# RESPONSE OF SUGAR BEET TO NITROGEN FERTILIZER AND SULPHUR SPRAY FREQUENCY IN MIDDLE EGYPT

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***Abstract***

Two field experiments were carried out in 2006/2007 and 2007/2008 seasons at Malawi Agricultural Experimental Research Station El Minia Governorate to study the effect of nitrogen soil fertilization level (60. 90 and 120 kg N/fed) and foliar fertilization of sulphur in the form of Calciume Poly Sulfide (30%) at concentration of 6 cm/L. which was applied (once at 70 days age, twice at 70 and 85 days as well as three times at 70, 85 and 90 days after sowing in addition to foliar spray with distilled water as control) on sugar beet Desperiz Poly N variety. The results indicated that:

Increasing nitrogen level up to 120 Kg/fed significantly increased growth of sugar beet root measurements (length, diameter and fresh weight) and its content from N, P, K, $SO_4$ and all amino acids (except cystein which increased more by 90 kg N/fed) as well as yield of roots.

However fertilization sugar beet plants by 90 kg N/fed significantly increased root quality percentages (total soluble solids, sucrose and purity) in addition it gave the highest sugar yield (ton/fed).

Foliar spray with sulphur solution twice or three times significantly increased diameter, fresh weight, yield of root and accumulation N, P, K, $SO_4$. while, some amino acids were increased and others were decreased in sugar beet root. Sulphur fertilization significantly decreased root quality measurements and it have insignificant effect on sugar yield. Fertilization sugar beet by 90 Kg N/F in combination with sulphur foliar spray three times during growing season obtained the greatest increases in root and sugar yield.

## INTRODUCTION

Sugar beet is grown for sugar production and it is the second important source sugar crop after sugar cane. Production of greater root tonnage doesn't solve the problems affecting profitable production. Sucrose% of root juice and the sugar yield is considered the main goal from the industrial view, however, root yield in addition to juice quality is the main target for the growers to gain the highest net income.

Fertilization is the most important factor which has a distinct role on production of many crops. Nitrogen is an essential nutrient element for building up protoplasm of plants. Achieving higher growth, yield and best quality of sugar beet is

controlled by nitrogen fertilization, where as decreasing N level significantly decreased both of growth and yield, while excess amount of it increase impurity% of juice root. Several studies (Moustafa, Zeinab *et al* 2000, Ouda, Sohier 2002 Azzazy 2004, Moustafa, Shafika *et al* 2005 and Awad Allah *et al* 2007) indicated that sugar beet production of high yield with best quality requires that nitrogen be in adequate supply to develop an optimum canopy for photosynthesis and at the same time doesn't increase juice impurities of sugar beet.

Sulphur nutrient can significantly increase crop yield and improve its quality. It is indispensable for strong growth of plant, as it can involved in its metabolism in a host of ways as described in many basic text. Drycott (1972) stated that sulphur is a constituent element of some amino acids, namely cystein and methionine and it is involved in synthesis of chlorophyll. Sulphur, also plays an important role in the synthesis of certain vitamins, carbohydrates and proteins. In recent years, sulphur has received increasing attention as world soils are becoming deficient in this element for that, use of sulphur as free fertilization is important for increasing and improving crop production. Concerning sugar beet Sexton (1996), have established the important of sulphur in the quality characteristics of sugar beet particularly in the levels of α-amino nitrogen in roots which reduce juice purity and therefore the extraction sugar yield. Popovic *et al* (1996) indicated that in young sugar beet hybrid sulphur had a maintained the activity of nitrate reduce and glutamate dehydrogenises. Protein synthesis was also suppressed in the absence of sulphur in nutrient medium. Chloroplast pigment contents and dry mass were increased while nitrate content was decreased with increasing concentration of sulphur. Thomas *et al* (2000) observed increased in arginine, serine and alanine in sugar beet tissue under conditions of sulphur deficiency. While proline and S concentration were markedly reduced in response to sulphur deficiency with decrease in yield and deleterious on beet quality. On other hand Hoffmann *et al* (1998) in Germany, concluded that there is no need for sulphur application to sugar beet production. In Egypt many researcher studied sulphur effect on sugar beet production, Moustafa, Zeinab *et al* (2006) reported that response degree of growth, quality, chemical composition and yield sugar beet differ according to the level of sulphur fertilization, which used and the differences in soil and environmental factors. In plants metabolism sulphur is closely involved with nitrogen. Bell *et al* (1995) indicated that increasing the concentration of sulphur in the nutrient solution improved sugar beet purity through reduced alpha amino N whish was increased as a result from excess nitrogen fertilization. Ouida, Sohier (2002), Moustafa, Shafika *et al* (2005), Nemeat Allah (2005) and Awed Allah *et al* (2007)

found that the interaction effect between nitrogen and sulphur application had significant effect on some traits of sugar beet .

This study aimed to find out the optimum nitrogen rate and the suitable time for sulphur spray to induce high quality, root and sugar yield of sugar beet under Middle Egypt condition (El Minia Governorate).

