{-1})		
Sugar beet varieties	N	P	K	Top	Root	Sugar
Gloria	1.03	0.39	1.48	16.78	37.66	5.88
Sultan	1.08	0.46	1.52	18.57	38.77	6.33
Desprez poly	1.06	0.45	1.56	18.26	38.54	6.24
LSD 5%	0.01	0.02	0.03	0.80	0.45	0.12
2009/2010						
Gloria	1.10	0.48	1.54	15.27	33.95	4.56
Sultan	1.09	0.42	1.50	18.01	35.96	5.29
Desprez poly	1.15	0.43	1.50	16.92	35.27	5.14
LSD 5%	0.01	0.01	0.02	0.77	1.22	0.49

Table (4): Effect of nitrogen fertilizer levels on some growth characters of roots and juice quality % at harvest in 2008/2009 and 2009/2010 seasons.

2008/2009						
Characters	Root growth characters			Juice quality %		
Nitrogen levels (N/fed.)	Length (cm)	Diameter (cm)	Fresh weight (g/plant)	Total soluble solids	Sucrose	Purity
80	36.54	16.74	1255.11	20.32	15.57	78.30
100	36.80	17.01	1275.56	20.50	15.97	78.25
120	37.27	17.35	1301.00	20.82	16.51	79.82
LSD 5%	0.32	0.27	20.10	0.12	0.72	0.02
2009/2010						
80	32.26	15.09	1131.22	19.32	13.54	70.57
100	32.84	15.68	1175.33	19.06	14.48	78.67
120	33.44	16.28	1220.44	19.48	15.17	77.19
LSD 5%	0.12	0.16	22.15	0.11	0.70	3.35

Table (5). Effect of nitrogen fertilizer levels on top, root, and sugar yields (ton fed^{-1}) and macro element % in roots at harvest in 2008/2009 and 2009/2010 seasons.

2008/2009						
Characters	Macro elements %			Yields (ton fed^{-1})		
Nitrogen levels (N/fed.)	N	P	K	Top	Root	Sugar
80	1.02	0.41	1.50	17.56	35.30	5.50
100	1.03	0.47	1.49	17.84	39.70	6.40
120	1.11	0.43	1.58	18.20	39.97	6.55
LSD 5%	0.05	0.05	0.07	0.40	0.84	0.31
2009/2010						
80	1.12	0.39	1.49	16.07	32.18	4.73
100	1.10	0.44	1.51	16.74	35.75	5.17
120	1.12	0.49	1.54	17.39	37.26	5.33
LSD 5%	0.01	0.03	0.02	0.37	1.11	0.23

seasons and between 80 and 100 kg N/fed. in the 1st season (Table 4). Increasing N-level from 80 to 120 kg N/fed. significantly increased purity % from 78.30 to79.82 % in the 1st season and from 70.57 to 77.19 % in the 2nd season, respectively. Insignificant decrease in purity % was found when N fertilizer level was increased from 100 to 120 kg N/fed. in the 2nd season. This may be due to the increases of amino compound concentrations caused by excessive uptake of nitrate late in the season. These results agree with those recorded by El- Sarag (2009). who reported that, increasing N fertilizer rates from 60 up to 120 kg N/fed increased T.S.S % and depressed sucrose and purity percentages. The insignificant increase of sugar (Table 4) may be due to (N) fertilizer increase fraction of the sucrose % assimilate entering the root that was used in growth at the expense of that stored as sugar (Milford and Watson 1971).

3.2.3. Effect on Macro-nutrients composition of beet root

The results in (Table 5) showed a significant increase in nitrogen (N), phosphorus (P) and potassium (K) percentages in the two seasons as affected by increasing the levels of (N). Application of 120 kg/fed. gave the highest (N and K %) in both seasons, and P % in the 2nd season only, whereas, adding (100 kg N/fed.) gave the highest P% in the 1st season. Such effect may be due to that (N) dressing enhanced the uptake of other elements which finally reflected in a better growth (Zeinab *et al.*, 2000). These results are in accordance with those obtained by Abou Zeid and Osman (2005) and Aly *et al.* (2009).

3.2.4. Effect on yields of top, root and sugar (ton fed^{-1}.)

The results given in (Table 5) demonstrated that top, root and sugar yields (ton fed^{-1}) significantly responded to the additional doses of nitrogen N/fed. with insignificant differences between 100 and 120 kg N/fed. in the 1st seasons while, in the 2nd season the differences between 100 and 120 kg N/fed. in top and root yields were significant. The highest N- level (120 kg N/fed.) increased root yield by 13.23 and 15.79% and sugar yield by 19.09 and 12.68 % in the 1st and 2nd seasons, respectively as compared with the lowest level (80 kg N/fed.).

