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EFFECT OF LEVEL AND TIME OF NITROGEN APPLICATION AND HARVESTING DATE ON YIELD AND QUALITY OF SUGAR BEET (*Beta vulgaris* L.)

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ABSTRACT: *Two field experiments were carried out during two successive seasons of 2003/2004 and 2004/2005 at Sakha Agric. Res. Station in Kafr El-Sheikh Governorate to study the effect of nitrogen application and harvesting date on yield and quality of sugar beet. Three nitrogen levels were applied, i.e., 90-120 – 150 kg N/fad. at three times, i.e., 60, 90 and 120 days from sowing. Sugar beet was harvested at three harvesting dates, i.e., 210, 220 and 230 days after sowing. A split split plot design with four replications was used in this experiment. The three nitrogen levels were allocated in the main plots, meanwhile, the three times of nitrogen application were arranged in the sub-plots. The three harvesting dates were arranged randomally distributed, in sub-sub plots.*

Results indicated that, increasing N-level from 90 to 150 kg N/fad. significantly increased values of root diameter as well as root, top and sugar yields per faddan, in top and root fresh weight/plant, the concentration of sodium and potassium and alkaline coefficience. While negative effects were found in dead levels percentage, root length, α-amino nitrogen and purity percentage. Also, increasing nitrogen rate reduced values of sucrose, extractability and extractable sugar percentages. Late application of nitrogen at 120 days after sowing significantly increased top yield, root dimensions, top weight/plant as well as sodium and α-amino nitrogen concentrations in roots. the opposite direction was found in root and sugar yields/fad., root weight/plant, dead leaves percentage as well as sucrose, extractability, extractable sugar, sugar losses to molasses, potassium alkaline coefficient and purity percentages, which reduced when time of nitrogen application was late at 120 days after sowing.

Delaying harvesting date to 230 days after sowing caused significant increases in root and sugar yields, root fresh weight/plant, root dimensions, dead laves percentage %, sodium %, potassium % and alkaline coefficient. On the other hand, early harvesting date gave the lowest values of top yield, top weight per plant, α-amino nitrogen, sucrose %, purity %, extractability and extractable sugar in both seasons.

Significant interaction effects were found between the deferent factors under study on root length, dead leaves, top yield, root yield, sugar yield, sucrose % and extractable sugar percentage.
Generally, it can be concluded that the appllcation of 150 kg N/fad. at 60 DAS and harvesting sugar beet plants at 230 DAS could be recommended for optimum root and sugar yields per unit area under the condition of this investigation.

Key words: DAS days after sowing , amino nitrogen – Dead leaules .

INTRODUCTION

It well known that sugar beet crop represents the second source for sugar production. Improving sugar extraction is considered one of the most important factors affecting in sugar production. Three are many factors, witch have a direct effect on juice extraction. Levels and time of nitrogen application with harvesting dates are three factors from many factors affecting on sugar beet yield and quality. Therefore, nitrogen levels and times of application became target for many investigators. Geweifel (1982) reported that root and sugar yields were increased with delaying harvesting date to 210 days, while it decreased top yield. Nemeat Alla, 1991; El-Kased *et al.*, 1993; Al-Labody, 1998 and Nemeat Alla and El-Geddawy (2001) found that nitrogen doses from 80-140 kg N/fad. appeared significant differences in values of root length and diameter, root and top yields as well as sucrose and purity percentages than other levels.

