EFFECT OF SOWING DATE, MINERAL AND BIO NITROGEN FERTILIZERS ON YIELD AND QUALITY OF SUGAR BEET

By

BASEM SOBHY IBRAHIM

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BASEM SOBHY IBRAHIM

Under the supervision of:

1. **Prof. Dr. Ali Abd-EL Maksoud EL-Hosary** A. A. El-Hosary
   Prof. Emeritus of Agron., Fac. of Agric., Benha Univ.

2. **Prof. Dr. Mohamed Ismail Salwau** ...Mohamed.....salwau
   Prof. and head of Agron., Fac. of Agric., Benha Univ.

3. **Prof. Dr. Adly Mohamed Morsy Saad** ..A..M..M..Saad
   Prof. of Agron., Fac. of Agric., Benha Univ.

4. **Prof. Dr. Ibrahim Hanafy EL-Geddawy** I. H. El-Geddawy
   Prof. Emeritus of Agron., Agricultural Research Center.

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Approval Sheet

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By

BASEM SOBHY IBRAHIM

B. Sc. Co-oper. and Agric., Sci., (1992).

Master of Science in Agricultural Science (Agronomy), 2006.

This thesis for Ph.D. degree has been

Approved by:

1. **Prof. Dr. El-Sayed Hefni Mohamed Hefni** .....Elsayed.....Hefni
   Prof. Emeritus of Agron., Fac. of Agric., Benha Univ.

2. **Prof. Dr. Ali Abd-EL Maksoud EL-Hosary** A.:A..El-Hosary
   Prof. Emeritus of Agron., Fac. of Agric., Benha Univ.

3. **Prof. Dr. Mohamed Ismail Salwau** ...Mohamed...salwau
   Prof. and head of Agron., Fac. of Agric., Benha Univ.

4. **Prof. Dr. Adly Mohamed Morsy Saad**......................
   Prof. of Agron., Fac. of Agric., Benha Univ.

5. **Prof. Dr. Abd El-Wahed Abd El-Hamed El-Sayed**..A..A.E..Mohamed
   Prof. of Agron., and Vice Dean for Postgraduate Studies and Research Fac. of Agric., Kafr El-Sheikh Univ.

Date of Examination: / / **2011**

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CONTENTS

INTRODUCTION

I. INTRODUCTION

Sugar beet crop plays an important role in sugar production on the national and international levels, it provides about 25 %* of the world sugar productions. The total amount of sugar beet root production reached to 222.78 million ton* in 2010 season corresponding to 7.840 million ton* in Egypt for the same season.

In spite of sugar beet crops is considered one of the new crops which recently introduced to the Egyptian agricultural rotation (1982) its production from row sugar amounted by 989774 ton/year* represent 49.7 %* from the nation local production of sugar.

In Egypt, sugar beet is grown in different locations, however, it is concentrated in the Northern region i.e. Nubaria city, Dakahlia and Kafr EL-Sheikh Governorates.

Nowadays, sugar beet has an important position in the crop rotation in the Egyptian agriculture and distinguish by high competition with the winter crops.

The important of this crop is not only limited at being a supplement for a sugar production, but it's also extend to the use of it's products in producing untraditional animal feed.

Sowing date is considered one of the important factor directly affected on the yield, its components and juice quality. Determining of sowing on great extent on the prevailing climatic

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* Annual Report of Sugar Crop Council (Jan., 2011).

conditions and ecological environments could be exception the reliable expression for the effect of climatic conditions on growth and productivity.

Fertilization plays a great and important role in the growth, yield and quality of sugar beet, for this reasons many studies were made to find out the optimum level of nutritional elements to induce the highest yield and the best quality.

Sugar beet producers face unique challenges in N-fertilizer management because of the relationships among root yield, crop quality and price. Top sugar beet yields require high N-rates, but excess N-supply decreases juice quality.

Sugar beet payments are based on tons of sugar delivered and juice quality.

One of the major concerns in today's world is the environmental pollution and soil contamination. Using of chemical fertilizers and pesticides has caused tremendous harm to the environment as well as in direct effect on the human being and the animal. An answer to this is the bio-fertilizer, an environmentally friendly fertilizer now used in most countries. Bio-fertilizers are organisms that enrich the nutrient quality of soil. The main sources of bio-fertilizers are bacteria, fungi, and cyanobacteria (blue-green algae). The most striking relationship that these have with plants is symbiosis, in which the partners derive benefits from each other. Bio-fertilizers will help to solve such problems as salinity of the soil and chemical run-offs from the agricultural fields. Thus, bio-fertilizers are important if we are to ensure a healthy future for the generations to come. (**Edugreen, 2007**).

The objective of this study was conducted to find out the relative influence of some mineral nitrogen fertilizers and bio-fertilizer on chemical composition and yield of sugar beet as well as to know to what extent could be use bio-fertilizer source to avoid the continuous pollution.

The present work was conducted to throw some light on the relative importance of two types of nitrogen (mineral and bio-fertilizers) to sugar beet in relation to yield and quality attributes under different sowing dates.

REVIEW OF LITERATURE

II. REVIEW OF LITERATURE

In order to fulfill the objective of this study, the literature will be reviewed under the following main heading:

1. **Effect of sowing date.**
2. **Effect of mineral nitrogen fertilizer.**
3. **Effect of bio-nitrogen fertilizer.**
4. **Interaction effects among sowing date, mineral and bio-nitrogen fertilizers.**

1. EFFECT OF SOWING DATE:

1. a. Yield and its components:

Ghandorrah and Refay (1994) in Saudi Arabia, studied the effect of four sowing dates on sugar beet. They concluded that the period from 15th October to 1st November was optimum for sowing sugar beet which gave the highest yields of sugar beet in the central region of Saudi Arabia. They also found that root yield significantly different at 4 different sowing dates.

Bassyouny and Zalat (1997) in Egypt, tested the effect of six sowing dates at 1st March, 15th March, 1st April, 15th April, 1st May and 15th May on sugar beet plant. They recorded that sowing dates at the 1st of May and 15th of April gave the highest values of root, sugar and top yields/fed.

Azzazy (1998) in Egypt, examined the effect of two sowing dates (November 1st and November 15th) on sugar beet. He showed that root diameter and root length were significantly affected by the two sowing dates. Sowing on November 1st produced slightly higher root and sugar yields than that, sown on November 15th. Top yield responded significantly to the tested sowing dates.

Ramadan and Hassanin (1999) in Egypt, evaluated six sugar beet genotypes (Sofi, Maghribel, Desperez polu-n, Marathon, Pamela and Eva) grown at three sowing dates (10 September, 12 October and 10 November). They found that early sowing date was accompanied by substantial increase in root length, root diameter, root weight/plant, root and sugar yields/fed.

Abou salama and El-sayed (2000) in Egypt, compared sowing dates on 1st and 15th October and 1st November in sandy calcareous, they found that mean root yield was 31.64, 18.73 and 11.51 t/fed from the three dates, respectively.

Al-Jbawi (2000) in Egypt, examined two sowing dates of sugar beet on 15th October and 15th November. Results obtained that the different sowing dates were significantly affected on root traits (length, diameter and weight), root, sugar and top yields, while delayed sowing date decreased all traits.

Shah *et al.* (2000) in Pakistan, studied different sowing dates (November 1st, 11th, 21st and December 1st, 11th and 21st) on sugar beet plant. The highest beet root yield (65.09 tons\ha) and sugar yield (8.5 tons\ha) were obtained from the crop sown on early date i.e. November 1st, while the lowest beet root yield

(26.23 tons\ha-1) and sugar yield (2.17 tons\ha-1) were recorded in the plots sown on December 21st that beet root yield and sugar yield decreased with delayed sowing.

Hassanin (2001) in Egypt, studied the effect of sowing dates on sugar beet; 21 October and 12 November in the first season and 24 October and 15 November in the second season. Results showed that sugar beet sown on October gave significantly highest root length, root diameter, root weight and top yield. On the other hand root/top ratio was not significantly affected by sowing date.

Shalaby (2003) in Egypt, studied the effect of sowing dates (September, October and November) on sugar beet. He found that the sowing in September gave the highest length, diameter and weight of root.

Attia *et al.* (2004) in Egypt, examined sowing dates on 1st September, 1st October and 1st November on sugar beet crop. Results revealed that sowing date of 1st October gave significantly highest yields of root, top and sugar.

Badawi *et al.* (2004) in Egypt, compared three sowing dates for sugar beet crop i. e. 1st September and 1st October and 1st November. They pointed out that sowing date of 1st October gave significantly highest yield components.

Enan (2004) in Egypt, grew sugar beet on 15th September and 15th October. He showed that sowing sugar beet early on 15th September significantly increase in value of length and diameter of root and top fresh weight/plant root, top and sugar yields/fed.

Sogut and Arioglu (2004) in Turkey, studied the effect of five sowing dates (5 February, 20 February, 7 March, 22 March and 5 April) on sugar beet plant. Sugar yield was significantly higher than that in February and March sowing dates.

Agami (2005) in Egypt, compared three sowing dates for sugar beet on 15^{th} September, 15^{th} October and 15^{th} November. They showed that sowing beet on 15^{th} October had a significant increase in root length and diameter and root yield. Early sowing on 15^{th} September had a significant increase in fresh and dry weights of root and leaves, top and sugar yields ton/fed.

Allam *et al.* (2005) in Egypt, tested sugar beet under different sowing dates on 1^{st} October, 15^{th} October and 1^{st} November. They showed that sowing on 1^{st} October was the best sowing date than other treatments in root diameter and root fresh weight in the first season as well as root and sugar yields (ton/fed) in the two seasons. While, sowing date of 1^{st} November surpassed the other dates in root length in both seasons.

Hassan *et al.* (2005) in Egypt, investigated the effect of three sowing dates on some sugar beet cultivars. They found that the highest root, top and sugar yields were achieved by sowing on 15^{th} October followed by 15^{th} September and 15^{th} November.

Leilah *et al* (2005) in Egypt, studied the effect of early sowing date of sugar beet (September 1^{st} and October 1^{st}) in sandy soil. Sowing sugar beets on October 1^{st} resulted insignificant increases in length, diameter and fresh weight of roots, foliage fresh weight, root, top and sugar yields.

Abd El-Aal and Abou El-Magd (2006) in Egypt, compared sowing dates on 15^{th} September, 15^{th} October and 15^{th}

November on sugar beet. They found that the sowing dates on 15th September and /or 15th October led to significant increase in the value of root fresh weight/plant when compared with the latest sowing date on 15th November. Early sowing on 15th September attained the highest root and sugar yields/fed followed by 15th October.

Abd El-Razek (2006) in Egypt, grew sugar beet on 15th August, 15th September and 15th October. He found that root length decreased with delaying sowing date beyond 15th August. The thickest root diameter, heaviest root weight, root and sugar yields were recorded for sowing on 15th September.

Ismail *et al.* (2006) in Egypt, examined sowing dates of sugar beet on 5th October, 25th October and 14th November and they showed that sowing date on 5th October exhibited a significant increase in root length, diameter and fresh weight of the individual roots compared with the other two sowing dates. Top yield decreased as sowing date was delayed from 5th October up to 14th November in both seasons.

Nassar (2006) in Egypt, studied sowing dates of sugar beet on 10 September, 12 October and 11 November. He found that early sowing dates at 10 September and 12 October were accompanied by a substantial increase in root length, root diameter, root and sugar yields/fed. Delaying sowing date to 11 November decreased root fresh weight/plant in both seasons as compared with 10 September.

El-Geddawy *et al.* (2007) in Egypt, sown sugar beet on 15th September and 15th October. They pointed out that sowing sugar beet early on 15th September significantly attained highest values of root length, root diameter, root and top fresh weight, root, top and sugar yields when compared with that obtained at the late sowing date on 15th October.

Mosa (2009) in Egypt, tested the different sowing dates (15th September, 15th October and 15th November) on some sugar beet cultivars. Results revealed that early sowing date on 15th September increased root dimensions and fresh and dry weight of the individual roots, fresh and dry weight of leaves as well as plant dry weight. Yields of top, root and sugar were gradually and significantly decreased as delayed sowing.

1. b. Juice quality and chemical constituents:

Dunn *et al.* (1990) found that early sowing date increased soluble carbohydrate concentration in root and crowns, while blade and petiole soluble carbohydrate concentration was higher in early than late sown sugar beet.

Ghandorrah and Refay (1994) in Saudi Arabia, concluded that the period from 15th October to 1st November was optimum for sowing sugar beet, which gave the highest root quality of sugar beet in the central region of Saudi Arabia. They also found that total soluble solids and reducing sugar significantly differed at four different sowing dates.

Bassyouny and Zalat (1997) in Egypt, pointed out that the highest values of sucrose percentage were recorded on the 15th April and 1st of May sowing dates (9.44 and 9.30 %, respectively), while the 1st March recorded the lowest value.

Azzazy (1998) in Egypt, obtained results showed that sucrose, purity and total soluble solids percentages were significantly affected by the two sowing dates and however, sowing on Nov., 1 produced slightly improved juice quality in terms of sucrose and purity percentages.

Ramadan and Hassanin (1999) in Egypt, pointed out that early sowing was accompanied by a substantial increase in sugar content, purity and recoverable sugar percentage. Moreover, early sowing was accompanied by a substantial decrease in juice impurities and sucrose loss to molasses.

Al-Jbawi (2000) in Egypt, concluded that the different sowing dates were significantly affected on juice quality percentages, while delayed sowing date decreased this trait.

Hassanin (2001) in Egypt, The results revealed that root quality in terms of sucrose, total soluble solids and purity percentages were not significantly affected by sowing date.

Shalaby (2003) in Egypt, found that sowing date had a significant effect on sugar beet quality. Sowing in September gave the highest technological characters values in terms of total soluble solids, sucrose and Purity percentages. The third date of sowing (November) gave the highest values of alpha-amino-nitrogen and sucrose loss to molasses percentages.

Attia *et al.* (2004) in Egypt, revealed that sowing date of 1st October gave significantly the highest total soluble solids, purity and sucrose percentages

Enan (2004) in Egypt, showed that sowing sugar beet early on 15th September significantly increased values of total soluble solids, sucrose and purity percentages.

Feller and Fink (2004) in Germany, obtained that sowing dates later than June at the experimental site are not recommended because they resulted in an increase in nitrate N-content in fresh weight and an average yield loss of 46% when compared with sowings on April. Soluble solids content was only slightly affected by sowing date.

Sogut and Arioglu (2004) in Turkey, studied the effect of five sowing dates; 5 February, 20 February, 7 March, 22 March and 5 April on sugar beet plant. Results showed that sowing date was significantly affected in purity percentage.

Agami (2005) in Egypt, examined three sowing dates on 15th September, 15th October and 15th November on sugar beet quality. He showed that the highest values of total soluble solids, sucrose and purity percentages were recorded on sowing in 15th September.

Allam *et al.* (2005) in Egypt, reported that sowing on 1st October gave the higher value than other treatments in sucrose % in the two seasons and purity % in the second season. Sowing date on 15th October was superior for purity and total soluble solids percentages in the first and second seasons, respectively. Sowing date on 1st November surpassed the other dates in total soluble solids percentage in the first season.

Hassan *et al.* (2005) in Egypt, indicated that the highest total soluble solids, sucrose and purity percentages of sugar beet were achieved by sowing on 15th October followed by 15th September and 15th November.

Leilah *et al.* (2005) in Egypt, studied the effect of early sowing of sugar beet on (September 1st and October 1st) in sandy soil. The highest total soluble solids, sucrose and purity percentages were found with sowing sugar beets on September 1^{st}.

Abd El-Aal and Abou El-Magd (2006) in Egypt, appeared that the earlier sowing dates on 15^{th} of September and October recorded significant increase in the value of sucrose and purity percentages.

Abd El-Razek (2006) in Egypt, found that sowing on 15^{th} August produced the highest average of sucrose and total soluble solids percentages, while the lowest values of these traits were obtained from sowing at the latest date on (15^{th} October). Delaying sowing date increased juice impurities components as potassium, sodium and alpha-amino nitrogen.

Ismail *et al.* (2006) in Egypt, concluded that early sowing of sugar beet on the 5^{th} of October surpassed significantly the other two dates (25^{th} of October and 14^{th} of November) in the values of most studied traits, while impurities in roots (alpha-amino-N, K and Na percentages) and sugar losses in molasses increased by delaying sowing date up to 14^{th} of November.

Nassar (2006) in Egypt, reported that delayed sowing date from 10 September to 11 November decreased sucrose and purity percentages, while delaying up to 11 November increased impurities components expressed as sodium, potassium and alpha-amino nitrogen contents in roots.

Osman *et al.* (2007) in Egypt, showed that sowing sugar beet early on 15^{th} September significantly attained higher values of sugar total soluble solids, sucrose and purity percentages compared with that obtained at the late sowing date on 15th October. On the contrary, sowing sugar beet early on 15th September significantly reduced the values of potassium, sodium and juice impurities percentages compared with that obtained at the late sowing date on 15th October.

Mosa (2009) in Egypt, revealed that sowing beet on 15th September improved juice quality traits in terms of TSS, sucrose and purity percentages and a decrease in impurities and sugar loss to molasses percentages.

2. EFFECT OF MINERAL NITROGEN FERTILIZER:

2. a. Yield and its components:

Edris *et al.* (1992) in Egypt, applied three nitrogen levels (45, 60 and 75 kg N/fed) on sugar beet. They reported that increasing nitrogen fertilization level increased root length and diameter. The highest yields of top and beet root were obtained with 75 kg N\fed.

El-Maghraby *et al.* (1997) in Egypt, applied nitrogen levels (0, 30, 60 and 90 kg/fed) on sugar beet plants. They found that increasing nitrogen rate up to 90 kg N\fed as soil application or 1.5 % N as foliar application caused a significant increase root length, root diameter, root and top weights\plant, root and sugar yields\fed.

Kruger and Nowakowski (1997) in Poland, reported that yields of roots increased with nitrogen dose up to 120 kg/ha.

Development of beet seedlings was markedly faster after application of a starting nitrogen dose (about 60 kg N/ha), although the content of mineral N in soil was high.

Azzazy (1998) in Egypt, supplied sugar beet with 40, 60 and 80 kg N/fed. He reported that increasing nitrogen levels up to 80 kg/fed increased root diameter significantly, while, sugar yield insignificantly increased.

El-Maghraby *et al.* (1998) in Egypt, indicated that increasing the level of nitrogen as foliar application from 0.5% to 1.0 and 1.5% caused a gradual and significant increase in root length, root diameter, top weight/plant, root and sugar yields (ton /fed).

Ibrahim (1998) in Egypt, applied five N levels (0, 25, 50, 75 and 100 kg/fad) to sugar beet crop. He found that addition of 100 kg N/fed gave significantly the maximum values of root length, root diameter, root fresh weight/plant, root yield and sugar yield/fed.

Khan *et al.* (1998a) in Pakistan, supplied sugar beet with 0, 50, 100, 150 or 200 kg N/ha and irrigated at intervals of 7, 14 or 21 days. They found root and sugar yields gave the highest at 83.5 and 10.3 t/ha, respectively.

Ouda *et al.* (1999) in Egypt, studied the effect of four levels of nitrogen fertilization (60, 80, 100 and 120 kg N/fed) on sugar beet crop. The results showed that root length and diameter were significantly affected by the tested treatments in the 1st season. Applying 120 kg N\fed gave the highest values on most studied characteristics.

Azzazy (2000) in Egypt, supplied three nitrogen levels

(50, 75 and 100 kg/fed) to sugar beet plants. He found that root length and root diameter were significantly increased as the applied N - level was raised from 50 to 75 and 100 Kg N/fad.

El-Shafai (2000) in Egypt, examined the effect of nitrogen fertilization at rates 0, 46 and 92 kg N/fed on sugar beet. The obtained results showed that increasing N-level up to 92 kg N\fed increased root fresh weight/plant, root and sugar yield significantly.

Hassanein and Hassouna (2000) in Egypt, supplied sugar beet crop with different nitrogen levels (0, 30 and 60 kg N/fed) in loamy soil. They showed that increasing nitrogen fertilizer up to 60 kg/fed caused a significant increase in all yield traits i.e. root, top and sugar yields.

Voronin (2000) studied sugar beet plants with application of nitrogen at rates of 90, 120, 150, and 180 kg/ha. He obtained the highest root yield with 150 kg/ha.

Ouda (2001) in Egypt, examined the effect of four levels of nitrogen fertilization (45, 60, 75 and 90 kg N/fed.) on sugar beet. The results cleared that root diameter and root weight/plant, root, top and sugar yields responded up to 90 kg N\fed, while root length and top weight/plant responded to N up to 75 kg N\fed.

Abou Shady *et al.* (2002) in Egypt, supplied sugar beet with 20, 40 and 80 kg N/fed. Results showed that increasing nitrogen doses from 20 up to 80 kg\fed increased values of root dimensions. The highest value of sugar yield was obtained from fertilizing sugar beet by 40 kg N/fed.

Ismail (2002) in Egypt, examined the effect of nitrogen fertilization at rates 60, 90 and 120 kg N/fed on sugar beet. He showed that increasing nitrogen rates up to 120 kg N\fed increased significantly values of root length, root diameter, fresh weight/plant, root and sugar yields, in both seasons.

Zalat *et al.* (2002) in Egypt, studied the effect of nitrogen fertilization at rates 30, 60 and 90 kg/fed on sugar beet. Sugar yield gave the highest values with 90 and decreased with decreasing nitrogen mineral.

El-Geddawy *et al.* (2003) in Egypt, applied nitrogen levels (0, 45 and 90 kg N/ fed) on sugar beet. They indicated that root and sugar yields were significantly and positively increased by increasing the applied doses of N up to 90 kg N/fed.

Attia *et al.* (2004) in Egypt, supplied sugar beet with 20, 60 and 80 kg N/fed. They showed that the highest values of root, sugar and top yields were obtained with the addition N levels at 60 kg N\fed.

Azzazy (2004) in Egypt, supplied sugar beet with 60, 75 and 90 kgN/fad and obtained that increasing nitrogen levels from 60 up to 90 kg N\fed, significantly increased length and diameter of root and root yield in both seasons.

El-Geddawy *et al.* (2004) in Egypt, supplied nitrogen levels (0, 45 and 90 kg N/ fed) on sugar beet. They found that addition of 90 kg N/fed gave significantly increased values of root diameter and root fresh weight/plant.

Ismail and Abo El-Ghait (2004) in Egypt, supplied sugar beet with 60, 80 and 100 kg N/fed and P fertilizers (0, 15 and 30 kg P_2O_5/fed). They found that the interaction between N and P fertilizers significantly increased root weight in both seasons, while, root length was markedly influenced in the 1st seasons. The highest root and sugar yields\fed were obtained with the interaction between 100 kg N\fed and 30 kg P_2O_5/fed.

Ramadan and Nassar (2004) in Egypt, studied the effect of nitrogen fertilization at rates of 0, 31, 62, 93 and 124 kg N/fed on sugar beet. They reported that application of nitrogen up to 124 kg N\fed gave the highest root weight, top and root yields. Each nitrogen increment up to 93 kg N\fed was accompanied by an increase in sugar yield.

Sahin *et al.* (2004) in Turkey, studied the effect of nitrogen fertilization at rates of 80 and 120 kg N/ha on sugar beet. Fertilizer applications significantly increased leaf, root and sugar yield.

Abd El-Aal and Mohamed (2005) in Egypt, studied the effect of nitrogen fertilization at rates of 60, 80 and 100 kg N/fed on sugar beet. Results reported that increasing nitrogen fertilization level up to 100 kg N/fed caused increases in root length, root diameter, root fresh weight/plant, root, top and sugar yields.

Abou-Zeid and Osman (2005) in Egypt, applied sugar beet with mineral nitrogen levels at rates of 0, 40 and 80 kg N/fed. Results indicate that root length was insignificantly increased, while, root diameter, root weight/plant, root yield and sugar yield were significantly increased and produced the highest values with application of 80 kg N/fed, in both seasons.

Allam *et al.* (2005) in Egypt, applied sugar beet with 65, 80 and 95 kg N/fed and found that increasing nitrogen fertilization level up to 95 kg N/fed surpassed other levels in root length, root diameter, root fresh weight, top and root yields, while, sugar yield decreased, in both seasons.

El-Sayed (2005) in Egypt, examined the effect of nitrogen fertilization at rates of 75, 100 and 125 kg N/fed on sugar beet. They reported that increasing nitrogen fertilization level at 100 kg N/fed produced significantly highest values of root length, root fresh weight and sugar yield in the 1st season, while, fertilization at 125 kg N\fed increased significantly root diameter and root fresh weight in the 2nd season. Root yield increased significantly in both seasons.

Ismail and Abo El-Ghait (2005) in Egypt, studied the effect of nitrogen fertilization at rates of 69 and 115 kg N/fed on sugar beet. They showed that nitrogen levels caused a significantly effect on root diameter, root fresh weight/plant and root yield in both seasons as well as sugar yield in the 1st season. The highest values of root yield was obtained with the addition nitrogen levels up to 115 kg\fed, while, sugar yield was obtained with 69 kg N\fed.

Kozicka (2005) in Poland, studied the effect of nitrogen fertilization at rates of 90 and 180 kg N/ha on sugar beet. He found that the doubled nitrogen dose from 90 to 180 kg N\ha caused a significant increase of average root mass, leaves and dry matter, while, enhanced a slight, insignificant and root yield increase.

Leilah *et al.* (2005) in Egypt, supplied sugar beet with 150, 200 and 250 kg N/ha in a sandy soil. They reported that nitrogen levels had a significant effects on all the estimated characters in both seasons. Adding 250 Kg N ha^{-1} produced the highest values of length, diameter and fresh weight of roots, foliage fresh weight/plant, root, top and sugar yields.

Moustafa *et al.* (2005) in Egypt, studied the effect of nitrogen fertilization rates (70, 90 and 110 kg N/fed.) on sugar beet. Results reported that increasing nitrogen fertilization level up to 110 Kg N /fed increased root, top and sugar yields.

