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EFFECT OF FOLIAR APPLICATION WITH ZINC, CUPPER AND MOLYBDENUM ON YIELD AND QUALITY OF SUGAR BEET.

Osman, M.S.H.; A.M. Ahmed; G.S. El-Sayed and A.M.H. Osman.
Sugar Crops Research Institute, Agric. Research Center, Giza, Egypt.

ABSTRACT

Two field trials were carried out at Sakha Research Station (Kafr El-Sheikh Governorate) during 2002/2003 and 2003/2004 seasons. The aim of this investigation was study the response of foliar application with zinc, cupper and molybdenum on yield and quality of sugar beet crops. Each experiment consisted of 12 treatments representing three levels (zero, 43 and 86 g/fed) of zinc sulfate $ZnSO_4$. H_2O (35% Zn), two levels (zero and 120 g/fed) of cupper sulfate $CuSO_4$. $_5H_2O$ (24.8% Cu) and two levels (zero and 56 g/fed) of ammonium molybdate (NH_4) 6 MO_7 O_{24}. 4 H_2O (54% Mo). Foliar application of studied treatments were done three times (60, 75 and 90 days) from sowing. Treatments were distributed in a complete randomized block design with four replications.

The results showed that increasing the level of zinc fertilizer up to 86g $ZnSO_4$/fed increased significant and leaf area, root length and root diameter in the 2nd season and leaf area index, leaves total dry weight/plant and leaf/weight ratio in the two seasons.

Cupper fertilizer levels up to 120g $CuSO_4$/fed showed significant effects on root/top ratio, root length and purity% in the 1st season, total soluble solids% in the 2nd season and leaf area, leaf area index, leaves total dry weight/plant, root fresh weight, sucrose% and biological (top and root yields),root and sugar yields in the two seasons.

Increasing the level up to 56g ammonium molybdate (NH_4) 6 $(MO_7$ $O_{24})$/fed showed significant effects on root diameter and top yield in the 1st season, leaf/weight ratio and root length in the 2nd season and root fresh weight, sucrose and purity% and biological (top and root yields), root and sugar yields in the two seasons.

The highest values of root and sugar yields 35.30, 34.00 and 4.78, 4.77 was resulted from the interaction between 43g $ZnSO_4$, 120g $CuSO_4$ and zero g ammonium molybdate/fed in the two seasons., respectively.

INTRODUCTION

Hanousek (1973) found that applied of Zn was applied at 0, 3, 4.8 or 6.6 kg/ha to sugar beet at 3 sites in 1970-2. Application of up to 4.8 kg/ha increased root yields and polarization and decreased forking of the roots, but the effect of 6.6 kg/ha was not greater. Zavrel (1978) found that application of 5, 10, 20 or 40 kg Zn/ha applied as $ZnSO_4$ to the leaves. Av. yield of roots with no applied Zn was 41.73 t/ha and was increased to a max. of 43.66 t (4.6% increase) with 10 kg Zn/ha and decreased with increase in applied Zn; yield of tops was 30.79 t/ha with no applied Zn and was max. at 32.29 t (4.9%) with 10 kg Zn/ha. Root sugar content was not affected by Zn, but digestion sugar yield was not affected by Zn, but digestion sugar yield was increased to a max. of 7.53 t/ha from 7.12 t without Zn by 10 kg Zn/ha. Lashkevich (1980) reported that application of Zn at a rate of 10 kg Zn as $ZnSO_4$/ha on PK background increased the sugar yields of sugar beet plants. Ljubic (1980) found that the maximum yield of sugar beet was given by the