Chochola (1992) showed that application of 60 kg N/fad. before sowing for sugar beet gave the highest refined sugar yield (8.29 t/ha.), while it decreased with delaying N-application. Bagdonas (1993) revealed that applying all the amount of nitrogen after emergence tended to reduce root sugar content. Zalat (1993) reported that, applying 66% of nitrogen dose at early stage and delaying harvest date till to 210 days from sowing significantly increased root and sugar yields, while it significantly decreased top yield. Gutmans and Nowakowski (1995) concluded that applying 66% of nitrogen rate before sowing and the rest at top dressing with delaying the harvest date increased sucrose percentage and α-amino nitrogen, while it decreased top yield. El-Geddawy, *et al.* (1997) concluded that application of 70 kg N/fad. for sugar beet in two equal doses gave the highest root and sugar yields. Laila *et al.* (1997) found that delaying harvesting date up to 200 days reduced top yield, but increased root and sugar yields; Juice purity and sucrose percentage. Zalat and Ibrahim (2002) showed that lowest sucrose %; Total soluble solids in term of (T.S.S.)

Abou-El-Magd *et al.* (2003) concluded that the highest values of root length and diameter as well as root and sugar yields were recorded when

sugar beet was harvested at 210 days from sowing. Mostafa *et al.*, (2005) reported that N level up to 110 kg N/fad. due to decrease in sucrose %, alkaline coefficient and increasing impurities (Na, K and α-amino N). Shafika *et al.* (2006) found that increasing N up to 110 kg N/fad. decreased (Na, K and amino N) and increased purity and sucrose percentages.

Therefore, the aim of this work was to find out the best nitrogen level and the proper time to application nitrogen fertilization as well as the optimum harvesting date to obtain the maximum yield and the highest quality characteristics of sugar beet.

MATERIALS AND METHODS

Two field experiments were conducted at Sakha Agric. Res. Station at Kafr El-Sheikh Governorate to study the optimum level and application date of nitrogen on yield and quality of sugar beet crop under three harvesting dates. The presented study included 27 treatments, which were the combination of three nitrogen levels, i.e., 90, 120 and 150 kg N/fed., three application dates, i.e., 60, 90 and 120 days from sowing (DAS) and three harvesting times, i.e., 210, 220 and 230 DAS after sowing

A split plot design with 4-replications was used, N-levels were allocated in the main plots, meanwhile the application times were arranged in the sub-plots. The harvesting dates were randomally distributed in sub-sub plots. The preceding crop was maize in the two seasons.

Sugar beet cultivar "KWS 9422" was sowing in ridges 50 cm, apart and 20 cm between hills. Each sub-sub plot included 4 ridges, each 3.5 m in length. The recommended dose of 15 kg P_2O_5/fad. and 48 kg K_2O/fad. were added before sowing during land preparation. Sowing took place on October 6^{th} and 14^{th} in 2003/2004 and 2004/2005 seasons, respectively. Physical and chemical analysis of the upper 30 cm of soil of the experimental site showed that the soil was clay loam containing 27 ppm available N, 16.20 ppm p and K, 280-35 ppm. Other agriculture practices were done as recommended by Sugar Crops search Institute. At harvest, the inner two ridges were harvested to determine yield and its components and quality of roots. A sample of ten sugar beet roots was taken at random for chemical analysis for estimating root dimensions (length and diameter), root and top fresh weight/plant and juice quality.

Juice quality characteristics were determined in the fresh roots using an automatic French system (HYCEL) as follows :

1. Sucrose percentage (pol%) was determined using polarimeter on a lead acetate extract of fresh macerate root according to the method of Le-Doct (1927).

2. Potassium and sodium percentages were determined using flame photometer and α-amino-N was determined using ninhydrin and hydrindantin method according to Carruthers *et al.* (1962).
3. Purity % was calculated according to the following formulas:
   Purity % = 99.36 – [14.27 (V1 + V2 + V3)/V4] (Devillers, 1988).
   Where : V_1 = Sodium % V_2 = Potassium %
   V_3 = α-amino % V_4 = Sucrose % (Pol %)
4. Sugar loss to molasses (SM), sugar extractable and extractability % were calculated according to the following formulas :
   Sugar loss to molasses = $(V_1 + V_2)\ 0.14 + V_3 \times 0.25 + 0.5$, Deviller (1988).
   Extractable sugar % = V4 – SM-0.6, Dexter *et al.* (1967).
   Extractability % = extractable sugar/sucrose %.
   Root fresh weight, root, sugar and top yields were determined as follows:
5. Root fresh weight (kg/plant).
6. Root yield (t./fad.) was determined from the two inner ridges basis.
7. Sugar yield (t./fad.) was calculated according to the following equation.
   Root yield × sucrose % × Purity %

