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EFFECT OF NITROGEN FERTILIZATION AND HARVESTING DATES ON SUGAR BEET PRODUCTIVITY AND QUALITY IN NEWLY RECLAIMED SANDY SOILS

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ABSTRACT

Two field experiments were carried out at Kalabsho Experimental Farm, Dakahlia Governorate, Sugar Crops Research Institute, Agricultural Research Center, during 2009/2010 and 2010/2011 seasons, to evaluate the effect of nitrogen fertilizer levels (100, 120, and 140 kg N/fad), three split applications of nitrogen fertilizer (two, three and four equal doses) and harvesting dates (180, 195 and 210 days after sowing) on productivity and quality of sugar beet cv. Gazelle. Increasing nitrogen fertilizer levels from 100 to 140 kg N/fad significantly increased root fresh weight, root length and diameter, root and sugar yields/fad in both seasons. The inverse was true in total soluble solids (TSS), sucrose and purity percentages in both seasons. Splitting nitrogen fertilizer from 2 to 4 equal doses significantly increased root fresh weight, root length and diameter, TSS %, purity % and root and sugar yields/fad in both seasons. On the other hand, it decreased sucrose % in both seasons. Delaying harvesting date from 180 to 210 days after sowing significantly increased all studied characters, except for root juice purity in both seasons. Splitting 140 kg N/fad into four equal doses and harvesting at 210 days after sowing are the suitable treatment to maximize sugar beet productivity and quality under the environmental conditions of the newly reclaimed sandy soils of Kalabsho region, Dakahlia Governorate.

Keywords: Sugar beet, *Beta vulgaris L*, nitrogen fertilizer levels, nitrogen split application, harvesting dates, yield, quality.

INTRODUCTION

Aiming to increase productivity of each unit area cultivated with sugar beet became necessary to maximize its usefulness and also to share in diminishing the wide gap between consumption and production of sugar. Developing high yielding varieties and its high demand for agricultural practices and other production input is necessary. Thereby, nitrogen fertilizer levels and its split application as well as harvesting dates are among these factors that enhance sugar beet productivity.

Nitrogen is referred as balance wheel of sugar beet nutrition because of the fact that the efficiency of other nutrients is based on it, as well as sugar beet productivity and quality. In this concern, El-Geddawy *et al.* (2006) found that increasing nitrogen doses from 60 up to 100 kg/fad significantly increased root length and diameter as well as root and top yields/fad, while sucrose and purity percentages were significantly decreased. Seadh *et al.* (2007) found that increasing nitrogen fertilizer levels from 50 up to 125 Kg N/fad significantly increased root and foliage fresh weight, root length and diameter, root/top ratio as well as root, top and sugar yields/fad, TSS, sucrose and purity percentages in both seasons. Seadh (2008) showed that application the highest level of nitrogen fertilizer (150 kg N/fad) produced the highest values of root and top yields and its components in both seasons. While, fertilizing beet plants with 125 kg N/fad came in the second rank with respect to these characters and resulted in the highest values of sugar yield in both seasons. Optimum means of sucrose and purity percentages were obtained with 75 kg N/fad in both seasons. Shewate *et al.* (2008) found that application of 180 Kg N/ha gave maximum root weight, root length and root yield. Abdel-Motagally and Attia (2009) observed that increasing nitrogen significantly increased root fresh weight and sugar yield (t/ha) of sugar beet. Abdou *et al.* (2009) stated that increasing nitrogen levels from 60 to 80 and 100 kg N/fad significantly increased root weight, root length and diameter as well as both root and sugar yields/fad in both seasons. On the other hand, it significantly decreased TSS, sucrose and purity percentages in the two seasons. El-Sarag (2009) concluded that increasing nitrogen fertilizer rates from 60 to 120 kg N/fad substantially improved most of the studied growth criteria and root yield. Meanwhile, adding 100 kg N/fad gave the optimum sugar yield. The highest sucrose and purity percentages were gained with the lowest nitrogen fertilizer rate (60 kg N/fad). Sarhan *et al.* (2012) reported that fertilizing sugar beet plants with 80 kg N/fad significantly increased root and sugar yields and its components as well as TSS % and markedly recorded the highest values of these characters. Nitrogen fertilizer at the level of 60 kg N/fad produced the highest values of sucrose and apparent juice purity percentages. Seadh (2012) showed that increasing NPK levels from 50 up to 100 % of the recommended dose (80 kg N + 30 kg P_2O_5 + 48 kg K_2O/fad) significantly affected root fresh weight, root length and diameter, TSS, sucrose and apparent purity percentages, root, top and sugar yields. Application 100 % of the recommended dose of NPK was the most effective treatment on these traits. Sharaf (2012) concluded that maximum values of all growth characters, yield components, quality and yields resulted by using the highest rate of nitrogen (120 kg N/fad), compared with other rates (80 and 100 kg N/fad). Seadh *et al.* (2013) noticed that nitrogen fertilizer levels significantly affected yield components as well as root, top and sugar yields/fad. Raising nitrogen levels accompanied with obvious increase in all studied characters. Application of 100 kg N/fad resulted in the highest values of all studied characters. Application of 80 kg N/fad came in the second rank *i.e.* it produced the best results after aforementioned (100 kg N/fad) level in both seasons.