## MATERIALS AND METHODS

Two field experiments were conducted at Mallawi Agricultural Experimental Research Station, El Minia Governorate, during 2006/2007 and 2007/2008 seasons, to study the effect of nitrogen and sulphur fertilization as well as their interaction on sugar beet Desprez Poly N variety. A split plot design with three replications was used. The main plots were assigned to nitrogen fertilizer rates (60, 90 and 120 kg/fed was added in form of ammonium nitrate 33%N) in two equal doses after 30 and 45 days from sowing date, whereas, foliar spray of sulphur occupied the sub plots was added in form of Calcium Poly Sulfate (30%) at concentration of 6 cm/L (once at 70 days age, twice at 70 and 85 days age and at a three time 70, 85 and 90 days after sowing in addition to foliar spray with distilled water as control).

Sub plot area 10.5 $m^2$ consisted of 5 rows of 3.5 m long at 60 cm apart and spacing between hills 20 cm. Sowing dates were September $23^{th}$ and $30^{th}$ for the $1^{st}$ and $2^{nd}$ seasons, respectively. The cultural practices for sugar beet field were carried out as recommended. Chemical and physical properties of the experimental soil were determined according to Chapman and Pratt (1967) in Table 1.

At harvest time (210 days from sowing) the three guarded rows were harvested topped: A sample of 10 roots was randomely taken and the following characteristics were determined 1- Root dimensions. 2- Root fresh weight (kg/plant).
3- Total soluble solids (TSS%) was determined with a hand refractometer.
4- Sucrose% was determined according to the procedure of Le Dect (1927)
5- Purity% (Sucrose % x 100)/ TSS% according to Supernova *et al* (1979)
6- N, P and K of root (g/100 g DW).
7- Various amino acids% in root/DW basis were determined according to A.O.A.C. (1990). Sulphate% according to Johnson and Nishita (1952).
8- Root yield of sugar beet (ton/fed).
9- Sugar yield (ton/fed) was determined according to the method of Delta sugar Company where approscimately 3.07% the sucrose% is considered as a loss with industrial practices. It was calculated according to the following equation:
Sugar yield (ton/fed) = Yield of root (ton/fed) x adjusted sucrose%.

Data obtained were statistically analyzed according to Snedecor and Cochran (1981). Treatments means were compared by using the least significant difference (LSD) at 5% level.

Table 1. Chemical and physical properties of the experimental sites.

| Property | Soil | |
|---|---|---|
| | 2006/2007 | 2007/2008 |
| Sand | 8.10 | 7.63 |
| Silt | 61.21 | 61.87 |
| Clay | 30.69 | 30.50 |
| Texture grade | Clay loam | Clay loam |
| $CaCO_3$ % | 1.63 | 2.08 |
| pH (1:2.5 soil suspension ) | 8.05 | 8.12 |
| EC (ds/m, 1:5 soil water ext.). | 1.16 | 1.11 |
| Soluble ions (meq/100 g soil) | | |
| $Ca^{2+}$ | 1.12 | 1.28 |
| $Mg^{2+}$ | 1.04 | 1.22 |
| $Na^{+}$ | 3.18 | 371 |
| $K^{+}$ | 0.23 | 0.33 |
| Cl | 1.32 | 1.46 |
| $CO_3^{2-} + HCO_3$ | 0.95 | 1.20 |
| $SO_4^{2-}$ | 3.35 | 3.88 |
| Available N (ppm) | 38.48 | 45.13 |
| Available P (ppm) | 11.17 | 11.25 |
| Available K (ppm) | 78.12 | 81.15 |

## RESULTS AND DISCUSSION

Data in Table 2 revealed that the effect of different levels of nitrogen and sulphur treatments as well as their interaction on length, diameter and fresh weight root in two growing seasons.

Results given showed that root growth measurements under study were gradually increased with the increase in N level. Moreover, such increases were significant except the differences between root length of plants received 120 kg N/fed and those plants fertilized by 90 kg N/fed in the 2nd season. Data in the 1st season indicated that the highest level of nitrogen (120 kg/fed) increased length, diameter and fresh weight root by 6.75 cm, 1.8 cm and 0.64 kg respectively compared with the lowest level (60 kg N/fed). The corresponding values were 10.2 cm, 2.8 cm and 0.79

kg in the 2nd season. These results were in agreement with those of Hashem *et al* (1997), Moustafa, Zeinab *et al* (2000), Azzazy (2004) and Awad Allah *et al* (2007) who found that growth criteria of sugar beet plants were significantly increased with increasing level of nitrogen fertilization.

Table 2. Effect of nitrogen and sulphur fertilizations on root characteristics of sugar beet.

