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Comparative studies of the three nitrogen fertilizers forms as ammonium in sugar beet plants in salt-affected soils under Fayoum condition

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ABSTRACT

To study the effect of nitrogen sources and levels of nitrogen on productivity and quality of sugar beet cv. Gloria, a field experiment was carried out at Fayoum Experimental Farm (clay loam soil), Fayoum Governorate, Soils, Water and Environmental Research Institute, Agricultural Research Center, Egypt, in two successive seasons of 2016/2017 and 2017/2018. Two experiment trails were laid out in a split-plot design with three replications. The main plots were assigned with sources of nitrogen fertilizers (anhydrous ammonia, aqua ammonia and urea) and the sub-plots were arranged in the rates of nitrogen (60, 75 and 90 Kg N/fed). The results showed that anhydrous ammonia significantly increases and recorded the highest value for Chlorophyll A, B, Shoots and roots fresh and dry weight, nitrogen, phosphorus, potassium and sodium uptake and at 120 and 200 days from sowing and root length and volume, sucrose% and sugar yield/fed and the level of the nitrogen found that the addition of 90 kg N/fed gave the highest of Chlorophyll A, B, Shoots and roots fresh and dry weight, nitrogen, phosphorus, potassium and sodium uptake at 120 and 200 days from sowing and root length and volume, and sugar yield/fed. while the addition of 60 Kg N/fed was decreasing this value but was an increase of sucrose % in both seasons compared with other nitrogen sources or with untreated treatment. It can be recommended that injection of anhydrous ammonia to the soil at 90 Kg N/fed maximize sugar beet productivity and quality under the environmental conditions of clay loam soils. Also, an economic analysis was done. Data shows that the highest profit was recorded with anhydrous ammonia which applied with 90 Kg N/fed.

KEYWORDS

Sugar beet, nitrogen sources, nitrogen rates, yields, quality, clay loam soils, economical study.

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1. INTRODUCTIONS

White sugar is considered carbohydrate-rich and therefore an important commodity, both regionally and globally. White sugar is second in the world. White sugar is produced from two major crops, sugar cane and sugar beet, sharing about 67 % and 33 % of total production, respectively, **(FAO 2018).**

In Egypt, sugar beet and sugarcane provide about 69.63% of the local demand for white sugar, while the remainder (30.37%) is imported from foreign countries. Annually, sugar beet is close to 58.9 % of total sugar production (2.25 million tons) compared to sugar cane, which provides 41.1% of total sugar production in Egypt, **(CCSC 2017)**. The world is grown about 4.82 million hectares and produce about 275.48 million ton from sugar beet. **(FAO,2018)** .The crop is also a promising alternative energy crop for the production of ethanol.

In Egypt, the sugar beet was grown in a commercial zone in the year 1982 and now the total area which grown for production in Egypt is 540079 fed and production of it about 1347283 tons of sugar with the rate of 2.5 tons/fed and the total area of sugarcane was 254098 fed and production 1025149 ton of white sugar with the rate of 4.03 ton/fed and from the above production of sugar beet and sugar cane that led to production which it is short duration crop (5-6 months) with high sucrose content (14-20%) while sugar cane is a long duration crop (12-14months) with low sucrose (10-12%) contents and the second point which the requirements of water of sugar cane is high when we compared with sugar beet which consumes about 2943 M^3/fed and for the sugar cane was consumed about 13100 M^3/fed. Especially that water shortage in Egypt, (**ASBAE. (2016)).**

Management techniques of any field crop such as fertilization procedures are else essential to boost crop productivity besides maintaining soil fertility under expected climate changes impacts. Fertilization is a substantially limiting factor to obtain maximum yield and quality, hence adequate supply of nitrogen (N) and micro-nutrients is an important strategy for maximizing sugar beet production **(Kiymaz and Ertek 2015; Mekdad and Rady 2015)**

Nitrogen is one of the major mineral nutrients that acts a necessary function in outgrowth and sugar crops productivity, and its quality indices **(Mahfouz *et al*. 2015; Mekdad and El-Sherif 2016 and Mekdad and Shaaban 2020).** It also Progresses soil water- exploitation efficiency **(Agami *et al*. 2018)**. Notwithstanding, the N is not a component of sucrose as the basic store product in beet crop, its insufficiency performed in sugar yield decrease in a sugar beet crop **(Laufer *et al*. 2016; Piskin 2017)**. However, higher-producing sugar beet crops need adequate N supplies for fast canopy growth **(Malnou *et al* 2006)** to can plants to intercept the full photosynthetically active radiation **(Draycott and Christenson 2003; Manderscheid *et al* 2010),** also helps in root forming to create a large-store capacity **(Wyse 1980)**. Hence, N deficit results in a decreased growth retard the beginning of sugar storage processes, which accounts for about 76% of the root dry weight **(Hoffmann *et al* 2005)**. However, an overdone and/or retard N increments cause plus the production of dark green coloured neglect and shifting in dry matter partition on account of sucrose storage, thereby decreasing sugar yield **(Abdel-Motagally and Attia 2009; Mekdad and Shaaban 2020)** and also increments the impurities (i.e; Na, K, and α-amino-N), which decreases sucrose crystallization from thick juice, and consequently development sugar losses in molasses during the sugar beet manufacture process **(Mekdad and Rady 2016; Mekdad and Shaaban 2020).** Thus, N nutrition must be managed pretty to obtain great root quantity with high sucrose content and least impurities accordingly maximize N-use qualifications **(Koch *et al*. 2016; Piskin 2017)**. Anhydrous ammonia is the most concentrated nitrogen source containing approximately 82% nitrogen. The high concentration, coupled with its being the primary nitrogen made during manufacture, makes it the least expensive nitrogen fertilizer source. Nitrogen exists in the soil as either the nitrate (NO^-_3) anion or the ammonium (NH^+_4) cation. The uptake of either form is influenced by soil pH, temperature, and the presence of other ions in the soil solution. The ammonium cation participates in cation exchange within the soil. Nitrogen is a very mobile nutrient and is subject to loss by volatilization as ammonium or leaching as nitrate if applied appreciably before the crop can take it up. The degree of risk of loss and the loos mechanical, leaching denitrification and volatilization of ammonia depends very much on individual soil and climatic conditions **Jones *et al;* (1991).**

Abashady *et al* (2011) observed that application of ammonia gas compared with urea as a source of nitrogen the ammonia gas was significantly increased root, sugar yield, sucrose and purity % as well as sugar extractable and extractability % and alkaline coefficient in both seasons.