application of 4 kg Zn/ha. Genaidy (1988) revealed that application of Zn fertilizer using 4 kg Zn/fed raised sugar content by 5%. He found that Zn fertilizer applied at a rate of 4 kg Zn/fed slightly increased root and sugar yields. Saif (1991) reported that soil application of 4 kg Zn/fed gave the highest value of tops criteria, i..e. leaves number, top fresh and dry weight/plant as well as top dry matter, fresh and dry weight of roots, root dry matter and root size of sugar beet root length and diameter, sucrose, TSS and purity percentage, produced a significant increase in yields of tops, roots and sugar t/fed. Sun *et al.* (1994) found t hat when $ZnSO_4$ was applied to sugarbeet, leaf area index was significantly higher (>3.0) after Zn application than that in treatments without Zn (<3.0), and it remained high (>3.0) for over 60 days in Zn treatments. Treatments of Zn increased dry matter accumulation and sugar content in roots. Osman (1997) found that soil application with 0, 3 and 6 kg Zn/fed as zinc sulfate and their mixtures (B + Zn + Mn) of 0.5 + 3 + 0.02 or 1 + 6 + 0.04 kg/fed insignificantly increased leaf area index (LAI), root length and diameter, root fresh weight, total soluble solids, sucrose and purity percentages as well as top, root and sugar yields/fed.

Hanousek (1973) found that applied of Cu was applied at 0, 3, 4.8 or 6.6 kg/ha to sugar beet at 3 sites in 1970-2. Application of up to 4.8 kg/ha increased root yields and polarization and decreased forking of the roots, but the effect of 6.6 kg/ha was not greater. Lashkevich (1980) reported that Cu had a positive effect on the sugar yields of sugar beet. Domska (1996) found that when sugarbeet was applied with 0.1 kg Cu/ha, it gave the highest root, shoot and sugar yield and sugar content.

Chernova (1975) found that application of 1 kg Mo/ha ammonium molybdate markedly increased growth rate of roots and shoots, plant Mo contents and increased root yields by 14.9 t/ha from 79.4 t/ha on plots given NPK alone and by 9 t/ha from 34 t/ha. Application of trace elements increased economic ytilization of applied N, P and K. Dragan *et al* (1987) found that when sugar beet was given 2 kg Mo/ha, root yields and sugar contents ranged from 17.15 t/ha and 18.2%, respectively. Jaszczolt (1998) obtained effects of 20 g Mo, thus providing 3.7-3.8 kg Mo, were more effective when applied during the period of rapid growth on sugar content and sucrose%. The aim of the present study is to study the effect of foliar application with zinc, cupper and molybdnum on yield and quality of sugar beet.

MATERIALS AND METHODS

Two field trials were carried out at Sakha Research Station (Kafr El-Sheikh Governorate) during 2002/2003 and 2003/2004 seasons. The aim of this investigation was study the response of foliar application with zinc, cupper and molybdenum on yield and quality of sugar beet crops. Each experiment consisted of 12 treatments representing three levels (zero, 43 and 86 g/fed) of zinc sulfate $ZnSO_4$. H_2O (35% Zn), two levels (zero and 120 g/fed) of cupper sulfate $CuSO_4$. $_5H_2O$ (24.8% Cu) and two levels (zero and 56 g/fed) of ammonium molybdate (NH_4) 6 MO_7 O_{24}. 4 H_2O (54% Mo). Foliar

application of studied treatments were done three times (60, 75 and 90 days) from sowing.

Treatments were distributed in a complete randomized block design with four replications. Nitrogen fertilizer was applied in the form of Urea 46% N and potassium in the form of potassium sulfate 48% K_2O was applied at 48 kg K_2O/fed as applied in two equal doses the 1st application was applied after thinning (45 days from sowing) and the 2nd two weeks later. Afixed dose of phoasphours (15 kg P_2O_5/fed) in the form of calcium superphosphate 15.5% P_2O_5 was added at seed bed preparation. Sowing took place during the 5th of November while harvest was done 7 months later. Plot size was 14 m^2. (4 rows of 50 cm apart and 7 m in length). Distance between hills was 20cm.

The preceding crop was rice in both seasons. All cultural practices were done as recommended by Sugar Crops Research Institute (SCRI). The physical and chemical analysis of the upper 30 cm of soil of the experimental site showed that the soil was clay loam containing 30.1% sand, 39.2% silt and 27.7% clay and 28.8 ppm available N, 16.38 ppm P and 420 ppm K^+ and and 0.34 ppm Zn, 6.05 ppm Cu and 9.55 ppm Mo, respectively, with a pH of soil 8.0. The commercial variety Gloria was used in the two seasons.