$$\text{Alkaline coefficient} = \frac{V_1 + V_2}{V_3}$$

The analysis of variance was carried out according to Gomez and Gomez (1984). Treatment means were compared using Duncan's multiple rang test (Duncan, 1955). All statistical analysis were performed using analysis of variance technique by means of (M. STAT) computer software package.

RESULTS AND DISCUSSION

1. Root and top fresh weight, root length and diameter and dead leaves % :

Root and top fresh weight (kg/plant), root length and diameter and dead leaves percentage as affected by N-level, time of nitrogen application and harvesting time as well as their interaction are presented in Table (1).

From data presented in Table (1) it can be seen that increasing nitrogen level from 90 to 150 kg N/fad. caused a significant increase in both, root and top fresh weight (kg/plant) as well as root length and diameter. These increases might be due to stimulation effect of nitrogen on building up new cells, cell division and cell enlargement as well as increasing the synthesized compounds that in turn increased number of leaves and root dimensions. On the other hand a significant reduction in dead leaves percentage were found in both seasons. Dead leaves percentage considered a good indicator to maturity degree of sugar beet crop. Similar results were obtained by Bessheit

1995, Nemeat Alla, 1997; Azab *et al.* 2000 and Esmail *et al.* 2005, which reported that nitrogen level significantly increased root fresh weight/plant.

Concerning to the effect of application time of nitrogen fertilizer on the same a for mentioned characters, it be concluded that with late time of nitrogen application from 60 to 120 days after sowing a significant increases in root and top fresh weight/plant, root length and diameter were detected in both seasons. Meanwhile dead leaves percentage was significantly decreased with delaying the time of nitrogen application. Similar results were obtained by Esmail *et al.* (2005), which concluded that 115 kg N/fad. caused a significant effect on root diameter.

Table (1): Root and top fresh weight (kg/plant), Rot length and diameter (cm) and dead levels % of sugar beet plant as influenced by nitrogen level, application time and harvest time in 2003/2004 and 2004/2005 seasons.

Treatments	Root fresh weight (kg/plant)		Top fresh weight (kg/plant		Root length (cm)		Root diameter (cm)		Dead leveas (% plant)	
	Seasons									
	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005
N- level (kg. N/fad.) (A):										
90	0.96b	1.00b	0.26c	0.17	35.98c	26.28c	10.42b	10.01b	38.72a	42.85a
120	1.24a	1.19a	0.30b	0.17	36.27b	29.37a	12.77a	11.71a	36.93b	40.26b
150	1.26a	1.22a	0.37a	0.18	37.52a	29.41a	12.70a	11.98a	36.92b	39.97c
F. test	*	*	**	NS	*	**	*	*	*	*
Application time (B):										
60 DAS	1.06c	0.97c	0.25c	0.16c	34.55c	26.84c	11.59b	11.02b	37.04a	44.19a
90 DAS	1.23b	1.05b	0.28b	0.17b	36.30b	27.71b	12.29a	11.92a	36.71b	41.79b
120 DAS	1.25a	1.19a	0.30a	0.18a	37.92a	28.77a	12.62a	12.20 a	36.83b	40.10c
F. test	*	**	**	*	*	*		*	*	**
Harvesting time (C) :										
210 DAS	0.99c	0.95b	0.41a	0.21a	37.79b	27.96b	11.87b	11.28c	26.64c	38.05c
220 DAS	1.20b	1.03b	0.29b	0.17b	41.12a	28.77a	12.76a	11.66b	38.08b	41.62b
230 Das	1.45a	1.22a	0.23c	0.14b	42.86a	28.74a	12.87a	12.86a	45.86a	46.40a
F. test	**	**	**	**	**	*	**	**	**	*
Interaction effect :										
A x B	ns	ns	ns	ns	ns	**	ns	ns	ns	ns
A x C	ns	ns	ns	ns	ns	ns	ns	ns	**	ns
B x C	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

*, ** and NS indicate P< 0.01 and not significant respectively means of each factor designated by the same letter are not significantly different at 5% level.