Splitting nitrogen fertilizer application is necessary for maximizing nitrogen uptake efficiency, economy of application, root yield as well as sugar yield per unit area. Nitrogen fertilizer must be applied either near the time of planting or side dressing early in the season, reducing the time between nitrogen application and nitrogen uptake which allows less opportunity for nitrogen to be leached out of the root zone, denitrified, or incorporated into soil microorganisms and either by-products. There are many investigations related with splitting of nitrogen application. In this respect, Basha (1998) found that application of nitrogen fertilizer at three equal doses (at sowing + at 35 and 65 days from sowing) resulted in the highest root fresh weight/plant and root yield (t/fad). Abdou (2000) pointed out that splitting nitrogen into four equal parts (at 45, 60, 75 and 90 days after sowing) in sandy soil resulted in the highest root length and diameter, root fresh weight, purity % as well as root and sugar yields/fad. On the other hand, splitting nitrogen fertilizer into two equal doses (at 45 and 60 days after sowing) associated with the highest sucrose and TSS percentages. Nemeat Alla (2001) concluded that application of 90 kg N/fad in two equal doses, at 4 and 8-leaf stages, gave the highest root yield (t/fad), while those plants received nitrogen fertilizer in a single dose, at sowing, produced the highest sucrose and juice purity percentages and sugar yield per faddan. Abo EL-Wafa (2002) showed that adding nitrogen fertilizer dose at three equal parts (before the first, second and third irrigations) was responsible for producing an economical yield of sugar beet. Sarhan and Ismail (2003) found that adding nitrogen fertilizer dose at two equal portions, after thinning and one month later, produced the highest fresh and dry yields of fodder beet roots (t/fad).

With respect to harvest dates; Abo El-Magd *et al.* (2003) stated that harvesting sugar beet after 210 days from sowing produced the highest values of root length and diameter, root weight/plant as well as root and sugar yields/fad, while reduced TSS %, sucrose % and purity % in both seasons. El-Geddawy *et al.* (2003) reported that root diameter, root fresh weight, TSS %, purity % and root and sugar yields/fad were positively increased by delaying harvest date up to 210 days after sowing. Aly (2006) found that delaying the harvest date up to 210 days after sowing significantly increased root length and diameter, root weight/plant, sucrose % and root and sugar yields/fad. The highest value of purity % was obtained with harvesting at 190 days after sowing. Abdou *et al.* (2009) reported that delaying harvest dates from 170 to 190 and 210 days after sowing significantly increased root length and diameter, root fresh weight/plant, TSS %, sucrose % and purity % as well as, root and sugar yields/fad in the two seasons.

So, this study was conducted in a newly reclaimed sandy soil to find out not only the best nitrogen level, but also its suitable splitting and the perfect date of harvesting.

MATERIALS AND METHODS

This investigation was carried out at Kalabsho Experimental Farm, Dakahlia Governorate, Sugar Crops Research Institute, Agricultural Research Center, during 2009/2010 and 2010/2011 seasons, to study the effect of nitrogen fertilizer levels, its split application and harvesting dates on productivity and quality of sugar beet "cv. Gazelle".

A split-split-plot design with four replicates was used in the two seasons. The main plots were assigned to three nitrogen fertilizer levels (100, 120 and 140 kg N/fad), the sub-plots to the three split application of nitrogen (two equal doses at the first and second irrigations, three equal doses at the three sequent irrigations and the sub sub-plots four equal doses at the four sequent irrigations and the sub sub-plots he three harvest dates (180, 195 and 210 days after sowing). Nitrogen in the form of urea (46.5% N) was applied as formerly mentioned levels.

