The Effect of Levels and Time of N Application on Yield and Quality of Transplanted Sugar Beet

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ABSTRACT

Sugar beet seedlings were field transplanted to determine sugar beet yield and quality as affected by levels and time of N application. Paper pots were used to produce sugar beet seedlings to avoided the losses in seedling through germination stage and to razing the density of plants as well. Two field experiments were carried out at Sakha Agric. Res. Station , Kafr El-Sheikh Governorate during 1999/2000 and 2000/2001 seasons, to study the effect of levels and time of nitrogen fertilizer application on yield and quality of transplanted sugar beet. A split-plot design with three replications was used. The levels of N were applied in the main plots, meanwhile, the times of nitrogen application were allocated in sub plots. Tuning of plants was at four true leaves stage for C.V. Rasploy in both seasons. The obtained results showed that, the highest dose of nitrogen (120 Kg/fed) gave the highest root yield and however, with lowest sucrose %, total soluble solids in term (T.S.S.) and purity percentage. It was also noticed that there was no significant effect for levels N fertilization on top, sugar yield and Top/root ratio in booths seasons where as, time of nitrogen application significantly affected root yield, sucrose %, T.S.S. and purity percentage in both seasons while, top yield and sugar yield significantly affected in the first and second season respectively. Top/ root ratio was not affected in both seasons.

INTRODUCTION

Nowadays, sugar beet (*Beta vulgaris* L.) has been introduced as a new sugar crop in Egypt to be the second source for sugar production after sugar cane. The aim was to decrease the gap between sugar production and sugar consumption. Soil and irrigation water are two limiting factors to cultivate the two crops per year on the same area. Thus, it is favourable to choose crop of low water requirement and short season. Sugar beet is preferable to satisfy these requirements

In fact, here exists a national desire for increasing sugar production to meet the increasing demand for sugar consumption. As a field crop, it has many factors, which have dried effect on sugar yield, density and nitrogen fertilization are two from these factors on sugar extraction. Therefore, transplanting and time of application became target to many investigators (Gibbons, 1984; Hollowell, 1986; Younts *et al.,* 1986; Burcky, 1988; Lumnan *et al.,* 1991 and Heath and Eleal, 1992). Transplanting is a method of increasing the yield (Prichard & Longley, 1916). As early as 1916, it was reported that transplantation of sugar beet eliminated hand thinning, which was necessary with direct seeding, and produced a higher yield (Prichard & Longley, 1916). However sugar beet transplanting has not been accepted in the U.S. on a filed production scale. The reason most after cited by growers, is the unavailability of a ready to use sugar beet transplanting system method. However, a complete

transplanting has been developed in Japan (Smith *et al.*,1988). Gibbons (1984) observed that transplanting sugar beet by paper pots out yielded conventionally drilled by 20-25% and improved quality of roots as sugar yield by 2 tons/ha. Hollowell, (1986) reported that sugar beet transplantation at 4 true leaf stage gave the highest large beet and quality than direct sowing. Younts *et al.*, (1986) found that sugar beet transplanted by paper pots increased sugar yield than direct sowing method. Burcky (1988) observed that transplanting sugar beet gave higher plant population, increased sugar yield by 1.4-4 tons/ha specially after late planting. Lunnan *et al.*, (1991) conducted that fertilization of sugar beet transplanted with 240 Kg N/ha. increased mean sugar yield from 4.92 to 7.62 tons/ha. El-Geddawy *et al.*, (1997) showed that sugar beet fertilized by 70 Kg N/fed and applied at equal dose after transplanting and after 90 days from sowing gave the highest root and sugar yields than direct sowing, the superiority id due to the high density for transplantation.

The objective of this investigation was to determine the relationship between levels, times of nitrogen fertilizer application on yield and quality of transplanted sugar beets.

MATERIALS AND METHODS

Tow field experiments were conducted at Sakha Agric. Res. Station. Kafr El Sheikh Governorate. Treatments were arranged in Split-plot design with three replications, the main plot included the three levels of nitrogen 80,100 and 120kg N/fed. Meanwhile, the four time of nitrogen application were allocated in the sub-plots, as follow.

A=1/2 dose of N at transplanting+1/2 at 90day from sowing .

B=1/2 dose of N after 30 days from transplanting+1/2 at 90day from sowing .