Osman (2005) in Egypt, applied sugar beet with 65, 80 and 95 kg N/fed and found that increasing nitrogen levels up to 95 kg N\fed had a significant effects on root length in both seasons and higher leaf area index, root diameter, root fresh weight and sugar yield.

Abu El-Fotoh and Abou El-Magd (2006) in Egypt, studied the effect of nitrogen fertilization at rates of 60, 80 and 100 kg N/fed on sugar beet. They showed that the highest values of root and sugar yields were obtained with the addition N levels at 80 kg N\fed, while, top yield was obtained with 60 from 100 kg N\fed.

El-Geddawy *et al.* (2006) in Egypt, applied three nitrogen levels (60, 80 and 100 kg N/fed) on sugar beet. Results showed that increasing N- dose from 60 up to 100 kg\fed increased significantly root length and diameter.

El-Shafai and Tantawy (2006) in Egypt, applied three nitrogen levels (60, 80 and 100 kg N/fed) on sugar beet. They found that root fresh weight/plant and root yield/fed increased significantly by increasing N-level up to 80 kg N/fed. Moreover, top fresh weight/plant was gradually and significantly increased as the applied N- level was raised from 60 to 80 and to 100 kg N/fed. Sugar yield/fed was insignificantly affected by N levels.

Moustafa and El-Masry (2006) In Egypt, examined the effect of nitrogen fertilization at rates of 80, 100 and 120 kg N/fed on sugar beet. They found that soil fertilization with nitrogen increased significantly leaf area/ plant and average root of sugar beet plant in both seasons. Meantime, yield of top, root and sugar significantly differed by nitrogen fertilization in both seasons.

Ismail *et al.* (2007) in Egypt, studied the effect of nitrogen fertilization at rates of 90, 110 and 130 kg N/fed on sugar beet. They showed that the root length, root diameter, fresh weight and root yield were increased by increasing rates of N up to 130 kg/fed.

Ouda (2007) in Egypt, applied two nitrogen levels (40 and 80 kg /fed) on sugar beet plants. Results showed that increasing nitrogen levels up to 80 kg/fed significantly increased root length, root diameter, leave fresh weight, root, top and sugar yields.

Enan *et al.* (2008) in Egypt, examined the effect of nitrogen fertilization at rates of 60, 80 and 100 kg N/fed on sugar beet. They found that nitrogen levels had a significant effects on all estimated characters. Adding 100 Kg N/fed produced the highest values of root length, root diameter, top, root and sugar yield/fed.

Abo-Elazm (2009) in Egypt, found that the highest values of root length, root fresh weight, plant fresh weight, leaves fresh weight/plant and sugar yield were obtained at 180 days from sowing with the addition of 80 kg N/fed.

Nemeat-Alla (2009) in Egypt, tested sugar beet with application of 90 and 120 kg N/fed. He showed that increasing nitrogen up to 120 kg N/fed significantly increased root length, root diameter, plant dry weight, top, root and sugar yields.

2. b. Juice quality and chemical constituents:

El-Geddawy *et al.* (1992) in Egypt, results cleared that the total soluble solids and sucrose percentages did not show much response to nitrogen application, however purity tending to increase with increasing level of nitrogen.

Nour El-Din *et al.* (1993) in Egypt, results showed that increasing nitrogen doses from 45 up to 75 kg\fed increased significantly purity and sodium percentages, while total soluble solids percentage was insignificant.

El-Maghraby *et al.* (1997) in Egypt, found that increasing nitrogen rate up to 90 kg N\fed as soil application or 1.5 % N as foliar application caused a significant increase total soluble solids, sucrose and purity percentages.

Azzazy (1998) in Egypt, reported that increasing nitrogen level up to 80 kg/fed decreased sucrose percentage significantly.

El-Maghraby *et al.* (1998) in Egypt, indicated that increasing the level of nitrogen as foliar application from 0.5% to 1.0 and 1.5% decreased total soluble solids and sucrose percentages, while, juice purity was not affected.

Jaszczolt (1998) found that root sugar content and juice purity in sugar beet were higher with foliar nitrogen application, but alpha-amino nitrogen content was lower compared with control (top dressing of N).

Khan *et al.* (1998b) in Pakistan, found nitrogen content leaves and roots were greater than without nitrogen fertilizer. Sugar yield, sucrose % and purity increased with increasing nitrogen.

Ibrahim (1998) in Egypt, applied five nitrogen levels (0, 25, 50, 75 and 100 kg / fad) for sugar beet crop. He found that addition of 100 kg N kg/fed significantly decreased the values of sucrose and purity percentages.

Azzazy (2000) in Egypt, found that sucrose and purity percentages were negatively affected by increasing N-level up to 100 kg N\fed.

El-Shafai (2000) in Egypt, obtained results showed that increasing N-level up to 92 kg N\fed decreased sucrose percentage.

Ouda (2001) in Egypt, studied the effect of four levels of nitrogen fertilization (45, 60, 75 and 90 kg N/fed.) on quality of sugar beet. The results revealed that TSS percentage responded up to 90 kg N\fed.

Abou Shady *et al.* (2002) in Egypt, showed that increasing N doses from 20 up to 80 kg\fed decreased values of sucrose and purity percentages.

Ismail (2002) in Egypt, obtained that fertilizing sugar beet with 60, 90 or 120 kg N/fed gave the maximum sucrose and purity percentages were not affected by the N levels.

Zalat *et al.* (2002) in Egypt, found that purity percentage significantly affected by 90 kg N/fed and gave the highest values in both seasons.

El-Geddawy *et al.* (2003) in Egypt, indicated that increasing N fertilizer over 45 kg N\fed declined values of total soluble solids and sucrose percentages. Juice purity was significantly and positively increased by increasing the applied doses of N.

El-Geddawy *et al.* (2004) in Egypt, found that addition of 90 kg N/fed gave insignificantly increases values of sucrose percentage on sugar beet roots.

Ramadan and Nassar (2004) in Egypt, reported that application of nitrogen up to 124 kg N\fed decreased sucrose, purity and quality traits of sugar beet.

Azzazy (2004) in Egypt, obtained that increasing nitrogen levels from 60 up to 90 kg\fed, significantly increased sucrose and purity of beet in both seasons.

Feller and Fink (2004) in Germany, found that addition of nitrogen for sugar beet plants did not affect soluble solids content, but increasing nitrogen supply led to major increase in nitrogen content.

Attia *et al.* (2004) in Egypt, showed that the highest values of total soluble solids percentage was obtained with the addition N levels at 60 kg N\fed, while sucrose and purity percentages were recorded with 20 kg N\fed.

Abd El-Aal and Mohamed (2005) in Egypt, showed that increasing nitrogen fertilization level up to 60 kg N\fed increased sucrose, total soluble solids and purity percentages of beets.

Allam *et al.* (2005) in Egypt, reported that increasing nitrogen fertilization level for sugar beet crop up to 90 kg N/fed surpassed other levels (60 and 80 kg N\fed) in leaves dry weight and total soluble solids percentage, while, sucrose and purity percentages decreased in both seasons.

Hoffmann (2005) in Germany, found that the effect of nitrogen supply on the nitrogen composition of sugar beet varieties with special emphasis on nitrogen supply by variety interactions. In 2001 and 2002, field trials with four varieties and four N treatments were carried out at six sites in Germany. Concentrations of sucrose, sodium, amino nitrogen, nitrate and total soluble nitrogen in the beet were determined. With increasing nitrogen supply, the concentration of amino nitrogen increased considerably and that of nitrate slightly. Thus, the nitrogen composition of sugar beet changed with increasing nitrogen supply and the percentage of amino nitrogen of total soluble nitrogen increased.

El-Sayed (2005) in Egypt, reported that increasing nitrogen fertilization level up to 100 kg N/fed produced significantly higher values of total soluble solids percentage in the 1^{st} season and 125 kg N\fed significantly increased total soluble solids percentage in the 2^{nd} season.

Ismail and Abo El-Ghait (2005) in Egypt, showed that nitrogen rates (69 and 115 kg N/fed) caused a significantly effect on sucrose percentage in beets in both seasons.

Kozicka (2005) in Poland, studied the effect of nitrogen fertilization at rates 90 and 180 kg N/fed on sugar beet. Results obtained that the doubled nitrogen dose from 90 to 180 kg N\ha enhanced a slight, statistically insignificant and lower sugar content in beet roots. The increase of N rate from 90 to 180 kg N\ha caused a significant increase of potassium and N-alpha NH_2 in roots but it also lowered sugar content.

Leilah *et al.* (2005) in Egypt, adding 250 kg N/ha for sugar beet on a sandy soil produced the highest values of purity percentage.

Osman (2005) in Egypt, found that the highest total soluble solids percentage of beets was obtained with increasing N level up to 95 kg N\fed but sucrose and purity percentages were decreased.

Moustafa *et al.* (2005) in Egypt, indicated that increasing nitrogen fertilization level for sugar beet up to 110 kg N /fad increased juice impurities (sodium and alpha-amino nitrogen percentages).

Abu El-Fotoh and Abou El-Magd (2006) in Egypt, showed that the highest values of sucrose and purity percentages of beets were obtained with increasing nitrogen level up to 80 kg N\fed.

El-Geddawy *et al.* (2006) in Egypt, showed that increasing N doses from 60 to 100 kg\fed decreased significantly sucrose and purity percentages of beets.

El-Shafai and Tantawy (2006) in Egypt, applied three nitrogen levels (60, 80 and 100 kg N/fed) on sugar beet. Gradual reductions in pol, randement and quality index percentages were detected accompanying the increase in nitrogen level.

Meanwhile, sugar yield/fed was insignificantly affected by nitrogen levels.

Moustafa and El-Masry (2006) in Egypt, found that soil fertilization with nitrogen increased significantly nutrient uptake (N) in both leaves and root of sugar beet plant in both seasons. Meantime, juice quality percentages i.e. sucrose, purity and impurities (Na, K and α-amino nitrogen) significantly differed by nitrogen and potassium fertilization in both seasons.

Ismail *et al.* (2007) In Egypt, showed that impurities content in sugar beet roots were increased by increasing rates of N up to 130 kg/fed, while sucrose and purity percentages were decreased in both seasons.

Mahmoud *et al.* (2007) in Egypt, found that application of 80 kg N\fed for sugar beet plants attained the highest TS-sugar in leaves at 150 and 180 days. Roots check treatment recorded a significant increment at 150 days from sowing. Meanwhile, nitrogen treatment significantly affected non reducing sugar at 180 and 150 days for leaves and roots, respectively.

Milan *et al.* (2007) in Slovak, studied the effect of nitrogen fertilization at rates of 12, 52, 72, 178, 180 and 240 kg N/ha on sugar beet. Results showed that increasing N doses from 12 up to 240 kg\ha increased alpha-amino nitrogen percentage in root, while sugar content decreased.

Ouda (2007) in Egypt, showed that increasing nitrogen level up to 80 kg/fed significantly increased TSS% of beets.

Enan *et al.* (2008) in Egypt, found that nitrogen rates (60, 80 and 100 kg N/fed) had a significant effects on all of beets estimated characters. Adding 80 kg N/fed produced the highest values of total soluble solids and sucrose percentages and the lowest values of impurities percentages.

Abo-Elazm (2009) in Egypt, found that the highest sucrose value of beets was obtained at 180 days from sowing with the addition of 80 kg N\fed.

Nemeat-Alla (2009) in Egypt, supplied sugar beet with 90 and 120 kg N/fed. He showed that application of nitrogen tended to decreased total soluble solids content.

3. EFFECT OF BIO-NITROGEN FERTILIZER:

3. a. Yield and its components:

EL-Badry and Bassel (1993) in Egypt, indicated that treatment with all tested bacteria strains showed increases in crop yield. Strains of *Azospirillum* had smaller effects than *Azotobacter*. The mixed culture of both bacterial strains gave higher yield.

Afify *et al.* (1994) in Egypt, studied the bacterization of sugar beet plant with *Azotobacter* chroococcum, Bacillus megaterium and *Baciluus circulans*. The treatment receiving all the three inoculants gave the next best root length and diameter, followed by *Azotobacter chroococcum* alone. Among bacterial inoculations both root and top weights of the plants receiving either two or three inoculations combination were better over single inoculants.

Hassanein and Hassouna (2000) in Egypt, studied the effect of biofertilizer inoculation on some sugar beet varieties in sandy clay loam soil. Biofertilizer treatment gave root yield higher than 30 kg N/fed with all tested varieties.

Maareg and Badr (2000) in Egypt, demonstrated that the application of *Azotobacter Chroococcum* as a (Cerealine) caused on increase in root and foliage weight/plant of sugar beet crop.

Cakmakci *et al.* (2001) in Turkey, studied the effect of seeds inoculation with bacteria of *Bacillus sp.* and *Pseudomonas* on sugar beet. They showed that seed inoculation with *Bacillus sp.* bacteria increased root and sugar yields as compared with control.

Markovacki and Milic (2001) inoculated sugar beet with *Azotobacter chroococcum* in field experiments over 10 years, it could be concluded that bacteria improved the yield of sugar beet.

Saleh (2003) in Egypt, inoculation sugar beet seeds with bio-fertilizer as microbin (*Azospirillum sp., Azotobacter sp., Bacillus megatherium var. phosphaticum, Pseudomonas sp.* and *Micorrhiza sp.*). Results indicated that the effect of bio-fertilizer was significant on root length, root diameter and yield ton/fed, in both seasons.

Attia *et al.* (2004) in Egypt, studied the effect of bio-fertilizer with rizobacteren and cerialine on sugar beet plants. They found that root, top and sugar yields in the three seasons were significantly affected. The highest values recorded by rizobacteren alone followed by mix. of rizobacteren and cerialine followed by cerialine alone when compared with the untreated control.

Badawi *et al.* (2004) in Egypt, studied the effect of bio-fertilizer with rizobacteren and cerialine on sugar beet plants. They found that root length, root diameter, both fresh and dry weight of roots and leaves and yield components were significantly affected. Fertilization with rizobacteren significantly increased the total of growth criteria.

El-Dsouky and Attia (2004) in Egypt, studied the effect of *Azotobacter chroococcum* and *Bacillus megaterium* on sugar beet plants. Single inoculation with either bacteria significantly increased yield.

El-Kholi *et al.* (2004) in Egypt, studied the effect of *Azospirillum brasil*ense, *Azotobacter chroococcum* and *Bacillus megatherium* on sugar beet growth. Results showed that treated sugar beet seeds with N_2 fixers significantly increased the fresh weight of sugar beet leaves and roots, sugar beet root and sugar yields when compared with control, in both seasons.

Neamat-Alla (2004) in Egypt, mentioned that inoculation of sugar beet seeds with *Azospirillum* and *phosphorine* (a biofertilizer consists of phosphate dissolving bacteria) had insignificant effect on root length and diameter.

Abou-Zeid and Osman (2005) in Egypt, studied the effect of inoculation of sugar beet seed with *Azotobacter chroococcum* and *Bacillus polymyxa*. They showed that application of both bio-fertilizers led to insignificant increase in root length, root diameter and root fresh weight at harvest, while, the same application led to significant increases in root and sugar yields.

Agami (2005) in Egypt, inoculation sugar beet seed with bio-fertilizer as cerealine caused an increase in length, diameter and fresh and dry weights of roots and leaves and sugar yield.

Mahmoud *et al.* (2007) in Egypt, studied the effect of inoculation of sugar beet seed with *Azotobacter*. Results cleared that seed inoculation with bacteria significantly responded in root yield.

Ouda (2007) in Egypt, studied the effect of inoculation of sugar beet seed with cerealine. Results showed that bio-fertilizer positively improved length, diameter and weight of root and yield of root and sugar.

Abo-Elazm (2009) in Egypt, found that the highest root length and sugar yield of sugar beet plants were obtained at 180 days from sowing with *Azotobacter* treatment.

Aly *et al.* (2009) in Egypt, studied the effect of seed inoculation and foliar application with *Azospirillum* and/or *Bacillus* on sugar beet growth. They showed that application of both bio-fertilizers either alone or in combination led to a significant improvement in most sugar beet traits. The highest stimulatory effects were exerted in plants treated with the mixture of *Azospirillum* and *Bacillus* than either of them alone. This treatment significantly improved growth parameters (root length, root diameter and root fresh weight), top, root and sugar yields.

3. b. <u>Juice quality and chemical constituents:</u>

EL-Badry and Bassel (1993) in Egypt, indicated that treatment with all tested strains showed increases in sugar content. Strains of *Azospirillum* had smaller effects than *Azotobacter* on sugar beet plants.

Hassouna and Hassanein (2000) in Egypt, biological fertilization had slightly positive effect on purity percentage of beets higher than the of mineral nitrogen fertilizer level (30 kg N/fed).

Maareg and Badr (2000) in Egypt, demonstrated that application of *Azotobacter Chroococcum* as a (cerealine) caused on increase in quality characters i.e., TSS, sucrose and purity percentages of beets.

Cakmakci *et al.* (2001) in Turkey, showed that seed inoculation with *Bacillus sp.* bacteria significantly affected quality parameters in sugar beet.

Saleh (2003) in Egypt, indicated the effect of bio-fertilizer microbin (*Azospirillum sp., Azotobacter sp., Bacillus megatherium var. phosphaticum, Pseudomonas sp.* and *Micorrhiza sp.*) was significant on chemical contents of beets as total soluble solids, sucrose and purity percentages in both seasons.

Attia *et al.* (2004) in Egypt, found that total soluble solids percentage in the second season, sucrose percentage in the three seasons and purity percentage in the third season were significantly affected. The highest values were recorded by rizobacteren alone followed by mix of rizobacteren and cerialine followed by cerialine alone when compared with the untreated control.

El-Dsouky and Attia (2004) in Egypt, studied the effect of *Azotobacter chroococcum* and *Bacillus megaterium* on sugar beet plants. Single inoculation with either bacteria significantly increased quality traits.

El-Kholi *et al.* (2004) in Egypt, the percentages of total soluble solids and sucrose were significantly increased when sugar beet plants inoculated with bio-fertilizer, while purity was not significant.

Agami (2005) in Egypt, inoculation sugar beet seeds with bio-fertilizer as cerealine caused an increase in total soluble solid, sucrose and purity percentages.

Abou-Zeid and Osman (2005) in Egypt, showed that application of both bio-fertilizers to sugar beet plants led to insignificant increase in total soluble solids, sucrose and purity percentages.

Ouda (2007) in Egypt, showed that inoculation of sugar beet seed with cerealine did not affect sucrose and total soluble solids percentages.

Abo-Elazm (2009) in Egypt, studied the effect of inoculation of sugar beet seed with *Azotobacter*. She found that the highest sucrose value was obtained at 180 days from sowing with *Azotobacter* treatment

Aly *et al.* (2009) in Egypt, showed that application of both bio-fertilizers either alone or in combination led to a significant improvement in most sugar beet traits. The highest stimulatory effects were exerted in plants treated with the mixture of *Azospirillum* and *Bacillus* than either of them alone. This treatment significantly improved root quality (total soluble solids and sucrose percentages). *Azospirillum* was more effective than *Bacillus* on root nitrogen and potassium percentages. But *Bacillus* was more effective on sucrose and purity percentages only.

4. EFFECT OF INTERACTION AMONG SOWING DATE, MINERAL AND BIO-NITROGEN FERTILIZERS:

El-Badry and El-Bassel (1993) in Egypt, studied the effect of the interaction between nitrogen fertilization at rates (0, 30, 45, 60 and 75 kg N/fed) and with or without bacterial inoculation on sugar beet productivity. Results indicated that the best economical rate of inorganic nitrogen fertilizers used 45 kg/fed + bacterial inoculation; as crop yield, total soluble compounds and sugar amount/fed, were about equal to those obtained with higher rates of 60 and 75 kg N/fad without inoculation in the first experiment. In the second experiment, they studied the effect of interaction between 75 kg N/fed and free nitrogen fixing *Azotobacter* and/or *Azospirillum* cultures. They found that treatment with all tested strains showed increases in weight of plants, crop yield as well as sugar content. Strains of *Azospirillum* had smaller effects than *Azotobacter*. The mixed culture of both bacterial strains gave higher yield.

Afify *et al* (1994) in Egypt, studied the bacterization of sugar beet plants with *Azotobacter chroococcum*, *Bacillus* *megaterium* and *Baciluus circulans* either alone or in combinations with fertilizer application 70 kg N/fed. Results indicated that root length, root diameter, leaves weight and root weight of the plant significantly increased by three inoculations combination over single inoculants. Also, the maximum total soluble solids and sucrose percentages were exhibited in plants receiving mineral NPK fertilizers followed by the combined three bacterial inoculants.

Azzazy (1998) in Egypt, studied the effect of interaction between two sowing dates (November 1st and November 15th) and nitrogen fertilizer levels at 20, 60 and 80 kg N/fed on sugar beet yield and its quality . Results obtained that the interactions between the studied factors had no significant effect on root length and diameter, sucrose % and root and sugar yields but purity % had significant in the first season, only. In both seasons, the highest values of root yield was produced from sugar beet sown on the November 1st with 80 kg N/fed, while the highest values of sugar yield was produced from sugar beet sown on the November 1st and fertilized with 40 kg N/fed.

Hassouna and Hassanein (2000) in Egypt, studied the effect of interaction between nitrogen fertilization at rates of 0, 30 and 60 kg N/fed and biofertilizer inoculation on some sugar beet varieties in sandy clay loam soil. Combination of the bio-fertilizer and fertilization at 60 kg N/fed significantly increased sucrose and purity percentages, while total soluble solids decreased.

Hassanein and El-Shebiny (2000) in Egypt, studied the effect of interaction between nitrogen fertilization at rates of 0, 65 and 130 kg N/fed and the contribution *Halex* as a bio-fertilizer on two sugar beet varieties in sandy clay loam soil. Combination of the bio-fertilizer as *Halex* + the 65 kg N/fed gave higher root yield.

Zalat *et al.* (2002) in Egypt, studied the effect of interaction between nitrogen fertilization at rates of 30, 60 and 90 kg/fed and inoculation of sugar beet seeds with cerealine. Results indicated that root and top yields significantly decreased with decreasing nitrogen application, with applied bio-fertilizer.

Saleh (2003) in Egypt, tested the interaction between inoculation sugar beet seed with bio-fertilizer as microbin (*Azospirillum sp., Azotobacter sp., Bacillus megatherium var. phosphaticum, Pseudomonas sp.* and *Micorrhiza sp.*) and fertilizer nitrogen level (20, 40 and 60 kg/fed). He obtained that top fresh weight, root weight/plant, root length and root diameter were significantly increased gradually by increasing nitrogen fertilizer. Adding bio + 40 kg N/fed gave the highest values than those receiving bio + 20 kg N/fed. The highest value of sugar beet yield/fed was recorded by adding 60 kg N/fed. Total soluble solids, sucrose and purity percentages increased by increasing nitrogen fertilizer up to bio + 40 and 60 kg N/fed in the first season and up to 60 kg N/fed in the second season, respectively.

Feller and Fink (2004) in Germany, studied the effect of five sowing dates (17 August early, 21 September medium, 12 October. late, 30 August early and 27 September medium) and nitrogen levels at 100, 175 and 250 kg/ha on sugar beet in sandy soil. They showed that late sowing dates required a reduced nitrogen supply to keep harvest nitrate contents below the 2500 mg/kg required by the processing industry. Early sowing dates resulted in low nitrate-N contents with effects produced by nitrogen supply. Increasing nitrogen supply led to major increase in NC if combined with late sowing dates.

Attallah (2004) in Egypt, evaluated the effect of bio-fertilizers (*Azospirillum lipoferum* bacteria), mineral nitrogen in the form of urea and their combinations on some sugar beet varieties in a clay loam soil. The combinations between the tested factors caused a significant increase studied characters and root yield, while total soluble solids and sucrose percentages recorded the highest values.

Attia *et al.* (2004) in Egypt, studied the effect of sowing dates on (1st September, 1st October and 1st November), bio-fertilizers with (rizobacteren and/or cerialine) and nitrogen fertilization at rates 20, 60 and 80 kg N/fed on sugar beet plants. They recommended that combination with sowing date on 1st October, bio-fertilizer with rizobacteren and nitrogen fertilization at 60 or 80 kg N/fed led to the highest production of crop sugar beet.

Agami (2005) in Egypt, studied the interaction between three sowing dates of sugar beet (15th September, 15th October and 15th November) and three levels of nitrogen with/or without bio-fertilizer as cerealine (80 kg N/fed, 60 kg N/fed + cerealine and 40 kg N/fed + cerealine). The interaction had marked effects on dry weight of plant, top yield, total soluble solids and sucrose percentages. Sowing date early in 15th September and inoculating seeds with bio-fertilizer (cerealine) + 60 kg N/fed gave the maximum values of previously characters. As well as sowing date in 15th October with 80 kg N/fed only without bio-fertilizer gave the maximum values of fresh weight of leaves/plant. Also, sowing date in 15th October and inoculating seeds with bio-fertilizer (cerealine) + 60 kg N/fed gave the maximum value of root diameter.

Allam *et al.* (2005) in Egypt, studied sowing dates of sugar beet on 1st October, 15th October and 1st November with application of 65, 80 and 95 kg N/fed. Results showed that the highest values of root yield was obtained from the interaction between sowing date of 1st October with the application of 95 kg N/fed in both seasons. The highest sugar yield was recorded from the interaction between sowing date of 1st October with the application of 80 and 65 kg N/fed in the first and second seasons, respectively.

Abou-Zeid and Osman (2005) in Egypt, studied the effect of interaction between inoculation of sugar beet seed with *Azotobacter chroococcum* and *Bacillus polymyxa* and different levels of mineral nitrogen at 0, 40 and 80 kg N/fed on sugar beet plants. Results given that root length was insignificantly increased by mineral nitrogen fertilizer or bio-fertilizers or by both of them in the first season. Inoculation with *Bacillus* alone or in combination with *Azotobacter* inoculation attained a distinct increase in the root yield values under the several of nitrogen in both seasons.

Leilah *et al.* (2005) in Egypt, studied the effect of early sowing of sugar beet (September 1st and October 1st) with application of nitrogen levels (150, 200 and 250 kg N/ha) in a sandy soil. They showed that the interaction between the studied factors had significant effects on root fresh weight and root yield in the two seasons.

