RESPONSE OF SOME SUGAR BEET GENOTYPES TO NITROGEN FERTILIZATION LEVELS UNDER NEWLY RECLAIMED SOIL CONDITIONS

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ABSTRACT

Two field experiments were conducted during 2009/2010 and 2010/2011 seasons in Koum Ousheem district, El-Fayoum Governorate. The major goal was to study the response of five multigerm sugar beet varieties namely; Oscar poly, Desprez poly N, Pleno, Nejma and H poly to three nitrogen fertilizer levels, i.e., 100, 120 and 140 kg N/fed.

The obtained results revealed that Desprez poly N variety significantly increased in growth traits, i.e., root diameter, root fresh weight and sugar yield/fed, while Nejma variety significantly surpassed in sucrose% and root yield/fed, and reduction in impurities% in both seasons.

Application of 140 kg N/fed. maximized yield productivity, represanted by improved average root weight, root and sugar yields/fed. However, juice impurities were increased as nitrogen level was increased from 100 to 140 kg/fed. On the contrary, a gradual reduction in sucrose% has been detected with the increase in nitrogen level over 120 kg/fed.

The interaction between Desprez poly N variety and nitrogen fertilization up to 140 kg N/fed. recorded the highest values in root and sugar yields/fed. Under the conditions of this study productivity of sugar beet varieties could be maximize by supply sufficient nitrogen fertilization levels from 120 to 140 kg N/fed.

Key words: Sugar beet genotypes, Different nitrogen levels and In newly reclaimed soils

INTRODUCTION

Sugar beet ranks the second sugar crop after sugar cane crop over all the world where it provides about 40% of the world sugar production. All sugar beet genotypes cultivated in Egypt are imported from foreign countries, so, it is preferable to evaluate them under Egyptian conditions especially under newly reclaimed soil to select the best suited ones. The varital differences in gen make up expression may be throw some light on their relative importance and behavior through the growing season. **Osman *et al* (2003)** showed that sugar beet Kawemira cultivar was superior in sucrose%, root, top and sugar yields/fed compared to cultivars Top, Lola, and Pleno. **Aly (2006), Azzazy *et. al.* (2007) and El-Sheikh *et. al.* (2009)** found significant differences among sugar beet varieties varied significantly for root fresh weight/plant, root and sugar yields/fed, 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/fed. **Enan *et. al.* (2009)** revealed that sugar beet varieties differed significantly in all studied traits in both seasons. Sugar yield in the 1st season, Farida variety gave a significant increase for sugar yield, juice quality, sucrose and purity% while it recorded the lowest values of impurities (Na, K and N%). **Abd El-Aal *et. al.* (2010)** detected significant variation in yield productivity and root quality among the varieties. Kawemira and Gloria varieties gave the highest sugar yield followed by Nejma. On the other hand, Lola variety exhibited the lowest sugar yield/fed.

Nitrogen application to sugar beet cultivation has been found essential for yield determination. This is because nitrogen has pronounced effects on growth and physiological processes of sugar beet, even to the extent of causing large changes in the physiological and chemical traits of yield at harvest. Root quality is a combination of all chemical and physical aspects of beet root which influence processing and hence yield of sugar and its product **Oldfield *et. al.* (1979)**. The optimum dose of nitrogen needed by sugar beet is greatly affected by many factors such as soil type, length of growing period, irrigation system, sugar beet variety … etc. In general, the literature cleared that sugar beet did not produce profitable crop under shortage of nitrogen. Nevertheless, high N levels decrease sucrose content and hence increased the content of molasses forming compounds, especially the amount of alpha amino N **Vandergeten and Venstallen (1991)**. Meantime, additional rates of nitrogen fertilizer were accompanied by gradual and significant increases in yields and quality. **El Hinnawy *et. al.* (2002)** and **Shafika and El Masry (2006)** found that increasing nitrogen rates from 60 up to 100 kg/fed significantly increased root growth and yield traits, while declined juice quality traits. **Neamet Alla (2004)** reported that there was a non significant effect on root length by applying 20, 40 and 60 kg N/fed. While, increasing N level from 90 to 140 kg/fed did not affect sucrose. High mineral nitrogen levels are being added to sugar beet in order to maximize its productivity in clay soils **(Abou Zeid and Osman 2005**). **Leilah *et. al.* (2005)** found that adding 250 kg N/ha (100 kg N/fed) produced the highest values of length, diameter and fresh weight of roots, foliage fresh weight as well as root, top and sugar yields/ha under the newly reclaimed soil in Egypt. **Pytlarzkozicka (2005)** showed that increase of nitrogen level from 90 to 180 kg/ha caused a significant increase in average root weight, potassium and nitrogen contents in roots, but it lowered sugar content. High nitrogen levels are recommended in sandy soils, but are subjected to leaching losses causing water pollution **(Aly *et. al.* 2009)**. **Abd El-Aal *et. al.* (2010)** revealed that nitrogen level of 120 kg/fed maximized yield productivity, root weight, root and sugar yield. However, juice impurities were increased as nitrogen level increased to 140 kg N/fed. A gradual decrease in sucrose% was observed by the increase nitrogen level over 80 kg/fed. **Osman *et. al.* (2010)** found that nitrogen fertilizer at 100 kg/fed recorded the highest root and sugar yields which amounted to 29.5, 2513 and 5.50, 4.65 t/fed, respectively in both seasons. The present study aimed to evaluate five suger beet verieties grown in newly reclaimed soil fertilized by three nitrogen levels.