Leilah *et al.* (2007) and Nemeat, Alla (2009) showed that fertilized sugar beet plants cv. Kawamura with urea as N-source enhanced root yield and its components. **Ghazy (2013)** found that urea as a nitrogen source gave higher root and sugar yield per Fadden of sugar beet than ammonium nitrate and ammonium sulphate. **Abd El-Megeed (2017)** concluded that anhydrous ammonia (82%N) has increased significantly the rice plant and its components, chlorophyll contents, dry matter, plant height, no of tiller and no. of panicle compared with urea (46%).

Abu-El-Fotoh and Abu-El-Maged (2006) found that using urea as a source of nitrogen has a significant effect on the quality of sugar beet juice such as sodium and potassium ions, extractable sugar and purity percentage. They added that the highest sucrose % (20.38%, 19.69%) was obtained by the application of urea as a source of nitrogen fertilizer. **Moustafa *et al* (2011)** pointed that when they added nitrogen fertilizer as urea with three rates (60,80 and 100) kg N/fed the Na, K and α-amino nitrogen as impurities, sugar losses to molasses, the yield of root and sugar were increased and juice purity was significantly decreased.

Moursi and Darwish (2014) observed that increasing the nitrogen rate from 30 to 90 kg N/fed to sugar beet plants led to an increase in root yield (ton/fed), top yield (ton/fed), root length (cm), root diameter (cm), sugar yield (ton/fed), N in tops % and N content in root % while sucrose % and purity % were decreased by increasing the nitrogen rate from 30 to 90 kg N/fed all parameter in the first and second season; respectively. **Nemeata alla *et al* (2014)** found that when they added urea with rate 60,75,90 and 105 kg N/ fed the increasing nitrogen level from 60 to 105 kg N/fed significantly increased root dimensions (length and diameter), dry matter accumulation (g/plant), root/top ratio, top yield, root yield per Fadden, sugar yield (ton/fed) and quality parameter such as (TSS%) while the sucrose percentage and juice purity percentage were decreased by increasing nitrogen level from 60 to 105 kg N/fed in both two seasons.

Abbas *et al* (2018) found that when they decreased the nitrogen rate from 100% to 75 % of recommended rate as 120kg N/fed in sandy soils as ammonium nitrate landed to significantly increase the sucrose % from 17.85%to 18.18 and 17.97 to 18.22% in two seasons respectively, on the other hand decreasing nitrogen from 100 to 75 % of recommended rate significantly decreased sugar lost in molasses in two seasons and decreasing nitrogen rate significantly decreased the top yield and also root yield in the two-season, respectively.

(Mekdad, 2015) showed that the sugar beet variety Kawemira has grown in sandy loam soil. When he added two levels of nitrogen 100 and 140 kg N/fed the Results indicated that N levels significantly increased all studied traits, root length and diameter, as well as root, and top fresh weight, also, to yield of the root, top, biological, gross sugar, white sugar and loss sugar, also K, Na and α-amino N. Whereas harvest index was decreased.

Lamani and Halikatti (2019) showed that application of 180 kg N/ha increased yield and the quality parameter such as α-amino-N, K, P and sucrose % were increased significantly while the root to shoot ratio and harvest index did not differ significantly.

Abd El-Motagally (2016) reported that when he adds the nitrogen fertilizer with rate 60, 90 and 120 Kg N/fed and he conducted that applying the N application of 90 kg /fed was the best treatment which increasing the sugar yield by improving the root quality and extractable sugar yields and he found that no significant differences in K accumulation in sugar beet roots in both seasons, the highest mean values of α amino-N content in roots were consistently found in the plants grown in the highest N treat soil at 90 days after planting and similarly the accumulation of Na in sugar beet roots.

Nemeat, Alla *et al.* (2002) indicated that root dimension of sugar beet (root length and diameter) at harvest, as well as dry matter accumulation, were significantly increased by increasing nitrogen fertilizer level from 40 to 90 kg N/fed.

Fadel (2002) found that increasing nitrogen fertilizer rate from 60 to 80 kg N/fed. gave maximum values of root length and diameter.

Badr (2004) found that increasing nitrogen rate from 60 up to 90 kg N/fed. Increased dry weight per plant, (LAI) leaf area index, (CGR) crop growth rate, root length and diameter of sugar beet.

El- Sayed (2005) found that nitrogen fertilizer application at 100 kg N/fed. Produced significantly higher values of root length and root fresh weight while 125 kg N/fed. Increased significantly root diameter and root fresh weight of sugar beet.

Barlog *et al* (2013) stated that application of four nitrogen rates (0,90,120 and 150 kg N/ha) the highest root yield was 150 kg N/ha and the highest top leaves was 120 kg N/ha in sugar beet plants and the polarization with the rate of 90 kg N/ha was the highest treatment and α-amino-N, K, Na and sugar loss to molasses with rate 150 kg N/ha were the highest treatments and all treatments were over the control.

Mostafa, Shafika and **Darwish (2001)** studied the effect of four N levels i.e; 0,45, 75 and 105 kg/fed. On sugar beet. They found that top and root yield was significantly increased with increasing N fertilizer up to 75 kg N/fed.

Mostafa, Shafika and **Darwish (2001)** studied the effect of nitrogen fertilizer levels i.e. 0, 45, 75 and 105kg N/fed. on sugar beet quality. They found that sucrose and purity % of sugar beet were decreased with increasing N-rate up to 105kg N/fed.

Abashady *et al* (2011) found that add three nitrogen levels (70,90 and 105 kg N/fed) to sugar beet the high rate of nitrogen fertilizer lead to increased the root yield, K, Na, α-amino-n in root and sugar yield ton/fed, ratio of top/root and sugar loss to molasses, on the other hand, the sucrose percentage, purity%, extractable sugar %, extractability% and alkalinity coefficient % were decreased in both seasons.

Mahmoud *et al* (2012) showed that on sugar beet plants treatments with rate 60,80 and 100 kg N/fed of nitrogen the juice quality, sucrose, purity, and sugar recovery were decreased as an N-rate increased while sucrose loss to molasses was increased as N rate increased and a substantial increase in root yield 24.9% and 21.5%) and recoverable sugar yield (16.7% and 11.3%) was reported as N rate increased from 60 to 100 kg N/fed in the first and second season, respectively.

The current work aims to compare different sources and rates of nitrogen used in the economic study as well as determining the optimal dose of each nitrogen source, which take the economic yield of sugar beet and reflect on the highest yield with the lowest cost into consideration under Fayoum Governorate conditions.