| Nitrogen (Kg/fed) | No. of sulphur application | 2006/2007 Root | | | 2007/2008 Root | | |
|---|---|---|---|---|---|---|---|
| | | Length (cm) | Diameter (cm) | Fresh weight (kg) | Length (cm) | Diameter (cm) | Fresh weight (kg) |
| 60 | S0 | 39.00 | 9.90 | 0.99 | 32.00 | 8.70 | 0.75 |
| | S1 | 37.00 | 9.00 | 1.01 | 32.90 | 9.00 | 0.76 |
| | S2 | 38.30 | 9.90 | 1.05 | 31.00 | 9.10 | 0.98 |
| | S3 | 39.00 | 9.60 | 1.05 | 32.20 | 9.20 | 1.01 |
| | Mean | 38.32 | 9.60 | 1.02 | 32.02 | 9.00 | 0.88 |
| 90 | S0 | 41.30 | 10.30 | 1.23 | 39.80 | 10.80 | 1.29 |
| | S1 | 41.30 | 11.10 | 1.32 | 41.50 | 11.00 | 1.32 |
| | S2 | 41.60 | 11.00 | 1.39 | 41.10 | 11.10 | 1.38 |
| | S3 | 41.60 | 11.40 | 1.40 | 41.50 | 11.30 | 1.39 |
| | Mean | 41.45 | 10.95 | 1.34 | 40.97 | 11.05 | 1.35 |
| 120 | S0 | 44.00 | 11.20 | 1.56 | 41.70 | 11.70 | 1.61 |
| | S1 | 45.30 | 11.30 | 1.64 | 42.50 | 11.30 | 1.62 |
| | S2 | 46.00 | 11.50 | 1.71 | 43.20 | 12.30 | 1.69 |
| | S3 | 45.0 | 11.60 | 1.72 | 41.50 | 11.90 | 1.74 |
| | Mean | 45.07 | 11.40 | 1.66 | 42.22 | 11.80 | 1.67 |
| Means of sulphur | S0 | 41.43 | 10.46 | 1.26 | 37.83 | 10.40 | 1.22 |
| | S1 | 41.20 | 10.46 | 1.32 | 38.96 | 10.43 | 1.23 |
| | S2 | 41.96 | 10.80 | 1.38 | 38.43 | 10.83 | 1.35 |
| | S3 | 41.86 | 10.86 | 1.39 | 38.40 | 10.80 | 1.38 |
| LSD at 5% | | | | | | | |
| Nitrogen levels (N) | | 1.322 | 0.132 | 0.270 | 2.831 | 0.579 | 0.205 |
| Sulphur spray No. (S) | | NS | 0.105 | 0.044 | NS | 0.311 | 0.106 |
| N x S | | NS | 0.102 | NS | NS | NS | NS |

Concerning the effect of sulphur, Data in table (2) showed also that root diameter and its weight were significantly affected by sulphur foliar treatments, whereas insignificant increase was detected between root diameter for both growing

seasons and root weight of the 2nd season between plants which sprayed once (S1) and those of control plants (S0) and sprayed the plants twice or three time gave insignificant difference in diameter or weight of root of both growing seasons. Both treatments (S2 and S3) significantly increased root diameter by 0.34 and 0.40 cm in 1st season and by 0.40 and 0.40 cm in the 2nd season respectively, compared with control treatment (S0). The corresponding increase in root weight were 0.12 and 0.13 kg for 1st season and 0.13 and 0.16 kg for the 2nd season respectively. Similar results were obtained by Moustafa, Zeinab *et al* (2006). Root diameter of sugar beet plants in the 1st season was significantly affected by the interaction between nitrogen and sulphur fertilization, thus the highest values of root diameter resulted from plants received 120 kg N/fed and spraied twice (S2) or three times (S3) by sulphur. In thise respect, Moustafa, Shafika *et al* (2005) and Awad Alla *et al* (2007) found a positive and significant effect on root growth traits due to interaction between N and S fertilization.

**2- QUALITY OF ROOT JUICE**

Juice quality measurement of sugar beet roots in terms of total soluble solids (TSS), sucrose and purity% as affected by nitrogen fertilizer and frequency of foliar spray with sulphur as well as their interaction are presented in Table (3).

Data given indicated that nitrogen fertilizer had a significant effect on juice quality in both seasons. Fertilizing sugar beet plant by 90 kg/fed significantly increased the value of quality in 1st season, however, adding 60 kg/fed in the 2nd season was enough to produce the highest values of TSS, sucrose%, while, 90 kg N/fed was still the suitable rate to attain the highest value of purity% in the 2nd season. On the other hand, increasing N fertilizer up to 120 kg/fed significantly decreased TSS%, by 0.30 and 1.0% compared with 60 and 90 kg N/fed respectively. The corresponding decrease values were 0.4 and 1.7% for sucrose and 3.4 and 4.7% for purity%. Data of the 2nd season showed that the increase nitrogen level from 60 to 90 kg/fed significantly increased TSS and sucrose% while increase nitrogen level to 120 kg/fed decreased TSS and sucrose%. Purity% was significantly decreased in root beet juice in plants fertilized by 60 or 120 kg/fed compared to that of 90 kg/fed. These results are in agreement with those by Moustafa, Zeinab *et al* (2000), Azzazy (2004) and Moustafa, Shafika *et al* (2005). On the other hand Ouda, Sohier (2002) stated that sucrose and TSS% were not significantly affected by nitrogen level.