Tantawy and El-Sayed (2006) in Egypt, studied the interaction between mineral nitrogen levels at 45 and 90 kg N/fed and bio-fertilizer with *Azotobacter chroococcum* and *Rhrizobium st.* on sugar beet plants. They showed that increasing N-dose up to 90 kg N/fad with both bacteria strains caused a significant reduction in the values of leaves dry weight and leaf N content. Application low dose of nitrogen (45 kg N/fad) with inoculation by Azotobacter significantly increased root, top and sugar yields.

Mahmoud *et al.* (2007) in Egypt, studied the interaction between nitrogen fertilizer level at 80 kg N/fed and inoculation of sugar beet seed with *Azotobacter*. They found that interaction significantly affected root and sugar yields compared with the untreated control.

Ouda (2007) in Egypt, studied the effect of interaction between nitrogen fertilization at rates of 40 and 80 kg/fed and inoculation of sugar beet seed with cerealine. Results showed that increasing N levels up to 80 kg /fed significantly increased root yield. The highest sugar yield was obtained when 40 or 80 kg N/fed with cerealine.

Abo-Elazm (2009) in Egypt, studied the interaction between nitrogen fertilizer level at 80 kg N/fed and inoculation of sugar beet seed with *Azotobacter*. Results obtained found that interaction significantly affected root and sugar yields compared with the untreated control.

MATERIALS AND METHODS

III. MATERIALS AND METHODS

Three field experiments of sowing dates i.e. 15th September, 15th October and 15th November were carried out in two successive seasons of 2006/2007 and 2007/2008 in the Experimental Farm of Sakha Agricultural Research Station, Kafr EL-Sheikh Governorate.

Each sowing date included 9 treatments, which were the combinations between three rates of mineral nitrogen and three sources of bio-fertilizer.

a. Mineral nitrogen fertilizer rates:

1. 30 kg N/fed. (control).
2. 60 kg N/fed.
3. 90 kg N/fed.

Nitrogen fertilizer was applied as urea (46% N) in two equal doses, the first one after thinning (45 days from sowing) and the second one at one month later.

b. Bio-fertilizer nitrogen sources were applied as cerealin:

1. Uninoculted (control).
2. Inoculation with Azospirillum bacteria.
3. Inoculation with Bacillus bacteria.

Sugar beet seed was inoculated by the examined bacteria through the following method: Seed of sugar beet variety Montebianco was mixed with a glue solution and the specific bacteria and left in unsunny place till be dried before sowing it.

Phosphorus fertilizer was added during land preparation at 30 kg P_2O_5/fed as calcium super phosphate (15.5 % P_2O_5), meanwhile, potassium fertilizer at 48 kg K_2O/fed as potassium sulphate (48% K_2O) was applied once with the first dose of nitrogen.

The nine combinations of mineral nitrogen and bio-fertilizer source were arranged in randomized completely block design with three replications was used. Plot area was 17.5 m^2 and consists of five ridges which were 7 meter in length, 50 cm in width; distance between hills was 20 cm.

The preceding crop was rice in both seasons. All cultural practices for growing sugar beet were done as recommended.

Soil mechanical and chemical properties of the experimental sites are presented in Table (1). Some metrological data of the experimental sites are presented in Table (2).

Recorded data:

At harvest (210 days from sowing), a sample of five plants was taken at random to determine the following characteristics:

a. Yield and its components:

1. Root length (cm).
2. Root diameter (cm).
3. Root fresh weight g/plant.
4. Top fresh weight g/plant
5. Root dry weight percentage/plant.
6. Top dry weight percentage/plant

At harvest four guarded rows were harvested, topped, cleaned and the following criteria were recorded:

7. Root yield (t/fed).
8. Top yield (t/fed).

Table (1): Soil mechanical and chemical properties of the experimental sites (0 – 30 on depth) during (2006/2007 and 2007/2008 seasons)

Season	2006/2007	2007/2008
Mechanical analysis		
Sand %	12.30	15.00
Silt %	26.60	23.95
Clay %	53.29	57.68
$CaCO_3$	2.35	2.16
Textural class	Clay	Clay
Chemical analysis		
Organic matter %	1.81	1.66
Available N ppm	40.70	36.90
Available P ppm	15.40	16.10
Available K ppm	389.9	415.2
pH	8.0	8.2
E.C ds/m	1.49	1.65
Cations and Anions (meq/L)		
Na^+	16.2	16.4
K^+	0.26	0.29
Ca^{++}	4.0	3.7
Mg^{++}	2.8	2.6
HCo_3^-	5.83	4.91
Cl^-	6.20	6.40
SO_4^{--}	3.70	4.30

Soil physical and chemical properties were determined according to **Jackson (1956).**

Table (2): Some metrological data of the experimental sites.

Month	2006/2007					2007/2008				
	Air temperature °C		Relative humidity %		Rain fall (mm/day)	Air temperature °C		Relative humidity %		Rain fall (mm/day)
	Max.	Min.	Max.	Min.		Max.	Min.	Max.	Min.	
September	33.0	16.8	89.0	52.0	-	32.0	13.0	74.5	55.7	-
October	29.0	13.4	76.0	49.5	-	29.2	12.0	75.0	54.7	-
November	23.5	8.9	77.0	58.6	-	26.0	8.0	78.0	52.7	-
December	19.7	4.5	82.0	62.2	0.3	21.0	3.7	79.0	55.5	0.4
January	18.7	4.1	87.0	58.5	-	18.0	1.4	74.0	58.0	1.2
February	21.3	5.6	95.4	67.6	1.6	20.4	3.0	79.0	63.3	1.3
March	22.0	5.8	79.2	51.7	-	25.0	5.8	77.0	53.0	-
April	25.3	7.5	80.5	49.5	0.4	27.8	8.3	70.0	46.0	-
May	30.0	12.0	76.3	45.0	-	29.0	10.0	70.5	42.5	-
June	33.0	16.5	82.4	56.0	-	33.0	15.0	82.5	50.0	-

Source: Rice Research & Training Center, Sakha, Kafr El-Sheikh, 33717. Egypt.

9. Sugar yield (t/fed) was calculated according to the following equation: Sugar yield (t/fed) = Root yield (t/fed) X sucrose %.

b. Juice quality:

10. Total soluble solids percentage, (TSS %) was determined by using hand refractometer (**A.O.A.C.,1995**).
11. Sucrose percentage was determined by using Saccharimeter according to the method described by **Le Docte (1927)**.
12. Purity percentage was calculated according to **Carruthers *et al.* (1962)** as follows:

    Purity = (sucrose % x 100) / TSS %.

c. Chemical constituents:

A sample of 100 g. of both leaves and roots was randomly taken from each treatment, ovened at 70 °C to determine root dry weight percentage. A dried sample of 0.1 g. from each treatment was digested by using sulfuric acid and the following elements were determined in the digested solution:

13. Nitrogen percentage in roots and tops were determined using micro Kjldahl apparatus according to **Pergl (1945).**
14. Potassium and sodium percentages in roots and tops were determined using flame photometer according to **Brown and Lilliland (1964).**
15. Nitrogen uptake of root was calculated according to the following equation: Root fresh weight (t/fed) x root dry matter% x nitrogen %.

16. Nitrogen uptake of tops was calculated according to the following equation: Top fresh weight (t/fed) x top dry matter % x nitrogen %.
17. Potassium uptake of root was calculated according to the following equation: Root fresh weight (t/fed) x Root dry matter % x Potassium %.
18. Potassium uptake of tops was calculated according to the following equation: Top fresh weight (t/fed) x top dry matter % x Potassium %.
19. Sodium uptake of root was calculated according to the following equation: Root fresh weight (t/fed) x Root dry matter% x Sodium %.
20. Sodium uptake of tops was calculated according to the following equation: Top fresh weight (t/fed) x Leaves dry matter % x Sodium %.

Statistical analysis:

The collected data were subjected to proper statistical analysis of variance according to **Sendecor and Cochran (1967)**. The heterogeneity of error variances across sowing dates seasons indicated that error terms were homogeneous. A combined analysis was done according to **Gomez and Gomez (1984).** For comparison among treatment means, Duncan's multiple range test was used **(Duncan, 1955)**. Also, simple correlation coefficient was computed among studied traits according to **Steel and Torrie (1980).** The prediction equations of sugar beet yields, error mean squares and nitrogen maximum response which estimated from combined analysis over two successive seasons were computed according to **Fox and Piekielek (1990).**

RESULTS

AND DISCUSSION

IV. RESULTS AND DISCUSSION

1. Effect of seasons:

Results given in Table (3) show the influence of seasonal effect on yield components. The collected results revealed that yield components in terms of root length, root diameter, root fresh weight/ plant and root dry matter appeared insignificant affected by the growing seasons. However, the differences between the two growing seasons with relation to their influence on top fresh weight and top dry matter were significant. These results may be due to changes of environments in the first season and second seasons under study (Table, 2).

Results given in Table (4) reveal the influence of the growing seasons on root, top and sugar yield of sugar beet crop. The collected data cleared that these traits were insignificantly affected by the growing seasons.

Results presented in Table (5) show that seasonal effect on juice quality measurements was significant for purity percentage. Whereas it could be noted that the insignificant effect of seasons on the values of total soluble solids and sucrose percentages assured that this trait mainly is affected by gene-make up rather than environmental condition.

Results presented in Table (6) show seasonal effect on the values of macro-elements in the different parts of sugar beet plants i.e. root and top. It could be noted that the content of root

Table (3): Seasonal effect on yield components of sugar beet crop at harvest in (2006/07 and 2007/08 seasons)

Season (S)	Root length (cm)	Root diameter (cm)	Root fresh weight (g/plant)	Top fresh weight (g/plant)	Root dry matter %/plant	Top dry matter %/plant
2006/07	23.47 a	11.56 a	864 a	234 b	23.83 a	15.84 a
2007/08	23.18 a	11.34 a	874 a	269 a	23.77 a	14.57 b

Table (4): Seasonal effect on yields of sugar beet crop at harvest in (2002/03 and 2003/04 seasons)

Seasons (S)	Root yield (t/fed)	Top yield (t/fed)	Sugar yield (t/fed)
2006/07	25.84 a	10.74 a	4.35 a
2007/08	25.99 a	10.62 a	4.27 a

Table (5): Seasonal effect on juice quality of sugar beet crop at harvest in (2006/07 and 2007/08 seasons)

Seasons (S)	Total soluble solids %	Sucrose %	Purity %
2006/07	22.33 a	17.48 a	78.74 a
2007/08	22.43 a	17.12 a	76.89 b

Table (6): Seasonal effect on nitrogen, potassium and sodium concentrations of sugar beet crop at harvest in (2006/07 and 2007/08 seasons)

Seasons (S)	Nitrogen in root %	Nitrogen in top %	Potassium in root %	Potassium in top %	Sodium in root%	Sodium in top %
2006/07	1.40 a	3.24 a	2.44 a	3.62 a	1.51 a	2.48 a
2007/08	1.38 a	3.30 a	2.50 a	3.56 a	1.47 a	2.43 a

Table (7): Seasonal effect on nitrogen, potassium and sodium uptake of sugar beet crop at harvest in (2006/07 and 2007/08 seasons)

Seasons (S)	Nitrogen uptake in root (kg/fed)	Nitrogen uptake in top (kg/fed)	Potassium uptake in root (kg/ fed)	Potassium uptake in top (kg/ fed)	Sodium uptake in root (kg/ fed)	Sodium uptake in top (kg/ fed)
2006/07	88.94 a	57.11 a	148.33 a	60.07 a	92.02 a	42.11 a
2007/08	86.27 a	52.52 a	152.47 a	54.16 b	89.39 a	37.45 b

and top from the percentages of nitrogen, potassium and sodium were not affected by the growing season.

Results presented in Table (7) show seasonal effect on the values of macro-elements uptakes in root and top of sugar beet plants. It is clearly show that nitrogen, potassium and sodium uptakes of root and top were not affected by the growing season except the values of potassium and sodium uptakes of top, which significantly affected by the growing seasons.

2. <u>Effect of sowing date</u>:

2. a. <u>Yield and its components:</u>

Results given in Table (8) show the influence of three sowing dates on some yield components in terms of root length, root diameter, root fresh weight and top fresh weight/plant in the two growing seasons. The obtained results cleared that sowing sugar beet on 15th September or 15th October significantly surpassed the latest sowing date (15th November) with respect to the above mentioned characteristics. However, the differences between 15th September and 15th October were not enough to reach the 5 % level of significance. It is obviously show that sowing sugar beet early increased the values of root dimensions as well as root and top fresh weight. This finding may be indicate to the relative importance of the early sowing dates, which allow to sugar beet plants to grow better than the late one. **Abd El-Aal and Abou El-Magd (2006), El-Geddawy *et al* (2007) and Mosa (2009)** found that the sowing sugar beet on 15th September led to significant increase in the value of root dimensions, root and top fresh weight/plant when compared with that obtained at the late sowing date.

Results in Table (9) show the effect of the examined sowing dates on root and top dry matter of sugar beet/plant. The collected results pointed out that delaying sowing date resulted in decreased the values of roots and top dry matter percentages. Delaying sowing dates from 15th September to 15th October reduced the values of these traits. The highest values of root and top dry matter percentage were recorded with 15th September sowing date. These results reassured that the early sowing date positively affected on growth criteria.

Once more, the interaction between sowing date and the growing season was insignificant in relation two their effect on these criteria. This finding may indicate to the relative effect of sowing dates on these traits.

Results obtained in Table (10) show the influence of different sowing dates on root, top and sugar yields of sugar beet at the two growing seasons and their combined.

Results revealed that sugar beet root yield statistically affected by the examined sowing dates. The both earlier sowing dates (15th September and 15th October) recorded better root yield than the late one (15th November). **Abd El-Aal and Abou El-Magd (2006) and Mosa (2009)** found that the early sowing date on 15th September attained the highest root yield/fed.

In general, it could be noticed that the highest root yield of sugar beet was produced when sugar beet plants was sown on the 15th October. This finding was true in the two seasons and

Table (8): Effect of sowing date on yield components of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	Root length (cm/plant)			Root diameter (cm/plant)			Root fresh weight/plant (g)			Top fresh weight/plant (g)		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
15 Sept.	24.57 a	24.20 b	24.38 b	11.79 a	11.61 a	11.69 a	885 a	883 a	884 a	231 ab	279 a	255 a
15 Oct.	25.16 a	25.07 a	25.11 a	11.62 ab	11.42 a	11.51 a	868 a	896 a	882 a	248 a	273 a	260 a
15 Nov.	20.69 b	20.28 c	20.48 c	11.27 b	11.01 b	11.14 b	838 b	843 b	840 b	222 b	255 a	239 b
F.test (DXS)			NS			NS			NS			NS

NS: not significant.

Table (9): Effect of sowing date on root and top dry matter of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	Root dry matter %			Top dry matter %		
	2006/07	2007/08	combined	2006/07	2007/08	combined
15 Sept.	26.15 a	26.05 a	26.10 a	17.42 a	16.06 a	16.74 a
15 Oct.	24.19 b	24.33 b	24.26 b	15.49 b	14.44 b	14.97 b
15 Nov.	21.16 c	20.95 c	21.05 c	14.61 c	13.19 c	13.90 c
F.test (DXS)			NS			NS

NS: not significant.

their combined. The relative advantage of this date may be due to that date is appropriate not only for the rapid growth, but also, for sugar storage by the end of the season where the crop harvested.

Sowing sugar beet on 15th October increased root yield by 23.47 %, 22.87 % and 23.17 % in the first, second seasons and their combined compared with 15th November sowing date.

Top yield of sugar beet as affected by sowing dates in the two seasons and their combined (Table, 10) pointed out that top yield/fed significantly affected by the studied sowing dates. The obtained which were results cleared that both of the early sowing dates i.e. 15th of September and October over passed the late sowing date (15th November). This finding was true in both seasons and their combined. **Agami (2005)** found that the early sowing date on 15th September had a significant increase in top yield of sugar beet.

Concerning the influence of sowing dates on sugar yield, the results in (Table, 10) show the relative importance of the early sowing date and reassured that sowing date is still one of the very critical factor directly affected on beet yield and its components.

The highest sugar yield was recorded with both early sowing dates (15th of September and October) without insignificant difference between them. However, it is clearly show that sowing sugar beet on 15th October attained additional increase in sugar yield amounted by 38.17 %, 35.07 % and 36.78 % when compared with that the late sowing date on 15th November in the first, second season and their combined, respectively. Regarding the effect of different sowing dates on yields of top, roots and sugar, it could be noted that the relative advantage of the early sowing date i.e. 15^{th} September and October than the late one mainly due to the suitable conditions prevailing during the early growth stages, which reflected on the yield components of the individual plants (Table, 8) and which in turn affected on the final crop at harvest in terms of root and sugar yields (Table, 10). **El-Geddawy *et al* (2007)** found that sowing sugar beet early on 15^{th} September significantly attained highest values of sugar yield when compared with that the late sowing date.

2. b. <u>Juice quality</u>:

Results presented in Table (11) reveal the influence of different sowing dates on juice quality measurements i.e. total soluble solids, sucrose and purity percentages. The results given distinctly clear that delaying sowing date to 15^{th} November attained a positive response in total soluble solids percentage. These results were true in both seasons and their combined. On the contrary, sucrose and purity percentages negatively affected by delaying sowing date. The earlier sowing date i.e. 15^{th} September attained the highest values in sucrose and purity percentages and the lowest values of these traits was recorded with the latest sowing date (15^{th} November). It is well known that the early sowing date was the better for the yield components and best quality. This fact due to the early sowing date mean harvest the plant grown before the temperature rising.

Concerning the interaction effect between sowing date and season, the obtained results revealed that total soluble solids and sucrose percentages did not affected by the studied sowing dates, however, the interaction between sowing date and season statistically affected purity percentage (Table, 11). These results coincide with those found by **Osman *et al* (2007) and Mosa (2009),** which found that sowing sugar beet early on 15th September significantly attained higher values of sucrose and purity percentages.

2. c. <u>Chemical constituents</u>:

Results in Table (12) show the effect of the studied sowing date on nitrogen, potassium and sodium percentages of sugar beet root. The results elucidated that nitrogen, potassium and sodium contents of root were significantly increased by the studied planting dates. It could be remarked that earliest sowing dates on 15th September recorded the lowest concentrations in root as it clearly show in the two growing seasons and their combined, while the highest values were recorded with latest sowing date (15th November).

Results in Table (13) show the concentration of nitrogen, potassium and sodium percentages of top under the studied sugar beet sowing dates. The results showed that nitrogen content of top was significantly decreased by sowing sugar beet on 15th September followed by 15th October and 15th November, respectively in both seasons and their combined. Concerning potassium and sodium percentages of sugar beet top, the available results in Table (13) reveal that the differences between the examined sowing dates in respect to their content did not reach the 5 % level of significance between 15th September and 15th October in the combined. **Osman *et al* (2007) and Mosa**

Table (10): Effect of sowing date on yield of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	Root yield (t/fed)			Top yield (t/fed)			Sugar yield (t/fed)		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
15 Sept.	27.20 a	27.22 a	27.21 b	11.59 a	11.81 a	11.70 a	4.68 a	4.69 a	4.69 a
15 Oct.	27.82 a	27.99 a	27.90 a	11.84 a	11.40 a	11.61 a	4.85 a	4.66 a	4.76 a
15 Nov.	22.53 b	22.78 b	22.65 c	8.79 b	8.65 b	8.72 b	3.51 b	3.45 b	3.48 b
F.test (DXS)			NS			NS			NS

NS: not significant.

Table (11): Effect of sowing date on juice quality of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	Total soluble solids %			Sucrose %			Purity %		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
15 Sept.	21.68 b	21.65 b	21.66 c	17.91 a	18.02 a	17.96 a	83.12 a	83.67 a	83.39 a
15 Oct.	22.50 a	22.15 b	22.32 b	18.23 a	17.56 a	17.89 a	81.26 a	79.66 b	80.46 b
15 Nov.	22.81 a	23.48 a	23.15 a	16.30 b	15.80 b	16.04 b	71.83 b	67.33 c	69.58 c
F.test (DXS)			NS			NS			*

*: significant, NS: not significant.

Table (12): Effect of sowing date on nitrogen, potassium and sodium concentrations in root of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	Nitrogen in root %			Potassium in root %			Sodium in root %		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
15 Sept.	1.29 c	1.18 c	1.24 c	2.14 c	2.21 b	2.18 c	1.29 b	1.19 c	1.24 c
15 Oct.	1.42 b	1.32 b	1.37 b	2.44 b	2.48 b	2.46 b	1.53 a	1.48 b	1.51 b
15 Nov.	1.48 a	1.62 a	1.55 a	2.72 a	2.80 a	2.76 a	1.71 a	1.74 a	1.72 a
F.test (DXS)			*			NS			NS

*: significant, NS: not significant.

(2009) found that early sowing date on 15th September significantly reduced the values of potassium, sodium and juice impurities percentages compared with that obtained at the late sowing date.

Regarding the collected results in Table (14) cleared the amounts of nitrogen, potassium and sodium uptakes of sugar beet roots. In the combined data, values of nitrogen uptake significantly increased with planting date on 15th October followed by 15th September and 15th November, respectively. However, results reveal that the studied sugar beet sowing dates were significantly differed in sodium uptake of root in both seasons and their combined.

Results in Table (15) show the effect of sowing date on nitrogen, potassium and sodium uptakes of sugar beet top. The lowest values of nitrogen, potassium and sodium uptakes of top were recorded with sowing date on 15th November, but it's not to reach of significance level between both planting dates 15th September and 15th October in the two seasons and their combined, except sodium uptake in top in the combined.

Regarding to the effect of interaction between sowing date and season was insignificantly affected on the most criteria, except purity percentage, nitrogen concentration in root and nitrogen uptake in top, which were significantly affected (Tables, 8-15). These result may be indicate that such criteria are more stable than purity and nitrogen percentage, which greatly affected by environments changes.

Table (13): Effect of sowing date on nitrogen, potassium and sodium concentrations in top of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	Nitrogen %			Potassium %			Sodium %		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
15 Sept.	2.83 c	2.76 c	2.80 c	3.44 b	3.35 b	3.40 b	2.36 b	2.33 b	2.35 b
15 Oct.	3.23 b	3.29 b	3.26 b	3.56 ab	3.53 b	3.54 b	2.43 b	2.39 ab	2.41 b
15 Nov.	3.64 a	3.83 a	3.74 a	3.86 a	3.79 a	3.83 a	2.62 a	2.54 a	2.58 a
F.test (DXS)			NS			NS			NS

NS: not significant.

Table (14): Effect of sowing date on nitrogen, potassium and sodium uptake in root of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	Nitrogen (kg/fed)			Potassium (kg/fed)			Sodium (kg/fed)		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
15 Sept.	94.43 a	86.69 b	90.66 b	151.9 a	157.2 a	154.5 a	91.55 ab	84.11 b	87.83 b
15 Oct.	99.51 a	92.83 a	96.17 a	162.7 a	167.1 a	164.9 a	102.9 a	100.7 a	101.8 a
15 Nov.	72.69 b	79.29 b	75.99 c	130.4 b	133.1 b	131.7 b	81.58 b	83.32 b	82.45 b
F.test (DXS)			*			NS			NS

*: significant, NS: not significant.

Table (15): Effect of sowing date on nitrogen, potassium and sodium uptake in top of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	Nitrogen (kg/fed)			Potassium (kg/fed)			Sodium(kg/fed)		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
15 Sept.	60.69 a	55.20 a	57.94 a	66.96 a	63.22 a	65.09 a	47.82 a	43.58 a	45.70 a
15 Oct.	61.43 a	56.31 a	58.87 a	63.83 a	58.07 a	60.95 a	44.96 a	39.78 a	42.37 b
15 Nov.	49.21 b	46.05 b	47.63 b	49.40 b	41.20 b	45.30 b	33.53 b	28.98 b	31.24 c
F.test (DXS)			NS			NS			NS

NS: not significant.

3. Effect of mineral nitrogen fertilizer rates:

3. a. Yield and its components:

Table (16) clears the influence of nitrogen fertilizer on sugar beet characteristics in the two growing seasons and their combined.

Results given in Table (16) reveal that increasing nitrogen fertilizer from 30 up to 90 kg N/fed increased root length, root and top fresh weight/plant. However, the differences between 60 and 90 kg N/fed was insignificant in their effect on these traits. Also, the results in Table (16) showed that root diameter gradually and significantly responded to the additional application of nitrogen up to 90 kg N/fed. These results were fairly true in the two growing seasons and their combined. These results may be due to the role of nitrogen element as an essential component in proteins, enzymes, chlorophyll and amino acids in the plant, which enhance plant growth and cell division. **Moustafa and El-Masry (2006) and Enan *et al* (2008)** found that soil fertilization with nitrogen up to 100 kg N/fed significantly increased root length diameter.

Results in Table (17) clear the effect of nitrogen fertilizer rates on root and top dry matter/plant at harvest. Results clarified that root and top dry matter/plant were statistically and positively affected by nitrogen fertilizer rates. It could be remarked that these traits whether in the two seasons and/or their combined gradually increased as nitrogen rate increased from 30 to 60 up to 90 kg N/fed. This result due to the known role of nitrogen in plant growth.

Results in Table (18) show the influence of nitrogen fertilization on root, top and sugar yields/fed. Results in Table (18) show that increasing nitrogen fertilizer from 30 to 60 and 90 kg N/fed statistically increased root yield/fed, whereas, the difference between 60 and 90 kg N/fed was not significant. It is seemed that application of 60 kg N/fed under this study was enough to produce the favorite yield. Application of 60 kg N/fed attained an additional increment in root yield amounted by 44.1 %, 42.18 % and 42.94 % over 30 kg N/fed treatment in the first, second seasons and their combined, respectively. **Nemeat-Alla (2009)** found that soil fertilization with nitrogen up to 120 kg N/fed significantly increased root yield.