The differences between 100 and 120 kg N/fed. had insignificant effect on sugar yield tons/ fed. in both seasons, so that adding N-fertilizer more than 100 kg N/fed. will not be of economic value for maximizing sugar yield. These findings are in agreement with those obtained by El-Geddawy *et al.* (2006), Nemeat Alla *et al.* (2007), Seadh (2008) and El- Sarag (2009). The increases in root yield by increasing N-level may be due to the role of nitrogen in accumulating carbohydrates, translocated from leaves to roots which in turn enhanced root fresh weight (Table 4) and finally root and sugar yields per unit area.

Table (6). Effect of interaction between sugar beet varieties and nitrogen fertilizer levels on sucrose, sugar yield (ton fed^{-1}.) and phosphorus% at harvest in 2009/2010 season.

2009/2010 season			
Sugar beet varieties x nitrogen fertilizer levels	Sucrose %	Sugar yield (ton fed^{-1})	Phosphorus %
Gloria x 80 kg N/fed.	14.11	4.42	0.423
Gloria x 100 kg N/fed.	14.99	5.25	0.490
Gloria x 120 kg N/fed.	14.25	4.53	0.513
Sultan x 80 kg N/fed.	13.86	4.65	0.347
Sultan x 100 kg N/fed.	15.55	5.76	0.437
Sultan x 120 kg N/fed.	15.73	5.78	0.383
Desprez poly x 80 kg N/fed.	12.65	4.60	0.410
Desprez poly x100 kg N/fed.	14.20	5.11	0.487
Desprez poly x120 kg N/fed.	14.24	5.62	0.460
LSD 5%	0.97	1.40	0.05

3.3. The interaction effect

The interaction between the studied varieties and nitrogen fertilizer levels had a significant effect on sucrose %, sugar yield (ton fed^{-1}) and P % in the 2nd season only (Table 6).

The highest values of sucrose % and sugar yield (ton fed^{-1}) were obtained by using Sultan variety and fertilized by N application at a level 120 kg N/fed.

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إستجابة بعض أصناف بنجر السكر للتسميد النيتروجينى فى الأراضى الرملية المستصلحة

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قسم بحوث المحافظة على الاصناف و* المعاملات الزراعية و**الفسيولوجى والكيمياء
معهد بحوث المحاصيل السكرية- مركز البحوث الزراعية - الجيزة - مصر

ملخص

أقيمت تجربتان حقليتان بمحطة بحوث كفر الحمام بمحافظة الشرقية خلال موسمى ٢٠٠٨/٢٠٠٩ و ٢٠٠٩/٢٠١٠ واشتملت الدراسة على ثلاثة معدلات من التسميد الازوتى (٨٠ و ١٠٠ و ١٢٠ كجم ن/فدان) وثلاثة اصناف من بنجر السكروهى جلوريا وسلطان وديسبريز بولى. أستخدم تصميم القطع المنشقة مرة واحدة فى أربع مكررات حيث وضعت الاصناف فى القطع الرئيسية ومعدلات التسميد الازوتى فى القطع الفرعية وقد أوضحت نتائج التجربة مايلى:

١- ادى استخدام الاصناف و التسميد النيتروجينى الى زيادة معنوية فى بعض صفات النمو (طول الجذر وسمك الجذر والوزن الطازج للجذر) وصفات الجودة (النسبة المئوية للمواد الصلبة الذائبة الكلية والسكروز والنقاوة) والمحصول (العرش والجذر والسكر طن/فدان) وكذلك النسبة المئوية للنيتروجين والفوسفور والبوتاسيوم فى الجذور فى كلا الموسمين.

٢-اعطى صنف سلطان اعلى قيم لمحصول الجذور وقد سجل ٣٨.٧٧ و ٣٥.٩٦ طن/فدان وكذلك محصول السكر ٦.٣٣ و ٥.٢٩ طن/فدان فى كلا الموسمين على الترتيب.

٣- اعطى معدل التسميد الازوتى ١٢٠ كجم ن/فدان اعلى قيم لمحصول الجذور وهى ٣٩.٩٧ و ٣٧.٢٦ طن/فدان وكذلك محصول السكر ٦.٥٥ و٥.٣٣ طن/فدان فى كلا الموسمين على الترتيب.

يمكن اقتصاديا تحت ظروف منطقة كفر الحمام بمحافظة الشرقية التوصية بزراعة الصنف سلطان مع التسميد الازوتى بمعدل ١٠٠ كجم ن/فدان للحصول على أعلى محصول جذور وسكر.

المجلة العلمية لكلية الزراعة - جامعة القاهرة - المجلد (٦٢) العدد الثالث (يوليو ٢٠١١):٣٢٩-٣٣٥.