It is worth to mentioning that, delaying harvest date from 210 to 230 DAS induced significant increases of root fresh weight/plant; root diamenssions and dead leaves percentage in both seasons (Table 1).

In the opposite direction, dallying the harvesting date up to 230 days significantly decreased top fresh weight/plant from 0.41 and 0.21 to 0.23 and 0.14 kg in both seasons, respectively. similar results were obtained by Geweifel (1982) and Laila (1997).

Data presented in Table (1) show that there were significant interactions between nitrogen level and time of nitrogen application on root length in the second season as well as between nitrogen level and harvesting date on dead leaves percentage on the first season.

Data presented in Table (2) indicate that application of 90 kg N/fad. at 90 DAS gave the highest root length, while 150 kg N/fad. gave the lowest one when it applied at 120 DAS.

Table (2): Root length (cm) as affected by the interaction between N-level and time of nitrogen application on 2004/2005 season.

Applications	N-level (kg/fad.)		
	90	120	150
60 DAS	26.06cd	30.97ab	26.51cd
90 DAS	32.57a	27.64bcd	26.10cd
120 DAS	29.38abc	28.43bcd	25.31d

Means designated by the same letter are not significantly different at 5% level, using Duncan's multiple range test.

Data in Table (3) show that sugar beet plants, which received 90 kg N/fad. and harvested at 230 DAS recorded the highest dead leaves percentage.

Table (3): Dead leaves % plant as affected by the interaction between N-level and harvesting date in 2003/2004 season.

Harvest time	N-level (kg/fad.)		
	90	120	150
210 DAS	26.61e	25.17e	28.14 e
220 DAS	36.20d	41.00 c	37.04 d
230 DAS	73.36a	44.62 b	45.59 b

Means designated by the same letter are not significantly different at 5% level, using Duncan's multiple range test.

2. Top, root and sugar yields/fad.

It is clear from Table (4) that the highest nitrogen level (150 kg N/fad.) significantly increased top, root and sugar yields/fad. to maximum values (8.25, 4.44; 29.42 and 29.76; 3.90 and 3.90 t/fad. in the first and second season, respectively. These observations are in agreement with those reported by Chochala (1992); El-Geddawy (1997); Zalat and Ibrahim (2002); Esmail *et al.* (2005); Mostafa *et al* (2005) and Shafika (2006) obtained a significant increase in root yield with increasing N fertilization from 69 to 115 kg N/fad.

Table (4): Top, Root yield and sugar yields/fad. of sugar beet as influenced by nitrogen level, application time and harvest time in 2003/2004 and 2004/2005 seasons.

Treatments	Top yield (t/fad.)		Root yield (t/fad.)		Sugar yield (t/fad.)	
	Season					
	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005
N- level (kg.N/fad.) (A)						
90	7.16c	3.78b	23.15c	22.74c	3.70c	3.63c
120	7.65b	3.77b	25.93b	25.11b	3.80b	3.70b
150	8.25a	4.44a	29.42a	29.76a	3.90a	3.90a
F. test	**	*	*	*	*	**
Application time (B):						
60 DAS	7.26c	3.61c	26.79a	28.11a	4.10a	4.15a
90 DAS	7.70b	3.83b	24.77b	27.71b	3.50b	3.92b
120 DAS	8.10a	4.26a	21.97a	23.18c	3.13c	3.05c
F. test	*	*	*	**	**	**
Harvesting time (C) :						
210 DAS	8.59a	4.57a	23.18c	24.25c	3.63c	3.79b
220 DAS	7.61b	3.84b	26.68b	26.66b	3.90b	3.81a
230 Das	6.86c	2.99c	30.09a	30.25a	4.03a	3.84a
F. test	**	**	**	*	**	*
Interaction effect :						
A x B	**	ns	ns	ns	ns	ns
A x C	ns	ns	ns	ns	ns	ns
B x C	ns	ns	ns	*	ns	*
A x B x C	ns	ns	ns	ns	ns	ns