Data recorded:

Vegetative characters: A sample of 10 plants was taken at random to determine:

1. Leaf area index (LAI) which calculated according to Watson (1958).
2. Leaves dry weight/plant (g).
3. Leaf/weight ratio (LWR g/cm^2): as described by Wareing and Philips (1981).

At harvest, plants of each plot for various treatments were uprooted and topped to estimate:

4. Biological yield = Root yield + Top yield (tons/fed).
5. Root/top ratio.
6. Root length (cm).
7. Root diameter (cm).
8. Root fresh weight (g).

B. Juice quality traits:

9. Total soluble solids% (TSS%) was determined using hand refractometer.
10. Sucrose% was determined according to Le Decote (1927).
11. Purity% was calculated according to Carruthers *et al.* (1962).

Apparent purity % = Sucrose % x 100/TSS %.

IV. Yield and yield components: At harvest plants of each plot for various treatments were uprooted and topped to estimate:

12. Top yield (ton/fed).
13. Root yield (ton/fed).
14. Sugar yield (ton/fed) was calculated according to the following:

Sugar yield (ton/fed) = Root yield (ton/fed) x sucrose %.

The collected data were statistically analyzed according to Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

I. Leaves traits at 150 days from sowing:

Leaf area index:

Data in Table 1 show that leaf area index was significantly affected by zinc fertilizer in the two seasons. The highest leaf area index 5.45 and 6.01 was recorded at 86 g $ZnSO_4$/fed., respectively. The effect of Zn on auxin was indirect, affecting the synthesis of tryptophain which led directly to the synthesis of hormon indole acetic acid which increased cell size. These results are in accordance with those reported by Saif (1991), Sun *et al.* (1994) and Osman (1997).

Results showed significant differences in leaf area index as affected by the two studied Cu fertilizer in the two seasons. The increase in leaf area index 0.58 and 0.86% was recorded at 120 g $CuSO_4$/fed., respectively. The important role in this parameters might be due to the important role of Cu on hormonal balance, activiting physiological and biochemical processes in plant.

The effect of Mo fertilizer levels, was insignificant on leaf area index in the two seasons.

Significant differences in ZnxCu interaction was affected leaf area index in the two seasons. The highest leaf area index 6.26 and 7.14 was recorded by 86 g $ZnSO_4$/fed along with the application of 120 g Cu SO_4/fed., respectively.

Leaves dry weight/plants (g):

Table 1 data cleare that leaves dry weight/plant was significantly affected by zinc fertilizer rate in the two seasons. The highest leaves dry weight/plant 31.27 and 40.90 g was recorded at 86 g Zn SO_4/fed., respectively. The effect of Zn on auxin was indirect, affecting the synthesis of tryptophain which led directly to the synthesis of hormon indole acetic acid which increased cell size. These results are in line with those reported by Saif (1991) and Sun *et al.* (1994).

Results showed significant differences in leaves dry weight/plant as affected by the two studied Cu fertilizer level in the two seasons. The increase in leaves dry weight/plant 6.62 and 9.36 g was recorded at 120 g $CuSO_4$/fed., respectively. The important role in this parameters might be due to the important role of Cu on hormonal balance, activiting physiological and biochemical processes in plant.

The effect of Mo fertilizer levels, was insignificant on leaves dry weight/plant in the two seasons.

Significant differences in ZnxCu interaction was affected leaves dry weight/plant in the two seasons. The highest leaves dry weight/plant 68.85 and 78.55 g was recorded by 86 g $ZnSO_4$/fed along with the application of 120 g $CuSO_4$/fed., respectively.

ZnxCuxMo interaction was significantly affected leaves dry weight/plant in the two seasons. The highest leaves dry weight/plant 71.49 and 79.99 g was recorded by 86 g $ZnSO_4$/fed, along with the application of 120 g $CuSO_4$/fed and 56 g ammonium molybdate/fed in the two seasons., respectively.