2.MATERIALS AND METHODS

Two field experiments were carried out during the winter seasons of 2016/2017 and 2017/2018 at the Experimental Station Farm of the Agriculture Research Centre, Tamia Research Station, Fayoum Governorate, Egypt to evaluate the effect of different nitrogen sources (anhydrous ammonia 82%, aqua ammonia 26% and urea 46%), nitrogen rates (Untreated, 60, 75 and 90 kg N/fed) and their interaction on yield and components and chemical constituents of sugar beet (c.v Gloria). A representative soil sample (0-30 cm) was taken before planting to determine some physical, chemical and nutritional properties (Table 1). Nitrogen application sources were as follow: (anhydrous ammonia 82%, Aqua ammonia 26% and urea 46% N), rate of them (Untreated, 60, 75, 90 KG N/fed) were added in three equal doses, Anhydrous ammonia fertilizer (82% N) was injected directly into the soil, at 15 cm depth with 30 cm spacing between the points of injection one week before planting, in soil containing 15% moisture content. Meanwhile, the solid N sources (urea) and liquid nitrogen sources (Aqua ammonia) were applied in three equal doses during the growing season 2016/2017 and 2017/2018. The first one was applied at planting, the second was applied before the first irrigation, where the last dose was applied before the second irrigation.

Potassium was applied as potassium sulphate 48 % K_2O, and phosphorus as calcium superphosphate 15.5% P2O5 at rates of 100 and 50 kg fed-1, respectively before sowing for all plots of the experimental soil.

The experiment was designed as a split-plot arrangement of treatments with three replicated. Sugar beet cultivars were assigned to the main plot; nitrogen fertilization levels were distributed randomly in the sub plots with three replication. The experimental unit area was 10.5 m^2 (1/400fed) (one Fadden = 4200 m^2). Seeds were sown on September 15 and 20 in the 2016 and 2017 seasons, respectively. The preceding summer crop was maize in both seasons.

The soils were analyzed for mechanical and some chemical properties according to **The mechanical analysis** was done according to **Piper (1950)**. **Total calcium carbonate** was determined according to **(Jackson, 1981). Soil organic matter** was determined according to the modified method of Walkley and Black, as described by **Jackson, (1973)**. **pH Soil** was measured in 1:2.5 soil water suspension **according to (Jackson,1981) and EC_e** was measured in saturated soil paste extract according to **(Jackson,1981) Soluble cations (Mg^{+2}, Ca^{+2}, Na^{+} and K^{+})** and soluble anions **(HCO_3^-, CO_3^{-2}, SO_4^{-2} and Cl^-)** were determined in soil paste extract as described by **Page *et al*;(1982). Exchangeable Sodium Percentage (ESP)** was calculated using the following equation as reported by **Richards (1954).**

$$\textbf{ESP} = \frac{Exchangable\ Na\ (meq100\ g-1 \times 100)}{CEC\ (meq\ 100-1)}.$$

Available nitrogen content in soil (mg /kg) was determined by the method described by **Jackson (1973). Available phosphorus** was extracted according to **Olsen *et al.* (1954).** and measured colourimetrically according to **Jackson (1967). Available potassium and sodium were** determined by flame photometrically as according to **Page *et al.* (1982). Boron content in the soil** was extracted using hot water according to **Berger and Truog (1939)** and determined by the Azmothine-H method according to **Bingham (1982). Zinc content in the soil** Available zinc was determined by the method described by **Soltanpour and Workman (1979).**

2.1. Yield and yield component characters:

At 120 days, as well as 200 days of beet cultivation, samples of five plants were randomly taken from the shoot as well as from the roots to estimate the content of both of them from N, P, K, and Na as well as to estimate the dry and fresh weight. At harvest (200 days after sowing) five plants were randomly chosen from the outer ridges of each subplot to estimate yield components characters as follows: 1 - Root length (cm).2 - Root diameter (cm). 3- shoot fresh weight (g /plant). 4- Root fresh weight (g/ plant). 5- shoot dry weight (g/plant).6- root dry weight (g/plant). Sucrose percentage (pol %) was polarimetically determined on a lead acetate extract of fresh macerated root according to the method of **Le- Docte (1927).**

At harvest, plants of all ridges from each sub-sub plot were harvested, cleaned, topped and weighed in addition to the weight of five plant samples.

2.3. Preparation of plant samples for analysis:

The plant part (leaves and roots) was weighed immediately after separation. Plant materials were cut into small portions, dried at 70º C for 24 hours in an aerated oven. After plant samples had become crisp, they were allowed to attain equilibrium with air for a few hours to establish reasonably stable moisture content before being weighed after being weighted. The crud crude dry materials were ground to pass a 60 mesh sieve in an agate ball-mill, and then thoroughly mixed, and a representative sample was stored in tightly stopper glass containers.

2.3.Plant analysis:

Representative portions of 0.5 g of the derived plant materials (shoot and root) were digested with the mixture of concentrated sulfuric and perchloric acids as described by **Page *et al.* (1982)**. Then, the extraction was diluted with distilled water to the volume of 50 ml in a measuring flask; this extraction was subjected to total N, K, Na, B and analysis as follow:

1- Total Nitrogen: Total nitrogen was determined by the Kjeldahl technique, **Jackson (1973)**.

2-Total potassium and sodium: was determined flame photometer as described by **Page *et al.* (1982)**.

2.4. Statistical Analysis:

Results were statistically analyzed using COSTATC software. The ANOVA test was used to determine the significantly ($p \leq 0.05$) treatment effect and the L.S.D Multiple Range Test was used to determine the significance of the difference between individual means **Gomez and Gomez (1984)**.

Table 1. Some physical and chemical analyses of the studied soil:

Property	2016-2017	2017-2018	Property	2016-2017	2017-2018
Particle size distribution, %			**Ec in soil paste extract ,dSm^{-1}**	**4.67**	**4.61**
Coarse sand	10.45	15.50	Soluble ions (mmole L^{-1})		
Fine sand	27.56	22.37	Na^+	18.63	17.20
Silt	21.25	19.40	K^+	4.13	3.52
Clay	40.74	42.73	Ca^{++}	12.48	12.70
Texture Class	Clay Loam	Clay Loam	Mg^{++}	11.46	12.68
pH in soil paste	8.92	8.67	Cl^-	16.88	18.63
O.M %	0.50	0.58	Hco_3^-	4.86	4.99
$CaCo_3$%	5.80	4.89	$So_4^=$	24.96	22.48
ESP %	18.3	15.90			

Available macro and micronutrients (mg kg^{-1})

	N	P	K	Fe	Mn	Cu	Zn	B
2016-2017	38.54	5.20	435	4.89	1.89	0.50	0.92	0.32
2017-2018	52.70	9.28	455	4.22	2.06	0.56	1.1	0.30