*, ** and NS indicate P< 0.01 and not significant respectively.
Means of each factor designated by the same letter are not significantly different at 5% level.

In respect to influence of nitrogen application time. Data in Table (4) pointed out that top yield was significantly increased with increasing time of N-application from 60 to 120 DAS, whereas, there was reflecting effect on root and sugar yields, which significantly recorded with delaying time of nitrogen application in the two seasons. Similar findings were obtained by Bagdonas (1993) and Zalat (1993).

Harvesting date affected significantly top yield/fad. in both seasons Table (4). delaying harvest date to 230 days from sowing recorded pronounced decrease in top yield in both seasons. On the other hand significant increases in root and sugar yields/fad. were observed returned to delaying in harvesting date from 210 to 230 days after sowing in the two seasons of study. These results are agree with those found by Laila, *et al.* (1997) and Abou-El-Magd (2003).

Significant positive interaction effect were found as results of interaction between level and time of nitrogen application on top yield/fad. in the first season as well as between time of nitrogen application and harvesting date on root and sugar yields/fad. in the second season (Table 2).

Application of 150 kg N/fad. at 90 DAS for sugar beet plants gave the highest top yield in the first season (Table 5). Data in the same Table show that adding nitrogen fertilizer for sugar beet plants at 90 DAS and harvested it at 230 DAS recorded the highest root yield in the second season. Sugar beet plants, which received nitrogen fertilizer at 60 DAS and harvested at 210 or 230 DAS gave the highest sugar yield/fad. in the second season (Table 5).

Table (5): Top yield, root yield and sugar yield (t/fad.) as affected by the interaction among N-level, time of nitrogen application and harvesting date in 2003/2004 season.

Application	Top yield (t/fad.) N-level (kg/fad.) in 2003/2004 season		
	90	120	150
60 DAS	7.23 bc	7.48b	7.06bc
90 DAS	5.97 c	7.61b	9.53a
120 DAS	8.27b	7.87b	8.16b
	Root yield (t/fad.) Harvest time (DAS) in 2004/2005 season		
	210	220	230
60 DAS	28.76a	29.17a	27.31ab
90 DAS	25.82b	27.38ab	29.93a
120 DAS	18.19c	20.42c	20.76c
	Sugar yield (t/fad.) Harvest time (DAS) in 2004/2005 season		
	210	220	230
60 DAS	4.72a	4.41ab	3.68c
90 DAS	4.02bc	4.03bc	3.78c
120 DAS	2.73d	2.77d	2.06d

Means designated by the same letter are not significantly different at 5% level, using Duncan's multiple range test.

3. Sodium, Potassium, α-amino-N, alkalinity coefficient and purity percentages:

In both seasons the highest nitrogen level (150 kg N/fad.) gave the highest values of sodium, potassium and Alkaline coefficient where as α-amino-N and purity percentages recorded the lowest values. 0.72; 0.71 and 92.67 and 92.50% respectively. this findings stand in conformity with those recorded by Abou Sheady *et al.* (2002); Esmail *et al.* (2005). They found that increasing nitrogen level to 115 kg N/fad. significantly increased α-amino-N concentration in roots of sugar beet; Mostafa *et al.* (2005) and Shafika (2006).