Table 3. Effect of nitrogen and sulphur fertilizations on root juice quality of sugar beet for two growing seasons ( 2006/2007 ) and (2007/2008)

| Nitrogen (Kg/fed) | No. of sulphur application | 2006/2007 Juice quality % | | | 2007/2008 Juice quality % | | |
|---|---|---|---|---|---|---|---|
| | | Total soluble solids (TSS) | Sucrose | Purity | Total soluble solids (TSS) | Sucrose | Purity |
| 60 | S0 | 19.9 | 16.4 | 82.00 | 18.2 | 15.1 | 83.00 |
| | S1 | 19.6 | 16.0 | 81.90 | 19.2 | 14.8 | 77.20 |
| | S2 | 19.3 | 15.8 | 81.70 | 19.5 | 15.2 | 78.00 |
| | S3 | 19.1 | 15.4 | 81.55 | 19.3 | 15.2 | 78.50 |
| | Mean | 19.5 | 15.9 | 81.79 | 19.1 | 15.2 | 79.18 |
| 90 | S0 | 20.7 | 17.6 | 85.10 | 19.3 | 16.2 | 83.30 |
| | S1 | 19.9 | 16.8 | 84.50 | 18.3 | 15.2 | 81.00 |
| | S2 | 20.1 | 16.3 | 81.40 | 18.3 | 14.8 | 80.70 |
| | S3 | 20.0 | 16.0 | 80.20 | 17.3 | 14.6 | 84.50 |
| | Mean | 20.2 | 16.7 | 82.80 | 18.3 | 15.2 | 82.50 |
| 120 | S0 | 19.3 | 15.5 | 80.00 | 17.4 | 14.2 | 81.60 |
| | S1 | 19.2 | 15.3 | 78.90 | 17.0 | 13.6 | 80.70 |
| | S2 | 19.1 | 14.9 | 77.80 | 17.2 | 13.6 | 79.10 |
| | S3 | 19.0 | 14.4 | 77.80 | 17.0 | 13.2 | 77.60 |
| | Mean | 19.2 | 15.0 | 78.10 | 17.1 | 13.7 | 79.75 |
| Means of sulphur | S0 | 19.9 | 16.5 | 82.40 | 18.3 | 15.2 | 82.80 |
| | S1 | 19.5 | 16.0 | 81.80 | 18.1 | 14.5 | 79.60 |
| | S2 | 19.5 | 15.7 | 80.30 | 18.3 | 14.5 | 79.30 |
| | S3 | 19.3 | 15.3 | 78.80 | 18.2 | 14.3 | 80.20 |
| LSD at 5% | | | | | | | |
| Nitrogen levels (N) | | 0.138 | 0.344 | 1.221 | 1.002 | 0.562 | 2.139 |
| Sulphur spray No. (S) | | 0.312 | 0.199 | 1.545 | NS | 0.443 | 2.301 |
| N x S | | NS | NS | NS | NS | NS | NS |

Results obtained in Table 3 show that the various juice quality measurement negatively and statistically affected by spraying treatments of sulphur, except TSS% in the 2nd season, the differences were not enough to reach the level of significance. Also, it could be noted that check treatment was more effective on juice quality measurement than the others treatments. In this respect of the effect of sulphur on quality of sugar beet, discrepant results were obtained by Mostafa, Zeinab *et al* (2006) and Awed Allah *et al* (2007).

The effect of interaction between nitrogen fertilization and sulphur spraying was insignificant on the previous traits in both seasons, Moustafa Shafika *et al* (2006) indicated that application of 90 kg N/fed with spray sulphur at 8 cm sulphur/L gave the highest sucrose content in beet juice.

**3-Chemical analysis of root**

**A) Nitrogen, Phosphorus, Potassium and sulfate concentrations**

Data in Table 4 show the effect of nitrogen and sulphur fertilization and their combination on N, P, K, and $SO_4$% in root beet at harvesting time for two growing seasons.

It can be noticed a gradual increase in N, P, K and $SO_4$ concentation with increasing nitrogen level (except K% for the 1st season). This increases were more evidence with N% than other elements such effect may be due to that N dressing enhanced the uptake of minerals which finally reflected to better growth of plants as discriped before. The same results were obtained by Moustafa, Zeinab *et al* (2000), Radha *et al* (2001) and Moustafa, Shafika *et al* (2005).

Table 4. Effect of nitrogen and sulphur fertilization on N, P, K and SO4% of sugar beet root for both growing seasons.

| Nitrogen (Kg/fed) | No. of sulphur application | 2006/2007 | | | | 2007/2008 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | N% | P% | K% | $SO_4$% | N% | P% | K% | $SO_4$% |
| 60 | S0 | 1.93 | 0.180 | 1.100 | 0.250 | 1.030 | 0.130 | 0.990 | 0.210 |
| | S1 | 2.10 | 0.180 | 1.150 | 0.250 | 1.280 | 0.160 | 0.980 | 0.290 |
| | S2 | 2.03 | 0.160 | 1.150 | 0.290 | 1.260 | 0.160 | 1.090 | 0.410 |
| | S3 | 2.03 | 0.130 | 1.150 | 0.370 | 1.460 | 0.180 | 1.110 | 0.480 |
| | Mean | 2.023 | 0.163 | 1.138 | 0.290 | 1.258 | 0.158 | 1.043 | 0.348 |
| 90 | S0 | 2.025 | 0.220 | 1.100 | 0.220 | 1.290 | 0.170 | 1.110 | 0.220 |
| | S1 | 2.015 | 0.240 | 1.190 | 0.280 | 1.450 | 0.200 | 1.230 | 0.320 |
| | S2 | 2.036 | 0.250 | 1.220 | 0.310 | 1.430 | 0.190 | 1.280 | 0.560 |
| | S3 | 2.035 | 0.220 | 1.240 | 0.500 | 1.500 | 0.220 | 1.270 | 0.630 |
| | Mean | 2.278 | 0.233 | 1.188 | 0.328 | 1.418 | 0.190 | 1.223 | 0.433 |
| 120 | S0 | 2.39 | 0.200 | 1.130 | 0.250 | 1.610 | 0.200 | 1.200 | 0.260 |
| | S1 | 2.35 | 0.260 | 1.140 | 0.270 | 1.550 | 0.200 | 1.270 | 0.440 |
| | S2 | 2.45 | 0.280 | 1.210 | 0.500 | 1.650 | 0.210 | 1.290 | 0.590 |
| | S3 | 2.48 | 0.280 | 1.270 | 0.730 | 1.660 | 0.220 | 1.290 | 0.750 |
| | Mean | 2.418 | 0.255 | 1.188 | 0.438 | 1.618 | 0.208 | 1.263 | 0.511 |
| Means of sulphur | S0 | 2.190 | 0.200 | 1.110 | 0.240 | 1.310 | 0.167 | 1.100 | 0.230 |
| | S1 | 2.200 | 0.227 | 1.160 | 0.267 | 1.427 | 0.187 | 1.160 | 0.350 |
| | S2 | 2.280 | 0.230 | 1.930 | 0.367 | 1.447 | 0.187 | 1.220 | 0.520 |
| | S3 | 2.87 | 0.210 | 1.220 | 0.534 | 1.540 | 0.200 | 1.223 | 0.870 |