3.RESULTS AND DISCUSSION

3.1. Effect of nitrogen sources and rates on sugar beet parameters at 120 days from sowing:

3.1.1: Nitrogen sources :

The results presented in Tables 2,3 and (3-1) showed that, weight average of fresh and dry for shoot and root (g), Chlorophyll A, Chlorophyll B, uptake of nitrogen. phosphorus, potassium and sodium in shoot and root of sugar beet at 120 days from sowing as affected by nitrogen sources, nitrogen rates and their interactions in 2016/2017 and 2017/2018 seasons. It is interesting to mention that all measure characters were significantly affected by nitrogen sources in both seasons. On average, plants grown on the untreated plot yielded the lowest and the results in the same tables, showed clearly that anhydrous ammonia treatment gave the highest values of sugar beet plant whereas Chlorophyll A and Chlorophyll B were 1.72, 2.05 mg/g and 1.20, 1.60 mg/g, in the 1^{st} and 2^{nd} seasons, respectively. Also, fresh and dry shoot weights were 362.79 and 386.21 g, for fresh and 38.15, 40.34 for dry at the first and second seasons, respectively. As for, nitrogen uptake by shoot and root were 1434.2, 1549.5 for the shoot and 2013.4, 2174.4 (mg/plant) for root, phosphorus uptake by shoot and root 94.2, 102.6 for the shoot and 621.2, 552.5 (mg/plant), potassium uptake by shoot and root 1595.4, 1571.5 for the shoot and 1587.1, 1562.7 (mg/plant) for root, sodium uptake by shoot and root 2191.5, 2741.8 for the shoot and 1389.5, 1408.9 (mg/plant) for root, Respectively. for the first and second seasons. Meaning that the superiority of ammonia gaseous was achieved comparing with the other sources of nitrogen. The superiority of gaseous ammonia may be due to its noticed reduction in soil pH, which increased the nutrient's availability and improved their efficiency uptake; therefore, the amount of dry matter was increased. This finding may be due to the great efficiency of gaseous ammonia as a source of nitrogen to fulfil the nitrogen needs of the plant. **Ragab and Ibrahim (2009), Seham (2012)** obtained similar results.

3.1.2: Nitrogen rates:

Results presented in Tables 2 to 3 and (3-1) show clearly that the effect of nitrogen rates was significant on all studied characters in both seasons. Sugar beet plants fertilized with a nitrogen fertilizer at the rate of 90 kg N/fed. gave the highest values of Chlorophyll A and Chlorophyll B were 1.60, 1.71 mg/g and 1.12,1.63 mg/g shoot fresh and dry were weight 360.77,374.45 for fresh and 39.38,40.91 g for dry, respectively. Also, root fresh and dry were weight 482.81,509.34 for fresh and 98.95,101.65 g for dry, nitrogen, phosphorus, potassium and sodium uptake by shoot were 1617.1, 1650.5 for the shoot and 2304.4, 2329.9 (mg/plant) for root, phosphorus uptake by shoot and root 83.5, 78.1 for the shoot and 565.0, 508.0 (mg/plant), potassium uptake by shoot and root 1622.9, 1534.6 for the shoot and 1764.7, 1865.1 (mg/plant) for root, sodium uptake by shoot and root 2390.7, 2802.3 for the shoot and 1394.1, 1304.1(mg/plant) for root; respectively. Compared with the untreated plots which gave the lowest value for all characters. the increment of root fresh weight owing to raising nitrogen rate might be attributed to the active effect of nitrogen in increasing photosynthesis and net assimilation rate translocated and stored in roots which led to increasing root length resulted in increasing root fresh weight. On the other hand, the increase in purity percentage caused by the lowest nitrogen rate may be due to the reduction in root length and root fresh weight resulted from smaller roots, which have the lowest wetted, therefore increased sucrose concentration, thus increased purity percentage. These results are in agreement with those of, **Telep, *et al*. (2008), Abd EL-Motagally and Attia (2009), Manderscheid *et al*. (2010), and Gobarah Mirvat *et al*. (2011)**, who found that increasing N supply increased juice impurities such as Na content.

3.Interaction effect between nitrogen sources and rates :

The obtained in tables 2,3 to 3-1 showed that the interaction effect between nitrogen sources and nitrogen rates was significant on all studied characters except Chlorophyll A and Chlorophyll Bin first season, and root fresh weight in both seasons, and root dry weight in second season only. And phosphorus uptake by root in both seasons and potassium uptake by a shoot in both seasons and Na –uptake by a shoot in the first season only and sodium uptake by root in both seasons, did not significant.

Table 2. Effect of nitrogen sources and rates on the sugar beet parameters at 120 days from sowing:

Treatment		Season 2016/2017						Season 2017/2018					
Source (S)	Rate (R) (kg/fed.)	Chl A (mg/g)	Chl B (mg/g)	Shoot fresh weight (g/plant)	Root fresh weight (g/plant)	Shoot dry weight (g/plant)	Root dry weight (g/plant)	Chl A (mg/g)	Chl B (mg/g)	Shoot fresh weight (g/plant)	Root fresh weight (g/plant)	Shoot dry weight (g/plant)	Root dry weight (g/plant)
Untreated		0.73	0.62	164.0	175.3	15.6	56.8	0.81	0.78	179.5	204.4	17.3	60.3
Anhydrous Ammonia	60	1.59	1.01	310.3	451.5	31.3	95.1	1.86	1.39	324.6	466.9	32.1	98.5
	75	1.73	1.25	363.5	459.6	37.1	98.8	2.08	1.63	391.7	505.6	41.1	102.6
	90	1.84	1.34	414.6	506.9	46.0	103.0	2.20	1.79	442.4	559.5	47.8	106.7
Mean		1.72	1.20	362.8	472.7	38.2	99.0	2.05	1.60	386.2	510.7	40.3	102.6
Aqua Ammonia	60	1.35	0.97	296.3	409.7	29.3	92.5	1.41	1.40	302.1	458.7	29.6	95.7
	75	1.51	1.04	324.2	454.5	32.7	94.3	1.66	1.08	333.9	464.3	34.4	97.7
	90	1.63	1.07	352.2	491.2	38.0	99.9	1.72	1.61	355.1	478.8	39.4	102.0
Mean		1.50	1.03	324.2	451.8	33.4	95.6	1.60	1.36	330.3	467.3	34.5	98.4
Urea	60	0.94	0.77	258.2	358.2	25.3	87.7	1.42	1.14	269.2	398.7	26.9	90.4
	75	1.16	0.86	294.0	410.5	30.0	91.0	1.15	1.20	297.4	437.2	30.9	93.4
	90	1.32	0.96	315.5	450.4	34.1	94.0	1.22	1.48	325.9	489.7	35.5	96.2
Mean		1.14	0.86	289.2	406.3	29.8	90.9	1.26	1.27	297.5	441.9	31.1	93.4
Means of nitrogen rates	60	1.29	0.92	288.3	406.5	28.7	91.8	1.56	1.31	298.6	441.4	29.6	94.9
	75	1.47	1.05	327.2	441.5	33.3	94.7	1.63	1.30	341.0	469.0	35.5	97.9
	90	1.60	1.12	360.8	482.8	39.4	99.0	1.71	1.63	374.5	509.3	40.9	101.7
LSD 0.05													
Nitrogen source (S)		0.05	0.14	5.99	38.48	0.56	0.44	0.10	0.22	18.00	43.13	0.56	0.66
Nitrogen rate (R)		0.04	0.13	10.42	15.63	0.82	0.30	0.06	0.11	9.89	26.94	0.33	0.91
S*R		N.S	N.S	18.57	N.S	1.42	0.51	0.11	0.20	17.14	N.S	0.58	N.S