Each sub sub-plot included five ridges, 60 cm apart and 3.5 m length, occupying an area of 10.5 m^2. Soil samples were taken at random from the experimental field area at a depth of 0-30 cm from soil surface and prepared for both mechanical and chemical analysis, according to Jackson (1973).The results are presented in Table 1.

Table 1: Mechanical and chemical soil properties at the experimental site during the two growing seasons.

Soil analysis		2009/2010 season	2010/2011 season
A: Mechanical properties:			
Fine sand (%)		3.40	4.00
Coarse sand (%)		68.00	67.30
Silt (%)		18.00	18.30
Clay (%)		10.60	10.40
Texture		Loamy sand	Loamy sand
B: Chemical analysis			
Soil reaction pH		7.20	7.50
Available N (ppm)		28.40	25.6
Available P (ppm)		11.00	10.8
Exchangeable K (ppm)		100.00	95.50
Fe (ppm)		3.40	3.31
Mn (ppm)		0.90	0.85
Zn (ppm)		2.20	2.15
Cu (ppm)		0.50	0.48
Soluble cations meq/100 g soil	Ca^{++}	0.44	0.43
	Mg^{++}	0.42	0.45
	Na^{+}	0.89	0.96
	K^{+}	0.04	0.05
Soluble anions meq/100 gsoil	CO_3^{--}	0.00	0.00
	HCO_3^{-}	0.90	0.95
	Cl^{-}	0.71	0.82
	SO_4^{--}	0.20	0.21

Calcium super phosphate (15.5 % P_2O_5) at the rate of 31 kg P_2O_5/fad was applied during soil preparation. Potassium sulphate (48 % K_2O) at the rate of 24 kg/fad was applied before ridging.

Sugar beet balls were sown using dry sowing method in the last week of October in both seasons. Irrigation was applied after sowing immediately. Plants were thinned to secure one plant/hill at 40 days after sowing. Plants were kept free from weeds, which were manually controlled by hand hoeing for three times. Other cultural practices were done as usual.

At each harvesting date, ten guarded plants were randomly taken from the two outer ridges of each sub-plot to determine root fresh weight, root length, and root diameter. Total soluble solids (TSS %) was measured in juice of fresh roots by using Hand Refractometer. Sucrose percentage (%) was determined Polarimetrically on lead acetate extract of fresh macerated roots according to the method of Carruthers and OldField (1960). Apparent purity percentage (%) was determined as a ratio between sucrose % and TSS % of roots (Carruthers and OldField, 1960).

At each harvest date, plants that produced from the two inner ridges of each sub-plot were collected and cleaned. Roots and tops were separated and weighed in kilograms, then converted to estimate root yield (t/fad). Sugar yield (t/fad) was calculated by multiplying root yield by sucrose percentage.
All obtained data were statistically analyzed according to the technique of analysis of variance for the split split-plot design as outlined by Gomez and Gomez (1984) using facilities of "MSTAT-C" computer software package. Revised Least Significant of Differences (RLSD) method was used to compare the differences between treatment means at 5% level of probability as described by Waller and Duncan (1969).

RESULTS AND DISCUSSION

1- Effect of nitrogen fertilizer levels:

Data in Table 2 show a positive relations between nitrogen fertilizer levels and root fresh weight, root length and diameter and root yield/fad in both seasons. On the other hand, each increase in nitrogen fertilizer level from 100 to 140 kg N/fad caused a gradual decrease in total soluble solids (TSS), sucrose and purity percentages in both seasons. Adding the highest level of nitrogen fertilizer (140 kg N/fad) recorded the highest values of root fresh weight (594.7 and 572.9 g), root length (23.6 and 23.6 cm), root diameter (9.2 and 9.5 cm), root yield (17.521 and 17.054 t/fad) and sugar yield (2.914 and 2.837 t/fad) in the first and second seasons, respectively. On the other hand, the highest values of TSS % (23.33 and 23.48 %), sucrose % (18.8 and 18.6 %) and purity % (80.8 and 79.4 %) in the first and second seasons, respectively were obtained by adding the lowest level of nitrogen fertilizer (100 kg N/fad). The increment in root fresh weight, root length and diameter as well as root and sugar yields/fad were found with increasing nitrogen levels up to 140 kg N/fad may be due to the role of nitrogen in encouragement of canopy growth that produced more photosynthetic products translocated to roots. This means good photosynthesis and more dry matter production. While, the decreases in total soluble solids (TSS), sucrose and purity percentages associated with the increases in nitrogen fertilizer levels from 100 up to 140 kg N/fad may be due to the role of nitrogen through the increases of cells size and its water content and thus root content of TSS become little through the dilution and helps plants to elongate its vegetative growth and delay maturity. Increasing nitrogen level up to 140 kg/fad helps plants to elongate its vegetative growth and delay maturity. So, big amounts of photosynthetic products pass through the new vegetative parts and thus decrease the storage of sucrose in roots in general it is know that sucrose generally forms more than 70 % of TSS in root. Increasing nitrogen fertilizer levels increased the other soluble solids according to the fact that uptake nitrogen and ∞–amino nitrogen content of the sugar beet root juice increase with increasing nitrogen levels. The aforementioned results generally are in good agreement with those stated by El-Geddawy *et al.*

(2006), Seadh *et al.* (2007), Abdou *et al.* (2009), Sarhan *et al.* (2012), Seadh (2012) and Seadh *et al.* (2013).

2- Effect of the split application of nitrogen fertilizer:

Results listed in Table 2 show that the split application of nitrogen fertilizer had significant effects on all studied characters in both seasons, except for juice purity % in the first season only. Increasing the number of the equal doses application of each nitrogen fertilizer level from 2 to 3 and 4 times resulted in gradual increases in root fresh weight, root length and diameter as well as root and sugar yields/fad. On the other side, it decreased quality parameters *i.e.* TSS, sucrose and purity percentages. The highest values of root fresh weight (587.7 and 570.2 g/plant g), root length (22.1 and 22.0 cm), root diameter (9.1 and 9.3 cm), root yield (17.365 and 16.919 t/fad) and sugar yield (2.974 and 2.871 t/fad) in the first and second seasons, respectively were recorded with adding nitrogen fertilizer into four equal portions (at the four sequent irrigations). While, adding nitrogen fertilizer into two equal portions (at the first and second irrigations) gave the highest values of TSS (22.6 and 22.9 %), sucrose (18.2 and 18.2 %) and purity (80.6 and 79.4 %) in the first and second seasons, respectively. The gradual increase caused by splitting nitrogen fertilizer from two, three up to four equal portions may be due to minimizing the loss of nitrogen by leaching in these sandy soils, where this investigation was carried out and saving suitable amounts of nitrogen as plants need during the different stages of life duration. While, the reduction in the percentages of TSS, sucrose and juice purity in sugar beet roots caused by splitting nitrogen fertilizer from two, three or four equal portions may be due to the fact that delaying the application of nitrogen fertilizer helps plants to elongate its vegetative growth and delay maturity, so big amounts of photosynthetic products pass through the new vegetative parts and thus decrease the storage of sucrose in roots. More, the splitting of nitrogen fertilizer doses in many times increased the root size and consequently makes dilution in sucrose % that reduced. These findings are in harmony with those reported by Basha (1998), Abdou (2000), Nemeat Alla *et al.* (2001), Abo El-Wafa (2002) Sarhan and Ismail (2003).

3- Effect of harvesting dates:

Data illustrated in Table 2 show that delaying harvesting date from 180 to 195 and 210 days after sowing had gradual significant increases in all studied characters during both growing seasons. The gradual increases in all studied characters associated with delaying harvesting dates from 180 to 195 and 210 days after sowing may be due to the long duration from sowing until harvesting that helped in formation of strong canopy that helped roots to grow more by providing them with photosynthetic products besides all that they absorbed from soil for a long time. Similar results were reported by El-Geddawy *et al.* (2006), Aly (2006) and Abdou *et al.* (2009).