Regarding S effect, data in Table (4) indicate that sulphur foliar application increased N, P, K and $SO_4$ concentration in sugar beet root as compared with the control (water spray). It can be noticed also, that the N% and $SO_4$% for both growing seasons as well as K% for the first season were gradually increased with increasing S foliar spray number,from one to three , while, the highest concentration for P in the 1st season and K in the 2nd one were found with twice foliar spray of sulphur. In this respect Radha *et al* (2001) and Moustafa, Shafika *et al* (2005) stated that the foliar application with sulphur has a positive effect in absorption of N,P,K and $So_4$ by sugar beet plants.

As for the interaction effect of nitrogen level and sulphur treatments on N,P,K and $SO_4$ % in sugar beet root it was noticed that the highly of concentration of N and $SO_4$ for two growing seasons and K for the first season were obtained with plants which received 120 kg N/fed and sprayed by three times with sulphur solution. However three time application with sulphur did not show any apparent differ on P% of both growing seasons and K% of the second season when compared with twice spray under level of 120 kg N/fed.

**B-Amino acids**

Results of chemical analysis for assessment amino acids as mg /100 gm in beet root (on dry matter basis) as affected by nitrogen level and sulphur foliar spray number as well as their interaction are presented in Table 5. In general, increase nitrogen level from 60 to 90 and 120 kg/fed led to increase (by different degree) in all amino acids concentration (except cystein). Those results are supported by the finding of Moustafa, Zeinab *et al* (2000) and Moustafa, Shafika *et al* (2005).

Table 5.

| Nitrogen (kg/fed) | No. of sulphur application | 1 ARG | 2 ASP | 3 CYS | 4 GLY | 5 GLU | 6 HTS | 7 LYC | 8 MET | 9 PRO | 10 SER | 11 THR | 12 VAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 60 | S0 | 70 | 215 | 43 | 136 | 328 | 121 | 107 | 50 | 170 | 160 | 115 | 140 |
| | S1 | 74 | 210 | 43 | 141 | 320 | 88 | 105 | 54 | 170 | 136 | 112 | 146 |
| | S2 | 66 | 214 | 42 | 146 | 327 | 112 | 99 | 60 | 176 | 130 | 112 | 140 |
| | S3 | 63 | 218 | 43 | 144 | 326 | 113 | 99 | 60 | 180 | 116 | 115 | 140 |
| | Mean | 68 | 214 | 43 | 142 | 325 | 108 | 103 | 56 | 174 | 136 | 114 | 142 |
| 90 | S0 | 77 | 219 | 46 | 150 | 329 | 116 | 115 | 66 | 178 | 167 | 120 | 158 |
| | S1 | 70 | 219 | 46 | 143 | 334 | 125 | 120 | 69 | 185 | 155 | 120 | 154 |
| | S2 | 70 | 219 | 50 | 139 | 333 | 120 | 107 | 73 | 185 | 110 | 120 | 162 |
| | S3 | 66 | 216 | 51 | 140 | 323 | 120 | 109 | 79 | 190 | 116 | 117 | 160 |
| | Mean | 71 | 218 | 48 | 143 | 329 | 120 | 113 | 72 | 185 | 142 | 119 | 159 |
| 120 | S0 | 78 | 219 | 40 | 165 | 330 | 132 | 140 | 70 | 179 | 180 | 130 | 180 |
| | S1 | 78 | 220 | 40 | 152 | 322 | 132 | 140 | 68 | 182 | 150 | 135 | 173 |
| | S2 | 71 | 218 | 50 | 155 | 330 | 130 | 120 | 78 | 196 | 133 | 116 | 166 |
| | S3 | 60 | 219 | 53 | 135 | 340 | 130 | 100 | 82 | 198 | 109 | 106 | 167 |
| | Mean | 72 | 219 | 46 | 152 | 331 | 131 | 125 | 75 | 189 | 143 | 122 | 172 |
| Means of sulphur | S0 | 75 | 218 | 43 | 150 | 329 | 123 | 121 | 62 | 176 | 176 | 122 | 159 |
| | S1 | 74 | 216 | 43 | 154 | 329 | 115 | 122 | 60 | 179 | 147 | 122 | 158 |
| | S2 | 69 | 217 | 47 | 147 | 330 | 121 | 109 | 70 | 186 | 124 | 116 | 156 |
| | S3 | 63 | 218 | 49 | 140 | 330 | 121 | 103 | 74 | 189 | 114 | 113 | 156 |