Chl = Chlorophyll

Table 3. Effect of nitrogen sources and rates on uptake of nitrogen, phosphorus, potassium and sodium on the sugar beet at 120 days from sowing at the first season:

Season		2016/2017							
Treatment		N - uptake		P- uptake		K - uptake		Na - uptake	
source (S)	Rates (R) (kg/fed.)	Shoot (mg/plant)	root (mg/plant)	shoot (mg/plant)	root (mg/plant)	shoot (mg/plant)	root (mg/plant)	shoot (mg/plant)	root (mg/plant)
Untreated		419.0	985.2	31.7	116.6	492.9	1120.6	918.9	494.8
Anhydrous Ammonia	60	1038.1	1773.3	66.0	440.0	1193.4	1360.2	1654.2	1276.9
	75	1363.3	2027.2	87.1	664.2	1527.3	1627.4	2070.5	1388.7
	90	1901.1	2239.6	106.6	759.3	2065.6	1773.6	2850.0	1502.9
Mean		1434.2	2013.4	86.6	621.2	1595.4	1587.1	2191.5	1389.5
Aqua Ammonia	60	952.5	1868.9	50.4	331.9	902.7	1458.6	1613.2	1111.3
	75	1191.0	2073.9	59.2	353.9	1091.0	1626.8	1652.4	1234.0
	90	1475.1	2336.8	73.4	467.8	1401.6	1760.3	2161.1	1339.8
Mean		1206.2	2093.2	61.0	384.5	1131.8	1615.2	1808.9	1228.4
Urea	60	788.2	1868.0	31.2	242.5	718.9	1462.0	1226.1	973.6
	75	1116.8	2083.1	41.5	319.3	1021.4	1600.6	1574.5	1117.0
	90	1475.1	2336.8	56.8	467.8	1401.6	1760.3	2161.1	1339.8
Mean		1126.7	2096.0	43.2	440.0	1047.3	1607.6	1653.9	1143.4
Means of nitrogen rates	60	926.3	1836.7	63.6	338.1	938.3	1426.9	1497.8	1120.6
	75	1223.7	2061.4	49.2	445.8	1213.2	1618.2	1765.8	1246.5
	90	1617.1	2304.4	62.6	565.0	1622.9	1764.7	2390.7	1394.1
L.S.D 0.05									
Nitrogen source (S)		98.06	36.27	8.26	80.78	176.23	27.36	276.83	159.37
Nitrogen rate (R)		68.2	20.22	5.26	119.05	140.37	15.54	149.62	112.15
S*R		118.14	35.03	9.12	N.S	N.S	26.92	259.15	N.S

Table 3. Effect of nitrogen sources and rates on uptake of nitrogen, phosphorus, potassium and sodium on the sugar beet at 120 days from sowing at the second season:

Season		2017/2018							
Treatment		N - uptake		P- uptake		K - uptake		Na - uptake	
source (S)	Rates (R) (kg/fed.)	Shoot (mg/plant)	root (mg/plant)	shoot (mg/plant)	root (mg/plant)	shoot (mg/plant)	root (mg/plant)	shoot (mg/plant)	root (mg/plant)
Untreated		463.4	996.3	23.1	118.2	516.5	1135.4	1110.1	523.6
Anhydrous Ammonia	60	1119.6	1853.8	75.6	398.9	1079.0	1363.8	1839.0	1321.2
	75	1528.2	2219.1	99.3	566.4	1531.5	1560.9	2902.6	1407.6
	90	2000.6	2450.3	132.9	692.1	2103.8	1763.4	3483.7	1497.9
Mean		1549.5	2174.4	102.6	552.5	1571.5	1562.7	2741.8	1408.9
Aqua Ammonia	60	1005.6	1721.9	61.5	403.8	861.6	1539.9	2142.7	1145.3
	75	1277.4	1897.3	72.9	427.3	1101.0	1650.2	2186.7	1235.5
	90	1574.9	2453.4	94.4	509.0	1335.2	1789.5	2651.2	1326.7
Mean		1286.0	2024.2	76.3	446.7	1099.3	1659.9	2326.9	1235.9
Urea	60	831.0	1853.5	42.7	204.7	694.3	1473.3	1727.9	981.5
	75	1111.4	2101.8	61.9	223.4	930.8	1554.5	2074.6	1000.1
	90	1375.9	2086.1	75.7	322.9	1164.7	2042.3	2272.0	1087.6
Mean		1106.1	2013.8	60.1	250.4	929.9	1690.0	2024.8	1023.1
Means of nitrogen rates	60	985.4	1809.7	79.7	335.8	878.3	1459.0	1903.2	1149.4
	75	1305.7	2072.7	59.9	405.7	1187.8	1588.5	2388.0	1214.4
	90	1650.5	2329.9	78.1	508.0	1534.6	1865.1	2802.3	1304.1
L.S.D 0.05									
Nitrogen source (S)		103.52	33.72	25.00	139.50	220.00	28.06	116.91	108.71
Nitrogen rate (R)		66.84	19.89	5.84	99.62	129.28	14.64	107.48	93.35
S*R		115.78	34.46	10.11	N.S	N.S	25.37	N.S	N.S

3.2. Effect of nitrogen sources and rates on sugar beet at harvest date:

3.2.1: Nitrogen sources :