T1

Leaf/weight ratio (LWR g/cm^2):

Table 2 show that leaf/weight ratio was significantly affected by zinc fertilizer rate in the two seasons. The highest leaf/weight ratio 0.105 and 0.104 g/cm^2 was recorded at 86 g $ZnSO_4$/fed., respectively. The effect of Zn on auxin was indirect, affecting the synthesis of tryptophain which led directly to the synthesis of hormon indole acetic acid which increased cell size. These result are in accordance with those reported by Saif (1991), Sun *et al.* (1994) and Osman (1997).

Results showed insignificant differences in leaf/weight ratio as affected by the two studied $CuSO_4$ fertilizer level in the two seasons.

The effect of ammonium molybdate fertilizer levels, was significant on leaf/weight ratio in the 2nd season. The highest leaf/weight ratio 0.103 g/cm^2 was recorded at zero level of Mo.

ZnxCu interaction significantly affected leaf/weight ratio in the two seasons. The highest leaf/weight ratio 0.110 g/cm^2 was recorded by 86 g $ZnSO_4$/fed along with the application of 120 g $CuSO_4$/fed.

ZnxMo interaction significantly affected leaf/weight ratio in the 1st season. The highest leaf/weight ratio 0.110 g/cm^2 was recorded by 86 g $ZnSO_4$/fed.

ZnxCuxMo interaction was significantly effect on leaf/weight ratio in the two seasons. The highest leaf/weight ratio 0.113 and 0.120 g/cm^2 was recorded by 86 g $ZnSO_4$/fed, along with the application of 120 g $CuSO_4$/fed and 56 g ammonium molbdate/fed., respectively.

IV. Yield and yield components:

1. Biological yield (ton/fed):

Results given in Table 2 show that biological yield was insignificantly affected by zinc fertilizer level in the two seasons. These results are in harmony with those obtained by Saif (1991) and Osman (1997).

Results showed significant differences in biological yield as affected by the two studied Cu and Mo fertilizer rates in the two seasons. The increase in biological yield 3.36 and 4.22 ton/fed was recorded at 120 g $CuSO_4$ and 56 ammonium molybdate/fed., respectively. The important role in this parameters might be due to the important role of Cu and Mo on hormonal balance, activiting physiological and biochemical processes in plant. This result are in agreement with that obtained by Domska (1996).

CuxMo interaction was significantly affected biological yield in the 2nd season. The highest biological yield 36.23 ton/fed was recorded by 56 g ammonium molybdate/fed.

2. Root/top ratio:

Table 3 showes insignificant differences in root/top ratio as affected by the two studied Zn and Mo fertilizer rates in the two seasons.

Results showed significant differences in root/top ratio as affected by the two studied Cu fertilizer level in the 1st season. The increase in root/top ratio 0.29 was recorded at 120 g $CuSO_4$/fed. The important role in this parameters might be due to the important role of Cu on hormonal balance, activiting physiological and biochemical processes in plant.

T2

T3

ZnxMo interaction significantly affected root/top ratio in the 1st season. The highest root/top ratio 4.66 was recorded by 43 g $ZnSO_4$/fed along with the application of 56 g ammonium molybdate/fed.

ZnxCuxMo interaction was significantly affected root/top ratio in the two seasons. The highest root/top ratio 5.17 was recorded by 120 g $CuSO_4$/fed in the 1st season and 4.80 was recorded by 86 g $ZnSO_4$ in the 2nd season.

II. Root traits at harvest.

1. Root length (cm):

Data in Table 3 cleare that root length was significantly affected by zinc fertilizer rate in the 2nd season. The increase in root length 5.76 cm was recorded at 86 g $ZnSO_4$/fed., respectively. The effect of Zn on auxin was indirect, affecting the synthesis of tryptophain which led directly to the synthesis of hormon indole acetic acid which increased cell size. These results are in agreement with those obtained by Saif (1991) and Osman (1997).

Results showed significant differences in root length as affected by the two studied Cu fertilizer level in the 1st season. The increase in root length 7.53 cm was recorded at 120 g $CuSO_4$/fed. The important role in this parameters might be due to the important role of Cu on hormonal balance, activiting physiological and biochemical processes in plant.