C=1/3dose of N at transplanting +2/3 at 90 day from sowing

D=2/3 dose of N at transplanting + 1/3 at 90 day from sowing

Sugar beet cultivar (Raspoly) was sowing in ridge 50 cm , apart and 20 cm between hills, plot area was 14 m^2. The recommended dose of P (15kgP_2O_5/fed) and K (48 kg K_2O/fed) were added. Sowing date was during 1st and 2nd week of October in 1999/2000 and 2000/2001 seasons, respectively. Other cultural practices were carried out as recommended. At harvest, tow guarded rows were harvested, yield and quality were determined. A sample of ten sugar beet root was taken at random for chemical analysis and the following data were recorded:

1- Total soluble solids percentage in term (T.S.S.) determining by using hand refractometer .
2- Sucrose % was determined by using saccharometer according to Le Docte (1927)
3- Purity % was calculated according to the following equation

purity % =(sucrose % / T.S.S %) X 100

4- Theoretical sugar yield was calculated according to the following equation

Sugar yield (ton/fed) = root yield (ton/fed) X sucrose %

treatments means were compared at 5% level of probability according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Data reported in Table (1) showed that the highest values of root yields were 25.13 and 28.62 ton/fed. in the first and second season respectively resulted from fertilization with 120 K N/fed.. while, splitting dose of N at transplanting and at 90 days from sowing significantly increased root yield (25.73 and 29.22 ton/fed.) during the 1st and 2nd seasons, respectively. These results are in agreement with those obtained by Gibbons (1984), Garg (1985), Heath (1992) and El-Geddawy (1997) since they found that application of nitrogen early with transplanting sugar beet significantly affected on root yield. Meanwhile , the top yields were not significantly affected under the different levels of N fertilizer application during both seasons, the highest values of top yield was recorded with highest dose of nitrogen 120 Kg per feddan 6.81 and 7.45 ton/fed. During 1999/2000 and 2000/2001, respectievly On the other hand, significant differences were recorded on top yield of sugar beet plant as a result of early application of nitrogen fertilizer with high dose which encourage vegetative growth for top and gave the highest Top yield (6.49 /fed.) than late of nitrogen application (5.13 ton/fed.) 30 days after transplanting. In addition the interaction of levels and time of nitrogen application had no significant effect on root and top yield of sugar beet plant during both seasons of the study (Table 1).

Data presented in Table (2) indicated that sucrose percentage decreased significantly by increasing levels of N application to sugar beet in the first season only. 120 Kg/fed. significantly decreased sucrose % by 6.52, 5.62% than 80 and 100 Kg N/fed.-while, in the second season nitrogen levels had no significant effect on sucrose percentage. In additions, time of nitrogen application significantly affected sucrose percentage and the highest values of sucrose content (21.89 and 21.42%) in the 1st and 2nd seasons, respectively . These results are agreed with those obtained by Lunnan (1991) and EL-Geddawy (1997.

It is worth mentioning that increasing nitrogen fertilizer level up to 120 Kg/fed. gave the highest sugar yield (5.18 and 5.79 ton/fed.) in the 1st and 2nd seasons respectively. But the differences were not great enough to reach the 5% level of significance. The time of nitrogen application significantly increased sugar yield in the second season only and recorded the highest yield (5.89 ton/fed.) when nitrogen dose splitting at equal doses at transplanting and at 90 days from sowing (as a recommendation). Similar results were obtained by EL-Geddawy (1997) found that applied nitrogen fertilizer at equal dose for transplanted sugar beet gave the highest sugar yield. The same trend of the

present results was noticed by Smith (1988), Imura *et al.* (1993) and El-Geddawy (1997). They reported that applied nitrogen for sugar beet transplanted as equal doses or early application due to high sugar yield than another treatments. Data reported in Table 2 cleared that the interaction of levels and time of nitrogen application had no significant effect on sucrose percentage and sugar yield of transplanted sugar beet.

Effect of levels and time of nitrogen application on total soluble solids and purity percentage are shown in Table (3). It is clear that the high nitrogen levels significantly reduced T.S.S from 22.93 to 21.74% in the first season and from 19.81 to 19.19% in the second season. In contrast, time of nitrogen application significantly increased T.S.S. ,when applied at 2 equal doses one after month from transplanting and the other after 90 days from transplanting and gave the highest values 22.72% and 20.48% in 1999/2000 and 2000/2001 , respectively. El-Gedawy (1997) reported that applied .70 Kg N/fed. as equal dose gave the highest T.S.S. . The data reported in Table, 3 showed also that purity percentage significantly affected by level and time of nitrogen application. This finding was true in both seasons. Increasing nitrogen levels from 80 To 120 Kg/fed.. Reduced purity percentage from 96.28 to 94.60% and from 95.46 to 94.40% during 1999/2000 and 2000/2001 seasons respectively. Whereas, time of N application recorded the highest purity 95.89% and 95.60 in both seasons respectively when the first dose of nitrogen fertilizer 30 days from transplanting by delaying the application.

Data obtained in Table (4) showed that increasing nitrogen fertilizer levels from 80 to 120 kg N /fed. Under both applications ; 1/2 at 30 days from transplanting + 1/2 at 90 days from sowing and 2/3 at transplanting + 1/3 at 90 days from sowing ; increased top/root ratio during both seasons of the study , but the differences were not great enough to reach the 5% level of significance

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Table 1. Effect of levels and time of nitrogen application on root and top yields of transplanted sugar beet.