MATERIALS AND METHODS

Two field experiments were conducted at Koum Ousheem district, El-Gomhoria village, El-Fayoum Governorate during 2009/2010 and 2010/2011 seasons. The soil of experimental site has a sandy loam texture (chemical and mechanical analysis are presented in Table 1). Five multigerm sugar beet varieties were used in this study as shown in Table (2).

Table (1) : Mechanical and chemical analysis of the experimental site in 2009/2010 and 2010/2011 seasons.

Mechanical and chemical analysis	Seasons	
	2009/2010	2010/2011
Clay %	30.5	31.1
Silt %	22.8	23.4
Sand %	46.7	46.5
pH	8.3	8.2
Available N (p.p.m)	8.1	8.3

Table (2) : Varieties and their origin country

No.	Variety	Country of origin
1	Oscar poly	Denmark
2	Desprez poly N	France
3	Pleno	France
4	Nejma	Sweden
5	H-poly	Sweden

In each experiment, a split plot design with three replications was used. Main plots were devoted for nitrogen fertilization levels (100, 120 and 140 kg N/fed) and sugar beet varieties were arranged in the sub plots. Plot size was 16.8 m^2 consists of 4 rows (60 cm apart) and 7 m long (1/250 for fed.). Planting dates were carried out on October 3rd and 5th in the 1st and 2nd seasons, respectively. Nitrogen fertilizer was added in the form of ammonium nitrate (33.5% N) in two equal doses, the first was added after thinning at 4-leaf stage and the other dose was after 3 applied 30 days later. The other recommended agricultural practices for growing sugar beet were followed. At harvest, two guarded rows were taken from each plot to determine root yield/fed. A sample of ten roots was taken randomly from each plot to estimate the following characteristics i.e. root fresh weight/plant, root length (cm) and diameter (cm) thereafter, analyzed for sucrose and impurities % (Na, K and α- amino N%). Sugar polarization (Sucrose %) was polarimetrically determined on a lead acetate extract of fresh macerated root according to **Le Docte (1927)**. Sodium and potassium were determined using Flame Photometer as described by **Page (1982)**. Alpha amino nitrogen was determined according to the method of **Carruthers *et al.* (1962)**. Sugar yield (ton/fed) = Root yield (ton/fed) x sucrose %. Data were statistically analyzed according to **Snedecor and Cochran (1981).**

RESULTS AND DISCUSSION

1. Varietal differences:

The obtained results in Table (1) clear that varieties significantly differed in root growth traits, sucrose%, root and sugar yields and impurities contents in both seasons. Oscar poly variety was superior in root length over the other varieties followed by Desprez poly N and then Pleno. Otherwise, Nejma and H poly varieties attained the lowest values of root length in both seasons. These results may be due to the genes expressions of varieties. These results are agreement with those obtained by **Osman *et al* (2003), Aly (2006), Azzazy *et al* (2007)** and **Enan *et al* (2009).**

Table 1: Variation in root growth, yields, quality% and impurities% traits at harvest in 2009/2010 and 2010/2011 seasons.