The effect of Mo fertilizer levels, was significant on root length in the 2nd season. Check treatment surpassed 56 g ammonium molybdate/fed by 1.50 cm. The important role in this parameters might be due to the important role of Mo on enzymes activity, hormonal balance, activiting physiological, biochemical and nitrogen processes during different physiological stages of growth of sugar beet plants.

CuxMo interaction was significantly affected root length in the 2nd season. The tallest root length 26.94 cm was recorded by 120 g $CuSO_4$/fed.

2. Root diameter (cm):

Table 4 showes that root diameter was significantly affected by zinc fertilizer rate in the 2nd season. The thicker in root diameter 11.40 cm was recorded at 43 g $ZnSO_4$/fed. The effect of Zn on auxin was indirect, affecting the synthesis of tryptophain which led directly to the synthesis of hormon indole acetic acid which increased cell size. These results are in agreement with those obtained by Saif (1991) and Osman (1997).

Results showed insignificant differences in root diameter as affected by the two studied Cu fertilizer rate in the two seasons.

The effect of Mo fertilizer levels, was significant on root diameter in the 1st season. The increase in root diameter 0.98 cm. The important role in this parameters might be due to the important role of Mo on enzymes activity, hormonal balance, activiting physiological, biochemical and nitrogen processes during different physiological stages of growth of sugar beet plants.

T4

Significant differences ZnxCu and CuxMo interactions were affected root diameter in the 2nd season. The thicker root diameter 12.15 and 11.41cm was recorded by 43 g $ZnSO_4$/fed, 120 g $CuSO_4$/fed as well as 56 g ammonium molybdate/fed.

3. Root fresh weight (g):

Results given in Table 4 cleare that root fresh weight was insignificantly affected by zinc fertilizer level in the two seasons. These results are in agreement with those obtained by Saif (1991) and Osman (1997).

Results showed significant differences in root fresh weight as affected by the two studied $CuSO_4$ fertilizer rate in the two seasons. The increase in root fresh weight 10.16 and 6.10 g., respectively. The important role in this parameters might be due to the important role of Cu on hormonal balance, activiting physiological and biochemical processes in plant.

The effect of ammonium molybdate fertilizer levels, was significant on root fresh weight in the two seasons. The increase in root fresh weight 12.92 and 11.28g., respectively. The important role in this parameters might be due to the important role of Mo on enzymes activity, hormonal balance, activiting physiological, biochemical and nitrogen processes during different physiological stages of growth of sugar beet plants.

CuxMo interaction was significantly affected root fresh weight in the 2nd season. The heaviest root fresh weight 1117.3 g was recorded by 56 g ammonium molybdate/fed.

III. Juice quality:

1. Total soluble solids percentage (TSS%):

Table 5 data showes that total soluble solids was insignificantly affected by zinc fertilizer level in the two seasons. These results are in agreement with those obtained by Saif (1991), Sun *et al.* (1994) and Osman (1997).

Results showed significant differences in total soluble solids as affected by the two studied $CuSO_4$ fertilizer rate in the 2nd seasons. The increase in total soluble solids 1.34% was recorded by 43 g $ZnSO_4$/fed along with the application of 120 g $CuSO_4$/fed. The important role in this parameters might be due to the important role of Cu on hormonal balance, activiting physiological and biochemical processes in plant. This result are in agreement with that obtained by Domska (1996).

The effect of ammonium molybdate (NH_4) 6 MO_7 O_{24} fertilizer level, was insignificant on total soluble solids in the two seasons. This result are in agreement with those obtained by Dragan *et al.* (1987) and Jaszczolt (1998).

ZnxMo interaction was significantly affected total soluble solids in the 1st season. The highest total soluble solids 17.91% was recorded by 56 g of ammonium molybdate.

CuxMo interaction was significantly affected total soluble solids in the 2nd season. The highest total soluble solids 17.47% was recorded by 120 g $CuSO_4$/fed.