Regarding the influence of nitrogen fertilization on top yield, the collected results appeared that top yield gradually responded to the applied dose of nitrogen up to 90 kg N/fed. The distinct influence of nitrogen on yield components of sugar beet often due to the effective role of N-element in plant metapolism in turn plant growth and finally on the products in terms of top and root yields (Table, 18). This finding indicates that the foliage part was more responded to nitrogen element than roots. **Abu El-Fotoh and Abou El-Magd (2006)** found that the highest values of top yield was obtained with increasing nitrogen rate from 60 to 100 kg N/fed.

Concerning sugar yield, the results given in Table (18) show that increasing nitrogen fertilizer let to pronoun increase in sugar yield. This results mainly due to the distinct effect of nitrogen element on root yield and sucrose percentage, Table 16. Increasing nitrogen fertilizer from 30 to 60 and 90 kg N/fed

Table (16): Effect of mineral nitrogen rate on some morphological of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	Root length (cm/plant)			Root diameter (cm/plant)			Root fresh weight (g/plant)			Top fresh weight (g/plant)		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
30	18.30 b	18.01 b	18.15 b	9.39 c	8.88 c	9.14 c	785 b	798 b	791 b	157 b	184 b	171 b
60	25.85 a	25.73 a	25.79 a	12.33 b	12.19 b	12.26 b	902 a	906 a	904 a	270 a	311 a	291 a
90	26.27 a	25.81 a	26.04 a	12.95 a	12.96 a	12.95 a	905 a	918 a	911 a	274 a	312 a	293 a
F.test (NXS)			NS			NS			NS			NS

NS: not significant.

Table (17): Effect of mineral nitrogen rate on root and top dry matter of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	Root dry matter %			Top dry matter %		
	2006/07	2007/08	combined	2006/07	2007/08	combined
30	22.11 c	22.18 c	22.15 c	15.15 b	14.08 b	14.61 b
60	23.77 b	23.92 b	23.84 b	15.59 b	14.61 b	15.10 b
90	25.62 a	25.22 a	25.42 a	16.78 a	15.01 a	15.90 a
F.test (NXS)			NS			NS

NS: not significant.

Table (18): Effect of mineral nitrogen rate on yield of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	Root yield (t/fed)			Top yield (t/fed)			Sugar yield (t/fed)		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
30	19.95 b	20.34 b	20.14 b	7.83 b	7.73 c	7.78 c	2.99 b	2.97 c	2.98 c
60	28.75 a	28.92 a	28.83 a	12.08 a	11.63 b	11.85 b	4.94 a	4.75 b	4.84 b
90	28.85 a	28.73 a	28.79 a	12.31 a	12.49 a	12.40 a	5.11 a	5.09 a	5.10 a
F.test (NXS)			NS			NS			NS

NS: not significant.

raised the values of sugar yield by 65.52 % and 70.09 % in the first season, 59.93 % and 71.30 % in the second season, and 62.41 % and 96.64 % in the combined over the two seasons. This observation could be important for the breeder to select based upon the high sucrose which compensates the decrease in root yield. **Ouda (2007)** found that increasing nitrogen rates up to 80 kg N/fed significantly increased sugar yield.

The prediction equations of sugar beet yields, error mean squares and nitrogen maximum response which estimated from combined analysis over two successive seasons (2006/2007 and 2007/2008) are given in Table (19).

The prediction equations of sugar yield, top yield and root yield which estimated from combined analysis were:

$Y_n = -0.330778 + 0.138356\ n - 0.000864\ n^2$ (with standard error of estimate equal to 0.078264) sugar yield. Whereas, the prediction for top yield was $Y_n = 0.178148 + 0.312361\ n - 0.001962\ n^2$ (with standard error of estimate equal to 1.96499). But, the prediction equation of root yield was $Y_n = 2.730926 + 0.726012\ n - 0.004850\ n^2$ (with standard error of estimate equal to 2.94277).

The results indicated that nitrogen fertilizer made its high contribution to the sugar yield. From a simple biological stand point heavy yields with high assimilation should be constructed on the nitrogen rates to contribute significantly to sugar yield/fed.

Profitability of sugar beet production is affected by selecting the appropriate rate of nitrogen fertilizer. Decision concerning optimal rates of fertilization involve fitting some types of continuous response model to the yield response data collected when several rates of fertilizer are applied. Comparisons among the response functions. Sugar, top and root yields were based on the mean sugar error. The model with least mean square error was considered to be the best model fitted to the yield data.

For sugar yield, it is clear from Table (19) that the least mean square error on the other hand, it shows the optimum rate of nitrogen fertilization according to this model was 79.95 kg N/fed. The optimum rate gives the maximum response. This model was the best model fitted to the sugar yield data because the mean square error for this model (0.6125) was less than those of the other two models (top and root yield).

Table (19): Prediction equations of sugar beet yields, error mean squares and nitrogen maximum response.

Yield	Prediction equations	Standard error	Nitrogen maximum response (kg N/fed)	Error mean squares
Sugar	$Y_n = -0.330778 + 0.138356\ n - 0.000864\ n^2$	0.78264	79.95	0.6125
Top	$Y_n = 0.178148 + 0.312361\ n - 0.001962\ n^2$	1.96499	79.60	3.8611
Root	$Y_n = 2.730926 + 0.726012\ n - 0.004850\ n^2$	2.94277	74.85	8.6599

Top yield, the mean square error for this yield was 3.8611. the optimum nitrogen fertilizer rate for the top yield was 79.60 kg N/fed. Whereas, root yield has large error mean square (8.6599) and the maximum rate of fertilizer nitrogen was 74.85 kg N/fed.

Generally, sugar yield model was more efficient than both top yield and root yield models. Thus, we can recommended that the optimum rate of nitrogen fertilizer of sugar beet production was 79.95 kg N/fed.

3. b. <u>Juice quality:</u>

Results in Table (20) show the effect of different nitrogen rates on juice quality measurements in terms of total soluble solids, sucrose and purity percentages in the two growing seasons and their combined analysis.

Results showed that total soluble solids, sucrose and purity percentages were statistically affected by the applied rates of nitrogen fertilizer, increasing the supplied dose of nitrogen positively affected on the values. It well be not enough to depend upon the values of total soluble solids percentage only with respect to juice quality. A throw some lights on the effect of nitrogen fertilizer on the values of sucrose and purity percentages, results showed that increasing nitrogen fertilization rate up to 90 kg N/fed surpassed the other rates (30 and 60 kg N\fed) in sucrose and purity percentages. While the highest value of total soluble solids percentage was recorded with application of 30 kg N/fed followed by 90 and 60 kg N/fed in the two seasons and their combined analysis.

Increasing the applied dose of nitrogen fertilizer caused a significant increase in the values of sucrose percentage. These results were true in the second season and the combined data. It could be deduced that applying 30 kg N/fed attained the lowest value of sucrose and purity percentages. **Abu El-Fotoh and Abou El-Magd (2006)** found that increasing nitrogen rates up to

80 kg N/fed gave the highest values of sucrose and purity percentages.

3. c. **Chemical constituents:**

Results in Table (21) show the influence of nitrogen fertilizer concentration of nitrogen, potassium and sodium percentages in root. Results elucidated that nitrogen content in root was significantly increased as the applied dose of nitrogen fertilizer increased from 30 to 60 and up to 90 kg N/fed in the two seasons and their combined data.

Results show that potassium and sodium concentrations in root were significantly affected by nitrogen fertilizer rates without significant difference between 30 and 60 kg N/fed in the combined analysis. Based on these results, it could be recommended by nitrogen application to decrease the impurities (potassium and sodium) consequently increased sugar extraction. This observation may be indicate to the relative important of nitrogen fertilizer application to sugar beet plants especially that this element appeared an effective role in juice quality Table (20).

Results given in Table (22) obviously show that increasing nitrogen fertilizer up to 90 kg N/fed attained a significant increase in the values of nitrogen concentration in the tops. This finding was true in the two seasons and their combined. However, application of 30 kg N/fed was enough to produce the highest concentration of potassium and sodium in top of sugar beet. Meanwhile, the differences between 60 and 90 kg N/fed on potassium concentration as well as between 30 and

Table (20): Effect of mineral nitrogen rate on juice quality of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	Total soluble solids %			Sucrose %			Purity %		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
30	23.39 a	23.32 a	23.36 a	15.69 b	15.28 c	15.48 c	67.10 b	65.41 c	66.28 b
60	21.37 c	21.55 b	21.46 c	18.09 a	17.37 b	17.73 b	84.71 a	80.99 b	82.85 a
90	22.24 b	22.40 b	22.32 b	18.67 a	18.73 a	18.69 a	84.40 a	84.26 a	84.83 a
F.test (NXS)			NS			NS			NS

NS: not significant.

Table (21): Effect of mineral nitrogen rate on nitrogen, potassium and sodium concentrations in root of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	Nitrogen %			Potassium %			Sodium %		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
30	1.22 c	1.25 c	1.23 c	2.59 a	2.70 a	2.64 a	1.62 a	1.57 a	1.60 a
60	1.34 b	1.37 b	1.35 b	2.52 a	2.49 ab	2.50 a	1.51 ab	1.50 ab	1.50 a
90	1.62 a	1.51 a	1.57 a	2.19 b	2.31 b	2.25 b	1.39 b	1.34 b	1.37 b
F.test (NXS)			NS			NS			NS

NS: not significant.

Table (22): Effect of mineral nitrogen rate on nitrogen, potassium and sodium concentrations in top of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	Nitrogen %			Potassium %			Sodium %		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
30	2.64 c	2.74 c	2.69 c	4.20 a	3.89 a	4.05 a	2.58 a	2.53 a	2.55 a
60	3.34 b	3.28 b	3.31 b	3.47 b	3.48 b	3.47 b	2.47 ab	2.45 ab	2.46 a
90	3.73 a	3.86 a	3.80 a	3.19 b	3.31 b	3.25 b	2.36 b	2.29 b	2.33 b
F.test (NXS)			NS			NS			NS

NS: not significant.

60 kg N/fed on sodium concentration were not enough to reach the rate of significance in top.

Results in Table (23) show the influence of mineral nitrogen rate on nitrogen, potassium and sodium uptake in root of sugar beet at two growing seasons and their combined analysis. Potassium and sodium uptakes in root of sugar beet plants almost appeared insignificant response to the studied rates of 60 and 90 kg N/fed. However, nitrogen uptake in root responded significantly to the applied nitrogen fertilizer rates. This finding was true in the two seasons and their combined.

Results given in Tables (24) show that nitrogen, potassium and sodium uptakes in top of sugar beet plant were significantly affected by the applied rates of nitrogen fertilizer. In general increasing nitrogen application tended to higher the values of nitrogen, potassium and sodium uptakes in top of sugar beet plants.

Concerning to the interaction effect between nitrogen fertilizer rates and seasons, results in Tables (16,17,18,20,21,22,23 and 24) showed that the studied characters were insignificantly affected, except nitrogen uptake in root was significant. This finding means that nitrogen uptake affected by environment changes.

4. Effect of bio- nitrogen fertilizer sources:

4. a. Yield and its components:

Results in Table (25) show that the effect of bio-nitrogen fertilizer sources on root dimensions, root and top fresh weight/plant at harvest. Results clarified that the above

Table (23): Effect of mineral nitrogen rate on nitrogen, potassium and sodium uptake in root of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	Nitrogen (kg/fed)			Potassium (kg/fed)			Sodium (kg/fed)		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
30	53.63 c	56.37 c	55.00 c	113.4 b	120.6 b	117.0 b	71.35 b	70.39 b	70.87 b
60	92.39 b	92.52 b	92.45 b	170.6 a	170.9 a	170.8 a	102.7 a	101.9 a	102.3 a
90	120.8 a	109.9 a	115.4 a	160.9 a	165.9 a	163.4 a	102.0 a	95.83 a	98.93 a
F.test (NXS)			*			NS			NS

*: significant, NS: not significant.

Table (24): Effect of mineral nitrogen rate on nitrogen, potassium and sodium uptake in top of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	Nitrogen (kg/fed)			Potassium (kg/fed)			Sodium (kg/fed)		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
30	32.01 c	28.64 c	30.33 c	50.69 b	41.95 b	46.32 b	30.67 b	27.29 b	28.98 b
60	62.72 b	56.09 b	59.41 b	64.07 a	58.57 a	61.32 a	46.70 a	42.27 a	44.49 a
90	76.60 a	72.82 a	74.71 a	65.44 a	61.97 a	63.70 a	48.94 a	42.78 a	45.86 a
F.test (NXS)			NS			NS			NS

NS: not significant.

mentioned root characters in terms of root length and diameter as well as root fresh weight/plant were statistically and positively affected by inoculation of sugar beet seed with bio-fertilizer. It could be remarked that root length, root diameter and top fresh weight/plant were increased as inoculation of sugar beet seeds with *Bacillus polymyxa* in the combined analysis, except root fresh weight/plant was increased with inoculation by *Azospirillum brasilense*. While, the lowest values were recorded without bio-fertilizers in the two seasons and their combined. **Saleh (2003), Agami (2005) and Aly *et al* (2009)** found that inoculation sugar beet seed with bio-fertilizer caused an increase in root length, root diameter as well as root and top fresh weight.

Regard to the combined analysis results of the two seasons showed that inoculation with *Bacillus polymyxa* gave the heaviest top fresh weight/plant, as well as greatest root length and diameter and surpassed by inoculation with *Azospirillum brasilense* and check treatment by 2.03 and 0.37 cm in length; 0.70 and 0.32 cm in diameter and 9.00 and 5.00 g in top fresh weight, respectively. These results may be due to the role of *Azospirillum brasilense* and *Bacillus polymyxa* bacteria in releasing more nitrogen element and make available for sugar beet plants to absorb it and make use of it in all biotic processes in the plants.

The results in Table (26) show that dry matter of root and top were significantly affected by inoculation of sugar beet seed with bio-fertilizer. The highest values of root and top dry matter significantly increased by inoculation with *Azospirillum*

Table (25): Effect of bio-nitrogen source on yield components of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Bio-nitrogen source (B)	Root length (cm/plant)			Root diameter (cm/plant)			Root fresh weight (g/plant)			Top fresh weight (g/plant)		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
Untreat	22.02 c	22.17 b	22.09 b	11.06 b	10.79 b	10.92 b	807 b	863 a	835 b	231 a	263 a	247 a
Azospirillum	23.69 b	23.83 a	23.75 a	12.00 a	11.62 a	11.30 a	901 a	882 a	891 a	236 a	266 a	251 a
Bacillus	24.70 a	23.56 a	24.12 a	11.62 a	11.63 a	11.62 a	884 a	877 a	880 a	235 a	278 a	256 a
F.test (BXS)			*			NS			*			NS

*: significant, NS: not significant.

Table (26): Effect of bio-nitrogen source on root and top dry matter of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Bio-nitrogen source (B)	Root dry matter %			Top dry matter %		
	2006/07	2007/08	combined	2006/07	2007/08	combined
Untreat	23.22 b	22.97 b	23.10 b	14.64 c	13.46 c	14.05 c
Azospirillum	24.61 a	24.95 a	24.78 a	16.98 a	15.90 a	16.44 a
Bacillus	23.66 b	23.40 b	23.53 b	15.91 b	14.34 b	15.12 b
F.test (BXS)			NS			NS

NS: not significant.

brasilense. While without inoculation gave the lowest one in the two growing seasons and their combined analysis.

Results given in Table (27) show the influence of bio-fertilizer on the root, top and sugar yield/fed. Concerning the influence of bio-fertilizer on root yield/fed, the available results elucidate that there was a positive response in the values of root yield to the inoculation with bio-fertilizer. However, it could be noted that both of bio-fertilizer sources surpassed check treatment (control) statistically with respect to their influence on yields of roots, tops and sugar/fed. Meanwhile the difference between the examined sources of bio-fertilizer i.e. *Azospirillum brasilense* and *Bacillus polymyxa* was mostly not reach the level of significance in the second season and the combined over the two seasons. Once more, the additional increase in the value of root yield as a result of inoculation with *Azospirillum brasilense* amounted by 7.73%, 7.52% and 7.65%, corresponding 11.14%, 6.15% and 8.67% when inoculation with *Bacillus polymyxa* higher than that produced without inoculation in the first, second seasons and their combined, respectively. **Aly *et al* (2009)** found that application of bio-fertilizer led to a significant improvement in root, top and sugar yields.

Combined analysis clarified that the inoculation with *Bacillus polymyxa* and *Azospirillum brasilense* gave 2.13 and 1.88 tons of root/fed higher than that produced without inoculation, respectively. In addition, inoculation with *Azospirillum brasilense* or *Bacillus polymyxa* gave the greater top yield/fed and out-yielded than that produced check treatment by 1.46 and 0.98 ton/fed, respectively. Once more, results given in Table (27) revealed that inoculation with *Azospirillum brasilense* recorded the highest values of sugar yield/fed followed by inoculation with *Bacillus polymyxa*, than the control (untreated).

Results collected in Table (27) reveal that yield of top was significantly increased as inoculation with bio-fertilizer sources. Inoculation with *Azospirillum brasilense* recorded the highest significant value of top fresh weight yield. Both of the used sources of bio-fertilizer i.e. *Azospirillum brasilense* and *Bacillus polymyxa* surpassed check treatment (control) with respect to top fresh weight yield. This findings were true in the second season and the combined.

As to the effect of bio-fertilizer sources on the sugar yield/fed, results obtained in Table (27) pointed out that sugar yield distinctly and positively responded to inoculation by bacteria sources. With respect to the additional benefit to inoculation by bacteria sources, it could be noticed that the additional increment in sugar yield as a result to inoculation by *Azospirillum brasilense* reached 16.71%, 13.92% and 15.31%, corresponding to 18.51%, 10.38% and 14.54% when inoculation by *Bacillus polymyxa* higher than that control treatment in the first and second seasons and their combined analysis, respectively. The relative influence of the studied bio-fertilizers could be mainly due to the vital role of these micro organisms with their ability in bio-nitrogen fixation which reflected on plant growth criteria in terms of root dimensions and root and fresh weight/plant which in turn reflected on the final products such as root, top and sugar yields. The relative effect of inoculation with bio-fertilizer sources on sugar yield was recorded before by **Cakmakci *et al* (2001),** which found that seed inoculation with bio-fertilizer increased sugar yield as compared with control.

4. b. Juice quality:

Results given in Table (28) show that juice quality in terms of total soluble solids, sucrose and purity percentages were significantly affected by inoculation of sugar beet seeds with bio-fertilizer. Inoculation with *Azospirillum brasilense* raised the values of sucrose percentage over that of control (without bio-fertilizer) amounted by 9.19%, 7.48% and 8.31%, while, inoculation with the same inoculation raised the values of purity percentage over that of control (without bio-fertilizer) amounted by 15.67%, 6.38% and 3.83% in the first, second seasons and their combined, respectively.

Generally, the highest values of sucrose and purity percentages were recorded by inoculation of sugar beet seeds with *Azospirillum brasilense* followed by inoculation with *Bacillus polymyxa*, while the lowest values were recorded without bio-fertilizers. Sucrose and purity percentages did not reach the level of significance between *Azospirillum brasilense* and *Bacillus polymyxa* in the two seasons and their combined. **El-Kholi *et al* (2004)** found that application of bio-fertilizers led to significant increase in sucrose and purity percentages.

4. c. Chemical constituents:

Results presented in Table (29) reveal the influence of bio-fertilizer on the nitrogen, potassium and sodium contents in

Table (27): **Effect of bio-nitrogen source on yield of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)**

Bio-nitrogen source (B)	Root yield (t/fed)			Top yield (t/fed)			Sugar yield (t/fed)		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
Untreat	24.32 c	24.86 b	24.58 b	9.77 b	9.97 b	9.87 c	3.89 b	3.95 b	3.92 b
Azospirillum	26.20 b	26.73 a	26.46 a	11.34 a	11.31 a	11.32 a	4.54 a	4.50 a	4.52 a
Bacillus	27.03 a	26.39 a	26.71 a	11.11 a	10.58 a	10.84 b	4.61 a	4.36 a	4.49 a
F.test (BXS)			NS			NS			NS

NS: not significant.

Table (28): Effect of bio-nitrogen source on juice quality of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Bio-nitrogen source (B)	Total soluble solids %			Sucrose %			Purity %		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
Untreat	23.05 a	22.44 a	22.74 a	16.54 b	16.44 b	16.49 b	71.91 b	73.55 b	77.73 b
Azospirillum	21.81 b	22.78 a	22.30 ab	18.06 a	17.67 a	17.86 a	83.18 a	78.24 a	80.71 a
Bacillus	22.14 b	22.06 a	22.10 b	17.84 a	17.26 a	17.55 a	81.13 a	78.87 a	80.00 a
F.test (BXS)			*			NS			*

*: significant, NS: not significant.

Table (29): Effect of bio-nitrogen source on nitrogen, potassium and sodium concentrations in root of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Bio-nitrogen source (B)	Nitrogen %			Potassium %			Sodium %		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
Untreat	1.19 c	1.14 c	1.17 c	2.60 a	2.65 a	2.63 a	1.64 a	1.55 a	1.60 a
Azospirillum	1.57 a	1.59 a	1.58 a	2.27 b	2.32 b	2.30 b	1.38 b	1.33 b	1.35 b
Bacillus	1.42 b	1.40 b	1.41 b	2.42 ab	2.52 b	2.47 a	1.50 ab	1.53 a	1.51 a
F.test (BXS)			NS			NS			NS

NS: not significant.

roots of sugar beet. Results showed that nitrogen content in root of sugar beet plants in terms was significantly increased by inoculation of sugar beet seeds with bio-fertilizers. The highest value of nitrogen content and the lowest values of potassium and sodium in roots were recorded by inoculation of sugar beet seeds with *Azospirillum brasilense*, while, the highest values of potassium and sodium in roots were recorded by inoculation of sugar beet seeds with *Bacillus polymyxa.*

Results in Table (30) reveal that seed inoculation with *Bacillus polymyxa* raised the values of nitrogen content in top over that of control (without bio-fertilizer) amounted by 24.65%, 33.09% and 28.62% in the first, second season and their combined analysis, respectively. The lowest value of potassium in top was recorded by inoculation of sugar beet seeds with *Azospirillum brasilense,* while, the lowest value of sodium in top was recorded by inoculation of sugar beet seeds with *Bacillus polymyxa* in both seasons and their combined data.

Results in Table (31) show that nitrogen uptake in root was significantly increased by inoculation of seed with *Azospirillum brasilense* followed *Bacillus polymyxa*. Regardless the significance, it could be noted that sodium uptake in sugar beet root recorded the lowest value by inoculation of seeds with *Azospirillum brasilense* in both seasons and their combined analysis.

Results in Table (32) reveal that nitrogen; potassium and sodium uptakes in top among the studied bio-fertilizer were significant compared with control in the two seasons and their combined, except the second season for potassium uptake in top.

Table (30): Effect of bio-nitrogen source on nitrogen, potassium and sodium concentrations in top of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Bio-nitrogen source (B)	Nitrogen %			Potassium %			Sodium %		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
Untreat	2.84 b	2.81 b	2.83 c	3.84 a	3.80 a	3.82 a	2.61 a	2.53 a	2.57 a
Azospirillum	3.33 a	3.32 a	3.33 b	3.45 b	3.17 b	3.31 b	2.42 b	2.38 ab	2.40 b
Bacillus	3.54 a	3.74 a	3.64 a	3.57 ab	3.70 a	3.64 a	2.39 b	2.36 b	2.37 b
F.test (BXS)			NS			NS			NS

NS: not significant.

Table (31): Effect of bio-nitrogen source on nitrogen, potassium and sodium uptake in root of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Bio-nitrogen source (B)	Nitrogen (kg/fed)			Potassium (kg/fed)			Sodium(kg/fed)		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
Untreat	69.69 c	66.51 c	68.10 c	146.1 a	151.1 a	148.6 a	92.75 a	87.67 a	90.21 a
Azospirillum	104.0 a	105.5 a	104.7 a	145.5 a	152.4 a	149.0 a	89.04 a	86.73 a	87.88 a
Bacillus	93.18 b	86.85 b	90.02 b	153.4 a	153.9 a	153.6 a	94.29 a	93.77 a	94.02 a
F.test (BXS)			NS			NS			NS

NS: not significant.

Table (32): Effect of bio-nitrogen source on nitrogen, potassium and sodium uptake in top of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Bio-nitrogen source (B)	Nitrogen (kg/fed)			Potassium (kg/fed)			Sodium (kg/fed)		
	2006/07	2007/08	combined	2006/07	2007/08	combined	2006/07	2007/08	combined
Untreat	44.83 b	40.53 b	42.68 b	54.53 b	50.51 a	52.52 b	37.44 b	34.17 b	35.81 c
Azospirillum	65.23 a	59.75 a	62.49 a	64.73 a	56.72 a	60.68 a	46.40 a	42.61 a	44.51 a
Bacillus	61.27 a	57.28 a	59.27 a	60.94 ab	55.35 a	58.15 a	42.47 a	35.55 b	39.01 b
F.test (BXS)			NS			NS			NS

NS: not significant.

The effect of the interaction between bio-nitrogen fertilizer sources and seasons are shown in Tables (25-32). The results cleared to insignificant effects on the most traits, except root length, root fresh weight, total soluble solids and purity percentages were significant, these results may be indicate to the effective role of micro organisms on yield component and juice quality through their influence on nitrogen soil content which as a direct role on such traits.

5. Interaction effects:

5. a. Effect of interaction between sowing dates and mineral nitrogen fertilizer rates

Results presented in Table (33) show the influence of the various combinations between nitrogen fertilizer and the examined sowing dates at harvest.

Results appeared the mean values of root length were insignificantly affected due to the interaction between sowing date and nitrogen fertilizer rate. Increasing nitrogen application almost attained a distinct increase in root length. This result was completely true in the two seasons and their combined. However, the collected results cleared that the most effective combination between the studied sowing dates and the used nitrogen rates was that between 60 kg N/fed and 15th October sowing date no significant response in this trait as a result to 90 kg N/fed for the same sowing date (15th October). This observation may be indicate that fact that sugar beet plants response to any treatment greatly affected by sowing date and that it could be profit from the low nitrogen rate with the suitable sowing date.