Rates of N (kg/fed)	Time of nitrogen application									
	A	B	C	D	mean	A	B	C	D	Mean
	Root yield					Top yield				
	First season									
80	24.20	19.40	21.80	20.80	21.55	6.40	4.20	5.60	5.80	5.50
100	25.20	20.20	23.40	22.80	22.90	6.90	5.10	5.90	6.67	6.14
120	27.80	22.40	25.70	24.60	25.13	7.53	6.10	6.60	7.00	6.81
Mean	25.73	20.67	23.63	22.73		6.28	5.13	6.03	6.49	
L.S.D. at 0.05 for Rates of Nitrogen					N.S.					N.S.
Time of N applications					3.62					0.77
Interaction					N.S.					N.S.
	Second season									
80	26.72	22.40	25.60	24.48	24.80	6.80	6.20	6.60	6.40	6.50
100	29.12	23.68	28.64	25.60	26.76	7.20	6.40	6.90	6.80	6.83
120	31.83	25.40	30.17	27.09	28.62	7.90	7.00	7.60	7.30	7.45
Mean	29.22	23.83	28.14	25.72		7.30	6.53	7.03	6.83	
L.S.D. at 0.05 for										
Rates of Nitrogen					0.88					N.S.
Time of N applications					3.19					N.S.
Interaction					N.S.					N.S.

A= 1/2 at transplanting + 1/2 at 90 days from sowing
B= 1/2 after 30 days from transplanting + 1/2 at 90 days from sowing.
C= 1/3 at transplanting + 2/3 at 90 days from sowing
D= 2/3 at transplanting + 1/3 at 90 days from sowing

Table 2. Effect of levels and time of nitrogen application on sucrose percentage and sugar yield of transplanted sugar beet

Rates of N	Time of nitrogen application									
	A	B	C	D	mean	A	B	C	D	Mean
	Sucrose %					Sugar yield (ton/fed.)				
	First season (1999- 2000)									
80	21.85	22.32	21.92	22.27	22.09	5.28	4.33	4.79	4.63	4.76
100	21.43	22.32	21.35	22.12	21.81	5.37	4.50	5.22	5.12	5.05
120	20.06	21.04	20.49	21.00	20.65	5.58	4.71	5.26	5.17	5.18
Mean	21.11	21.89	21.25	21.80		5.41	4.51	5.09	4.97	
L.S.D. at 0.05 for										
Rates of Nitrogen					0.72					N.S.
Time of N applications					0.34					N.S.
Interaction					N.S.					N.S.
	Second season (2000/2001)									
80	20.34	21.64	20.44	20.75	20.79	5.43	4.85	5.27	5.01	5.14
100	20.11	21.50	20.21	20.53	20.58	5.86	5.08	5.81	5.17	5.48
120	20.01	21.12	20.20	20.33	20.41	6.37	5.36	6.03	5.40	5.79
Mean	20.15	21.42	20.28		20.62	5.89	5.10	5.70	5.19	
L.S.D. at 0.05 for										
Rates of Nitrogen					N.S.					N.S.
Time of N applications					0.40					0.54
Interaction					N.S.					N.S.

A= 1/2 at transplanting + 1/2 at 90 days from sowing
B= 1/2 after 30 days from transplanting + 1/2 at 90 days from sowing.
C= 1/3 at transplanting + 2/3 at 90 days from sowing
D= 2/3 at transplanting + 1/3 at 90 days from sowing

Table 3. Effect of levels and time of nitrogen application on total soluble solids and purity percentages of transplanted sugar beet.

Rates of nitrogen	Time of nitrogen application									
	A	B	C	D	Mean	A	B	C	D	Mean
	Total soluble solids					Purity percentage				
	First season (1999/2000)									
80	22.73	23.15	22.71	23.11	22.93	96.13	96.42	96.17	96.38	96.28
100	21.97	23.15	23.18	23.27	22.89	95.84	96.42	96.43	96.49	96.31
120	21.29	21.85	21.68	22.15	21.74	94.24	94.83	94.50	94.81	94.60
Mean	22.00	22.72	22.52	22.84		95.4	95.89	95.70	95.89	
L.S.D. at 0.05 for										
Rates of Nitrogen					0.70					0.45
Time of N applications					0.34					0.21
Interaction					N.S.					N.S
	Second season (2000- 2001)									
80	19.37	20.77	19.62	19.47	19.81	95.21	96.00	95.35	95.27	95.46
100	19.12	20.62	19.33	19.10	19.54	95.07	95.92	95.19	95.13	95.33
120	18.84	20.04	18.84	19.05	19.19	94.20	94.88	94.20	94.32	94.4
Means	19.11	20.48	19.26	19.21		94.82	95.6	94.91	94.91	
L.S.D. at 0.05 for										
Rates of Nitrogen					0.40					0.22
Time of N applications					0.41					0.23
Interaction					N.S.					N.S.