2. Sucrose percentage:

Data in Table 5 indicate that sucrose% was insignificantly affected by zinc fertilizer level in the two seasons. These results are in agreement with those obtained by Saif (1991), Sun *et al.* (1994) and Osman (1997).

Results showed significant differences in sucrose% as affected by the two studied $CuSO_4$ and ammonium molybdate fertilizer rates in the two seasons. The increase in sucrose% was 1.28, 1.10% and 1.40, 1.02%. The important role in this parameters might be due to the important role of Cu and Mo on hormonal balance, activiting physiological and biochemical processes in plant. These results are in agreement with those obtained by Domska (1996) and Dragan *et al.* (1987) and Jaszczolt (1998)., respectively.

CuxMo interaction was significantly affected sucrose% in the two seasons. The highest sucrose% 13.46 and 13.36 was recorded by 120 g $CuSO_4$/fed, along with the application of 56 g ammonium molbdate/fed and 120 g $CuSO_4$/fed., respectively.

3. Purity percentage:

Results given in Table 6 showes that purity% rate was insignificantly affected by zinc fertilizer level in the two seasons. These results are in agreement with those obtained by Saif (1991), Sun *et al.* (1994) and Osman (1997).

Results showed significant differences in purity% as affected by the two studied $CuSO_4$ fertilizer rate in the 1st season. The increase in purity% was 4.41 and 0.52% in the two seasons. The important role in this parameters might be due to the important role of Cu on hormonal balance, activiting physiological and biochemical processes in plant. This result are in agreement with that obtained by Domska (1996).

The effect of ammonium molybdate fertilizer level, was significant on purity% in the two seasons. The increase in purity% was 5.67 in the 1st season and 2.98% in the 2nd one., respectively. The important role in this parameters might be due to the important role of Mo on enzymes activity, hormonal balance, activiting physiological, biochemical and nitrogen processes during different physiological stages of growth of sugar beet plants. These results are in agreement with those obtained by Dragan *et al.* (1987) and Jaszczolt (1998).

CuxMo interaction significantly affected purity% rate in the two seasons. The highest purity%78.13 and 78.94% was recorded by 56 g ammonium molbdate/fed., respectively.

IV. Yield and yield components:

3. Top yield (ton/fed):

Table 6 data show that top yield were insignificantly affected by Zn and Cu fertilizer rates in the two seasons. These results are in agreement with those obtained by Saif (1991), Domska (1996) and Osman (1997).

The effect of ammonium molybdate fertilizer levels, was significant on top yield in the 1st season. The increase in top yield was 1.36 ton/fed was recorded by 56 g ammonium molybdate.

T5

T6

The important role in this parameters might be due to the important role of Mo on enzymes activity, hormonal balance, activiting physiological, biochemical and nitrogen processes during different physiological stages of growth of sugar beet plants.

ZnxMo interaction significantly affected top yield in the 1st season. The highest top yield 9.24 ton/fed was recorded by 56 g ammonium molybdate.

ZnxCuxMo interaction was significantly affected top yield in the 1st season. The highest top yield 10.75 ton/fed was recorded by 86 g $ZnSO_4$/fed and 56 g ammonium molbdate/fed.

4. Root yield (ton/fed):

Results given in Table 7 showes that root yield was insignificantly affected by zinc fertilizer level in the two seasons. This result are in agreement with those obtained by Saif (1991) and Osman (1997).

Results showed significant differences in root yield as affected by the two studied $CuSO_4$ and ammonium molybdate fertilizer rates in the two seasons. The increase in root yield was 10.14, 6.10 and 3.71, 3.32 tons/fed., respectively. The important role in this parameters might be due to the important role of Cu and Mo on hormonal balance, activiting physiological and biochemical processes in plant. This result are in agreement with that obtained by Domska (1996).

CuxMo interaction significantly affected root yield in the 2nd season. The highest root yield 35.3 and 34.08 tons/fed was recorded by 120 g $CuSO_4$/fed, along with the application of 56 g ammonium molbdate/fed.

5. Sugar yield (ton/fed):

Data in Table 7 cleare that sugar yield was insignificantly affected by zinc fertilizer rate in the two seasons. These results are in agreement with those obtained by Saif (1991) and Osman (1997).