1) Arginine 2) Aspartic 3) Cystein4) Glycine5) Glutamic 6) Histidine
7) Lycine 8) Methionine 9) Proline 10) Serine 11) Threlonine 12) Valine

Concerning sulphur effect on the individual amino acids concentration, results given in Table(5) revaled that increasing spray number by sulphur solution increased some amino acids such as Cystein, Methionine and Prolin, while, decreased Arginine, Glycine, Lycine, Serine, Thrionine and Valine. Sulphur fertilization had no clear effect on the accumulation of the other amino acids. These finding are in according with the results of Thomas *et al* (2000) and Moustafa, Shafika *et al* (2005).

In was mentionable that the interaction between nitrogen and sulphur application had no evident effect on concentration of amino acids, further more an inconstant trend was selected by analysis of sugar beet. Similar results were obtained in the 2nd season with approximately the same trend.

**4-Root and sugar yield**

**A) Root yield**

Results recorded in Table 6 clearly indicate that nitrogen fertilizer levels and sulphur foliar spray number as well as their interaction had significant effect on root yield for both growing seasons.

It can be noticed that increasing N level from 60 kg to 90 kg/fed markedly and significantly increased root yield for both growing seasons, whoever, eventually further N rate to 120 kg/fed significantly and insignificantly increased root yield of the first and the second growing season respectively.

In first season highest level of nitrogen fertilization (120 kg/fed) increased root yield by 11.15 and by 5.975 ton/fed compared with levels of 60 and 90 kg/fed respectively.

Table 6. Effect of nitrogen and sulphur fertilizers on root and sugar yield (tons/fed) for both growing seasons.

| Nitrogen (Kg/fed) | No. of sulphur application | 2006/2007 Yield (tons/fed) | | 2007/2008 Yield (tons/fed) | |
|---|---|---|---|---|---|
| | | Root | Sugar | Root | Sugar |
| 60 | S0 | 24.56 | 3.30 | 24.00 | 2.860 |
| | S1 | 24.70 | 3.20 | 26.40 | 3.100 |
| | S2 | 25.96 | 3.30 | 28.60 | 3.430 |
| | S3 | 27.23 | 3.33 | 28.97 | 3.500 |
| | Mean | 25.612 | 3.282 | 26.992 | 3.222 |
| 90 | S0 | 28.76 | 4.10 | 32.90 | 4.200 |
| | S1 | 28.90 | 3.96 | 34.56 | 4.170 |
| | S2 | 31.66 | 4.13 | 35.73 | 4.160 |
| | S3 | 33.83 | 4.36 | 36.63 | 4.360 |
| | Mean | 30.787 | 4.160 | 34.955 | 4.222 |
| 120 | S0 | 35.63 | 4.13 | 36.60 | 4.060 |
| | S1 | 36.93 | 4.46 | 36.80 | 3.830 |
| | S2 | 37.06 | 4.36 | 37.03 | 3.860 |
| | S3 | 37.43 | 4.43 | 37.13 | 3.760 |
| | Mean | 36.762 | 4.342 | 36.890 | 3.877 |
| Means of sulphur | S0 | 29.650 | 3.976 | 31.166 | 3.740 |
| | S1 | 30.176 | 3.873 | 32.586 | 3.700 |
| | S2 | 31.56 | 3.963 | 33.786 | 3.816 |
| | S3 | 32.83 | .973 | 34.243 | 3.840 |
| LSD at 5% | | | | | |
| Nitrogen levels (N) | | 1.191 | 0.227 | 2.222 | 0.413 |
| Sulphur spray No. (S) | | 0.558 | NS | 0.858 | NS |
| N x S | | 0.559 | 0.225 | 1.811 | 0.168 |

The corresponding increases were 9.898 and 1.895 ton/fed for the 2nd season. Such increases may be due to encourage effect of highest level of N on the previous trails of root growth as mentioned before (Table 2). These results are in full agreement with the results obtained by Ouda, Sohier (2002), Azzazy (2004), Moustafa, Shafika *et al* (2005) and Awad Allah *et al* (2007).

Concerning the effect of foliar spray with sulphur on root yield, it was noticed (Table 6) that sulphur foliar spray three times in both seasons in addition twice in the second season significantly increased root yield compared to other S-treatments.S2 and S3 treatments increased root yield by 1.91and 3.18 ton /f compared with S0 treatment in first season. The corresponding increases reached to 2.62 and 3.078 toN/f in the second season.

This increases may be attributable to enhanced influence of sulphur fertilization on root diameter and its weight (Table 2).

These finding confirmed the previous reports of Popovic *et al* (1996), El Adl (2002), Nemeat Allah (2005), Moustafa, Zeinab *et al* (2006) and Awad Allah *et al* (2007). On the other hand, Ouda, Sohier (2002) stated that the root yield was significantly decreased by adding sulphur fertilizer.