Traits	Root growth traits			Quality %	Yields (t/fed)		Impurities%		
2009/2010									
Varieties	**Root length (cm)**	**Root diameter (cm)**	**Root fresh weight (g)**	**Sucrose %**	**Root yield (t/fed)**	**Sugar yield (t/fed)**	**N%**	**Na%**	**K%**
Oscar poly	30.48	13.41	1278	15.47	32.05	4.96	1.97	1.75	5.85
Pleno	27.79	13.33	1286	14.93	31.59	4.72	1.89	1.66	5.49
Desprez poly N	28.65	13.91	1298	15.47	32.98	5.10	1.90	1.80	5.40
Nejma	27.09	13.12	1287	15.80	32.18	5.08	1.75	1.58	5.00
H poly	26.97	12.52	1271	15.53	32.32	5.02	2.05	1.90	5.65
LSD 5%	**0.61**	**0.31**	**21**	**0.21**	**0.91**	**0.06**	**0.02**	**0.04**	**0.19**
2010/2011									
Oscar poly	29.17	13.53	1300	15.72	32.84	5.16	2.02	1.86	5.75
Pleno	26.64	13.19	1313	15.04	30.31	4.56	1.70	1.78	5.39
Desprez poly N	27.08	13.92	1295	16.33	33.77	5.51	1.80	2.02	5.15
Nejma	25.63	12.89	1145	16.58	31.25	5.18	1.51	1.70	4.90
H poly	26.37	12.74	1319	15.76	32.29	5.09	1.95	2.07	5.50
LSD 5%	**0.81**	**0.52**	**26**	**0.11**	**0.73**	**0.04**	**0.02**	**0.02**	**0.09**

Root diameter of Desprez poly N variety out weighed the other varieties. This was true in both seasons with an exception compared with the other varieties in the in the 2nd season where Oscar poly variety had root diameter similar to the increase that of Desprez poly N. This increase in root diameter may be attributed to the gene make up of varieties. Similar results were reported by **Leilah *et al* (2005), Azzazy *et al* (2007), Enan *et al* (2009)** and **El-Sheikh *et al* (2009).**

The differences between varieties in root fresh weight were insignificant except the case of Desprez poly N with H poly variety where there was significant difference for this trait. Sucrose percentage was variable between varieties in both seasons and the highest value was recorded for Nejma variety while the lowest value was obtained by Pleno. These results coincide with those finding recorded by **Aly (2006), Azzazy *et al.* (2007)** and **El-Sheikh *et al.* (2009).**

Varieties were significantly different in root and sugar yields/fed in the 1st and 2nd seasons. Desprez poly N variety surpassed the other varieties in root and sugar yields, where it attained 32.98 and 5.10 t/fed. in the 1st season, respectively. The corresponding values were 33.77 and 5.51 t/fed. in the 2nd season, respectively. Otherwise, Pleno variety attained the lowest for root and sugar yields/fed in both seasons. These differences may be due to the varietal genetic make up. These results are in line with those obtained by **Aly (2006), Azzazy *et al* (2007),** and **Enan *et al* (2009).**

Impurities content were significantly variable between varieties in both seasons. Nejma variety recorded the lowest impurities content compared with the other varieties. Similar results were found by **Aly (2006)** and **Enan *et al* (2009).**

Table 2: Effect of nitrogen fertilizer levels on growth traits, yields, quality% and impurities% at harvest in 2009/2010 and 2010/2011 seasons.

Traits	Root growth traits			Quality %	Yields (t/fed)		Impurities%		
2009/2010									
Nitrogen fertilizer levels (kg/fed)	**Root length (cm)**	**Root diameter (cm)**	**Root fresh weight (g/plant)**	**Sucrose %**	**Root yield (t/fed)**	**Sugar yield (t/fed)**	**N%**	**Na%**	**K%**
100	28.50	13.00	1170	16.10	30.23	4.87	1.45	1.34	5.07
120	29.60	14.40	1185	15.29	32.38	4.95	1.70	1.54	5.35
140	30.30	15.00	1453	14.93	34.06	5.09	1.98	1.73	5.45
LSD 5%	**0.40**	**0.31**	**11**	**0.29**	**0.81**	**0.02**	**0.03**	**0.06**	**0.07**
2010/2011									
100	29.40	14.75	1289	16.56	30.56	5.06	1.35	1.40	4.55
120	30.70	15.15	1367	15.85	32.09	5.09	1.75	1.72	5.18
140	32.20	16.20	1399	15.25	33.63	5.13	1.90	1.80	5.30
LSD 5%	**0.12**	**0.18**	**13**	**0.17**	**0.62**	**0.02**	**0.03**	**0.08**	**0.05**