Application of nitrogen fertilizer at 120 days after sowing ignorantly increased values of sodium and α-amino-nitrogen in both seasons (Table 6). On the other hand, leating application of nitrogen fertilizer at 120 days after sowing significant decreased the concentration of potassium; alkaline coefficient and purity percentage in both seasons.

Table (6): Sodium, Potassium, α-amino-nitrogen, alkaline coefficient (AC) and purity % of sugar beet as influenced by nitrogen level, application time and harvest time in 2003/2004 and 2004/2005 seasons.

Treatments	Sodium %		Potassium %		α-amino-N %		Alkaline coefficient. (AC) %		Purity %	
	Seasons									
	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
N- level (kg. N/fad.) (A)										
90	1.36c	1.33c	4.10c	4.14c	0.69c	0.68c	7.91c	7.90c	94.19a	94.13a
120	1.40b	1.39b	4.21b	4.20b	0.70b	0.70b	8.01b	8.13b	93.61b	93.72b
150	1.50a	1.49a	4.47a	4.62a	0.73a	0.71a	8.17a	8.61a	92.67c	92.50c
F. test	**	**	**	*	*	**	**	**	**	**
Application time (B):										
60 DAS	1.35c	1.39c	4.41a	4.50a	0.68b	0.65c	8.47a	9.06a	93.73a	93.46a
90 DAS	1.40b	1.44b	4.33b	4.25b	0.72a	0.71b	7.96b	8.01b	93.28b	93.33b
120 DAS	1.44a	1.48a	4.05c	4.21c	0.72a	0.73a	7.63c	7.79c	93.25c	93.15c
F. test	**	**	**	*	*	**	**	**	**	**
Harvesting time (C) :										
210 DAS	1.34c	1.31c	4.01c	4.00c	0.69b	0.67c	7.75c	7.93c	94.17a	94.21a
220 DAS	1.40b	1.42b	4.28b	4.25b	0.69b	0.69b	8.08b	8.22b	93.55b	93.45b
230 Das	1.48a	1.50a	4.50a	4.71a	0.74a	0.74c	8.23a	8.39a	92.72c	92.16c
F. test	**	**	**	**	**	**	**	**	**	**
Interaction effect :										
A × B	ns	ns	ns	ns	Ns	ns	ns	ns	ns	ns
A × C	ns	ns	ns	ns	Ns	ns	ns	ns	ns	ns
B × C	ns	ns	ns	ns	Ns	ns	ns	ns	ns	ns
A × B × C	ns	ns	ns	ns	Ns	ns	ns	ns	ns	ns

*, ** and NS indicate P< 0.01 and not significant respectively means of each factor designated by the same letter are not significantly different at 5% level .

The harvesting date significantly affected sodium, potassium, α-amino-N, alkaline coefficience and purity percentages in both seasons (Table 6). Delaying harvest date up to 230 days significantly increased sodium, potassium and α-amino-N, while it significantly decreased alkaline coefficient and purity percentages in the two seasons of study.

The interaction between the three factors under study fialed to exert any significant effect on sodium, potassium, α-amino-N percentage, alkaline coefficient and purity percentage in both seasons (Table 6).

4. Sucrose %, extractable sugar %, Extractable 5 and Sugar losses to molasses (mg/100g):

Highly significant differences were observed in both seasons between mean values of sucrose, extractability, extractable sugar and sugar losses in molasses due to different harvesting times (Table 7). Early harvest at 210 days from sowing gave the highest values of sucrose, extractability and extractable sugar percentages. In the onsite early harvest recorded the lowest sugar losses in molasses. Generally, we can concluded that early harvest date was useful for sugar beet quality.

Table (7): Sucrose %, extractable sugar %, Extractable 5 and Sugar losses to molasses (mg/100g) of sugar beet as influenced by nitrogen level, application time and harvest time in 2003/2004 and 2004/2005 seasons.