Results obtained in Table (34) clear the effect of sowing date and nitrogen fertilizer rate on root diameter at harvest. It is clearly show that there were a positive and significant increase in root diameter of sugar beet plants due to the interaction between sowing date and the applied doses of nitrogen. These findings were fairly true not only in the two growing seasons but also in their combined.

Once more, data obtained showed that the early sowing date i.e. 15th September let to a continuous increase in the values of root diameter with increasing the applied nitrogen up to 90 kg N/fed. This result has to pay our attention that to increase diameter root, it will be needed to sow earlier which may be reflected on the yield which greatly affected by root size than root length.

Sowing sugar beet crop on 15th September seemed to be better for root diameter under the different rates of nitrogen. The highest values of root diameter of sugar beet crop at harvest were recorded with combination between 90 kg N/fed and the early sowing date (15th September).

Table (35) reveals the influence of nitrogen rates and sowing date interaction on top yield of sugar beet crop at harvest. Data illustrated in Table (35) obviously show that this trait almost increased with increasing nitrogen fertilizer under the various sowing dates. A general view to the collected results, it could be noticed that the highest top yield with highest the nitrogen rate, this result was mostly true with the different

Table (33): Effect of interaction between sowing date and mineral nitrogen rate on root length (cm) of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			combined		
	Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)		
	30	60	90	30	60	90	30	60	90
15 Sept.	19.59 c	27.11 a	27.00 a	19.48 d	26.44 b	26.67 ab	19.54 e	26.78 b	26.83 ab
15 Oct.	20.33 c	27.52 a	27.63 a	20.11 d	27.19 ab	27.92 a	20.22 e	27.35 ab	27.78 a
15 Nov.	14.96 d	22.93 b	24.18 b	14.44 e	22.59 c	23.81 c	14.70 f	22.76 d	24.00 c
F.test(DXNXS)							NS		

NS: not significant

Table (34): Effect of interaction between sowing date and mineral nitrogen rate on root diameter (cm) of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			combined		
	Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)		
	30	60	90	30	60	90	30	60	90
15 Sept.	9.30 c	12.78 a	13.30 a	9.11 d	12.48 b	13.22 a	9.21 d	12.63 b	13.26 a
15 Oct.	9.26 c	12.70 a	12.89 a	8.81 d	12.44 b	13.00 ab	9.04 d	12.57 b	12.94 ab
15 Nov.	9.63 c	11.52 b	12.67 a	8.74 d	11.63 c	12.67 ab	9.19 d	11.57 c	12.67 b
F.test(DXNXS)							NS		

NS: not significant

Table (35): Effect of interaction between sowing date and mineral nitrogen rate on top yield (t/fed) of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			combined		
	Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)		
	30	60	90	30	60	90	30	60	90
15 Sept.	8.73 c	13.13 a	12.92 a	8.93 d	13.10 ab	13.40 a	8.83 d	13.11 a	13.16 a
15 Oct.	8.85 c	13.44 a	13.23 a	9.41 d	11.90 bc	12.87 ab	9.13 cd	12.67a	13.05 a
15 Nov.	5.93 d	9.69 bc	10.78 b	4.85 e	9.90 d	11.20 c	5.39 e	9.79 c	10.99 b
F.test(DXNXS)							NS		

NS: not significant

sowing dates for the two seasons and their combined analysis. Also, it may have to record that the differences between the two sowing date, i.e. 15th September or 15th October were not significantly whether the plant fertilized by 60 or 90 kg N/fed, however, the higher values of top yield/fed was produced with 90 kg N/fed with the early two sowing dates.

Table (36) clears the interaction between sowing dates and nitrogen fertilization and its effect on sucrose in the two growing seasons and their combined analysis. Results given distinctly show that increasing the applied nitrogen fertilizer up to 90 kg N/fed caused a relative increase in sucrose in the two seasons and their combined over the two seasons. However, it could be noted that the difference between the two nitrogen rates (60 and 90 kg N/fed) under the early sowing date (15th September) were insignificantly in their influence on sucrose in the two seasons.

Results presented in Table (37) reveal the values of nitrogen percentage of sugar beet roots at harvest as affected by the interaction effect between sowing dates and nitrogen application rates in the two growing seasons and their combined.

The available results pointed out that increasing nitrogen applied to sugar beet plants from 30 up to 90 kg N/fed was accompanied by a gradual increase in the root nitrogen percentage. This finding was fairly true in the two seasons and the combined over the two seasons. Also, it is clearly show that even under the same nitrogen rate delaying sowing date from 15th September to 15th October and 15th November increased the values of nitrogen percentage in sugar beet root.

Results illustrated in Table (38) show the influence of nitrogen fertilizer in combination with sowing dates on sodium percentage (Na %) of sugar beet top at harvest. The results obtained cleared that sodium percentage of sugar beet top significantly affected by the different combination between nitrogen rates and sowing dates in the two seasons and their combined analysis.

An examined view to the illustrated results in Table (38), it could be deduced that affecting of sodium percentage in sugar beet top by the interaction of the studied factors was as opposite as in nitrogen percentage of sugar beet roots. Delaying sowing dates increased the values of sodium percentage of sugar beet top. This observation mostly was true in the two seasons as well as their combined analysis. It is worth mentioned that the results in Table (38) showed an inverse response in the values of sodium percentage with increasing nitrogen application. This result was true under the various sowing dates.

Results illustrated in Table (39) show the response of nitrogen uptake in roots to the combination between sowing dates and nitrogen rates.

Results show in Table (39) clearly reveals that there was a general increased in the values of nitrogen uptake in roots due to the increase in the applied doses of nitrogen. This finding was completely true under the various sowing dates not only in the two growing seasons, but also in the combined over two seasons.

The highest values of nitrogen uptake in roots recorded with the plant sown on 15th October with 90 kg N/fed.

Table (36): Effect of interaction between sowing date and mineral nitrogen rate on sucrose percentage of sugar beet root at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			combined		
	Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)		
	30	60	90	30	60	90	30	60	90
15 Sept.	16.08 b	18.98 a	18.67 a	16.32 c	18.73 a	19.02 a	16.20 c	18.85 ab	18.84 ab
15 Oct.	16.16 b	19.09 a	19.45 a	16.43 c	17.21 b	19.02 a	16.30 c	18.15 b	19.23 a
15 Nov.	14.82 b	16.20 b	17.89 a	13.07 d	16.18 c	18.13 ab	13.95 d	16.19 c	18.01 b
F.test(DXNXS)								NS	

NS: not significant.

Table (37): Effect of interaction between sowing date and mineral nitrogen rate on nitrogen percentage of sugar beet root at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			combined		
	Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)		
	30	60	90	30	60	90	30	60	90
15 Sept.	1.13 d	1.25 cd	1.49 b	1.09 d	1.11 d	1.36 bc	1.11 d	1.18 d	1.42 bc
15 Oct.	1.13 d	1.42 b	1.69 a	1.13 d	1.27 cd	1.56 ab	1.13 d	1.35 c	1.62 a
15 Nov.	1.40 b	1.36 bc	1.69 a	1.54 ab	1.71 a	1.62 a	1.47 bc	1.54 ab	1.66 a
F.test(DXNXS)								*	

*: significant.

Table (38): Effect of interaction between sowing date and mineral nitrogen rate on sodium percentage of sugar beet top at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			combined		
	Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)		
	30	60	90	30	60	90	30	60	90
15 Sept.	2.52 abc	2.35 c	2.23 c	2.59 a	2.39 a	2.04 b	2.56 abc	2.37 c	2.13 d
15 Oct.	2.47 bc	2.41 bc	2.43 bc	2.35 a	2.46 a	2.39 a	2.41 bc	2.43 bc	2.41 bc
15 Nov.	2.78 a	2.67ab	2.44 bc	2.65 a	2.54 a	2.46 a	2.72 a	2.60 ab	2.45 bc
F.test(DXNXS)								NS	

NS: not significant.

Table (40) show the influence of the interaction between sowing dates and nitrogen rates on sodium uptake (Na-uptake) sugar beet top at harvest.

The available results revealed that the combination between the rates of the two factors occurred a statistical effect on sodium uptake of sugar beet top. This finding was fairly true in the two seasons and their combined. It is obviously show that the middle nitrogen dose attained the highest values of sodium uptake in sugar beet top sown on the 15th September. It is also noted that delaying sowing dates let to a distinct decrease in the values of sodium uptake. This observation was true under the different rate of nitrogen.

With the exception of nitrogen percentage and nitrogen uptake in roots, the other traits showed insignificant differences due to the effect of interaction between sowing dates, mineral nitrogen fertilizer rates and seasons (Tables, 33-40). This result may be due to the unchanged effect of the interaction between sowing date and mineral nitrogen fertilizer rates from season to season.

5. b. <u>Effect of interaction between sowing dates and bio-nitrogen fertilizer sources</u>:

Results in Table (41) point out the effect of the interaction between sowing dates and bio-fertilizer treatments on root length of sugar beet roots at harvest.

The results obtained showed that root length of sugar beet root appeared a positive and statistical effect to the combination between sowing date and nitrogen bio-fertilizer

Table (39): Effect of interaction between sowing date and mineral nitrogen rate on nitrogen uptake (kg/fed) of sugar beet roots at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			combined		
	Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)		
	30	60	90	30	60	90	30	60	90
15 Sept.	60.10 e	99.12 c	114.4 b	57.92 c	89.37 b	112.8 a	59.01 e	94.24 c	118.7 b
15 Oct.	56.36 e	106.0 c	136.2 a	59.00 c	95.78 b	123.7 a	57.68 e	100.9 c	129.9 a
15 Nov.	44.45 f	72.05 d	101.6 c	52.20 c	92.40 b	93.37 b	48.32 f	82.22 d	97.42 c
F.test(DXNXS)								*	

*: significant.

Table (40): Effect of interaction between sowing date and mineral nitrogen rate on sodium uptake (kg/fed) of sugar beet leaves at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			combined		
	Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)			Mineral nitrogen rate (kg N\fed)		
	30	60	90	30	60	90	30	60	90
15 Sept.	38.05 cd	54.12 a	51.30 a	35.08 d	51.69 a	43.97 bc	36.57 c	52.91 a	47.64 ab
15 Oct.	31.44 d	49.00 ab	54.45 a	29.60 d	42.52 bc	47.20 ab	30.52 d	45.76 b	50.83 ab
15 Nov.	22.53 e	36.99 cd	41.07 bc	17.18 e	32.60 d	37.15 cd	19.85 e	34.80 cd	39.11 c
F.test(DXNXS)								NS	

NS: not significant.

Table (41): Effect of interaction between sowing date and bio-nitrogen source on root length (cm) of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			combined		
	Bio -nitrogen source (B)			Bio-nitrogen source (B)			Bio-nitrogen source (B)		
	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus
15 Sept.	22.30 c	25.11 ab	26.30 a	22.52 c	25.15 ab	24.93 ab	22.41 c	25.13 a	25.61 a
15 Oct.	24.04 b	25.37 ab	26.07 a	24.00 b	25.81 a	25.41 ab	24.02 b	25.59 a	25.74 a
15 Nov.	19.74 e	20.59 de	21.74 cd	20.00 d	20.52 d	20.33 d	19.87 e	20.56 de	21.04 d
F.test(DXBXS)								NS	

NS: not significant.

treatments. Results given illustrated that the two bio-fertilizer sources over passed check treatment with respect to their influence on this trait. This finding was fairly true under the various sowing dates. The difference between the two bio-fertilizer sources was insignificant with respect to their effect on root length.

Results illustrated in Table (42) clear the effect of the different combination between sowing dates and bio-fertilizer treatments on root yield/fed at the two growing seasons and their combined.

Results obtained showed that there was statistical and positive effects in the values of root yield/fed. This finding was completely true not only in the two growing seasons but, also in their combined.

It is worth mentioning that both of nitrogen bacterial source i.e. *Azospirillum brasilense* and/or *Bacillus polymyxa* appeared a distinct effect on root yield amounted by about 3 tons in the early sowing date i.e. 15^{th} September and 15^{th} October, corresponding about one ton with 15^{th} November.

Based upon the obtained results it could be deduced that bio-nitrogen fixation bacteria sources were more effective in the earlier sowing dates (15^{th} September and 15^{th} October) than the late one (15^{th} November) which affected on the available nitrogen around the plant grown consequently effected on root yield at harvest. It is also observed that the differences between the two bio-fertilizer treatment, (*Azospirillum brasilense* and/or *Bacillus polymyxa*) and sowing date on 15^{th} September were significantly compared without inoculation as the same sowing date.

In general, it could be possible to recommend by any of the examined bio-nitrogen fixation bacteria to increase root yield especially in the early sowing dates where the temperature may be enhance and activate the bio-fertilizer organism. The fruitful influence of the nitrogen fixation bacterial may be due to the effective role of the prevalent temperature in the early sowing date.

Table (43) show sugar yield as affected by interaction between nitrogen fixation bacterial and sowing dates in the two seasons and their combined. Results revealed that there was statistical and positive responses in the values of sugar yield/fed in the two growing seasons and their combined.

It is worth mentioning that both of nitrogen fixation bacterial source i.e. *Azospirillum brasilense* and/or *Bacillus polymyxa* appeared a distinct effect on sugar yield amounted by about one ton in the early sowing date i.e. 15th September.

Based upon the obtained results it could be deduced that nitrogen fixation bacteria sources were more effective in the earlier sowing dates (15th September and 15th October) than the late one (15th November) which affected on the available nitrogen around the plant grown consequently effected on sugar yield. It is also observed that the differences between the two bio-fertilizer treatment, (*Azospirillum brasilense* and/or *Bacillus polymyxa*) and sowing date on 15th September were significantly compared without inoculation as the same sowing date.

In general, it could be possible to recommend by any of the examined nitrogen fixation bacterial to increase sugar yield especially in the early sowing dates. The fruitful influence of the nitrogen fixation bacterial may be due to the effective role of the prevalent temperature in the early sowing date.

Results given in Table (44) point out influence of the various combinations of sowing dates and nitrogen fixation bacterial treatments on purity percentage of sugar beet juice at harvest. The results obtained revealed that both of nitrogen fixation bacterial organisms had a positive and significant effect on juice purity percentage. Also, it is obviously show that the effecting of these organisms in nitrogen fixation was clear in the early sowing dates (15^{th} September and 15^{th} October). However, the highest and the significant influence on juice purity percentage were due to these organisms at the early sowing date (15^{th} September). This result may be indicating to the effecting of nitrogen fixation bacterial greatly affected by the prevalent conditions.

Results obtained in Table (45) clear the influence of sowing dates and bio-fertilizer treatments interaction in relation to its effect on sodium percentage (Na%) of sugar beet roots at harvest. Results showed that as sowing date delayed the values of sodium percentage increased. This finding was fairly true under the various bio-fertilizer treatments. Also, it could be deduced it well be expected that delaying sowing dates will share in the increase in the values of impurities (sodium, potassium

Table (42): Effect of interaction between sowing date and bio-nitrogen source on root yield (t/fed) of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			combined		
	Bio -nitrogen source (B)			Bio -nitrogen source (B)			Bio -nitrogen source (B)		
	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus
15 Sept.	24.72 c	27.83 ab	29.05 a	25.46 c	28.16 ab	28.05 ab	25.09 c	27.99 a	28.55 a
15 Oct.	26.68 b	28.03 ab	28.74 a	26.80 bc	28.81 a	28.35 ab	26.74 b	28.42 a	28.54 a
15 Nov.	21.55 e	22.74 de	23.31 d	22.33 d	23.24 d	22.78 d	21.94 e	22.99 d	23.05 d
F.test(DXBXS)								NS	

NS: not significant.

Table (43): Effect of interaction between sowing date and bio-nitrogen source on sugar yield (t/fed) of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			Combined		
	Bio -nitrogen source (B)			Bio -nitrogen source (B)			Bio -nitrogen source (B)		
	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus
15 Sept.	3.96 c	4.96 ab	5.13 a	4.19 c	4.99 a	4.92 a	4.07 c	4.98 a	5.03 a
15 Oct.	4.57 b	4.98 ab	5.02 ab	4.43 bc	4.83 a	4.73 ab	4.50 b	4.91 a	4.88 a
15 Nov.	3.15 d	3.68 c	3.70 c	3.24 e	3.69 d	3.45 de	3.19 e	3.68 d	3.57 d
F.test(DXBXS)								NS	

NS: not significant.

Table (44): Effect of interaction between sowing date and bio-nitrogen source on purity percentage of sugar beet root at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			combined		
	Bio -nitrogen source (B)			Bio -nitrogen source (B)			Bio -nitrogen source (B)		
	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus
15 Sept.	73.40 c	89.20 a	86.75 ab	79.01 cd	84.18 ab	87.81 a	76.21 c	86.69 a	87.28 a
15 Oct.	75.81 c	85.08 ab	82.90 b	76.97 d	81.35 bc	80.65 bcd	76.39 c	83.22 b	81.77 b
15 Nov.	66.51 d	75.26 c	73.73 c	64.65 f	69.19 e	68.16 ef	65.58 e	72.23 d	70.94 d
F.test(DXBXS)								NS	

NS: not significant.

and nitrogen) consequently decreasing juice quality. Once more, it is distinctly show that using any of the bio nitrogen fixation bacterial sources lowered the impurities in sugar beet roots consequently improved juice quality and sugar extraction.

The lowest values of sodium percentage in roots were recorded with inoculation of seeds with *Bacillus polymyxa* in the first sowing date i.e. 15th September; this observation was true in the two growing seasons and their interaction.

The effect of interaction was insignificant on root length, root diameter, sugar yields, purity and sodium percentages (Tables, 41 - 45), This result may be due to the unchanged effect of the interaction of sowing dates and bio-nitrogen fertilizer sources from season to season.

5. c. <u>Effect of interaction between mineral nitrogen fertilizer rates and bio-nitrogen fertilizer sources</u>:

Effect of the interaction between nitrogen rate and bio-nitrogen bacteria source on root diameter at harvest is shown in Table (46).

Results show that increasing nitrogen rate raised the values of root diameter under the various bio-fertilizer treatments. It is worth mentioning that the increasing rate in root diameter was higher under the two types of bacteria than check treatment. This result was true in the two growing seasons and their combined. The highest root diameter was recorded with the combination between 90 kg N/fed and inoculation of seed with *Azospirillum brasilense*, but it was not enough to reach the level of significance between 60 and 90 kg N/fed. The pronounced effect of this combination mainly due to the effective role of nitrogen on growth criteria.

Results illustrated in Table (47) reveal the effect of the various combinations between nitrogen rate and nitrogen fixation bacterial sources on top yield of sugar beet at harvest.

Results showed that increasing nitrogen rate raised the values of top yield under the various bio-fertilizer treatments. It is worth mentioning that the increasing rate in top yield was higher under the two types of bacteria than check treatment. This result was true in the two growing seasons and their combined. The highest top yield was recorded with the combination between 60 kg N/fed and inoculation of sugar beet seed with *Azospirillum brasilense.*

The results in table (48) reveal the values of sucrose percentage as affected by interactions between nitrogen fertilizer and bio-fertilizer treatments.

Results obtained cleared a significant influence on the values of sucrose percentage of sugar beet roots due to the various combinations between nitrogen fixation bacterial sources and nitrogen rates. It is also distinctly show that even under the various bio-fertilizer treatments increasing nitrogen rate increased sucrose percentage in sugar beet roots. The highest values of sucrose percentage was found with the combination between 90 kg N/fed and inoculation of sugar beet seed with *Azospirillum brasilense* as a bio-nitrogen fixation bacteria.

Results illustrated in Table (49) reveal the effect of the various combinations between nitrogen rate and bio-nitrogen fixation bacteria source on nitrogen percentage of sugar beet top

Table (45): Effect of interaction between sowing date and bio-nitrogen source on sodium percentage of sugar beet root at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	2006/07			2007/08			combined		
	Bio -nitrogen source B)			Bio -nitrogen source (B)			Bio -nitrogen source (B)		
	Untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus
15 Sept.	1.38 bc	1.23 c	1.26 c	1.05 d	1.09 d	1.45 bc	1.21 d	1.16 d	1.35 cd
15 Oct.	1.66 ab	1.36 bc	1.58 abc	1.64a b	1.26 cd	1.56 bc	1.65 b	1.31 d	1.57 bc
15 Nov.	1.91 a	1.54 bc	1.67 ab	1.97 a	1.67 ab	1.59 bc	1.94 a	1.61 b	1.63 b
F.test(DXBXS)							NS		

NS: not significant.

Table (46): Effect of interaction between mineral nitrogen rate and bio-nitrogen source on root diameter (cm) of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	2006/07			2007/08			combined		
	Bio -nitrogen source (B)			Bio -nitrogen source (B)			Bio-nitrogen source (B)		
	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus
30	9.15 d	9.37 d	9.67 d	8.89 c	8.93 c	8.85 c	9.02 d	9.15 d	9.26 d
60	11.26 c	13.37 a	12.37 b	10.56 b	13.04 a	12.96 a	10.91 c	13.21 a	12.67 b
90	12.78 ab	13.26 a	12.82 ab	12.92 a	12.89 a	13.07 a	12.85 ab	13.07 ab	12.94 ab
F.test(NXBXS)							NS		

NS: not significant

Table (47): Effect of interaction between mineral nitrogen rate and bio-nitrogen source on top yield (t/fed) of sugar beet at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	2006/07			2007/08			combined		
	Bio-nitrogen source (B)			Bio-nitrogen source (B)			Bio-nitrogen source (B)		
	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus
30	6.96 e	8.09 de	8.45 d	6.87 d	8.74 c	7.59 cd	6.92 e	8.41 d	8.02 d
60	10.52 c	13.19 a	12.54 ab	10.74 b	12.70 a	11.46 ab	10.63 c	12.95 a	12.00 b
90	11.85 b	12.75 ab	12.33 ab	12.32 a	12.48 a	12.68 a	12.09 ab	12.61 ab	12.51 ab
F.test(NXBXS)							NS		

NS: not significant

at harvest. The obtained results pointed out that using nitrogen fertilizer and/or nitrogen fixation bacterial sources attained a significant increase in the percent of nitrogen in sugar beet top.

Results shown in Table (50) clear the values of purity percentage of sugar beet juice as affected by the interaction between mineral nitrogen rate and nitrogen bacterial sources in terms of *Azospirillum brasilense* and *Bacillus polymyxa*. The collected results cleared that both of bacterial sources over passed check treatment. It is seem that the used rates up to 90 kg N/fed were still suitable to attain a distinct increment in the values of purity percentage. This result may be indicating to the important of restudy of fertilizer rotes for sugar beet crop.

With the exception of nitrogen percentage in top, the other traits showed insignificant differences due to the effect of interaction between mineral nitrogen fertilizer rates, bio-nitrogen fertilizer sources and seasons (Tables, 46-50), This result may be due to the unchanged effect of the interaction of mineral nitrogen fertilizer rates and bio-nitrogen fertilizer sources from season to season.

5. d. <u>Effect of interaction among sowing date, mineral nitrogen fertilizer rate and bio-nitrogen fertilizer source</u>:

Results given in Table (51) show the values of sucrose percentage as affected by the second order interaction i.e. the various combinations among three sowing date, three nitrogen rates and three bio-fertilizer treatments.

An examined view toward the collected results, it could be noted that sucrose percentage greatly affected by the different

Table (48): Effect of interaction between mineral nitrogen rate and bio-nitrogen source on sucrose percentage of sugar beet root at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	2006/07			2007/08			Combined		
	Bio-nitrogen source (B)			Bio-nitrogen source (B)			Bio-nitrogen source (B)		
	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus
30	13.85 d	16.41 c	16.81 bc	13.56 e	16.61 cd	15.65 d	13.70 e	16.51 d	16.23 d
60	17.65 abc	18.47 ab	17.14 ab	17.49 bc	17.40 bc	17.23 bc	17.57 c	17.93 bc	17.68 c
90	18.12 ab	19.31 a	18.57 a	18.27 ab	18.99 a	18.91 a	18.20 abc	19.15 a	18.74 ab
F.test(NXBXS)							NS		

NS: not significant

Table (49): Effect of interaction between mineral nitrogen rate and bio-nitrogen source on nitrogen percentage of sugar beet topat harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	2006/07			2007/08			combined		
	Bio-nitrogen source (B)			Bio-nitrogen source (B)			Bio-nitrogen source (B)		
	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus
30	1.54 d	2.96 c	3.43 abc	2.20 d	2.67 cd	3.36 bc	1.87 e	2.81 d	3.39 bc
60	3.14 bc	3.32 abc	3.56 ab	2.80 cd	3.49 abc	3.56 abc	2.97 cd	3.40 bc	3.56 ab
90	3.85 a	3.72 ab	3.65 ab	3.45 abc	3.83 ab	4.32 a	3.65 ab	3.77 ab	3.98 a
F.test(NXBXS)							*		

*: significant.

Table (50): Effect of interaction between mineral nitrogen rate and bio-nitrogen source on purity percentage of sugar beet root at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Mineral nitrogen rate (kg N\fed)	2006/07			2007/08			combined		
	Bio-nitrogen source (B)			Bio-nitrogen source (B)			Bio-nitrogen source (B)		
	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus
30	58.55 e	72.70 cd	70.05 d	59.76 d	69.31 c	67.17 c	59.15 e	71.01 d	86.61 d
60	80.49 b	87.43 a	86.22 a	79.77 b	81.90 b	81.29 b	80.13 c	84.66 b	83.76 b
90	76.68 bc	89.41 a	87.10 a	81.12 b	83.52 b	88.15 a	78.90 c	86.46 ab	87.63 a
F.test(NXBXS)							NS		

NS: not significant.

combination among the studied factors. Also, it is obviously clear that increasing the applied rate of nitrogen was more benefit and effective on this trait whether in the early sowing date (15th September) and/or in the latest one (15th November).

Moreover, the available results in Table (51) revealed that inoculation of sugar beet seed which *Bacillus polymyxa* as a bio-nitrogen fixation bacteria source surpassed *Azospirillum brasilense* as well as check treatment; however, this superiority was not enough to reach the level of significance at the first sowing date. This finding was fairly true in the two growing seasons and their combined.