2. Nitrogen levels effect:

Data presented in Table (2) indicate that nitrogen levels significantly affected all the studied characteristics in both seasons. It was noticed that increasing N levels up to 140 kg N/fed caused increases in all the studied traits except sucrose% which was reduced by increasing N levels. The increases are amounted by 1.8-cm, 2-cm and 283 g/plant in the 1st season for root length, root diameter and root fresh weight corresponding to 2.8-cm, 1.45-cm and 110 g/plant in the 2nd season, respectively. These results may be attributed to N role in excessive vegetative growth; increase in root length, diameter and then root fresh weight. These findings coincide with those obtained by **Leilah *et al.* (2005)**, **Pytlarzkozicka (2005)** and **Abd El-Aal *et al.* (2010).**

Otherwise, the reduction in sucrose was noticed when N level was increased up to 140 kg/fed, it may be due to the fact that increasing applied N resulted increasing water retention by the tap root and intern decrease sucrose% of root fresh weight **(Draycott, 1972).** This result is agreement with those reported by **Leilah *et al.* (2005)**, **Pytlarzkozicka (2005)** and **Abd El-Aal *et al.* (2010).**

Yields of roots and sugar per feddan were increased by increasing N levels up to 140 kg/fed in both seasons. The increases were 2.15 and 1.68 t for roots and 0.08 and 0.14 t for sugar when N level increased from 100 to 120kg and from 120 to 140 kg N/fed in the 1st season, respectively. Corresponding to 1.53 and 1.54 t for roots and 0.03 and 0.04 t for sugar/fed in the 2nd season, respectively. These increments in yields of roots could be due to the excessive vegetative growth i.e length, diameter and root fresh weight by increasing N level up to 140 kg N/fed. Also, the increments of sugar yield could be attributed to increase sucrose% and root yield. These results are coinciding with those obtained by **Leilah *et al.* (2005)**, **Pytlarzkozicka (2005)** and **Abd El-Aal *et al.* (2010).**

Impurities content was increased by increasing N levels up to 140 kg N/fed. These increases in impurities were decreased quality% as sucrose% and decreased sugar yield as final product. This result is in line with those obtained by **Oldfield *et al*. (1979), Vendergeten and Venstallen (1991)** and **Leilah *et al.* (2005).**

C- Significant interactions:

Results obtained in Table (3) show that sucrose%, root yield and sugar yield were significantly affected by the interaction between varieties and N levels in both seasons. For sucrose%, was noticed that adding 100 kg N/fed gave the highest value of sucrose% especially for the Nejma variety (16.93 and 17.10%) in the 1st and 2nd seasons, respectively. Otherwise, increasing N level up to 140 kg N/fed decreased sucrose% in all varieties especially for Pleno variety (14.19 and 14.50%) in the 1st and 2nd seasons, respectively. These results could be attributed to the gene make up of varieties and the role of N element which increase impurities content in roots and then decrease quality%.

Table 3: Interaction between varieties and nitrogen fertilizer levels on quality and yields at harvest in 2009/2010 and 2010/2011 seasons.