Treatments	Sucrose %		Extractable sugar %		Extractable %		Sugar losses to molasses (mg/100 g)	
	Seasons							
	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
N-level (kg.N/fad.) (A):								
90	16.97a	16.95a	14.94a	14.91a	88.04a	87.96a	1.43c	1.44b
120	15.15b	15.77b	13.59b	13.72b	86.84b	87.00b	1.46b	1.45b
150	14.30c	14.18c	12.18c	12.05c	85.17c	84.98c	1.52a	1.53a
F. test	**	**	**	**	**	**	**	**
Application time (B):								
60 DAS	16.33a	15.81a	14.25a	13.72a	87.26a	86.78a	1.48a	1.49a
90 DAS	15.15b	15.14b	13.07b	13.07b	86.27b	86.33b	1.48a	1.47b
120 DAS	14.50c	14.75c	12.45c	12.68c	85.86c	85.97c	1.45b	1.47b
F. test	**	**	**	**	**	**	**	**
Harvesting time (C) :								
210 DAS	16.61a	16.57a	14.59a	14.56a	87.84a	87.87a	1.42c	1.41c
220 DAS	15.64b	16.36b	13.57b	13.29b	86.76b	86.52b	1.47b	1.47b
230 Das	14.45c	13.77c	12.33c	11.62c	85.33c	84.39c	1.52a	1.55a
F. test	**	**	**	**	**	**	**	**
Interaction effect :								
A × B	ns	**	ns	ns	ns	**	ns	ns
A × C	ns	**	ns	**	ns	ns	ns	ns
B × C	ns	ns	ns	**	ns	ns	ns	ns
A × B × C	ns	ns	ns	ns	ns	ns	ns	ns

*, ** and NS indicate P< 0.01 and not significant respectively means of each factor designated by the same letter are not significantly different at 5% level.

The interaction between nitrogen level and nitrogen application date as well as between nitrogen level and harvesting time significantly affected sucrose percentage in the second season (Table 8). Also, the interaction between nitrogen level and harvesting time as well as between time of nitrogen application and harvesting time had a significant effect on extractable sugar percentage in the second season (Table 9).

Application of 90 or 120 kg N/fad. at 60 DAS recorded the highest sucrose percentage in the second season (Table 8). Sugar beet plants, which received 90 kg N/fad. and harvested at 210 DAS gave the highest sucrose percentage in the second season (Table 8).

Table (8): Sucrose % as affected by the interaction between N-level and application time of nitrogen as well as between N-level and harvesting date in 2004/2005 season.

N-level (kg/fad.)	Adding time (DAS)			Harvest time (DAS)		
	60	90	120	210	220	230
90	14.64ab	13.97bc	14.47ab	16.22a	14.57b	12.30d
120	14.95a	13.51c	12.70d	15.06b	13.84c	12.26d
150	11.73e	11.74e	10.75f	12.42d	11.45e	10.36f

Means designated by the same letter are not significantly different at 5% level, using Duncan's multiple range test.

Adding 90 kg N/fad. for sugar beet plants and harvested it at 210 DAS as well as application of nitrogen fertilizer at 60 DAS and harvesting sugar beet plants at 210 DAS resulted in the highest extractable sugar percentage in the second season (Table 9).

Table (9): Extractable sugar % as affected by the interaction between harvesting date and N-level as well as between harvesting date and time of nitrogen application in 2004/2005 season.

Harvest time (DAS)	N-level (kg/fad.)			Adding time (DAS)		
	90	120	150	60	90	120
210	16.22a	15.06b	12.42d	15.37a	14.41b	13.92b
220	14.57b	13.84c	11.45e	14.09b	13.27c	12.50d
230	12.30d	12.26d	10.36f	11.87e	11.55e	11.50e

Means designated by the same letter are not significantly different at 5% level, using Duncan's multiple range test.