Once more, the results obtained showed that the recommended treatment under this study, which attained the highest value of sucrose percentage was the early sowing date (15th September) with 90 kg N/fed under inoculation of sugar beet seeds treatment with *Bacillus polymyxa* as a bio-nitrogen fixation bacteria source.

Results in Table (52) show the effect of the interaction among nitrogen rates, sowing dates and bio-fertilizer treatments on nitrogen percentage of sugar beet roots at harvest.

The presented results cleared that the values of nitrogen percentage of sugar beet roots almost attained the lowest values when the sugar beet plants grown had sown on the early sowing i.e. 15th September. This observation means increase in root juice quality consequently high sugar production. This result was true in the two seasons and their combined under the various bio-fertilizer treatments.

Table (51): Effect of interaction among sowing date, mineral and bio-nitrogen fertilizers on sucrose percentage of sugar beet root at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	Mineral nitrogen rate (kg N\fed)	2006/07			2007/08			combined		
		Bio-nitrogen source (B)			Bio-nitrogen source (B)			Bio-nitrogen source (B)		
		untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus
15 Sept.	30	12.93 f	17.30 a-d	18.01 abc	13.89fg	18.26abc	16.79bcd	13.41 j	17.78 b-g	17.40 c-g
	60	18.80 ab	19.53 ab	18.61 abc	19.02 ab	18.36 ab	18.80 ab	18.91 a-e	18.94 a-d	18.70 a-f
	90	17.57 a-d	19.26 ab	19.61a	18.07 abc	19.48 a	19.50 a	17.82 b-g	19.37 a	19.55 a
15 Oct.	30	13.95 ef	17.40 a-d	17.14 ab	14.33 efg	17.68 a-d	17.29 a-d	14.14 ij	17.54 b-g	17.22 d-g
	60	19.15 ab	19.29 ab	18.83 ab	17.95 abc	16.82bcd	16.86bcd	18.55 a-f	18.06 a-g	17.85 a-g
	90	19.10 ab	19.28 ab	18.95 ab	18.46 ab	18.77 ab	18.84 a	18.78 a-e	19.02 a-d	18.90 a-e
15 Nov.	30	14.66 def	14.51 def	15.29 c-f	12.45 g	13.90 fg	12.87 g	13.56 ij	14.21 ij	14.08 ij
	60	15.00 c-f	16.60 b-e	16.99 a-e	15.52 def	17.01bcd	16.02 cde	15.26 hi	16.80 fgh	16.50 gh
	90	16.68 b-e	19.39 ab	17.58 a-d	17.29 a-d	18.73 ab	18.38 ab	16.99 e-h	19.06 a-d	17.98 a-g
F.test (D X N X B X S)								NS		

NS: not significant.

Table (52): Effect of interaction among sowing date, mineral and bio-nitrogen fertilizers on nitrogen percentage of sugar beet root at harvest in (2006/07, 2007/08 seasons (S) and their combined)

Sowing date (D)	Mineral nitrogen rate (kg N\fed)	2006/07			2007/08			combined		
		Bio-nitrogen source (B)			Bio-nitrogen source (B)			Bio-nitrogen source (B)		
		untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus	untreat	Azospirillum	Bacillus
15 Sept.	30	1.13 ghi	1.20 f-i	1.07 hi	1.00 fgh	1.34 c-f	0.93 gh	1.07 ijk	1.27 f-i	0.99 jk
	60	1.13 ghi	1.47 c-f	1.13 ghi	0.73 h	1.27 d-g	1.34 c-f	0.93 k	1.37 d-h	1.24 g-j
	90	1.27 e-i	1.60 bcd	1.60 bcd	1.07 e-h	1.60 bcd	1.40 cde	1.17 g-k	1.60 a-d	1.50 c-f
15 Oct.	30	1.00 i	1.27 e-i	1.13 ghi	0.87 h	1.47 cd	1.07 e-h	0.93 k	1.37 d-h	1.10 ijk
	60	1.20 f-i	1.60 bcd	1.47 c-f	1.07 e-h	1.47 cd	1.27 d-g	1.13 h-k	1.54 b-e	1.37 d-h
	90	1.40 d-g	1.93 a	1.74 abc	1.60 bcd	1.60 bcd	1.47 cd	1.50 c-f	1.77 ab	1.60 a-d
15 Nov.	30	1.07 hi	1.60 bcd	1.54 cde	1.07 e-h	1.87 ab	1.67 a-d	1.07 ijk	1.73 abc	1.60 a-d
	60	1.20 f-i	1.60 bcd	1.27 e-i	1.40 cde	2.00 a	1.74 abc	1.30 e-i	1.80 a	1.50 c-f
	90	1.34 d-h	1.88 a	1.86 ab	1.47 cd	1.67 a-d	1.74 abc	1.40 d-g	1.77 ab	1.80 a
F.test (D X N X B X S)								NS		

NS: not significant.

Based upon the scientific view, its is well known that the high juice quality attributed with the low impurities such as nitrogen, sodium and potassium, the best combination between the three studied factors was that for plant sown early on 15th October with 30 kg N/fed without bio-fertilizer treatments. This result could be acceptable, that is because bio-nitrogen bacterial sources such as *Azospirillum brasilense* and *Bacillus polymyxa* will save additional nitrogen in soil around the plant grown in turn raised it in the plant tissue.

Results presented in Table (53) reveal the interaction among the three factors under study on the values of nitrogen uptake in sugar beet top at harvest, in both growing seasons and their combinations.

Results recorded had no clear cut trend could be deduced due to the examined factors, however, it could be noted that inoculated sugar beet seed by micro organism such as *Azospirillum brasilense* as a bio-nitrogen fixation organisms attained additional increase in the quantity of nitrogen uptake in plant top compared by check treatment. These results may be due to the known role of such kind of bacteria in nitrogen fixation. This result was completely true in the first season and the combined over the two seasons. On the contrary using *Bacillus polymyxa* inoculation sugar beet seed recorded higher nitrogen in the second season with no significant different compared with *Azospirillum brasilense* and/or un-inoculated seeds.

The effect of interaction between sowing dates, mineral nitrogen fertilizer rates, bio-nitrogen fertilizer sources and

Table (53): Effect of interaction among sowing date, mineral and bio-nitrogen fertilizers on nitrogen uptake (kg/f) of sugar beet top at harvest in (2006/07, 2007/08 seasons (S) and their combined).

Sowing date (D)	Mineral nitrogen rate (kg N\fed)	2006/07		
		Bio-nitrogen source (B)		
		untreat	Azospirillum	Bacillus
15 Sept.	30	7.32 l	48.00 f-i	47.24 f-i
	60	51.04 fgh	77.34 abc	70.20 cde
	90	83.52 abc	90.54 a	71.06bcd
15 Oct.	30	24.53 jk	35.41 hij	46.24 f-i
	60	51.79 fgh	87.79 ab	69.79 cde
	90	76.50 a-d	81.36 abc	79.46 abc
15 Nov.	30	12.55 kl	31.78 ij	35.03 hij
	60	24.15 ghi	54.19 efg	60.20 def
	90	54.04 efg	80.75 abc	72.25bcd
F.test (D X N X B X S)		-		

Sowing date (D)	Mineral nitrogen rate (kg N\fed)	2007/08		
		Bio-nitrogen source (B)		
		untreat	Azospirillum	Bacillus
15 Sept.	30	17.20 gh	29.01 fgh	31.89 fgh
	60	42.77 d-h	70.56 a-e	70.04 a-e
	90	75.16 ab	74.65 abc	85.48 a
15 Oct.	30	24.01gh	43.52 c-h	46.73 b-g
	60	40.83 d-h	75.73 ab	57.79 a-f
	90	72.22 a-d	66.41 a-e	79.60 a
15 Nov.	30	12.46 h	28.89 fgh	24.07 gh
	60	39.34 e-h	65.19 a-e	42.59 d-h
	90	40.76 d-h	83.82 a	77.30 ab
F.test (D X N X B X S)		-		

Sowing date (D)	Mineral nitrogen rate (kg N\fed)	combined		
		Bio-nitrogen source (B)		
		untreat	Azospirillum	Bacillus
15 Sept.	30	12.26 g	38.50 def	39.56 def
	60	46.90 cde	73.95 ab	70.12 ab
	90	79.34 fa	82.55 a	78.27 ab
15 Oct.	30	24.27 fg	39.46 def	46.49 cde
	60	46.31 cde	81.76 a	63.79 abc
	90	74.36 ab	73.88 ab	79.53 a
15 Nov.	30	12.51 g	30.34 ef	29.55 ef
	60	40.75 def	59.69 bc	51.40 cd
	90	47.40 cde	82.28 a	74.77 ab
F.test (D X N X B X S)		NS		

seasons was insignificant on sucrose percentage, nitrogen percentage in root and nitrogen uptake in top, Tables (51, 52 and 53), this result indicate to that sucrose percentage attributed by gene make up effect.

6. Correlation study:

The results obtained in Tables (54, 55 and 56) discussed to what extend the choice characteristics correlated with each other with respect to their effect on sugar yield.

Results cleared that all the studied criteria i.e. root yield/fed, top yield/fed, root fresh weight/plant, top fresh weight/plant, sucrose percentage and purity percentage recorded a positive correlation with sugar yield.

It could be deduced from the obtained results whether for the individual season and/or the combined over the two seasons that root yield and top yield as well as sucrose and purity percentages strongly correlated with sugar yield, meanwhile root and top fresh weight/plant come to the 2^{nd} order. This result may be considered a very important indication to the breeder to keep in his mined throughout his choice in plant breeder program.

Table (54): Simple correlation study for the first season (2006/2007).

	SY	RY	TY	RW	TW	S%	P%
	1st sowing date (15th September)						
SY	1						
RY	0.967**	1					
TY	0.947**	0.928**	1				
RW	0.844**	0.830**	0.824**	1			
TW	0.730**	0.778**	0.724**	0.727**	1		
S%	0.863**	0.721**	0.767**	0.699**	0.478*	1	
P%	0.959**	0.908**	0.863**	0.839**	0.673**	0.899**	1
	2nd sowing date (15th October)						
SY	1						
RY	0.940**	1					
TY	0.965**	0.887**	1				
RW	0.698**	0.703**	0.729**	1			
TW	0.716**	0.782**	0.635**	0.577**	1		
S%	0.891**	0.689**	0.871**	0.558**	0.515**	1	
P%	0.879**	0.920**	0.827**	0.800**	0.665**	0.682**	1
	3rd sowing date (15th November)						
SY	1						
RY	0.957**	1					
TY	0.987**	0.925**	1				
RW	0.779**	0.803**	0.763**	1			
TW	0.616**	0.725**	0.570**	0.607**	1		
S%	0.884**	0.722**	0.915**	0.561**	0.365	1	
P%	0.931**	0.933**	0.925**	0.885**	0.602**	0.755**	1

*Significant at 0.05 level of significance, ** Significant at 0.01 level of significance.
SY: sugar yield, RY: root yield, TY: top yield, RW: root fresh weight/plant, TW: top fresh weight/plant, S%: sucrose percentage and P%: purity percentage.

Table (55): Simple correlation study for the second season (2007/2008).

	SY	RY	TY	RW	TW	S%	P%
	1st sowing date (15th September)						
SY	1						
RY	0.968**	1					
TY	0.948**	0.936**	1				
RW	0.617**	0.641**	0.573**	1			
TW	0.677**	0.719**	0.727**	0.615**	1		
S%	0.881**	0.747**	0.789**	0.459*	0.479*	1	
P%	0.825**	0.786**	0.802**	0.529**	0.500**	0.742**	1
	2nd sowing date (15th October)						
SY	1						
RY	0.910**	1					
TY	0.796**	0.639**	1				
RW	0.715**	0.778**	0.619**	1			
TW	0.648**	0.689**	0.545**	0.559**	1		
S%	0.771**	0.447*	0.769**	0.364	0.333	1	
P%	0.961**	0.931**	0.731**	0.767**	0.669**	0.650**	1
	3rd sowing date (15th November)						
SY	1						
RY	0.969**	1					
TY	0.988**	0.945**	1				
RW	0.805**	0.800**	0.777**	1			
TW	0.669**	0.723**	0.656**	0.611**	1		
S%	0.963**	0.872**	0.965**	0.739**	0.570**	1	
P%	0.965**	0.923**	0.963**	0.783**	0.649**	0.946**	1

*Significant at 0.05 level of significance, ** Significant at 0.01 level of significance.
SY: sugar yield, RY: root yield, TY: top yield, RW: root fresh weight/plant, TW: top fresh weight/plant, S%: sucrose percentage and P%: purity percentage.

Table (56): Simple correlation study for the combined over the two seasons (2006/2007 and 2007/2008).

	SY	RY	TY	RW	TW	S%	P%
	1st sowing date (15th September)						
SY	1						
RY	0.967**	1					
TY	0.946**	0.930**	1				
RW	0.749**	0.750**	0.710**	1			
TW	0.663**	0.704**	0.700**	0.612**	1		
S%	0.869**	0.731**	0.774**	0.609**	0.454**	1	
P%	0.901**	0.855**	0.831**	0.728**	0.553**	0.837**	1
	2nd sowing date (15th October)						
SY	1						
RY	0.917**	1					
TY	0.896**	0.767**	1				
RW	0.668**	0.730**	0.641**	1			
TW	0.644**	0.721**	0.555**	0.579**	1		
S%	0.842**	0.567**	0.829**	0.418**	0.377**	1	
P%	0.913**	0.919**	0.783**	0.748**	0.637**	0.668**	1
	3rd sowing date (15th November)						
SY	1						
RY	0.960**	1					
TY	0.986**	0.929**	1				
RW	0.791**	0.801**	0.768**	1			
TW	0.620**	0.705**	0.597**	0.598**	1		
S%	0.921**	0.787**	0.940**	0.649**	0.443**	1	
P%	0.927**	0.893**	0.923**	0.800**	0.537**	0.858**	1

*Significant at 0.05 level of significance, ** Significant at 0.01 level of significance.
SY: sugar yield, RY: root yield, TY: top yield, RW: root fresh weight/plant, TW: top fresh weight/plant, S%: sucrose percentage and P%: purity percentage.

SUMMARY

V. SUMMARY

A field trial was carried out at the Experimental Farm of Sakha Agricultural Research Station, Kafr El-Sheikh Governorate, Egypt in the two successive seasons of 2006/2007 and 2007/2008 to study the influence of mineral nitrogen rate and bio-nitrogen fertilizer under three sowing dates on the yield, its components and juice quality of sugar beet crop.

Each sowing date included 9 treatments, which were the combinations between three mineral nitrogen fertilizer rates (30, 60 and 90 kg N/fed) and three sources of bio-N fertilizer (inoculation with Azospirillum, Bacillus N-fixers bacteria and untreated (control)).

Nitrogen fertilizer was applied as urea (46% N) in two equal doses, the first one after thinning (45 days from sowing) and the second one at one month later.

Sugar beet seed was inoculated by the examined bacteria through the following method: Seed of sugar beet variety Montebianco was mixed with a glue solution and the specific bacteria and left in unsunny place till be dried before sowing it.

The nine combinations of mineral nitrogen and bio-fertilizer source were arranged in randomized completely block design with three replications was used. Plot area was 17.5 m^2, which consisted of 5 ridges of 7 m in length and 50 cm in width, with 20 cm distance between hills. A combined analysis for the three sowing dates over the two seasons was done.

At harvest (210 days from sowing), a sample of five plants was taken at random to determine the following characteristics:

a. Yield and its components:

1. Root length (cm).
2. Root diameter (cm).
3. Root fresh weight g/plant.
4. Top fresh weight g/plant
5. Root dry weight percentage/plant.
6. Top dry weight percentage/plant

At harvest four guarded rows were harvested, topped, cleaned and the following criteria were recorded:

7. Root yield (t/fed).
8. Top yield (t/fed).
9. Sugar yield (t/fed).

b. Juice quality:

10. Total soluble solids percentage.
11. Sucrose percentage.
12. Purity percentage.

c. Chemical constituents:

13. Nitrogen percentage in roots and tops.
14. Potassium and sodium percentages in roots and tops.
15. Nitrogen uptake of root (kg/fed).
16. Nitrogen uptake of tops (kg/fed).
17. Potassium uptake of root (kg/fed).
18. Potassium uptake of tops (kg/fed).

19. Sodium uptake of root (kg/fed).

20. Sodium uptake of tops (kg/fed).

Results could be summarized as follows:

1. Effect of season:

1. Results revealed that root length and diameter, fresh weight/plant and root dry matter were insignificantly affected, while top fresh weight and dry matter were significantly affected by the growing season at harvest.
2. Root, top and sugar yields were insignificantly affected by the growing season at harvest.
3. Purity percentage was significantly affected by the growing season, whereas, total soluble solids and sucrose percentages were not affected.
4. Percentages of nitrogen, potassium and sodium in roots and top, as well as nitrogen, potassium and sodium uptakes of root were not affected by the growing season, while the values of potassium and sodium uptakes of top were significantly affected by the growing season.

2. Effect of sowing date:

1. There was insignificant difference between sowing on 15^{th} of September and 15^{th} October in their effect on root diameter, fresh weight and top fresh weight/plant. While root length was significantly increased by sowing sugar beet on 15^{th} of October, in the second season and the combined. The greatest values of root and top dry matter percentages were recorded in case of sowing beets on 15^{th} of September, while delaying

sowing dates from 15th September to 15th October reduced their values.

2. The earlier and middle sowing dates (15th September and 15th October) recorded better root yield/fed than that attained at the late one (15th November) in the two seasons and their combined analysis.
3. The early sowing date on 15th September had the greatest top yield/fed, while the late one (15th November) gave the lowest value of this trait, in both seasons and their combined analysis.
4. The highest sugar yield/fed was recorded with both early sowing dates (15th of September and October) without significant difference between them, in both seasons and their combined analysis.
5. The combined analysis of the two seasons showed that delaying sowing to 15th November attained a positive response in total soluble solids percentage, while the highest values of sucrose and purity percentages were recorded with the early sowing on 15th September.
6. Sugar beets sown earlier on the 15th of September contained the lowest nitrogen, potassium and sodium percentages, while the highest values were recorded with the latest sowing date on 15th November, in both seasons and their combined analysis.
7. In both seasons and their combined, nitrogen content in top decreased significantly and gradually by delaying planting date from 15th September to 15th October and to 15th November.

8. Differences in potassium and sodium contents in sugar beet top did not reach the 5 % level of significance in case of sowing sugar beet on 15th September and/or 15th October, in both seasons and their combined analysis.
9. Values of nitrogen uptake in root increased significantly with planting dates of 15th October followed by 15th September and 15th November, respectively, in both seasons and their combined analysis.
10. The lowest values of nitrogen, potassium and sodium uptakes in top were recorded by sowing sugar beet on 15th November. The difference between 15th October and 15th November reach to significance in their influence on these traits, in the two seasons and their combined analysis.
11. The effect of the interaction between sowing date and season was insignificantly on the most criteria, except purity percentage, nitrogen concentration of root and nitrogen uptake of top.

3. Effect of mineral nitrogen fertilizer rate:

1. In both seasons and their combined, increasing nitrogen fertilization level from 30 up to 90 kg N/fed increased root length, root and top fresh weight/plant. However, the differences between both (60 and 90 kg N/fed) were significant in their effect on these traits compared with 30 kg N/fed. Root and top dry matter/plant were increased as nitrogen rate increased from 30 to 60 up to 90 kg N/fed.

2. Increasing nitrogen fertilization rate from 30 to 90 kg N/fed statistically increased root yield ton/fed. Application of 60 kg N/fed was enough to produce the favorite yield and additional increment in root yield amounted to 44.1 %, 42.18 % and 42.94 % over than gained by applying 30 kg N/fed treatment in the first, second seasons and their combined analysis, respectively.
3. The results appeared that top yield gradually increased with increasing dose of nitrogen up to 90 kg N/fed, in the two seasons and their combined analysis.
4. Increasing nitrogen fertilizer from 30 to 60 and 90 kg N/fed raised the values of sugar yield by 65.52 % and 70.09 % in the first season, 59.93 %; by 71.30 % in the second season and by 62.41 % and 96.64 % in the combined over the both seasons.
5. Nitrogen fertilization rate of 90 kg N/fed surpassed both other rates (30 and 60 kg N\fed) in sucrose and purity percentages, while the highest value of total soluble solids percentage was recorded with application of 30 kg N/fed, in the two seasons and their combined analysis.
6. Nitrogen content in root was significantly increased as the applied dose of nitrogen fertilizer increased in both seasons and their combined. Potassium and sodium contents in root were insignificantly affected between 30 and 60 kg N/fed in the combined. Based on these results, it could be recommended by nitrogen application to decrease the impurities (potassium and sodium) consequently increased sugar extraction.

7. Application of 90 kg N/fed attained a significant increase in the values of nitrogen content in the top. However, application of 30 kg N/fed was enough to produce the highest contents of potassium and sodium in top of sugar beet in both seasons and their combined analysis.
8. Nitrogen uptake in root significantly with increasing nitrogen fertilizer rate. However, potassium and sodium uptakes in root insignificantly responded to the applied rates between 60 and 90 kg N/fed, in the two seasons and their combined analysis.
9. Increasing nitrogen application tended to increase the values of nitrogen, potassium and sodium uptakes in top of sugar beet plants in the two seasons and their combined analysis.
10. The studied characters were insignificantly affected by the interaction between mineral nitrogen fertilizer rate and season, except nitrogen uptake in root was significant.

4. Effect of bio-nitrogen fertilizer source:

1. The combined analysis of the two seasons showed that inoculation of sugar beet seed with *Azospirillum brasilense* gave the highest root fresh weight/plant, root dry matter and top dry matter and surpassed that inoculated with *Bacillus polymyxa* and check treatment.
2. The highest value of root dry matter significantly increased by inoculation of sugar beet seed with *Azospirillum brasilense*, while the lowest ones were recorded by the un-inoculated, in both seasons and their combined analysis.

3. Inoculation of seed with *Azospirillum brasilense* increased root yield by 7.73%, 7.52% and 7.65%, corresponding 11.14%, 6.15% and 8.67% when inoculation with *Bacillus polymyxa* higher than that produced without inoculation in the first, second seasons and their combined, respectively.
4. Inoculation of seed with *Azospirillum brasilense* gave the greater top yield/fed than that produced without inoculation and *Bacillus polymyxa* by 1.45 and 0.48 ton/fed in the combined, respectively. Sugar yield as a result to inoculation by *Azospirillum brasilense* reached 16.71%, 13.92% and 15.31%, corresponding to 18.51%, 10.38% and 14.54% when inoculation of seeds with *Bacillus polymyxa* higher than that control treatment, in the first and second seasons and their combined analysis, respectively.
5. In the first, second seasons and their combined, respectively, inoculation of seed with *Azospirillum brasilense* significantly raised the values of sucrose percentage over that of control (without bio-fertilizer) amounted by 9.19%, 7.48% and 8.31%, while, inoculation with the same inoculation significantly raised the values of purity percentage over that of control amounted by 15.67%, 6.38% and 3.83%.
6. Sucrose and purity percentages reach the level of significance between inoculation of seed with *Azospirillum brasilense* and/or *Bacillus polymyxa* compared with control treatment in both seasons and their combined analysis.
7. The highest value of nitrogen content and the lowest values of potassium and sodium in roots were recorded by inoculation of seed with *Azospirillum brasilense*, while, the highest

values of potassium and sodium in roots were recorded without bio-fertilization, in the two seasons and their combined analysis.

8. The lowest value of potassium in top was recorded by inoculation of seed with *Azospirillum brasilense*, while the lowest value of sodium in top was recorded by inoculation of seed with *Bacillus polymyxa* in both seasons and their combined analysis.
9. Nitrogen uptake in root was significantly increased by inoculation of seed with *Azospirillum brasilense* followed by *Bacillus polymyxa*. Sodium uptake in root recorded the lowest value by inoculation seed with *Azospirillum brasilense* in both seasons and their combined analysis.
10. Nitrogen, potassium and sodium uptakes in top among the studied bio-fertilizer were significant compared without inoculation, in the two seasons and their combined, except the second season for potassium uptake in top.
11. The studied characters were insignificantly affected by the interaction between bio-nitrogen fertilizer source and season, except root length, root fresh weight; as well as total soluble solids and purity percentages.

5. Interaction effects:

5. a. Effect of interaction between sowing date and mineral nitrogen fertilizer rate:

1. In both seasons and their combined, the highest values of root diameter were recorded with 90 kg N/fed with 15th

September sowing date. The difference combination between 60 or 90 kg N/fed and 15th September sowing date was significantly responded on root length compared with the interaction between 30 kg N/fed with the same sowing date, in both seasons and their combined analysis.

2. The difference values of top yield between sowing date 15th September or 15th October were significantly whether the sugar beet plants fertilized by 60 or 90 kg N/fed compared with the delaying date as the same rates of fertilization, in the two seasons and their combined analysis.
3. Increasing the applied nitrogen fertilizer up to 90 kg N/fed caused a relative increase in sucrose in the two seasons and their combined. However, the difference between the nitrogen rate (60 kg N/fed) and the sowing date on (15th September or 15th October) was significantly in their influence on sucrose compared with the sowing date on 15th November as the same rate of fertilization, in both seasons and their combined analysis.
4. Results showed that even under the same nitrogen rate, delaying sowing date from 15th September to 15th October and 15th November increased the values of nitrogen percentage in root.
5. The results obtained cleared that sodium percentage of top significantly affected by the different combination between nitrogen rate and sowing date in the two seasons and their combined analysis.

6. The highest values of nitrogen uptake in roots were recorded with sowing sugar beet on 15th October with 90 kg N/fed in the two seasons and their combined analysis.
7. The middle nitrogen rate (60 kg N/fed) attained the highest values of sodium uptake in top of sugar beet plants sown on 15th September in the second season and the combined analysis.
8. With the exception of nitrogen percentage and nitrogen uptake in roots, the other traits showed insignificant differences due to the effect of interaction between sowing dates, mineral nitrogen fertilizer rates and seasons.