The combination of nitrogen and sulphur fertilization was also had a significant effect on root yield for both growing seasons. Data (Table 6) of the 1st season exhibited significant increase in root yield when the plants received 120 kg N/fed with sulphur foliar spray by all times comparing with another treatments. While data of the second season indicated that highest root yield values (without significant difference) were obtained when sugar beet plants recived 120 kg N/f only or with combination of all times of sulphur foliar spray as well as when using 90 kg N/f combined with twice or three times by sulphur foliar spray. Similar results were found by Moustafa, Shafika *et al* (2005) While Awad Allah *et al* (2007) stated that insignificant interaction effect between nitrogen fertilizer levels x elemental sulphur levels with regard to root yield of sugar beet.

**B) Sugar yield**

Data in Table 6 indicate that sugar yield significantly increased as nitrogen level increased from 60 to 90 kg N/fed, such increases were 0.878 and 1.0 ton sugar/fed in both seasons respectively. While increasing N level from 90 to 120 kg/fed had insignificant effect on sugar yield, although it increased sugar yield by 0.182 to N/fed in the 1st season but decreased sugar yield by 0.345 in the 2nd season .

This finding was attributed to decrease sucrose% with increasing N level to 120 Kg/fed (Table 3). The aforementioned results are in the same trend with those obtained by Moustafa, Zeinab, *et al* (2000), Moustafa, Shafika, *et al* (2005) and Awad

Allah, *et al* (2007). They reported that newly cultivated sandy soil increasing the applied dose of nitrogen over 90 kg/fed in decreased the sugar yield . While Ouda, Sohier (2002) founded that sugar yield tons/fad. Was increased by applying N up to 120 kg/fed it can be notice also, Sugar yield for both growing seasons was increased with two or three times foliar spray with sulphur (S2 and S3) but those increases were insignificant comparing with S1 and S2 treatment. In this respect Nemeat Alla (2005), Moustafa, Shafika, *et al* (2005), Moustafa, Zeinab, *et al* (2006) and Awad Allah *et al* (2007). They recorded that there was a significant difference among sulphur levels on sugar yield of sugar beet.

As regard of the interaction between nitrogen and sulphur on sugar yield, data in Table (6) show that the highest sugar yield ton/fed (without significant difference) were obtained for the 1st season by treatments of 120 kg N/fed with all sulphur foliar spray times (S1, S2 and S3) as well as 90 kg N/f with applying three time spray S3 with sulsion of sulphur, Results of the 2nd season indicated that 90 kg N/ed in combination sprayed three time by sulphur (S3) treatment only significantly increased sugar yield compared with the other interaction treatments. Similar result was obtained by Moustafa, Shafika, *et al* (2005) where as Ouda, Sohier (2002) founded a significant decrease in sugar yield with each N increment when the high S level was used on the other hand Awad Allah *et al* (2007) found insignificant interaction effect between nitrogen levels x elemental sulphur levels with regard to sugar yield of sugar beet.

## REFERENCES

1. A.O.A.C. 1990. Official methods of analysis. Association of Official Analysis Chemist, 15th ed. Washington, U.S.A.
2. Abd Alla, M.A.A. 1998. Influence of sulphur and organic manure application on yield of sugar beet, subsequent crops and some chemical properties of salt affected soils. Ph.D. Thesis, Fac. of Agric. Kafr El-Sheik, Tanta Univ.
3. Awad Allah, M.A., E.A. Abd El Latief and M.S.H. Ahmed. 2007. Influence of nitrogen fertilizer and elemental sulphur levels on productivity and technological characteristics of sugar beet under middle Egypt conditions. Assiut J. of Agric. Sci., 38 (3): 1-16.
4. Azzazy, N.B. 2004. Yield and quality of some sugar beet varieties as affected by water quality and N fertilization. Egyptian J. of Agric. Res. 82 (4): 1733-45.
5. Bell, C., J., Jones, J., Franklin, G. Milford and R. Leigh. 1995. Sulphate supply and its effect on sap quality during growth in sugar beet storage roots. Zeitschrift furpflanzenernahrung und odenkunde, 158 (1): 93-95.