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تأثير معدلات ومواعيد إضافة السماد الأزوتى ومواعيد الحصاد على محصول وجودة بنجر السكر

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الملخص العربى

أجريت تجربتان حقليتان فى محطة البحوث الزراعية بسخا – محافظة كفرالشيخ خلال موسمى ٢٠٠٤/٢٠٠٥ وذلك بغرض دراسة أنسب معدل للسماد الآزوتى وأفضل ميعاد لإضافته وكذلك أفضل ميعاد لحصاد نباتات بنجر السكر للوصول الى أعلى محصول وجودة لبنجر السكر.

تم دراسة ثلاث معدلات للسماد الآزوتى وهى ٩٠ – ١٢٠ – ١٥٠ كجم نيتروجين/فدان وقد تم إضافتها فى ثلاث مواعيد هى بعد ٦٠، ٩٠، ١٢٠يوم من الزراعة، كما تم حصاد نباتات بنجر السكر فى ثلاث مواعيد هى بعد ٢١٠، ٢٢٠، ٢٣٠ يوماً من الزراعة. وقد استخدم تصميم القطع المنشقة مرتين فى أربع مكررات حيث وضعت معدلات السماد الأزوتى فى القطع الرئيسية ومواعيد الإضافة فى القطع الشقية الأولى ومواعيد الحصاد فى القطع الشقية الثانية.

أظهرت النتائج أنه بزيادة معدل السماد الأزوتى من ٩٠ الى ١٥٠ كجم نيتروجين/فدان أدت الى زيادة كل من قطر الجذر ومحصول العرش والجذور والسكر للفدان. ونفس التأثير تم ملاحظته لكل من الوزن الطازج لكل من العرش والجذور للنبات وكذلك تركيز كل من الصوديوم والبوتاسيوم وكذا معامل القلوية فى حين كان هناك تأثير سلبى لزيادة معدلات التسميد الأزوتى على النسبة المئوية للأوراق الميته وطول الجذر والنيتروجين الأمينى وكذلك النسبة المئوية للنقاوة.

أدت زيادة معدلات التسميد الأزوتى أيضاً الى نقص نسبة السكروز ونسبة السكروز المستخلص .

أدت الإضافة المتأخرة للسماد الأزوتى عند ١٢٠يوم من الزراعة الى زيادة كل من محصول العرش، قطر وطول الجذر، وزن العرش/نبات وتركيز كل من الصوديوم) والنيتروجين الأمينى فى الجذور. بينما أدت الى نقص كل من محصول الجذور والسكر للفدان، وزن الجذر للنبات، النسبة المئوية للأوراق الميته وكذا النسبة المئوية لكل من السكروز والسكر المستخلص والسكر المفقود فى المولاس ومحتوى البوتاسيوم ومعامل القلوية وكذا النسبة المئوية للنقاوة .

أظهرت النتائج أن الحصاد المتأخر عند ٢٣٠ يوم من الزراعة أعطى زيادة معنوية فى محصول الجذور والسكر للفدان، محصول الجذور الطازج للنبات، قطر وطول الجذور، والنسبة المئوية للأوراق الميته وكذا محتوى كل من الصوديوم والبوتاسيوم ومعامل القلوية. ومن ناحية أخرى فقد أعطى الحصاد المبكر أقل القيم لكل من محصول العرش للفدان، محصول العرش للنبات، محتوى النيتروجين الأمينى، النسبة المئوية للسكروز، النسبة المئوية للنقاوة والسكر المستخلص بكلا موسمى الزراعة .

وعامة يمكن أن نستخلص من هذا البحث أن إضافة السماد الأزوتى لنباتات بنجر السكر بمعدل ١٥٠كجم آزوت/للفدان وذلك بعد ٦٠ يوم من الزراعة وحصاد النباتات عند ٢٣٠ يوم من الزراعة يمكن أن ينصح به للحصول على أعلى محصول من الجذور والسكر لوحدة المساحة .