Traits	Sucrose%			Root yield (t/fed)			Sugar yield (t/fed)		
2009/2010									
Fertilizer levels (kg/fed)									
Varieties	100 kg	120 kg	140 kg	100 kg	120 kg	140 kg	100 kg	120 kg	140 kg
Oscar poly	15.47	15.70	15.24	30.60	32.51	33.05	4.73	5.10	5.04
Pleno	15.91	14.68	14.19	30.00	31.92	32.85	4.77	4.69	4.66
Desprez poly N	16.02	15.44	14.95	30.68	32.32	35.95	4.91	4.99	5.37
Nejma	16.93	15.36	15.11	30.20	31.85	34.50	5.11	4.89	5.21
H poly	16.16	15.26	15.16	29.68	33.32	33.95	4.80	5.08	5.15
LSD 5%		0.10			0.17			0.04	
2010/2011									
Oscar poly	16.53	15.51	15.12	31.90	32.40	34.23	5.27	5.03	5.18
Pleno	15.87	14.75	14.50	28.37	31.26	31.30	4.50	4.61	4.54
Desprez poly N	17.10	16.52	15.37	32.35	33.55	35.40	5.53	5.54	5.44
Nejma	17.19	16.67	15.88	28.94	31.55	33.25	4.97	5.26	5.28
H poly	16.13	15.78	15.36	31.22	31.67	33.98	5.04	5.00	5.22
LSD 5%		0.20			0.19			0.05	

For root yield, it was cleared that adding 140 kg N/fed for Desprez poly N variety attained the highest value of roots yield compared to the other interactions in the 1st and 2nd seasons, respectively. On the other hand, adding 100 kg N/fed to H poly variety recorded the lowest root yield in the 1st season only and Pleno variety only in the 2nd season, respectively. The increase in root yield may be due to excessive vegetative growth criteria length, diameter and fresh weight of individual root which all may be due to different responecs of the tested varieties those controlled by their genetic make up.

For sugar yield, it was noticed that increasing N level up to 140 kg N/fed with Desprez poly N variety gave the highest yield of sugar by 5.37 t/fed, meanwhile adding 120 kg N/fed with Desprez poly N variety gave the highest value of sugar yield by 5.54 t/fed in the 1st and 2nd seasons, respectively.

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استجابة بعض التراكيب الوراثية لبنجر السكر للسماد النيتروجينى تحت ظروف الاراضى حديثة الاستصلاح.

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أجريت تجربتان حقليتان فى موسمى ٢٠٠٩/٢٠١٠، ٢٠١٠/٢٠١١ فى قرية الجمهورية بمركز كوم اوشيم بمحافظة الفيوم. بهدف دراسة استجابة ٥ أصناف من بنجر السكر وهى اوسكار بولى – ديسبريز بولى ان – بلينو – نجما – اتش بولى لثلاثة مستويات من التسميد النيتروجينى هى ١٠٠ و ١٢٠ و ١٤٠ كجم ن/فدان.

اوضحت النتائج ما يلى: زادت معنويا صفات النمو مثل قطر الجذر، وزن الجذر الغض/نبات ومحصول الجذور/فدان في الصنف ديسبريز بولي ان، بينما تفوق الصنف نجما معنويا في صفات النسبة المئوية للسكروز وحاصل الجذور/فدان وأيضا انخفاض النسب المئوية للشوائب في الموسمين.

ادى زيادة مستوى التسميد النيتروجينى حتى ١٤٠ كجم نيتروجين/فدان الى تعظيم قيم الانتاجية المتمثلة فى متوسط وزن الجذر وحاصل الجذور والسكر للفدان بينما استمرت الزيادة فى الشوائب. وعلى العكس من ذلك فقد لوحظ انخفاض تدريجى فى النسبة المئوية للسكروز بزيادة مستوى التسميد النيتروجينى مقارنة بالمستوى الاقل (١٠٠ كجم ن/ف). كما لوحظ اختلاف كبير بين الاصناف المستخدمة فى الانتاجية وصفات الجودة. كما اوضحت النتائج انه تحت ظروف هذه الدراسة ومن واقع التداخل بين عاملى الدراسة ان التسميد النيتروجينى بمعدل ١٤٠ كجم نيتروجين/فدان كان كافيا تماما لمعظمة انتاجية السكر بالطن/ف عن طريق زيادة محصول الجذور. سجل التفاعل بين الصنف ديسبريز بولي ان ومستويات التسميد النيتروجيني حتي ١٤٠ كجم نيتروجين/فدان أعلي القيم في حاصلا الجذور السكر/فدان تحت ظرف هذة الدراسة يمكن معظمة انتاجية أصناف بنجر السكر بإمداد كافي من مستويات نيتروجين فيما بين ١٢٠-١٤٠ كجم/فدان.