A= 1/2 at transplanting + 1/2 at 90 days from sowing
B= 1/2 after 30 days from transplanting + 1/2 at 90 days from sowing.
C= 1/3 at transplanting + 2/3 at 90 days from sowing
D= 2/3 at transplanting + 1/3 at 90 days from sowing

Table 4. Effect of levels and time of nitrogen application on top/ root ratio of transplanted sugar beet.

Rates of nitrogen	Time of nitrogen application									
	A	B	C	D	Mean	A	B	C	D	Mean
	Top / root ratio					Top / root ratio				
	First season (1999/2000)					Second season (2000/2001)				
80	27.56	21.98	27.31	27.82	26.17	25.48	27.85	25.76	26.29	26.35
100	27.96	25.38	25.51	29.01	26.97	24.88	27.10	24.57	27.65	26.04
120	28.05	27.42	25.70	28.51	27.42	24.86	28.86	25.30	27.05	26.52
Mean	27.86	24.93	26.17	28.45		25.07	27.94	25.20	27.00	
L.S.D. at 0.05 for										
Rates of Nitrogen					N.S.					N.S
Time of N applications					N.S.					N.S
Interaction					N.S.					N.S

A= 1/2 at transplanting + 1/2 at 90 days from sowing
B= 1/2 after 30 days from transplanting + 1/2 at 90 days from sowing.
C= 1/3 at transplanting + 2/3 at 90 days from sowing
D= 2/3 at transplanting + 1/3 at 90 days from sowing

الملخص العربي

تأثير معدلات ومواعيد أضافه السماد الآزوتي على محصول وجودة البنجر المشتول

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أقيمت تجربتان حقليتان في محطة البحوث الزراعية بسخا - محافظة كفر الشيخ في الموسمين الزراعيين ١٩٩٩/٢٠٠١ ، ٢٠٠٠/٢٠٠١ وذلك بغرض دراسة تأثير ثلاث معدلات من التسميد الآزوتي ٨٠، ١٠٠، ١٢٠ وحدة نيتروجين/ فدان وكذلك أربعة توليفات مختلفة لمواعيد إضافة السماد الآزوتي على البنجر المشتول بالأصص الورقية Paperpots . نظرا لأهميه شتل بنجر السكر بهذه الطريقة لزيادة الكثافة النباتية لوحدة المساحة تحت ظروفنا المحلية التي تعانى من نقص الكثافة النباتية لاسباب عديدة ومختلفة والشتل بهذه الأصص سوف يعالج جزء من هذه المشكلة ولذا وجب القيام بمزيد من البحوث في هذا المجال وقد استخدم تصميم القطع المنشقة مرة واحدة في ثلاث مكررات وزعت معدلات السماد الآزوتي في القطع الرئيسية بينما وزعت مواعيد الإضافة التالي ذكرها في القطع الشقية:

١. ١/٢ الكمية بعد الشتل مباشرة + ١/٢ عند ٩٠ يوم من الزراعة
٢. ١/٢ الكمية بعد شهر من الشتل + ١/٢ عند ٩٠ يوم من الزراعة
٣. ١/٣ الكمية بعد الشتل مباشرة + ٢/٣ عند ٩٠ يوم من الزراعة
٤. ٢/٣ الكمية بعد الشتل مباشرة ١/٣ عند ٩٠ يوم من الزراعة

تم زراعة التجارب بالصنف رأس بولي في الأسبوع الأول والثاني من شهر أكتوبر للموسم الأول والموسم الثاني على التوالي وتشير النتائج المتحصل عليها على ان معدلات السماد الآزوتي أدت إلى ظهور تأثير معنوي على محصول الجذور في العام الثاني وعلى نسبة السكروز في العام الأول وعلى كلا من النقاوة ، المواد الصلبة الذائبة الكلية في الموسمين معا، كما كان لمواعيد الإضافة تأثيرا معنويا على كلا من محصول الجذور ونسبة السكروز ونسبة المواد الصلبة الذائبة الكلية وكذلك النقاوة في موسمي الزراعة ، وعلى محصول العرش في العام الأول فقط ومحصول السكروز في العام الثاني فقط. بينما لم يكن هناك تأثيرا معنويا للتفاعل بين مواعيد ومعدلات الإضافة على أي صفه من الصفات تحت الدراسة في كلا الموسمين. كما تشير النتائج ان بنجر السكر الذي تم استجاب لمعدلات التسميد الآزوتي المرتفعة ١٢٠ كجم ن/ف ، كما كان للإضافات المبكرة للتسميد الآزوتي اثر واضح عن الإضافات المتأخرة في كل الصفات التي أظهرت فروقا معنوية .