Average fresh and dry weight (g), for root and shoot, nitrogen, potassium, phosphorus and sodium uptake in root and shoot of sugar beet at harvest date as affected by nitrogen sources, nitrogen rates and their interactions in 2016/2017 and 2017/2018 seasons are shown in Tables 4-5. Results recorded clearly that all measured characters were significantly affected by nitrogen sources in both seasons. Sugar beet plants received anhydrous ammonia over urea by a percentage of 20.72%,22.48% for the root length (cm) and volume (cm^3) 30.52 and 50.39 % for root length 24.32 and 20.61 % of root fresh weight25.70 and 22.16 %, for a dry weight of root, fresh and dry weight of shoot (ton /fed) 37.62 and 39.65 % for shoot fresh weight and shoot dry weight (kg/fed) 36.73 and 42.00 %, sucrose % 6.57 and 9.95 % and the yield of the sugar 31.89 and 32.30 %, respectively, (nitrogen uptake by shoot and root 19.02,14.26 % for nitrogen uptake by shoot and 18.11,20.35 % for nitrogen uptake by roots, phosphorus uptake by shoot and root 21.77, 25.35% for the shoot and 31.44,25.93 %, potassium uptake by shoot and root 52.98,57.86 % for the shoot and 26.27,22.43 % for root, sodium uptake by shoot and root 48.56,38.18 % for the shoot and 26.47,22.62 for root, for the first and second season, respectively. Compared with the untreated plots which gave the lowest value for all characters. These results may be due to that nitrogen has a vital role in building up metabolites, activating enzymes and carbohydrates accumulation which transferred from leaves to developing root which in turn enhanced root length, diameter, and the fresh weight finally roots yield per unit area. Similar findings were reported by **Ramadan *et al*. (2003) and El-Hassanin *et al*. (2016) and Abbas *et al* (2018).**

3.2.2: Nitrogen rates :

Results presented in Tables 4-5 show clearly that the effect of nitrogen rates was significant on all studied characters in both seasons. Adding 60 kg N/fed as nitrogen rate gave the lowest values compared to 75 and 90 kg N/fed treatments for all characters such as fresh and dry weight for root were 10.05,7.50 % and 8.58,6.85 % for fresh root and 9.56,8.47 and 8.16,7.54 for dry at the root first and the second season, respectively. yield of the sugar 3.17,3.07 % and 2.38 ,1.74% first and second season, respectively, shoot fresh and dry weight (ton /fed) 10.42,10.45 and 5.56,18.26 % for shoot fresh weight and for shoot dry weight (kg/fed) 10.42,10.69 and 9.00,11.42% first and second season, respectively, root length (cm) and volume (cm^3) 10.72,14.07 and 15.58,7.34 % for root length and 18.40,19.34 and 25.02,14.55 % for root volume first and second season, respectively, (nitrogen uptake by shoot and root 15.00,11.76 and14.61,10.73 % for nitrogen uptake by shoot and 15.80,17.09 and 11.28, 18.08 % for nitrogen uptake by roots, phosphorus uptake by shoot and root 16.97, 25.09 % and 16.92 , 28.94 % for the shoot and 17.32 , 16.46 % and 11.88 , 10.83 % for root , potassium uptake by shoot and root 10.31,10.05 % and 16.5,15.22% for the shoot and 10.12,8.97 and 8.40,7.89% for root, sodium uptake by shoot and root 2.64,2.67 and 3.11,3.46 % for the shoot and 10.46,9.29 and 8.56 ,8.02% for root , for the first and second season, respectively. Compared with the untreated plots which gave the lowest value for all characters. this is may be attributed to the increment of growth attributes gained by increasing nitrogen fertilizer level may be due to the role of nitrogen in developing root dimensions by increasing division or elongation of cells and also enhancing leaf initiation and increment chlorophyll concentration in leaves and photosynthesis process. This was associated with the accumulation of carbohydrates translocated from leaves to develop roots, consequently increasing root size The aforementioned findings are in agreement with those of **Attia *et al*. (2004) NemeatAlla(2005), Gomaa *et al*. (2005) and Awad-Allah *et al*. (2007).**

Data showed that increasing nitrogen rates from 60 to 90 kg N/fed led to a decrease in the percentage of sucrose for two seasons. **Weeden (2000)** explained that with an increase of nitrogen in the soil, the amino acid in root increases that it causes sugar crystallization and so decreasing of extractable sugar. And These results may be due to that nitrogen has a vital role in building up metabolites, activating enzymes and carbohydrates accumulation which transferred from leaves to developing roots which in turn enhanced root length, diameter, and the fresh weight finally roots yield per unit area. Similar findings were reported by **Ramadan *et al*. (2003) and ElHassanin *et al*. (2016) and Abbas *et al* (2018).**

3-2-3: Interaction effect between nitrogen sources and rates:

The obtained results in table 4 to 5 showed that the interaction effect between nitrogen sources and nitrogen rates was not significant on all studied characters except root volume, sucrose %, N – uptake by a shoot in the first season, root volume, sucrose%, the yield of sugar, the weight of fresh root, for the second season; respectively, were significant in both seasons.

Table 4. Effect of nitrogen sources and rates on the sugar beet parameters at harvest date:

Season		2016/2017								Season 2017/2018							
Treatment																	
Nitrogen source (S)	Nitrogen rate (R) (kg/fed.)	Root length (cm)	Root volume (cm3)	Sucrose %	yield of sugar (ton/fed)	Weight of fresh root (ton/fed)	Weight of dry roots (ton/fed)	Shoot fresh weight (ton/fed)	Shoot dry weight (kg/fed)	Root length (cm)	Root volume (cm3)	Sucrose %	yield of sugar (ton/fed)	Weight of fresh root (ton/fed)	Weight of dry roots (ton/fed)	Shoot fresh weight (ton/fed)	Shoot dry weight (kg/fed)
Untreated		14.3	386	14.9	1.9	12.5	2.1	2.6	301.0	14.7	438	15.0	2.0	13.0	2.5	3.0	324.0
Anhydrous Ammonia	60	24.7	867	17.9	3.6	23.2	4.1	6.1	593.5	25.4	1045	18.2	3.7	23.6	4.3	6.5	596.8
	75	27.2	1036	17.2	3.7	25.3	4.4	6.7	644.0	29.8	1322	17.8	3.9	25.5	4.5	7.3	684.5
	90	31.8	1253	16.4	3.8	27.9	4.9	7.4	722.8	32.4	1606	17.0	4.0	28.1	5.1	7.9	772.1
Mean		27.9	1052	17.2	3.7	25.5	4.5	6.7	653.4	29.2	1325	17.7	3.9	25.7	4.6	7.2	684.5
Aqua Ammonia	60	23.3	792	17.3	3.2	22.1	3.8	5.7	546.4	24.3	853	17.8	3.6	23.3	4.1	6.4	585.0
	75	26.2	941	16.7	3.3	23.8	4.1	6.2	620.4	28.1	1069	17.1	3.5	24.4	4.3	6.5	611.7
	90	28.5	1080	16.0	3.3	25.0	4.2	6.9	681.3	29.8	1170	16.8	3.6	25.5	4.4	7.4	695.9
Mean		26.0	938	16.7	3.3	23.6	4.0	6.2	616.1	27.4	1030	17.2	3.5	24.4	4.3	6.7	630.9
Urea	60	20.5	672	16.4	2.6	18.3	3.1	4.3	435.9	21.3	739	16.8	2.8	19.2	3.4	4.9	449.9
	75	22.5	784	16.0	2.8	20.8	3.6	4.9	475.6	24.3	905	16.1	2.95	21.8	3.9	5.0	482.4
	90	26.3	962	15.8	2.9	22.3	3.9	5.4	522.1	26.0	1000	15.4	2.95	23.0	4.1	5.5	513.8
Mean		23.1	806	16.1	2.8	20.5	3.5	4.9	477.9	23.8	881	16.1	2.91	21.3	3.8	5.2	482.0
Means of nitrogen rates	60	22.9	777	17.2	3.2	21.2	3.7	5.4	525.3	23.7	879	17.6	3.36	22.0	3.9	5.9	543.9
	75	25.3	920	16.6	3.3	23.3	4.0	5.9	580.0	27.4	1099	17.0	3.44	23.9	4.2	6.3	592.9
	90	28.9	1098	16.1	3.4	25.1	4.4	6.6	642.0	29.4	1259	16.4	3.50	25.6	4.6	6.9	660.6
LSD 0.05																	
Nitrogen source (S)		0.87	1.55	0.28	0.10	0.93	0.18	0.44	52.25	0.11	14.42	0.29	0.05	0.63	0.11	0.27	75.97
Nitrogen rate (R)		0.83	9.81	0.13	0.07	0.58	0.17	0.33	59.96	0.62	74.32	0.14	0.05	0.34	0.19	0.26	59.85
S*R		N.S	17.00	0.23	N.S	N.S	N.S	N.S	N.S	N.S	128.7	0.28	0.08	0.59	N.S	N.S	N.S

Table 5. Effect of nitrogen sources and rates on uptake of nitrogen, phosphorus, potassium and sodium on the sugar beet at harvest date:

Treatment		Season 2016/2017								Season 2017/2018							
		N - uptake by		P- uptake by		K - uptake by		Na - uptake by		N - uptake by		P- uptake by		K - uptake by		Na - uptake by	
Nitrogen source (S)	**Nitrogen rate (R) (kg/fed**	**shoot (kg/fed)**	**root (kg/fed)**	**shoot (kg/fed)**	**root (kg/fed)**	**shoot (kg/fed)**	**root (kg/fed)**	**shoot (kg/fed)**	**root (kg/fed)**	**shoot (kg/fed)**	**root (kg/fed)**	**shoot (kg/fed)**	**root (kg/fed)**	**shoot (kg/fed)**	**root (kg/fed)**	**shoot (kg/fed)**	**root (kg/fed)**
Untreated		2.9	8.1	1.1	2.0	4.3	20.5	6.2	16.8	3.0	8.4	1.4	2.7	4.0	20.8	6.7	17.2
Anhydrous Ammonia	60	7.1	23.5	2.3	3.9	9.2	54.8	13.2	34.8	7.3	24.6	2.8	4.8	9.9	58.1	12.7	37.2
	75	8.8	27.6	2.7	4.5	10.2	58.9	13.5	37.5	8.4	28.6	3.5	5.3	11.0	61.8	13.1	39.6
	90	9.7	34.2	3.3	5.6	11.4	67.2	13.7	43.0	9.3	34.6	4.3	6.1	12.8	70.0	13.5	44.9
Mean		8.5	28.4	2.7	4.6	10.3	60.3	13.5	38.5	8.3	29.3	3.5	5.4	11.2	63.3	13.1	40.6
Aqua Ammonia	60	6.8	22.0	2.4	3.7	7.9	50.9	9.8	32.4	6.9	24.0	2.8	4.4	8.6	55.6	10.9	35.6
	75	7.7	26.5	2.9	4.4	8.4	55.7	10.0	35.6	8.1	26.1	3.0	4.7	9.8	58.8	11.3	37.6
	90	8.6	29.5	3.5	4.7	9.1	57.7	10.3	37.0	8.9	30.8	4.0	5.1	11.3	60.6	11.7	38.8
Mean		7.7	26.0	2.9	4.3	8.5	54.8	10.0	35.0	8.0	26.9	3.2	4.7	9.9	58.4	11.3	37.3
Urea	60	6.5	21.6	1.9	3.0	5.9	42.2	8.7	26.8	6.5	22.0	2.2	3.7	5.7	46.1	9.2	29.4
	75	7.0	23.5	2.1	3.5	6.7	48.4	9.1	30.8	7.3	23.8	2.7	4.4	7.3	52.7	9.5	33.8
	90	8.0	27.2	2.7	4.1	7.5	52.6	9.4	33.6	8.1	27.2	3.5	4.8	8.3	56.4	9.8	36.2
Mean		7.2	24.1	2.3	3.5	6.7	47.7	9.1	30.4	7.3	24.3	2.8	4.3	7.1	51.7	9.5	33.1
Means of nitrogen rates	60	6.8	22.3	2.2	3.5	7.7	49.3	10.6	31.4	6.9	23.5	2.6	4.3	8.1	53.3	10.9	34.1
	75	7.8	25.9	2.6	4.1	8.5	54.3	10.9	34.6	7.9	26.1	3.0	4.8	9.4	57.8	11.3	37.0
	90	8.7	30.3	3.2	4.8	9.3	59.2	11.1	37.9	8.8	30.9	3.9	5.3	10.8	62.3	11.7	34.0
LSD 0.05																	
Nitrogen source (S)		0.10	2.62	N.S	0.48	1.16	2.67	0.84	1.79	0.14	0.98	0.31	0.33	2.27	1.69	1.07	1.13
Nitrogen rate (R)		0.07	1.90	0.35	0.31	1.25	2.29	N.S	1.48	0.06	1.32	0.30	0.32	1.45	2.68	N.S	1.72
S*R		0.12	N.S	N.S	N.S	N.S	N.S	N.S	N.S	0.11	N.S	N.S	N.S	N.S	N.S	N.S	N.S