5. b. Effect of interaction between sowing date and bio-nitrogen fertilizer source:

1. Root length was significantly increased by the effect of interaction between sowing date of 15th September and inoculation of seed with bio-fertilizers compared without inoculation.
2. Inoculation of sugar beet seed with bio-fertilizers appeared a distinct effect on root and sugar yields in both early sowing dates (15th September and 15th October) compared by control treatment in both seasons and their combined analysis.
3. The highest values of purity percentage were recorded with sown sugar beet on 15th September and/or 15th October compared by sown on 15th November under inoculation of seed with bio-fertilizers in the two seasons and their combined analysis.

4. The lowest values of sodium percentage in roots were recorded with inoculation of seed with *Bacillus polymyxa* under the first sowing date i.e. 15th September; this observation was true in the two seasons and their interaction.
5. The effect of interaction between sowing date, bio-nitrogen fertilizer source and season was insignificant on root length, root and sugar yields as well as purity and sodium percentages.

5. c. Effect of interaction between mineral nitrogen fertilizer rate and bio-nitrogen fertilizer source:

1. The highest root diameter and top yield were recorded with the combination between 90 kg N/fed with inoculation of sugar beet seeds with *Azospirillum brasilense*, but it was not enough to reach the level of significance between 60 and 90 kg N/fed. in both seasons and their combined analysis.
2. The highest values of sucrose percentage was found with the combination between 90 kg N/fed with inoculation of seeds with *Azospirillum brasilense*, in both seasons and their combined analysis.
3. Using nitrogen fertilizer and/or nitrogen fixation bacterial sources attained a significant increase in the percent of nitrogen in sugar beet top.
4. Using rates up to 90 kg N/fed with inoculation of sugar beet seeds with *Bacillus polymyxa* were still suitable to attain a distinct increment in the values of purity percentage in the second season and the combined analysis.

5. With the exception of nitrogen percentage in top, the other traits showed insignificant differences due to the effect of interaction between mineral nitrogen fertilizer rates, bio-nitrogen fertilizer sources and seasons.

5. d. Effect of interaction among sowing date, mineral nitrogen fertilizer rate and bio-nitrogen fertilizer source:

1. The highest value of sucrose percentage recorded by the early sowing date (15th September) with 90 kg N/fed under inoculation of seeds treatment with *Bacillus polymyxa* as a fixation to nitrogen element, in both seasons and their combined analysis.
2. The lowest value of nitrogen percentage was recorded under sown on 15th October with 30 kg N/fed with out bio-fertilizer treatments, in the two seasons and their combined analysis.
3. The highest values of nitrogen uptake in top were recorded when the plant had fertilized with 90 kg N/fed and *Azospirillum brasilense* inoculation sugar beet seeds under sowing date on 15th September, in the first season and the combined analysis.
4. The effect of interaction between sowing dates, mineral nitrogen fertilizer rates, bio-nitrogen fertilizer sources and seasons was insignificant on sucrose percentage, nitrogen percentage in root and nitrogen uptake in top.

6. Correlation study:

Results cleared that root yield/fed, top yield/fed, root fresh weight/plant, top fresh weight/plant, sucrose percentage and purity percentage recorded a positive correlation with sugar yield.

Conclusion

According to the presented resulted from this investigation, it can be concluded that sowing dates on 15th September and/or 15th October with applying 60 or 90 kg N/fed and inoculated sugar beet seed with bio-nitrogen fertilizer sources (*Azospirillum brasilense* and/or *Bacillus polymyxa*) could be recommended for maximizing sugar beet productivity.

Inoculation of seed sugar beet with *Bacillus polymyxa* and applied 90 kg N/fed in the first sowing date (15th September) gave the highest values of sucrose percentage. On the other hand the highest sucrose percentage was obtained by sowing date of sugar beet on 15th October with applied 90 kg N/fed and mixed bio-fertilizer *Azospirillum brasilense*. The above mentioned results could be responded under Kafr El-Sheikh Governorate.

LITERATURE CITED

VI. LITERATURE CITED

Abd El-Aal, A. M. and Amal, Z. A. Mohamed (2005): Genotype x environment interaction and stability analysis for sugar beet yield and its component of some sugar beet genotypes. Annals Agric. Sci., Moshtohor, 34 (2): 527-544.

Abd El-Aal, A. M. and B. M. Abou El-Magd (2006): Effect of sowing and harvesting dates on yield and quality of some sugar beet varieties. Egypt. J. Appl. Sci., 21 (8b): 472-485.

Abd El-Razek, A. M. (2006): Response of sugar beet to planting date and number of days to harvesting under North Sinai conditions. Egypt. J. Agric. Res., 84 (3): 867-881.

Abo-Elazm, S. (2009): Biochemical studies on sugar beet. M.Sc. Thesis. Fac. Agric., Cairo University, Egypt.

Abou salama, A. M. and S. I. El-sayed (2000): Studies on some sugar beet cultivars under Middle Egypt conditions 1- Response to planting and harvesting dates. Assiut. J. Agric. Sci., 31 (1): 137-159.

Abou Shady, K. A.; Mona, M. Shehata; M. F. M. Ibrahim and B. M. Abou El-Magd (2002): Fertilizer effect on sugar beet growth, yield and quality. Annals Agric Sci., Moshtoher. 40 (1): 81-92.

Abou zeid, M. Y. and M. S. H. Osman (2005): Yield and quality of sugar beet as affected by bio and Mineral N-fertilization. Egypt. J. Appl. Sci., 20 (8b): 416-433.

Abu El-Fotoh, H. G. and B. M. Abou El-Magd (2006): Sugar beet productivity and quality as affected by nitrogen sources and rates. Egypt. J. Appl. Sci., 21 (5): 375-386.

Afify, Aida. H, F. M. Hammouda, A. M. Basyouni, and F. I. A. Hauka (1994): Effect of bacterization and mineral fertilization on the main characters and major insect infestation of sugar beet plants. J. Agric. Sci. Mansoura Univ., 19 (1): 201-208.

Agami, K. (2005): Effect of planting date, plowing depth and nitrogen fertilizer on yield and quality of sugar beet at Noubaria. Ph.D. Thesis, Fac. Agric., Moshtohor, Zagazig Univ., Benha Branch, Egypt.

Al-Jbawi, E. M. (2000): Performance of some sugar beet genotypes under different environments. M.Sc. Thesis , Fac. Agric. cairo. Univ., Egypt.

Allam, S. A. H.; K. El-Sh. Mohamed; G. S. El-Sayed and A. M. H. Osman (2005): Effect of sowing date, nitrogen fertilizer and row space on yield and quality of sugar beet crop. Annals Agric. Sc., Moshtohor, 43 (1): 11-24.

Aly, M. H.; Zeinab, R. Moustafa and A. M. H. Osman (2009): Effect of seed inoculation and foliar application with Azospirllum brasiliense and or Bacillus megatherium on productivity and quality os sugar beet.

Egypt J. Appl. Sci., 24 (2A): 56-90.

Association of Official Agricultural Chemist (A. O. A. C.) (1995): Official methods of analysis published by the A.O.A.C., Box 540, Washington.

Attallah, M. Z. (2004): Effect of biofertilizer, city garbace compost, mineral-N and their combinations on productivity on sugar beet cultivars. J. Agric. Sci. Mansoura Univ., 29 (7): 4281-4294.

Attia, A. N.; A. A. Kandil; M. S. Sultan; M. A. Badawi and S. E. Seadh (2004): Effect of planting dates, biofertilization and NK combination levels on: I-Growth and yield components of sugar beet. The 4th Scientific Conf. Agric. Sci., 7-9 Dec. 2004, Fac. Agric. Assiut Univ., Agron: 727-746.

Azzazy, N. B. (1998): Effect of sowing date, irrigation interval and nitrogen fertilization on yield and quality of sugar beet under Upper Egypt conditions. Egypt. J.Agric. Res., 76(3): 1099-1113.

Azzazy, N. B. (2000): Water stress and nitrogen fertilization with relation to yield and quality of sugar beet. Egypt J. Appl. Sci., 15(7): 114-124.

Azzazy, N. B. (2004): Yield and quality of some sugar beet varieties as affected by water quality and nitrogen fertilization. Egypt. J. Agric. Res., 82(4): 1733-1745.

Badawi, M. A.; A. A. Kandil; M. S. Sultan; A. N. Attia; and S. E. Seadh (2004): Effect of planting dates, biofertilization and NK combination levels on: II- Yield and quality of sugar beet. The 4th Scientific Conf. of Agric. Sci., 7-9 Dec. 2004, Fac. of Agric. Assiut Univ., Agron: 747-762.

Bassyouny, A. M. and S. S. Zalat (1997): Effect of summer planting and harvesting dates in relation to insect infestation on sugar beet yield and quality. Egyptian J. Appl. Sci., 12 (6): 108-120.

Brown J. D., and O. Lilliand (1964): Rapid determination of potassium , sodium in plant material and soil extraction by flame photometry. Proc. Amer. Soc. Hort. Sci., 48:340-364.

Cakmakci, R., F. Kanter and F. Sahin (2001): Effect of N2-fixing bacterial inocul;ation on yield of sugar beet and barley. Plant Nutr. Soil Sci., 164, 527-531.

Carruthers, A., and J. F. T. Oldfield (1962): Methods for the assessment of beet quality. Int. Sug. J., 63 (1): 103-105.

Duncan, D. B. (1955): Multiple ranges and multiple F. test Biometrics, 11:1-24.

Dunn, G.; G. S. Lee and W. R. Schnehl (1990): Effect of planting date and nitrogen fertilization soluble carbohydrate concentration in sugar beet. J. Sugar Beet Res., (2): 1-10.

Edris, A. S. A., Nemat, A. Nour El-Din; I. H. M. El-Geddawy and A. M. A. El-Shafei (1992): Effect of plant density, nitrogen and potassium fertilizers on yield and its attributes of sugar beet. Pak. Sugar J., July

Sept., 21-25.

Edugreen(2007): www.edugreen.teri.res.in/explore/bio/ferti.htm.

El-Badry, M. and A. El-Bassel (1993): Improving sugar beet crop by inculation with free living nitrogen fixing bacteria. The 6th International Sym.on nitrogen fixation with non-Lequmes. Ismailia, Egypt, 6-10 sep.

El-Dsouky, M. M. and K. K. Attia (2004): Effect of mineral, organic and biofertilization on yield and quality of sugar beet plants. Assuit, J., Agric. Sci., 35 (3): 161-180.

El-Geddawy, I. H.; A. M. A. El-Shafai and N. B. Azzazy (2006): Yield and quality of sugar beet varieties as affected by planting densities and nitrogen fertilization. J. Agric. Sci. Mansoura Univ., 31 (1): 43-54.

El-Geddawy, I. H.; El-Din-N. A. W.; A. S. A. Edris and A. M. A. El-Shafei, (1992): Sugar beet quality as affected by plant density, nitrogen and potassium fertilizers. Pakistan-sugar J.,6 (2): 26-30.

El-Geddawy, I. H.; M. S. Osman, M. G. A. Taha and S. A. A. M. Enan (2007): Transplanting using paper pots technique and nutrition with relation to yield and its attributes of sugar beet under different planting dates. Egypt, J. Agric. Res., 85 (1): 191-210.

El-Geddawy, I. H.; M. S. Osman, M. G. Abd EL-Fadeil and A. H. S. EL-Labbody (2003): Effect of some agri-practices on yield and its attributes of sugar beet.

Egypt. J. Agric. Res., 81 (4): 1671-1691.

El-Geddawy, I. H.; M. S. Osman; M. G. Abd El-Fadeil and A. H. S. El-Labbody (2004): Effect of some Agri-practices on the vegetative growth and chemical constituents of sugar beet. Egypt J. Agric. Res., 82 (1): 215-237.

El-Kholi, M. M. A., A. N. Ibrahim and M. H. Ali (2004): Effect of N_2 fixers and N-fertilization on sugar beet yield and quality. Egypt. J. Agric. Res., 82 (2):107-130.

El-Maghraby, Samia, S.; Mona, M. Shehata and Y. H. Tawfik (1997): Effect of soil and foliar application of nitrogen and potassium on sugar beet. Adv. Agric. Res., 2 (1): 161-175.

El-Maghraby, Samia, S.; Mona, M. Shehata and Y. H. Tawfik (1998): Effect of soil and foliar application of nitrogen and potassium on sugar beet. Egypt. J. Agric. Res., 75 (2): 665-679.

El-Sayed, G. S. (2005): Effect of nitrogen and magnesium fertilization on yield and quality of two sugar beet varieties. Egypt. J. Agric. Res., 83 (2): 709-724.

El-Shafai, A. M. A. (2000): Effect of nitrogen and potassium fertilization on yield and quality of sugar beet in Sohag. Egypt. J. Agric. Res., 78(2): 759-767.

El-Shafai, A. M. A. and M. T. Tantawy (2006): Effect of land leveling and nitrogen fertilization on yield and quality of sugar beet. Egypt. J. Appl. Sci., 21 (11): 19-31.

Enan, S. A. A. M (2004): Effect of transplanting and soil application of boron and zinc on yield and quality of sugar beet. Ph. D. Thesis, Fac. of Agric., Al-Azhar Univ., Egypt.

Enan, S. A. A. M; Dalia, I. H. El-Geddawy and N. M. Awad (2008): Response of sugar beet yield and quality to ploughing depth and nitrogen fertilization levels. Egypt. J. Appl. Sci., 23 (11B): 491-510.

Feller, C. and M. Fink (2004): Nitrate content, soluble solids content and yield of table beet as affected by cultivar, sowing date and nitrogen supply. Hort. Sci., 39 (6): 1255-1259.

Fox, R. H. and Piekielek (1990): Long-term nitrogen fertilization of continuous manured and non-manured corn and corn in a 3-year corn rotation. The first six years, 1982-1987. Agron. Series No. 110. College of Agric., Penn State Univ., U. S. A.

Ghandorah, M. O. and Y. A. Refay (1994): Effects of sowing date and cultivar on sugar beet (*Beta vulgaris* L.) production in the central region of Saudi Arabia. Arab Gulf Journal of Scientific Research., 12(3): 465-478.

Gomez, K. A. and A. A. Gomez (1984): Statistical Procedures For Agricultural Research. A Wiley- Inter-Science Publication, John Wiley and Sons, New York.

Hassan, H. F. M., A. M. A. El-Shafai and A. M. Gomaa (2005): Yield and technological characteristics of some sugar beet cultivars as affected by sowing and harvesting dates. Egypt. J. Agric. Res., 83 (4): 1689-1710.

Hassanein, M. A. and G. M. El-Shebiny (2000): Contribution of bio-and mineral nitrogen fertilization in sugar beet yield. Alex. Sci. Exch., 21 (2): 129-143.

Hassanein, M. A. and M. G. Hassouna (2000): Effect of bio- and mineral nitrogen fertilization on sugar beet yield and quality in the new reclaimed areas at Noubaria region. Alex. Sci. Exch., 21 (2): 153-161.

Hassanin, M. A. (2001): Effect of hill spacing and potassium fertilization at two sowing dates on sugar beet yield and quality. Bull. Fac. Agric., Cairo Univ., 52: 27-46.

Hassouna, M. G. and A. Hassanein (2000): Sugar beet yield and quality as affected by biological and mineral nitrogen fertilization in the nemly reclaimed areas at Nubaria region. Alex. Sci. Exch., 21 (3): 211-219.

Hoffmann, C. M. (2005): Changes in nitrogen composition of sugar beet varieties in response to increasing nitrogen supply. J. Agro. and Crop Sci.,, 191 (2): 138-145.

Ibrahim, N. F. M. (1998): The effect of some fertilization elements on the yield and quality of sugar beet. Ph.D. Thesis, Fac. of Agric., Zagazig Univ., Egypt.

Ismail, A. M. A. (2002): Evaluation of some sugar beet varieties under different nitrogen levels of El-Fayium. Egypt. J. Appl. Sci., 17(2):75-85.

Ismail, A. M. A. and R. A. A. El-Ghait, (2005): Effect of nitrogen sources and levels on yield and quality of sugar beet. Egypt. J. of Agric. Rec., 83 (1): 229-239.

Ismail, A. M. A. and R. H. A. Abo El-Ghait (2004): Effect of balanced fertilization of NPK on yield and quality of sugar beet. Egypt. J. Agric. Res., 82 (2): 717-729.

Ismail, A. M. A.; A. H. S. Al-Labbody and N. M. S. Shalaby (2006): Variability and traits relationships in nine sugar beet varieties under three sowing dates. Egypt. J. Plant Breed, **10** (1): 387-406.

Ismail, A. M. A.; A. H. S. Al-Labbody and N. M. S. Shalaby (2007): Evaluation of some sugar beet varieties under different combinations of NPK fertilizers. Egypt. J. Appl. Sci., **22** (3): 77-90.

Jackson, K. I. (1956): Soil chemical analysis advanced course (4^{th} printing, 1968). Published by the Auther. Soil Sci., Dept. Wisconsin Univ. USA.

Jaszczolt, E. (1998): Influence of two methods of fertilizing sugarbeet with trace elements on the yields of roots and sugar. Gazeta-Cukrownicza. 106: 12, 232-234. (C.F. Record 11 of 166 - CAB Abst., 1998/08-2000/07).

Khan, M. A. A., Sighania, R. A., Begum, H., K. Lakshminarayana and Srinivas, T. (1998a): Effect of nitrogen and phosphorus fertilization on nutrient status and uptake in sugar beet. International, J. Tropical Agric., 14: 169-175.

Khan, S. N., Rehman, S., Ahmed, G., Buriro, U. A. and Jamro, G. H. (1998b): Root and sugar yield of sugar beet as affected by nitrogen and irrigation levels. Pakistan Sugar Journal, 12 (1): 17-20.

Kozicka, P. (2005): The effect of nitrogen fertilization and anti fungal plant protection on sugar beet yielding. Plant Soil Environ., 51 (5): 232-236.

Kruger, K. W. and M. Nowakowski (1997): Effect of nitrochalk and potassium salt fertilization on sugar beet yield and quality. Biuletyn-Instytutu-Hodowli-i-Aklimatyzacji-Roslin., 202: 125-130.

Le Docte, A. (1927): Commercial determination of sugar beet root using the Sacks Le-Docte Process. Int. Sugar J. **29:** 488-492.

Leilah, A. A., M. A. Badawi, Said, E. M., M. H. Ghonema and M. A. E. Abdou (2005): Effect of planting dates, plant population and nitrogen fertilization on sugar beet productivity under the newly reclaimed sandy soli in Egypt. Sci. J. King Univ., 6 (1): 95-109.

Maareg, M. F. and Sohir, Badr (2000): In pact the three soil biofertilizers applied separately and in Compination with nematicied on *Meloidogyne incongnita* infecting sugar beet. Egypt. J. Agronematology., 4(1/2): 71-82.

Mahmoud, Ebtesam A.; I. H. El-Geddawy; H. S. El-Beltagy and Shereen, M. S. Abo-El-Azm (2007): Chemical composition, yield and its components of sugar beet as affected by NPK treatments. Egypt. J. Appl. Sci., 22 (11B): 457-479.

Markovacki, N. and V. Milic (2001): Use of azotobacter chroococcum as potentially useful in agricultural application. Annals of Microbiology, 51: 145-158.

Milan, M.; K. Karol and Z. Stefen (2007): The effect of nitrogen input on polarized sugar production and qualitative parameters of sugar beet. J. of Central European Agric., 8 (1): 63-71.

Mosa, D. T. M. A. (2009): Effect of sowing and harvesting dates on yield and quality of some sugar beet varieties. M.Sc. Thesis, Fac. Agric., Cairo Univ. Egypt.

Moustafa, Shafika, N. and A. A. El-Masry (2006): Effect of nitrogen and potassium fertilization with or without spraying by iron combined with manganese on some physio-chemical properties, productivity and quality of sugar beet crop. Annals of Agric. Sci., Moshtohor, 44(4): 1431-1446.

Moustafa, Shafika, N.; Safaa S .M. El-Sayed; A. M. E. Gomaa and Zeinab, R. Moustafa (2005): Response of sugar beet to nitrogen and sulphur as foliar application. Egypt. J. Appl. Sci., 20 (9): 45-58.

Nassar, A. M. A. (2006): Differential response of some varieties from different types of sugar beet to plant density and harvesting dates. Bull. Fac. Agric., Cairo Univ., 607-620.

Neamat-Alla, H. E. A. E. (2004): Effect of some agronomic practices on yield and quality of sugar beet. M.Sc. Thesis. Fac. Agric., Tanta univ., Egypt.

Neamat-Alla, H. E. A. E. (2009): Effect of nitrogen, calcium and boron fertilization on productivity and quality of sugar beet under different planting patterns. Ph. D. Thesis. Fac. Agric., Kafr El-Sheikh Univ., Egypt.

Nour El-Din, Nemat, A.; A. S. A. Edris, I. H. M. El-Geddawy and A. M. A. El-Shafei (1993): Effect of plant density, nitrogen and potassium fertilizers on growth characters of sugar beet. Pak. Sugar J. Jan-March page 7-10.

Osman M. S.; I. H. EL-Geddawy; M. G. Abd-El-Fadeil and S. A. A. M. Enan (2007): Transplanting using paper pots technique and micro nutrition with relation to juice quality and chemical constituents of sugar beet at different planting dates. Egypt, J. Agric. Res., 85 (1): 211-229.

Osman, A. M. H. (2005): Influence of nitrogen and potassium fertilization on yield and quality of two sugar beet varieties. Egypt. J. Agric. Res., 83 (3): 1237-1254.

Ouda, Soheir M. M. (2001): Response of sugar beet to N and K fertilizers levels under sandy soil conditions. Zagazig J. Agric Res., 28 (2): 275-297.

Ouda, Soheir M. M. (2007): Effect of chemical and bio-fertilizer of nitrogen and boron on yield and quality of sugar beet. Zagazig J. Agric. Res., 34 (1): 1-11.

Ouda, Sohier, M. M.; A. M. A. El-Shafai and N. B. Azzazy (1999): Effect of farmyard manure and nitrogen fertlization on yield and quality of sugar beet in sandy soil. Zagazig J. Agric. Res., 26 (6): 1487-1493.

Pergl, F. (1945): Quantitative organic micro analysis. 4th Ed. J. and Churchill LTP. London.

Ramadan, B. S. H. and A. M. Nassar (2004): Effect of nitrogen fertilization on yield ad quality of some sugar beet varieties. Egypt. J. Agric. Res., 82 (3): 1253-1268.

Ramadan, B. S. H. and M. A. Hassanin (1999): Effect of sowing dates on yield and quality of some sugar beet varieties. J. Agric. Sci. Mansoura Univ., 24 (7): 3227-3237.

Sahin, F.; R. Cakmakci and F. Kanter (2004): Sugar beet and barley yields in relation to inoculation with N_2-fixing and phosphate solubilizing bacteria. Plant and Soil, 265: 123-129.

Saleh, S. A. (2003): Effect of intercropping onion with sugar beet and Bio-nitrogen fertilization on their yield, yield components, chemical analysis and use efficiency. Annals Agric. Sc., Moshtohor, 41 (2): 599-611.

Shah,I. H., N. U. Rasool and G. Saeed (2000): Effect of sowing time and plant population on root yield and accumulation of sugar in sugar beet. Pakistan, J. of Biological Sci., 3 (12): 2005-2007.

Shalaby, N. M. (2003): Effect of environmental conditions on the behaviors of different genotypes of sugar beet for root yield and quality. Ph. D. Thesis, Fac. Agric., Al-Azhar Univ. Egypt.

Snedecor, G. V. and W. G. Cochran (1967): Statistical methods 6th Ed Iowa Stat Univ. Press, Amess, Iowa, USA.

Sogut, T. and H. Arioglu (2004): Plant density and sowing date effect on sugar beet yield and quality. J. Agron., 3 (3): 215-218.

Steel, R. G. D. and J. H. Torrie (1980): Principles and Procedures of statistics, a biometrical approach. Mc-Grow-Hill Book Co., 2nd Ed, New York, U. S. A.

Tantawy, E. A. and S. S. M. El-Sayed (2006): Efficiency of diazotrophic bacteria under different levels of mineral nitrogen and molybdenum on yield and quality of sugar beet. J. Agric. Sci. Mansoura Univ., 31 (8): 5281-5296.

Voronin, V. M. (2000): Nitrogen fertilizers and productivity. Sakharnaya Svekla, No. 1: 10-13. Record 130 of 831 - CAB Absts. 1998/08-2000/07.

Zalat, S. S.; M. F. Ebraheim and B. M. Abo El-Maggd (2002): Yield and quality of sugar beet (*Beta Vulgaris L.*) as affected by bio and mineral nitrogen fertilization. J. Adv. Agric. Res., 7(3):613-620.

ARABIC SUMMARY

الملخص العربي

" تأثير مواعيد الزراعة والأسمدة النيتروجينية المعدنية والحيوية علي محصول وجودة بنجر السكر "

أقيمت تجربة حقلية لثلاث مواعيد زراعة (١٥ سبتمبر ، ١٥ أكتوبر و ١٥ نوفمبر) بالمزرعة البحثية لمحطة سخا للبحوث الزراعية بمحافظة كفر الشيخ – مصر خلال موسمي الزراعة ٢٠٠٦/٢٠٠٧ و٢٠٠٧/٢٠٠٨ لدراسة تأثير مواعيد الزراعة والأسمدة النيتروجينية المعدنية والحيوية علي محصول وجودة بنجر السكر.

اشتمل كل ميعاد زراعة علي ٩ معاملات هي التوافيق بين ثلاث معدلات من النيتروجين (٣٠ ، ٦٠ و ٩٠ كجم نيتروجين/فدان) و ثلاث معاملات للتسميد الحيوي (بدون تلقيح ، التلقيح بالأزوسبيريللوم ، التلقيح بالباسيلس). تم ترتيب تواليف المعاملات التسعة في تصميم القطاعات الكاملة العشوائية في ثلاث مكررات لكل ميعاد زراعة. تم تنفيذ التجربة في أرض طينية درجة حموضتها ٨,١ ، وأضفيت الأسمدة النيتروجينية علي دفعتين حيث أضيفت الدفعة الأولي بعد عملية الخف والدفعة الثانية بعد شهر من الأولي ، وقد تم تلقيح تقاوي بنجر السكر ببكتريا الأزوسبيريللوم والباسيلس مع اضافة مادة لاصقة وتركت التقاوي في مكان ظليل غير مشمس حتي جفت وتم ضمان التصاق البكتريا بالتقاوي. كانت مساحة القطعة التجريبية ١٧,٥ مترا مربعا ، اشتملت علي ٥ خطوط والمسافة بين الخطوط ٥٠ سم وبين الجور ٢٠ سم.