4- Effect of interactions:

4.1- The interaction between nitrogen fertilizer levels and its split application:

Data listed in Table 3 show that root fresh weight, root and sugar yields/fad in both seasons and root length and total soluble solids (TSS) in the first season were significantly affected by the interaction between nitrogen fertilizer levels and its split application. The highest values of root fresh weight (664.1 and 646.6 g/plant), root yield (19.696 and 19.203 t/fad) and sugar yield (3.232 and 3.119 t/fad) in the first and second seasons, respectively and the highest value root length (25.3 cm) in the first season were obtained by fertilizing sugar beet plants with 140 kg N/fad in four equal portions at the four sequent irrigations. While, the highest value of total soluble solids (24.0 %) in the first season was obtained by fertilizing sugar beet plants with 100 kg N/fad in two equal portions at the first and second irrigations.

4.2- The interaction between nitrogen fertilizer levels and harvesting dates:

Results presented in Table 4 show that total soluble solids (TSS), sucrose % and sugar yield were significantly affected by the interaction between nitrogen fertilizer levels and harvesting dates in both seasons. The highest values of TSS % (25.2 and 24.9), sucrose % (20.5 and 19.9) and sugar yield (3.356 and 3.085 t/fad) in the first and second seasons, respectively were obtained by fertilizing sugar beet plants with the lowest level of nitrogen fertilizer (100 kg N/fad) and harvesting at 210 days after sowing.

4.3- The interaction between nitrogen fertilizer split application and harvesting dates:

Results presented in Table 5 cleared that sucrose % was significantly affected by the interaction between nitrogen fertilizer split application and harvesting dates in the second season. The highest value of sucrose (19.3 %) was obtained from sugar beet plants fertilized with nitrogen fertilizer in two equal portions at the first and second irrigations after thinning and harvested at 210 days from sowing.

It could be concluded that fertilizing with 140 kg N/fad in four equal portions at the four sequent irrigations and harvesting at 210 days after sowing for maximizing sugar beet productivity and quality under the environmental conditions of Dakahlia Governorate.

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Table 3: Root fresh weight, root length, total soluble solids (TSS), root and sugar yields as affected by the interaction between nitrogen fertilizer levels and its split application.

Treatments		Root fresh weight (g/plant)		Root length (cm)	TSS (%)	Root yield (t/fad)		Sugar yield (t/fad)	
		I	II	I	I	I	II	I	II
100 kg N/fad	Two equal doses	493.7	463.3	18.5	23.9	14.672	13.745	2.888	2.663
	Three equal doses	515.8	491.6	19.6	23.1	15.246	14.626	2.883	2.731
	Four equal doses	544.1	510.8	20.4	22.9	16.003	15.110	2.925	2.733
120 kg N/fad	Two equal doses	526.6	489.1	19.6	22.7	15.484	14.455	2.848	2.643
	Three equal doses	536.6	511.6	20.1	21.4	15.879	15.174	2.739	2.599
	Four equal doses	555.0	553.3	20.6	21.2	16.397	16.444	2.766	2.760
140 kg N/fad	Two equal doses	523.3	497.5	21.5	21.3	15.375	14.972	2.601	2.589
	Three equal doses	596.6	574.1	24.0	20.9	17.493	16.985	2.910	2.804
	Four equal doses	664.1	646.6	25.3	20.8	19.696	19.203	3.232	3.119
F. test		*	*	*	*	*	*	*	*
RLSD (5 %)		26.1	22.1	1.1	0.8	0.781	0.652	0.132	0.123

Table 4: Total soluble solids (TSS), sucrose percentages and sugar yield as affected by the interaction between nitrogen fertilizer levels and harvesting dates during 2009/2010 (I) and 2010/2011 (II) seasons.

Treatments		TSS (%)		Sucrose (%)		Sugar yield (t/fad)	
		I	II	I	II	I	II
100 kg N/fad	180 DFS	21.0	21.5	16.8	16.9	2.366	2.304
	195 DFS	23.7	24.0	19.2	19.0	2.974	2.738
	210 DFS	25.2	24.9	20.5	19.9	3.356	3.085
120 kg N/fad	180 DFS	20.7	21.2	16.4	16.4	2.370	2.356
	195 DFS	22.0	22.2	17.7	17.5	2.865	2.708
	210 DFS	22.5	22.6	18.2	18.0	3.118	2.938
140 kg N/fad	180 DFS	20.5	21.3	16.1	16.3	2.582	2.592
	195 DFS	21.0	21.6	16.7	16.7	2.932	2.851
	210 DFS	21.4	21.8	17.0	16.9	3.229	3.069
F. test		*	*	*	*	*	*
RLSD (5 %)		0.6	0.8	0.5	0.4	0.132	0.143

Table 5: Sucrose percentages as affected by the interaction between nitrogen splitting application and harvesting dates during 2010/2011 season.