Results showed significant differences in sugar yield as affected by the two studied $CuSO_4$ and ammonium molybdate fertilizer levels in the two seasons. The increase in sugar yield 0.74, 0.52 and 0.90, 0.70 tons/fed., was recorded by 120 g $CuSO_4$ and 56 g ammonium molybdate. The important role in this parameters might be due to the important role of Cu and Mo on enzymes activity, hormonal balance, activiting physiological, biochemical and nitrogen processes during different physiological stages of growth of sugar beet plants. This result are in agreement with that obtained by Domska (1996).

CuxMo interaction significantly affected sugar yield in the 2nd season. The highest sugar yield 4.77 ton/fed was recorded by 120 g $CuSO_4$/fed, along with the application of 56 g ammonium molbdate/fed.

T7

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تأثير الرش بالزنك والنحاس والموليبدنيوم على محصول وجودة بنجر السكر

محمود سيد حسن عثمان ، عبد اللاه محمد احمد ، جمال سعد السيد و عادل محمود حسن عثمان.

معهد بحوث المحاصيل السكريه- مركز البحوث الزراعيه - الجيزه – مصر

أقيمت تجربتان حقليتان بمحطه البحوث الزراعيه بسخا بمحافظه كفر الشيخ لدراسه تأثير الرش بالزنك والنحاس والموليبدنيوم على محصول وجوده بنجر السكر خلال موسمى الزراعه ٢٠٠٢/٢٠٠٣ و٢٠٠٣/٢٠٠٤ .

- وإشتملت الدراسة على ثلاثة مستويات من التسميد بعنصر الزنك (صفر و٤٣ و٨٦ جم كبريتات زنك/فدان) ومستويين من التسميد بعنصر النحاس (صفر و ١٢٠ جم كبريتات نحاس/فدان) ومستويين من التسميد بعنصر الموليبدنيوم (صفر و ٥٦ جم امونيوم موليبدات/فدان) ووزعت المعاملات فى تصميم قطعات كاملة العشوائية فى أربع مكررات.

أوضحت النتائج المتحصل عليها:

١- تفوق التسميد بعنصر الزنك ٨٦ جم كبريتات زنك/فدان معنويا فى صفات مساحة الاوراق وطول وقطر الجذر فى (الموسم الثانى فقط ودليل مساحة الاوراق ووزن المادة الجافة الكلية للاوراق ونسبة مساحة الاوراق /الوزن الجاف فى (كلا الموسمين).

٢- تفوق التسميد بعنصر النحاس ١٢٠ جم كبريتات نحاس/فدان معنويا فى صفات نسبة وزن الجذر/ العرش وطول الجذر والنسبة المئوية للنقاوة فى (الموسم الاول) والنسبة المئوية للمواد الصلبة الذائبة الكلية فى (الموسم الثانى) ومساحة الاوراق ودليل مساحة الاوراق ووزن المادة الجافة الكلية للاوراق والوزن الطازج للجذور والنسبة المئوية للسكروز ومحصولى الجذور والسكر فى (كلا الموسمين).

٣- تفوق التسميد بعنصر الموليبدنيوم ٥٦ جم امونيوم موليبدات/فدان معنويا فى صفات صفة قطر الجذر ومحصول العرش فى (الموسم الاول) و ونسبة مساحة الاوراق /الوزن الجاف وطول الجذر فى (الموسم الثانى فقط) ووزن الجذر الطازج والنسبة المئوية للسكروز والنقاوة والمحصول البيولوجى والجذور والسكر طن/فدان فى (كلا الموسمين).

يمكن التوصية للحصول على اعلى محصول جذور (٣٥,٣٠ و ٣٤ طن/فدان) ومحصول سكر (٤,٧٨ و ٤,٧٧ طن/فدان) معنويا بزراعة الصنف جلوريا مع اضافة ٤٣ جم كبريتات زنك و١٢٠ جم كبريتات نحاس وصفر امونيوم موليبدات/فدان فى كلا الموسميين.