3.3.Economical study:

An economic analysis of the combined result using the partial technique is appropriate. The results of the partial budget are given in Tables 6 and 7. Data show that the highest profit was recorded when the full dose of anhydrous ammonia was applied at all rates. as well as the rate of 90 Kg N/fed the more profit followed by the 75 Kg N/fed and the 60 Kg N/fed and untreated treatment was given the lowest profit. These results are agreed with **(Abd El-Megeed,2017).**

Lists of costs:-

N unit from anhydrous ammonia = 6.25 L.E

N unit from Aqua ammonia = 6.25 L.E

N unit from urea = 7 L.E

Lists of prices:-

A ton of shoots = 50 L.E

A ton of root Varies according to sugar percentage as follow :

Sugar %	Price	Sugar %	Price
15	570 L.E	18	645 L.E
16	595 L.E	19	670 L.E
17	620 L.E	----------	---------

Data presented in the above table take from **El-Fayoum Sugar Manufacturing Company**

Conclusion:

Maximum sugar beet yield components and uptake of nutrients were archived by anhydrous ammonia followed by aqua ammonia followed by urea with a rate of 90 kg N/fed under the environmental conditions of clay loam soil in Tamia region, Fayoum Governorate, Egypt.

Table 6. Economical study for the first season in 2016-2017.

Treatment	Rate kg N\fed.	Yield			Income. L.E			Costs L.E				net return L.E
		root yield ton/fed	Sucrose%	Shoot yield ton/fed	Root yield L.E	Shoot yield L.E	total (root + shoot) L.E	Cost of N units	cost of cultivation L.E	Total Cost	cost of rent	
Untreated		12.48	15	2.61	7114	131	7244	0	3830	3830	2500	914
Anhydrous ammonia	60	21.41	17	5.16	13532	258	13790	375	3830	4205	2500	7085
	75	23.89	17	5.64	15094	282	15376	469	3830	4299	2500	8577
	90	26.69	16	6.24	16193	312	16505	563	3830	4393	2500	9612
Aqua ammonia	60	20.09	17	4.55	12683	228	12911	375	3980	4355	2500	6056
	75	22.21	16	4.98	13464	249	13713	469	3980	4449	2500	6764
	90	23.41	16	5.40	14199	270	14469	563	3980	4543	2500	7427
Urea	60	16.23	15	3.28	9415	164	9579	420	3890	4310	2500	2769
	75	18.62	16	3.90	11274	195	11469	525	3890	4415	2500	4554
	90	19.88	15	4.39	11551	220	11771	630	3890	4520	2500	4751

Table 7. Economical study for the second season in 2017-2018.

Treatment	Rate kg N\fed.	Yield			Income. L.E			Costs L.E				net return L.E
		root yield ton/fed	Sucrose%	Shoot yield ton/fed	Root yield L.E	Shoot yield L.E	total (root + shoot) L.E	Cost of N units	cost of cultivation L.E	Total Cost	cost of rent	
Untreated		13.03	15	3.02	7427	151	7578	0	3830	3830	2500	1248
Anhydrous ammonia	60	22.51	17	6.07	13956	304	14260	375	3830	4205	2500	7555
	75	24.03	17	6.48	14899	324	15223	469	3830	4299	2500	8424
	90	26.11	16	7.46	15536	373	15909	563	3830	4393	2500	9016
Aqua ammonia	60	22.13	17	5.87	13721	294	14014	375	3980	4355	2500	7159
	75	23.60	16	5.90	14042	295	14337	469	3980	4449	2500	7388
	90	24.13	16	6.18	14357	309	14666	563	3980	4543	2500	7624
Urea	60	17.38	16	4.01	10341	201	10542	420	3890	4310	2500	3732
	75	19.95	15	4.19	11372	210	11581	525	3890	4415	2500	4666
	90	21.88	15	4.39	12472	220	12691	630	3890	4520	2500	5671

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الملخص العربى

دراسات مقارنة لثلاث اسمده نيتروجينية محتوية على النيتروجين في صورة أمونيوم على نبات بنجر السكر في الأراضي المتأثرة بالأملاح في محافظه الفيوم

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يهدف البحث الى دراسة تأثير مصادر النيتروجين ومستوياته على إنتاجية وجودة بنجر السكر صنف. جلوريا تم إجراء تجربة حقلية في مزرعة الفيوم التجريبية (تربة طينية طمييه) بمحافظة الفيوم، التابعة لمركز البحوث الزراعية، مصر، في موسمين متتاليين ٢٠١٧/٢٠١٦ و٢٠١٨/٢٠١٧. تم وضع تصميم التجربة في تصميم القطع المنشقة مرة واحدة بثلاثة مكررات. وقد تم وضع مصادر الأسمدة النيتروجينية (الأمونيا الغازية والأمونيا المائية واليوريا) في القطع الرئيسية وتم وضع معدلات النيتروجين (٦٠، ٧٥، ٩٠ كجم نيتروجين / فدان) في القطع المنشقة. وقد أظهرت النتائج أن الأمونيا الغازية زادت معنوياً وسجلت أعلى قيمة لكل من كلوروفيل، A وB والنيتروجين، الفوسفور، البوتاسيوم، والصوديوم الممتص بواسطة الأوراق والجذور وذلك عند ١٢٠ و٢٠٠ يوم من الزراعة وطول الجذر والحجم. ووجد أن إضافة ٩٠ كجم نيتروجين / فدان أعطت أعلى نسبة من الكلوروفيل A وB ووزن الاوراق الطازج والجاف ووزن الجذور الطازج والجاف والنيتروجين والفوسفور والبوتاسيوم والصوديوم. وبعد ١٢٠ و٢٠٠ يوم من الزراعة وطول وحجم الجذور ومحصول السكر / فدان بينما أدت إضافة ٦٠ كجم نتروجين / فدان إلى انخفاض هذه القيمة ولكن كانت زيادة السكروز في كلا الموسمين. وبالتالي يمكن أن يوصى بحقن الأمونيا الغازية في التربة عند ٩٠ كجم N / فدان للحصول على الحد الأقصى من إنتاجية بنجر السكر وجودته في ظل الظروف البيئية للتربة الطينية الطميية لمحافظة الفيوم. كما تم إجراء تحليل اقتصادي، وقد أشارت البيانات إلى أن أعلى ربح تم تسجيله باستخدام الأمونيا الغازية مع ٩٠ كجم نتروجين / فدان.

الكلمات الدالة: بنجر السكر، مصادر النيتروجين، معدل النيتروجين، المحصول، جوده البنجر، أراضي طينية طمييه، دراسة اقتصادية