Nitrogen doses	Harvest dates		
	180 DFS	195 DFS	210 DFS
Two equal doses	16.8	18.7	19.3
Three equal doses	16.5	17.7	18.4
Four equal doses	16.1	17.2	18.0
F. test	*		
RLSD (5 %)	0.5		

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تأثير التسميد النيتروجينى ومواعيد الحصاد على إنتاجية وجودة بنجر السكر فى الأراضى الرملية حديثة الإستصلاح

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أقيمت تجربتان حقليتان بأرض التجارب البحثية التابعة لمعهد بحوث المحاصيل السكرية بناحية قلابشو – مركز بلقاس – محافظة الدقهلية خلال موسمى ٢٠٠٩/٢٠١٠ و٢٠١٠/٢٠١١م بغرض دراسة تأثير ثلاث مستويات من السماد النيتروجينى (١٠٠ ، ١٢٠ و١٤٠ كجم N/فدان) وتجزئة إضافتها أ) الإضافة على دفعتين متساويتين ، ب) الإضافة على ثلاث دفعات متساوية ، ج) الإضافة على أربع دفعات متساوية وكذلك ثلاثة مواعيد للحصاد (بعد١٨٠ ، ١٩٥ و٢١٠ يوماً من الزراعة) على إنتاجية وجودة بنجر السكر صنف جازيلى. نفذت التجارب فى تصميم القطع المنشقة مرتين فى أربع مكررات. ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى:

أدت زيادة مستويات النيتروجين من ١٠٠ إلى ١٤٠ كجم N/فدان إلى زيادة معنوية فى الوزن الطازج للجذر ، طول وقطر الجذر وكذلك محصولى الجذور والسكر بالطن/فدان فى كلا الموسمين. بينما ادت زيادة مستويات النيتروجين إلى نقص معنوى فى النسبة المئوية لكل من المواد الصلبة الذائبة الكلية والسكروز والنقاوة خلال الموسمين.

أدت زيادة عدد مرات إضافة النيتروجين من دفعتين إلى أربع دفعات متساوية إلى زيادة معنوية تدريجية فى الوزن الطازج للجذر ، طول وقطر الجذر وكذلك محصولى الجذور والسكر بالطن/فدان فى كلا الموسمين. كما أدت نفس المعاملة إلى نقص معنوى فى النسبة المئوية للمواد الصلبة الذائبة الكلية والسكروز بالجذور خلال الموسمين وكذلك النسبة المئوية للنقاوة فى الموسم الثانى.

أدى تأخير ميعاد الحصاد من ١٨٠ إلى ١٩٥ وحتى ٢١٠ يوماً من الزراعة إلى زيادة معنوية تدريجية لجميع الصفات تحت الدراسة عدا النسبة المئوية للنقاوة بالجذور.

أظهرت النتائج المتحصل عليها وجود تفاعل معنوى بين مستويات السماد النيتروجينى و عدد مرات إضافته فى صفات الوزن الطازج للجذر و محصولى الجذور والسكر بالطن/فدان فى كلا الموسمين وكذلك صفتى طول الجذر (سم) و النسبة المئوية للمواد الصلبة الذائبة الكلية فى الموسم الأول كانت أفضل النتائج لجميع هذه الصفات هو إضافة السماد النيتروجينى بمعدل ١٤٠ كجم N/فدان على أربعة دفعات متساوية، ما عدا النسبة المئوية للمواد الصلبة الذائبة الكلية فإن أكبر قيمة لها فى الموسم الأول نتجت من خلال التسميد النيتروجينى بمعدل ١٠٠ كجم N/فدان عندما أضيفت على دفعتين متساوتين.وجد تفاعل معنوى بين مستويات السماد النيتروجينى و مواعيد الحصاد لصفات النسبة المئوية للمواد الصلبة الذائبة الكلية والسكروز بالجذور وكذلك محصول الجذور بالطن/فدان فى كلا الموسمين. ونتجت أفضل القيم لتلك الصفات من التسميد النيتروجينى بمعدل ١٤٠ كجم N/فدان والحصاد بعد ٢١٠ يوماً من الزراعة. وجد تفاعل معنوى بين عدد مرات إضافة السماد النيتروجينى و مواعيد الحصاد لصفة النسبة المئوية للسكروز بالجذور فى الموسم الثانى فقط ، حيث كانت أكبر قيمة لمحتوى الجذور من السكر عند إضافة السماد النيتروجينى على دفعتين متساوتين والحصاد عند ٢١٠ يوماً من الزراعة.