وقد تم أخذ الصفات التالية عند الحصاد (٢١٠ يوم من الزراعة):

أ. المحصول ومكوناته:

١. طول الجذر (سم).

٢. قطر الجذر (سم).

٣. وزن الجذر الطازج/نبات (جم).

٤. وزن العرش الطازج/نبات (جم).

٥. النسبة المئوية للمادة الجافة في الجذر/نبات.

٦. النسبة المئوية للمادة الجافة في العرش/نبات.

٧. محصول الجذر (طن/فدان).

٨. محصول العرش (طن/فدان).

٩. محصول السكر (طن/فدان).

ب. صفات الجودة:

١٠. النسبة المئوية للمواد الصلبة الذائبة الكلية.

١١. النسبة المئوية للسكروز.

١٢. النسبة المئوية للنقاوة.

ج. المكونات الكيميائية:

١٣. النسبة المئوية للنيتروجين في الجذر والعرش.

١٤. النسبة المئوية للبوتاسيوم والصوديوم في الجذر والعرش.

١٥. الكمية الممتصة من النيتروجين في الجذر (كجم/فدان).

١٦. الكمية الممتصة من النيتروجين في العرش (كجم/فدان).

١٧. الكمية الممتصة من البوتاسيوم في الجذر (كجم/فدان).

١٨. الكمية الممتصة من البوتاسيوم في العرش (كجم/فدان).

١٩. الكمية الممتصة من الصوديوم في الجذر (كجم/فدان).

٢٠. الكمية الممتصة من الصوديوم في العرش (كجم/فدان).

ويمكن تلخيص النتائج المتحصل عليها فيما يلي:

١. تأثير السنوات:

١. أشارت النتائج إلى أن طول وقطر الجذر والوزن الغض للجذر/نبات والمادة الجافة في الجذر لم يتأثروا معنويا باختلاف السنوات ، بينما تأثر الوزن الغض والمادة الجافة بالأوراق/نبات معنويا.

٢. دلت النتائج علي أن محصول الجذر والسكر والعرش لم يتأثروا معنويا باختلاف السنوات.

٣. لم تتأثر معنويا كلا من النسبة المئوية للمواد الصلبة الذائبة الكلية والسكروز ، بينما تأثرت النسبة المئوية للنقاوة باختلاف السنوات.

٤. أوضحت النتائج أن محتوي الجذر والكمية الممتصة من النيتروجين والبوتاسيوم والصوديوم لم يتأثروا معنويا باختلاف السنوات فيما عدا الكمية الممتصة من البوتاسيوم والصوديوم في الأوراق.

٢. تأثير مواعيد الزراعة:

١. لم يكن هناك اختلافات معنوية بين ميعادي الزراعة ١٥ سبتمبر و ١٥ أكتوبر لصفات قطر الجذر والوزن الغض للجذور والأوراق/نبات في كلا الموسمين والتحليل التجميعي ،بينما أدي ميعاد الزراعة في ١٥ أكتوبر الي زيادة معنوية في طول الجذر في الموسم الثاني والتحليل التجميعي. تحققت أعلي نسب مئوية للمادة الجافة في الجذور والأوراق عند ميعاد الزراعة ١٥ سبتمبر وبتأخير ميعاد الزراعة الي ١٥ أكتوبر انخفضت هذه النسب.

٢. أعطت مواعيد الزراعة المبكرة (١٥ سبتمبر و ١٥ أكتوبر) أفضل محصول جذور مقارنة بميعاد الزراعة المتأخر في ١٥ نوفمبر في كلا الموسمين والتحليل التجميعي.

٣. زاد محصول العرش بالزراعة في ١٥ سبتمبر بينما أعطي ميعاد الزراعة ١٥ نوفمبر أقل القيم في كلا الموسمين والتحليل التجميعي.

٤. سجل محصول السكر أعلي القيم عند الزراعة في ميعادي ١٥ سبتمبر و ١٥ أكتوبر ،لكن الفروق بين القيم لم تصل لمستوي المعنوية بين الميعادين في كلا الموسمين والتحليل التجميعي.

٥. أدي تأخير الزراعة الي ١٥ نوفمبر لاستجابة موجبة في النسبة المئوية للمواد الصلبة الذائبة الكلية، بينما تحققت أعلي نسبة مئوية للسكروز والنقاوة بالزراعة المبكرة في ١٥ سبتمبر وذلك في التحليل التجميعي.

٦. سجل محتوي الجذور من النيتروجين والبوتاسيوم والصوديوم عند ميعاد الزراعة ١٥ سبتمبر اقل القيم ، بينما سجلت أعلي القيم عند تأخير الزراعة الي ١٥ نوفمبر في كلا الموسمين والتحليل التجميعي.

٧. انخفض محتوي الأوراق من النيتروجين معنويا عند الزراعة في ١٥ سبتمبر يليه ١٥ أكتوبر ثم ١٥ نوفمبر في كلا الموسمين والتحليل التجميعي.

٨. لم يكن محتوي الأوراق من البوتاسيوم والصوديوم معنويا بين ميعادي الزراعة ١٥ سبتمبر و ١٥ أكتوبر في كلا الموسمين والتحليل التجميعي.

٩. زادت معنويا الكمية الممتصة من النيتروجين في الجذر عند الزراعة في ١٥ أكتوبر يليه ١٥ سبتمبر ثم ١٥ نوفمبر في كلا الموسمين والتحليل التجميعي.

١٠. تحققت أقل كمية ممتصة من النيتروجين والبوتاسيوم والصوديوم في الأوراق عند الزراعة في ١٥ نوفمبر ووصلت الاختلافات بين القيم الي مستوي المعنوية بين ميعاد الزراعة ١٥ أكتوبر وبين الزراعة في ١٥ نوفمبر في كلا الموسمين والتحليل التجميعي.

١١. تأثر معنويا كل من النسبة المئوية للنقاوة ومحتوي الجذور من النيتروجين والكمية الممتصة من النيتروجين في الأوراق، بينما لم تتأثر معنويا باقي الصفات بالتفاعل بين مواعيد الزراعة والسنوات.

٣. تأثير معدلات التسميد بالنيتروجين المعدني:

١. زاد طول الجذر والوزن الغض للجذور والأوراق/نبات في كلا الموسمين والتحليل التجميعي بزيادة معدلات النيتروجين من ٣٠ إلي ٦٠ الي ٩٠ كجم ن/فدان ، ووصلت الزيادة بين القيم الي مستوي المعنوية بين معدلات التسميد ٦٠ و ٩٠ كجم ن/فدان وبين معدل ٣٠ كجم ن/فدان ،كما ازدادت نسبة المادة الجافة في الجذور والأوراق بزيادة معدلات النيتروجين من ٣٠ إلي ٦٠ الي ٩٠ كجم ن/فدان.

٢. زاد محصول الجذور (طن/فدان) زيادة معنوية وذلك بزيادة معدلات النيتروجين من ٣٠ إلي ٦٠ الي ٩٠ كجم ن/فدان ، كما أن اضافة النيتروجين بمعدل ٦٠ كجم ن/فدان كان كافيا لتحقيق أفضل محصول للجذور بزيادة قدرها ٤٤,١ % ، ٤٢,١٨ % و ٤٢,٩٤ % مقارنة بمعدل التسميد ٣٠ كجم ن/فدان في الموسمين الأول والثاني والتحليل التجميعي لهما علي الترتيب.

٣. أدي زيادة معدل التسميد النيتروجيني الي ٩٠ كجم ن/فدان الي زيادة معنوية في محصول العرش في كلا الموسمين والتحليل التجميعي.

٤. زاد محصول السكر (طن/فدان) بزيادة معدلات النيتروجين من ٣٠ إلي ٦٠ الي ٩٠ كجم ن/فدان بمقدار ٦٥,٥٢ % ، ٧٠,٠٩ % في الموسم الأول وبمقدار ٥٩,٩٣ % ، ٧١,٣٠ % في الموسم الثاني وبمقدار ٦٢,٤١ % ، ٩٦,٦٤ % في التحليل التجميعي للموسمين علي الترتيب.

٥. تفوق التسميد بمعدل ٩٠ كجم ن/فدان علي باقي معدلات النسميد في النسبة المئوية للسكروز والنقاوة ،بينما تفوق التسميد بمعدل ٣٠ كجم ن/فدان علي

باقي معدلات التسميد في النسبة المئوية للمواد الصلبة الذائبة الكلية فـي كـلا الموسمين والتحليل التجميعي.

٦. زاد تركيز النيتروجين في الجذر معنويـا بمعـدلات التـسميد المختلفـة مـن النيتروجين في كلا الموسمين والتحليل التجميعي ، بينما لـم يتـأثر تركيـزي البوتاسيوم والصوديوم في الجذر معنويا باختلاف التسميد النيتروجيني بين ٣٠ ، ٦٠ كجم ن/فدان في التحليل التجميعي.

٧. زاد معنويا محتوي الأوراق من النيتـروجين بإضـافة معـدلات النيتـروجين المدروسة في حين أن التسميد بمعدل ٣٠ كجم ن/فدان أعطـي أعلـي القـيم لتركيزي البوتاسيوم والصوديوم في الأوراق.

٨. لم تتأثر الكمية الممتصة من البوتاسيوم والصوديوم في الجذر معنويا بإضـافة معدلات النيتروجين ٦٠ ، ٩٠ كجم ن/فدان بينما تأثرت الكمية الممتصة مـن النيتروجين في الجذر معنويا بإضافة معدلات النيتروجين المدروسة فـي كـلا الموسمين والتحليل التجميعي.

٩. زادت الكميات الممتصة من النيتروجين والبوتاسيوم والصوديوم فـي الأوراق بزيادة معدلات النيتروجين من ٣٠ إلي ٦٠ الي ٩٠ كجم ن/فـدان فـي كـلا الموسمين والتحليل التجميعي.

١٠. لم يكن هناك تأثير معنوي علي كل الصفات المدروسـة فيمـا عـدا الكميـة الممتصة من النيتروجين في الجذر والتي تأثرت معنويا بالتفاعل بين معـدلات التسميد بالنيتروجين والسنوات.

٤. تأثير التسميد الحيوي بالنيتروجين:

١. أوضح التحليل التجميعي للموسمين أن تلقيح تقاوي بنجر السكر بالأزوسبيريللوم أعطي أعلي وزن طازج للجذور ووزن مادة جافة في الجذور والأوراق متفوقا علي الباسيلس أو الغير معاملة (كنترول).

٢. زادت معنويا المادة الجافة بالجذر والأوراق مع تلقيح البذور بالأزوسبيريللوم ،بينما انخفضت مع الكنترول في كلا الموسمين والتحليل التجميعي.

٣. أدي تلقيح البذور بالأزوسبيريللوم الي زيادة محصول الجذور بمقدار ٧,٧٣ ، ٧,٥٢ ، ٦,٦٥ % ، كما أدي التلقيح بالباسيلس الي زيادة بمقدار ١١,١٤ ، ٦,١٥ ، ٨,٦٧ % وذلك مقارنة بالكنترول الغير معامل خلال الموسمين والتحليل التجميعي.

٤. زاد محصول العرش بمقدار ١,٤٥ ، ٠,٤٨ (طن/فدان) مع تلقيح البذور بالأزوسبيريللوم مقارنة بالكنترول الغير معامل والملقح بالباسيلس علي الترتيب خلال التحليل التجميعي. أدي تلقيح البذور بالأزوسبيريللوم الي زيادة محصول السكر معنويا بمقدار ١٦,٧١ ، ١٣,٩٢ ، ١٥,٣١ % ، كما أدي التلقيح بالباسيلس الي زيادة معنوية بمقدار ١٨,٥١ ، ١٠,٣٨ ، ١٤,٥٤ % وذلك مقارنة بالكنترول الغير معامل خلال الموسمين والتحليل التجميعي.

٥. أدي تلقيح البذور بالأزوسبيريللوم الي زيادة النسبة المئوية للسكروز معنويا بمقدار ٩,١٩ ، ٧,٤٨ ، ٨,٣١ % ، والي زيادة النسبة المئوية للنقاوة معنويا بمقدار ١٥,٦٧ ، ٦,٣٨ ، ٣,٨٣ % وذلك مقارنة بالكنترول الغير معامل خلال الموسمين والتحليل التجميعي علي الترتيب.

٦. أدي تلقيح البذور بالأزوسبيريللوم إلي تحقيق أعلي نسبة للنيتروجين وأقل نسبة للبوتاسيوم والصوديوم في الجذر وكذلك أقل نسبة للبوتاسيوم في الأوراق ،بينما أدي التلقيح بالباسيلس الي تحقيق أعلي نسبة للبوتاسيوم والصوديوم في الجذر وأقل نسبة للصوديوم في الأوراق في كلا الموسمين والتحليل التجميعي.

٧. زادت الكمية الممتصة من النيتروجين في الجذر معنويا بتلقيح البذور بالأزوسبيريللوم يليه الملقح بالباسيلس ،كما تحققت أعلي كمية ممتصة من الصوديوم في الجذر بالتلقيح بالأزوسبيريللوم وذلك في كلا الموسمين والتحليل التجميعي.

٨. تأثرت الكمية الممتصة من النيتروجين والبوتاسيوم والصوديوم في الأوراق معنويا بتلقيح البذور بالبكتريا في كلا الموسمين والتحليل التجميعي فيما عدا الكمية الممتصة من البوتاسيوم في الأوراق في الموسم الثاني.

٩. أوضحت النتائج أن جميع الصفات لم تتأثر معنويا فيما عدا طول الجذر والوزن الطازج للجذر/نبات والنسبة المئوية للمواد الصلبة الذائبة الكلية والنقاوة بالتفاعل بين التسميد الحيوي بالنيتروجين والسنوات.

٥. تأثير التفاعلات:

٥. أ. تأثير التفاعل بين مواعيد الزراعة ومعدلات التسميد بالنيتروجين المعدني:

١. تحققت أعلي قيمة لقطر الجذر بالزراعة في ١٥ سبتمبر مع اضافة ٩٠ كجم ن/فدان ، وأثر التفاعل بين ميعاد الزراعة ١٥ سبتمبر ومعدل التسميد بالنيتروجين المعدني ٦٠ أو ٩٠ كجم ن/فدان تأثيرا ايجابيا علي طول الجذر مقارنة بالتفاعل بين معدل ٣٠ كجم ن/فدان ونفس ميعاد الزراعة في الموسمين والتحليل التجميعي.

٢. أدي التفاعل بين ميعاد الزراعة ١٥ سبتمبر أو ١٥ أكتوبر ومعدل التسميد بالنيتروجين المعدني ٦٠ أو ٩٠ كجم ن/فدان الي زيادة معنوية في محصول العرش مقارنة بالتفاعل بين ميعاد الزراعة المتأخر ونفس معدلي التسميد في كلا الموسمين والتحليل التجميعي.

٣. زادت النسبة المئوية للسكروز معنويا بالتفاعل بين ميعاد الزراعة في ١٥ سبتمبر أو ١٥ أكتوبر ومعدل التسميد بالنيتروجين المعدني ٦٠ كجم ن/فدان مقارنة بالزراعة في الميعاد المتأخر ونفس معدل التسميد في كلا الموسمين والتحليل التجميعي.

٤. أشارت النتائج الي أن التاخير في مواعيد الزراعة مع اضافة معـدلات التـسيد بالنيتروجين المعدني أدي الي زيادة النسبة المئوية للنيتروجين في الجذر ،كمـا تأثرت معنويا النسبة المئوية للصوديوم فـي الأوراق بالتفاعـل بـين مواعيـد الزراعة ومعدلات التسميد المعدني المدروسة فـي كـلا الموسـمين والتحليـل التجميعي.

٥. أعطي التفاعل بين ميعاد الزراعة ١٥ أكتوبر ومعدل التسميد النيتروجينـي ٩٠ كجم ن/فدان أعلي قيمة للكمية الممتصة من النيتروجين في الجذر بينما تحققـت أعلي كمية ممتصة من الصوديوم في الأوراق بالتفاعل بين ميعاد الزراعـة ١٥ سبتمبر ومعدل التسميد ٦٠ كجم ن/فدان في كلا الموسمين والتحليل التجميعي.

٦. لم تتأثر جميع الصفات المدروسة معنويا بينما تأثرت النسبة المئوية للنيتروجين والكمية الممتصة من النيتروجين في الجذور بالتفاعل بين مواعيـد الزراعـة ومعدلات التسميد بالنيتروجين المعدني والسنوات.

٥. ب. تأثير التفاعل بين مواعيد الزراعة والتسميد الحيوي بالنيتروجين:

١. زاد طول الجذر معنويا بالتفاعل بين ميعاد الزراعة المبكـر ١٥ سـبتمبر وأي مصدر للتسميد الحيوي مقارنة بالكنترول الغير معامـل فـي كـلا الموسـمين والتحليل التجميعي.

٢. أدي التفاعل بين استخدام التسميد الحيوي و مواعيد الزراعة ١٥ سـبتمبر و١٥ أكتوبر الي زيادة محصول الجذور والسكر مقارنة بالغير معامل حيويا في كـلا الموسمين والتحليل التجميعي.

٣. تحققت أعلي نسبة مئوية للنقاوة بالتفاعل بين مواعيد الزراعـة ١٥ سـبتمبر و١٥ أكتوبر وبين تلقيح البذور حيويا مقارنة بتأخير الزراعة الي ١٥ نـوفمبر وذلك في كلا الموسمين والتحليل التجميعي.

٤. أدي التفاعل بين ميعاد الزراعة في ١٥ سبتمبر وتلقيح البذور بالباسيلس الي تسجيل أقل قيمة للنسبة المئوية للصوديوم في الجذر في كلا الموسمين والتحليل التجميعي لهما.

٥. أشارت النتائج إلي أن طول الجذر ومحصول الجذور والسكر والنسبة المئوية للنقاوة والنسبة المئوية للصوديوم في الجذر لم يتأثروا معنويا بالتفاعل بين مواعيد الزراعة والتسميد الحيوي بالنيتروجين والسنوات.

٥. ج. تأثير التفاعل بين معدلات التسميد بالنيتروجين المعدني والتسميد الحيوي بالنيتروجين:

١. أدي التفاعل بين تلقيح البذور بالأزوسبيريللوم ومعدل التسميد بالنيتروجين المعدني ٩٠ كجم ن/فدان الي زيادة قطر الجذر ومحصول العرش لكنها لم تصل الي حد المعنوية مقارنة بالتسميد بمعدل ٦٠ كجم ن/فدان في كلا الموسمين والتحليل التجميعي.

٢. تحققت أعلي قيمة للنسبة المئوية للسكروز بالتفاعل بين تلقيح البذور بالأزوسبيريللوم ومعدل التسميد بالنيتروجين المعدني ٩٠ كجم ن/فدان في كلا الموسمين والتحليل التجميعي.

٣. أدي التسميد المعدني للنيتروجين مع/أو التسميد الحيوي بالنيتروجين الي زيادة معنوية في النسبة المئوية للنيتروجين في الأوراق.

٤. أعطي التفاعل بين تلقيح البذور بالباسيلس ومعدل التسميد بالنيتروجين المعدني ٩٠ كجم ن/فدان أعلي قيمة للنسبة المئوية للنقاوة في كلا الموسمين والتحليل التجميعي.

٥. أشارت النتائج إلي أن النسبة المئوية للنيتروجين في الأوراق تأثرت معنويا بالتفاعل بين معدلات التسميد بالنيتروجين المعدني والتسميد الحيوي بالنيتروجين والسنوات علي عكس الصفات الأخري.

٥. د. تأثير التفاعل بين مواعيد الزراعة ومعدلات التسميد بالنيتروجين المعدني والتسميد الحيوي بالنيتروجين معا:

١. تحققت أعلي قيمة للنسبة المئوية للسكروز بالتفاعل بين ميعاد الزراعة في ١٥ سبتمبر ومعدل التسميد النيتروجيني ٩٠ كجم ن/فدان وتلقيح البذور بالباسيلس في كلا الموسمين والتحليل التجميعي.

٢. تحققت أقل قيم للنسبة المئوية للنيتروجين في الجذور بالتفاعل بين معدل التسميد بالنيتروجين المعدني ٣٠ كجم نيتروجين/فدان وبدون التلقيح الحيوي للبذور عند الزراعة في ١٥ أكتوبر.

٣. كان أفضل تفاعل لتحقيق أعلي قيم للكمية الممتصة من النيتروجين في الأوراق بين معدل التسميد بالنيتروجين المعدني ٩٠ كجم نيتروجين/فدان و تلقيح البذور بالأزوسبيريللوم عند الزراعة في ١٥ سبتمبر وذلك في الموسم الأول والتحليل التجميعي.

٤. أشارت النتائج إلي أن كل من النسبة المئوية للسكروز والنسبة المئوية للنيتروجين في الجذور والكمية الممتصة من النيتروجين في الأوراق لم يتأثروا معنويا بالتفاعل بين مواعيد الزراعة ومعدلات التسميد بالنيتروجين المعدني والتسميد الحيوي بالنيتروجين والسنوات.

٦. دراسة الارتباط:

أوضحت دراسة الارتباط البسيط بين المتغيرات المدروسة (محصول الجذور والعرش والسكر والوزن الطازج للجذر والعرش والنسبة المئوية للسكروز والنقاوة) وجود ارتباط موجب وعالى المعنوية بينها وبين حاصل السكر. ودلت

هذه النتائج أنه فى حالة الانتخاب لاى صفة من هذه الصفات المرتبطـــة ســـيتبعها مباشرة التحسين للصفة الأخرى المرتبطة معها.

الاستنتاج

بناءا علي ما تحصل عليه من نتائج في خلال هذه الدراسة فقد تبين أن ميعاد الزراعة الأول (١٥ سبتمبر) أو الثاني (١٥ أكتوبر) مع التسميد النيتروجيني بمعدل ٦٠ أو ٩٠ كجم ن/فدان وتلقيح تقاوي بنجر السكر بالمخصب الحيوي الذي يحتوي علي بكتريا الأزوسبيريللوم أو الباسيلس قد أعطي أفضل نتائج للمحصول ومكوناته وبدون فروق معنوية بينهما، غير أنه فيما يتعلق بالنسبة المئوية للسكروز فقد تأثرت بالمعاملة الحيوية، فعلي حين أعطت التقاوي المعاملة بالمخصب الحيوي الذي يحتوي علي بكتريا الباسيلس ميزة نسبية للنسبة المئوية للسكروز في الميعاد الأول (١٥ سبتمبر) مع ٩٠ كجم ن/فدان نجد أن نفس معاملة النيتروجين مع المعاملة بالمخصب الحيوي الذي يحتوي علي بكتريا الأزوسبيريللوم كانت هي الأفضل في موعد الزراعة الثاني (١٥ أكتوبر)، وذلك تحت الظروف المصرية بمحافظة كفر الشيخ.

" تأثير مواعيد الزراعة والأسمدة النيتروجينية المعدنية والحيوية علي محصول وجودة بنجر السكر"

رسالة مقدمة من

باسم صبحي ابراهيم

بكالوريوس العلوم التعاونية الزراعية ١٩٩٢

ماجستير في العلوم الزراعية (محاصيل) - كلية الزراعة - جامعة بنها ٢٠٠٦

للحصول علي درجة دكتوراه الفلسفة في العلوم الزراعية (محاصيل)

وقد تمت مناقشة الرسالة والموافقة عليها

اللجنة

١. أ.د/ **السيد حفني محمد حفني** ....

أستاذ متفرغ المحاصيل بكلية الزراعة - جامعة بنها.

٢. أ.د/ **علي عبد المقصود الحصري** ....

أستاذ متفرغ المحاصيل بكلية الزراعة - جامعة بنها.

٣. أ.د/ **محمد اسماعيل سلوع** ....

أستاذ ورئيس قسم المحاصيل بكلية الزراعة - جامعة بنها.

٤. أ.د/ **عدلي محمد مرسي سعد** ....

أستاذ المحاصيل بكلية الزراعة - جامعة بنها.

٥. أ.د/ **عبد الواحد عبد الحميد السيد** ....

أستاذ المحاصيل ووكيل كلية الزراعة لشئون الدراسات العليا والبحوث - جامعة كفر الشيخ.

تاريخ الموافقة / /٢٠١١

" تأثير مواعيد الزراعة والأسمدة النيتروجينية المعدنية والحيوية علي محصول وجودة بنجر السكر"

رسالة مقدمة من

باسم صبحي ابراهيم

للحصول علي درجة

دكتوراه الفلسفة في العلوم الزراعية

(محاصيل)

لجنة الاشراف العلمي:

١. **أ.د علي عبد المقصود الحصري** ....

أستاذ متفرغ المحاصيل بكلية الزراعة – جامعة بنها.

٢. **أ.د/ محمد اسماعيل سلوع** ....

أستاذ ورئيس قسم المحاصيل بكلية الزراعة – جامعة بنها.

٣. **أ.د/ عدلي محمد مرسي سعد** ....

أستاذ المحاصيل بكلية الزراعة – جامعة بنها.

٤. **أ.د/ ابراهيم حنفي محمود الجداوي** ....

أستاذ متفرغ المحاصيل – مركز البحوث الزراعية.

٢٠١١

" تأثير مواعيد الزراعة والأسمدة النيتروجينية المعدنية الحيوية على محصول وجودة بنجر السكر"

رسالة مقدمة من

باسم صبحي ابراهيم

للحصول علي درجة

دكتوراه الفلسفة في العلوم الزراعية

"محاصيل"

من

قسم المحاصيل

كلية الزراعة – جامعة بنها

٢٠١١