6. Chapman, H.D. and P.F. Pratt. 1967. Methods of analysis for soil plant and water. Univ. California, Agric. Sci. August 2nd Printing, 150-179.
7. Drycott, A.P. 1972. Sugar beet Nutrition Applied Science Publishers LTD London.
8. El Adl, H.A. 2002. Yield and quality of sugar beet as influenced by sulphur applied as a soil amendment in Kafr El-Sheik, M.Sc. Thesis Fac. of Agric. Cairo Univ.
9. El-Kammah, M.A. and R.A. Ali. 1996. Responsiveness of sugar beet biomass to bond applied sulphur, and its effects on the profitability of potassium and zinc fertilizers under clay soils. J. Agric. Sci. Mansoura Univ., 21 (1): 383-405.
10. Hashem, F.A., S.E. El-Maghraby and M.M. Wassif. 1997. Efficiency of organic manure and residual sulphur under saline irrigation water and calcareous soil conditions. Egy. J. of Soil Sci., 37 (4): 451-455.
11. Hoffmann,C., HJ. Koch, G. Schlinker, G. Sander, M. Sauer and K. Burcky. 1998. Supply and nutrient demand of sugar beet for beet for sulphur Zucker in dustrie 123 (9): 675-682.
12. Johnson, C.M. and H. Nishita. 1952. Micro estimation of sulphur in plant materials, soil and irrigation water. Anal. Chem. 24,736-742.
13. Le Decte, A. 1927. Commercial determination of sugar beet in the beet root using of the Sachr Le Decte Process. Int. Sug. J. 29: 488-492.
14. Moustafa, Shafika N., Safaa S.M. El Sayed., A.M.E. Gomaa and Zeinab R. Mostafa. 2005. Response of sugar beet to nitrogen and sulphur foliar application levels. Egypt. J. Applied. Sci., 20: 45-58
15. Moustafa, Zeinab R., Shafika N. Moustafa, G. B. Marie and K.A. Aboushady. 2000. Influence of nitrogen fertilizer on some quality, technological aspects, productivity and amino acids accumulation of sugar beet. J. Agric. Sci. Mansoura Univ., 25 (8): 4795-4808.
16. Moustafa, Zeinab R., Safaa S.M. El Sayed, Shafika N. Moustafa, and A.M.E. Gomma. 2006. Physio-chemical properties, quality and yield as affected by foliar sprays with Boron and Sulphur in sugar beet plants. Minufiya J. Agric. Res. 31 (4): 957-970.
17. Nemeat Alla, E.A.E. 2005. Yield and quality of sugar beet as affected by different nitrogen and sulphur rates under clay soils. J. Agric. Sci. Mansoura Univ., 30 (2): 7255-7264.
18. Ouda, Sohier M.M. 2002. Response of sugar beet to N and K fertilizers levels under sandy soil conditions. Zagazig. J. Agric. Res. 28 (2): 275-297.
19. Popovic, M., S. Kevresan, J. Kandrac, J. Nikolic, N. Petrovic and R. Kastori. 1996. The role of sulphur in defoxication of cadmium in young sugar beet plants. Biologia plantarum, 38 (2): 281-287.

20. Radha, J., N. Nautiyal and C. Chatterjee. 2001. Effect of sulphur on sugar cane growth, metabolism and yield attributes at variable nitrogen levels. Sugar Cane International January (2001).
21. Sapronova, A.R., A.E. Jashman and V.A. Loseava. 1979. General technology of sugar and sugar substances. Plischcvaya Promyshlennost Pub. Moscow, 464P.
22. Sendecor, G.V. and W.G. Cochran. 1981. Statiscal Methods 6th ed. pp.393 Lowa State. Univ. Press, Ames, Lowa. USA.
23. Sexton, J.J. 1996. The effects of sulphur deficiency on nitrogen metabolism in sugar beet.Ph. D.These Univ.of Wolver Hampton.
24. Thomas, S.G., P.E. Bilsborrow, T.J. Hocking and J. Bennett. 2000. Effect of sulphur deficiency on growth and metabolism of sugar beet (*Beta Vulgaris* cv. Druid). J. of the Sci. of Food and Agric., 80: 2057-2062.

# استجابة بنجر السكر للتسميد النيتروجيني والرش بالكبريت في مصر الوسطى

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اجريت تجربتان حقليتان في موسمي ٢٠٠٦/ ٢٠٠٧ و٢٠٠٧/٢٠٠٨بمحطه بحوث ملوي محافظة المنيا لدراسة تاثير معدل التسميد النيتروجيني (٦٠ و٩٠ و١٢٠ كجم/فدان) وتكرار الرش بمحلول كالسيوم بولي سيلفيد كسماد ورقي كبريتي (مره ومرتين وثلاثه) وتداخلاتهما علي بنجر السكر صنف (ديسبرس بولي ن). واوضحت النتائج مايلي:

– زيادة معدل التسميد النيتروجيني حتي ١٢٠ كجم/فدان ادت الي زياده معنويه لطول وسمك والوزن الطازج للجذر ايضا محصول الجذور وتركيز النيتروجين والفسفور والبوتاسيوم والكبريت والاحماض الامينيه (ماعدا السيستين حيث زاد معنويا بمعدل ٩٠كجم/ فدان مقارنة ب ١٢٠ كجم/فدان ). بينما ادي التسميد بمعدل ٩٠ كجم/فدان الي زياده معنويه لصفات الجوده ( النسبه المئويه لكل من المواد الصلبه الكليه والسكروز والنقاوه) ايضا لمحصول السكر.

– ادي تكرار رش نباتات بنجر السكر بمحلول التسميد الكبريتي سواء مرتين او ثلاثه الي زياده معنويه في الوزن الطازج والسمك ومحصول الجذور وتركيز النيتروجين والفوسفور والبوتاسيوم والكبريت بينما زاد تركيز بعض الاحماض الامينيه وقل تركيز البعض الاخر. مع نقص معنوي للجوده وعدم التاثير علي محصول السكر.

– ادت معاملة التسميد النيتروجيني بمعدل ٩٠ كجم/فدان مع الرش ثلاث مرات بمحلول التسميد الكبريتي الي تسجيل اعلي زياده في كل من محصول الجذور والسكر مع ملاحظة عدم وجود اختلافات معنويه مع تأثير بعض المعاملات الاخري.