توصى هذه الدراسة بتسميد بنجر السكر بالسماد النيتروجينى بمعدل ١٤٠ كجم N / فدان على أربع دفعات متساوية قبل الرية الأولى والثانية والثالثة والرابعة والحصاد بعد ٢١٠ يوماً من الزراعة للحصول على أعلى إنتاجية وجودة للمحصول تحت ظروف منطقة قلابشو بمحافظة الدقهلية.

قام بتحكيم البحث

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Table 2: Root fresh weight, root length and diameter, total soluble solids (TSS), sucrose and purity percentages as well as root and sugar yields as affected by levels and time of nitrogen fertilizer and harvesting dates during 2009/2010 (I) and 2010/2011 (II) seasons.

Characters Treatments	**Root fresh weight (g)**		**Root length (cm)**		**Root diameter (cm)**		**TSS (%)**		**Sucrose (%)**		**Purity (%)**		**Root yield (t/fad)**		**Sugar yield (t/fad)**	
Seasons	**I**	**II**	**I**	**II**	**I**	**II**	**I**	**II**	**I**	**II**	**I**	**II**	**I**	**II**	**I**	**II**
A- Nitrogen fertilizer levels:																
100 kg N/fad	517.9	488.6	19.53	19.1	8.6	8.7	23.3	23.4	18.8	18.6	80.8	79.4	15.307	14.494	2.899	2.709
120 kg N/fad	539.4	518.0	20.1	19.6	8.8	9.0	21.7	22.0	17.4	17.3	80.1	78.8	15.920	15.358	2.784	2.667
140 kg N/fad	594.7	572.7	23.6	23.6	9.2	9.5	21.0	21.5	16.6	16.6	79.1	77.3	17.521	17.054	2.914	2.837
F. test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
RLSD (5 %)	15.4	10.1	0.8	0.7	0.2	0.3	0.1	0.2	0.3	0.3	1.3	1.4	0.339	0.293	0.073	0.056
B- Split application of nitrogen fertilizer:																
Two equal doses	514.5	483.3	19.8	19.8	8.7	8.8	22.6	22.9	18.2	18.2	80.6	79.4	15.177	14.391	2.779	2.632
Three equal doses	549.7	525.8	21.2	20.6	8.9	9.1	21.8	22.1	17.5	17.4	80.2	78.5	16.206	15.595	2.844	2.711
Four equal doses	587.7	570.2	22.1	22.0	9.1	9.3	21.6	21.9	17.1	17.0	79.2	77.5	17.365	16.919	2.974	2.871
F. test	*	*	*	*	*	*	*	*	*	*	NS	*	*	*	*	*
RLSD (5 %)	15.1	12.8	0.62	0.8	0.2	0.3	0.2	0.3	0.3	0.4	-	1.4	0.455	0.377	0.078	0.073
C- Harvesting dates (days from sowing):																
180	503.0	493.0	19.2	19.5	8.6	8.5	20.7	21.3	16.4	16.5	79.2	77.7	14.842	14.613	2.439	2.417
195	556.2	526.3	21.3	20.8	8.9	9.1	22.3	22.6	17.8	17.7	80.1	78.6	16.421	15.639	2.924	2.766
210	592.7	560.0	22.6	22.0	9.2	9.5	23.0	23.1	18.6	18.3	80.6	79.1	17.485	16.653	3.234	3.030
F. test	*	*	*	*	*	*	*	*	*	*	NS	NS	*	*	*	*
RLSD (5 %)	13.8	13.7	0.9	0.7	0.2	0.2	0.3	0.3	0.3	0.2	-	-	0.434	0.419	0.073	0.084
D- Interactions:																
A X B	*	*	*	NS	NS	NS	*	NS	NS	NS	NS	NS	*	*	*	*
A X C	NS	NS	NS	NS	NS	NS	*	*	*	*	NS	NS	NS	NS	*	*
B X C	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	NS	NS	NS
A X B X C	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

*** and NS indicate that P < 0.05 and not significant.**