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EFFECT OF SOWING DATES AND MINERAL SULPHUR FERTILIZER ON YIELD AND QUALITY OF SUGAR BEET UNDER NEWLY RECLAIMED SOILS

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ABSTRACT

Two field trials were conducted out in 2009/2010 and 2010/2011 seasons at Kom Osheim, El-Fayoum Governorate to study the effect of three sowing dates (1st October; 15th October and 1st November) and soil application of sulphur fertilizer in the form of Calcium poly sulfide $CaSO_4$ (30% sulphur) at the levels of (zero, 125 and 250 kg $CaSO_4$/fed, mixed with soil) which were applied at 45 and 75 days age, on Kawemira variety. A split plot design with four replicates in both seasons was used. The main plots were assigned to sowing dates, whereas, soil application with $CaSO_4$ in the sub plots. The results indicated that: early sowing dates at 1st October significantly increased root diameter, root fresh weight/plant, as well as, root and sugar yields/fed, while, mineral contents SO_4% and N% were significantly decreased as compared with the other two sowing dates 15th October and 1st November. While, sown sugar beet at 15th October gave the highest sugar% in both seasons, respectively. Soil application with sulphur ($CaSO_4$) level up to 250 kg $CaSO_4$/fed significantly increased root diameter, root fresh weight/plant, sucrose% and yields/fed (root and sugar), while, minerals content of SO_4% and N% were increased as compared with control and sulphur ($CaSO_4$) level with 125 kg $CaSO_4$/fed in both seasons, respectively. The interaction between early sowing date at 1st October and soil application with 250 kg $CaSO_4$/fed significantly increased sucrose%, root and sugar yields/fed in both seasons.

INTRODUCTION

Egyptian Government imports large amounts of sugar, i.e. about 1.10 million ton, every year to face the rapid increase of population. Sugar beet plays a prominent role for sugar production, about 37.27% of locally sugar production. (CCSC, 2010).

There are many factors affecting yield and quality of sugar beet as nutritional status as well as some agro practices application, i.e., fertilization, sowing dates and methods. With respect to sowing dates, Allam *et al*. (2005) showed that the highest value of root and sugar yields/fed were obtained when sugar beet sowing date at 1st October. Ismail *et al.* (2006) found that early sowing date at 1st October led to significant increase in root fresh weight, sucrose%, purity%, sugar and root yields/fed as compared with delay sowing dates to 15th October and 1st November. El-Geddawy *et al*. (2007) showed that sowing sugar beet early at 15th September significantly attained the higher value of root length, diameter, root fresh weight/plant, root and sugar yields/fed than at late sowing date to 15th October. Mosa (2009) studied three sowing dates to 15th September, October and November. He found that early sowing date to 15th September significantly increased root length, diameter, root and sugar yields/fed as compared with delay sowing

date to 15th October or November. El-Hosry *et al*. (2010) revealed that root length and root yield/fed were significantly increased with sowing date at 15th October as compared to 15th Sepember and 15th November.

There is a great need to find out the proper technical recommendations for improving the productivity and quality of sugar beet under Egyptian conditions. Because the most Egyptian soils suffer from a high pH values particularly newly reclaimed soil, the availability of P, K (Table 2) and micronutrients is reduced. The use of sulphur might help in decreasing soil alkalinity during sulphur biological oxidation. 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. Draycott (1972) and Thomas *et al*. (2000) stated that sulphur is a constituent element of some amino acids, namely Cystein and Methionine and it is involved in synthesis of chlorophyll, 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. In this subject, El-Kammah and Ali (1996) and Hashem *et al.* (1997) indicated that yields of roots and sugar were significantly increased with increasing levels of applied sulphur. Also, Nemeat Alla (2005) reported that sulphur fertilizer level at 300 kg/fed led to significant differences in root growth, i.e. length and diameter, as well as root yield/fed as compared with the other two levels 100 and 200 kg/fed in both seasons. Ouida, Sohier (2002), Shafika *et al.* (2005), Zeinab *et al.* (2006) and Awed Allah *et al.* (2007) reported that response degree of growth, quality, chemical composition and yield of sugar beet differ according to the level of sulphur fertilization. Osman and Shehata, Mona (2010) foliar spray with sulphur in the form of Calcium Poly Sulfide (30%) at concentration of 6 cm/l which was applied once, twice and three times at 70, 85 and 90 days after sowing in addition to foliar spray with distilled water as control. The results observed that there were significant increases in root diameter, root fresh weight/plant, root yield/fed and accumulation N, P, K, and SO_4. While, root quality significantly decreased. Ferweez *et al*. (2011) indicated that sulphur fertilization level at 200 kg/fed had a significant increase on root diameter, pol%, Na content, α- amino nitrogen, sugar recovery%, quality index and sugar yield/fed in the two growing seasons. The aim of this study to find out the suitable sowing dates and level of $CaSO_4$ as soil application to induce high quality and yields/fed of sugar beet plants under newly reclaimed soil conditions.

MATERIALS AND METHODS

Two field trials were conducted out in 2009/2010 and 2010/2011 seasons at Kom Osheim, El-Fayoum Governorate to study the effect of three sowing dates (1st October; 15th October and 1st November) and soil application of sulphur fertilizer in the form of Calcium poly sulfide ($CaSO_4$ 30% sulphur) at the levels of (zero, 125 and 250 kg $CaSO_4$/fed, mixed with

soil) which were applied at 45 and 75 days age, on Kawemira variety. The mean of temperature degree and relative humidity% in both seasons are presented in Table (1). The preceding crop was maize in both seasons. A split plot design with four replicates in both seasons was used. The main plots were assigned to sowing dates, whereas, soil application with $CaSO_4$ in the sub plots. Sub plot area was 12.25 m^2 consisted of 5 ridges of 3.5 m long at 70 cm apart and spacing between hills 20 cm. Some physical and chemical analysis of the experimental soils according to Page (1982) in Table 2. Nitrogen fertilizer at the level of 100 kg/fed in the form of ammonium nitrate (33.5% N) was applied in four equal doses, the first was applied after thinning and the others was applied at 2-weeks interval after the first application. Phosphorus fertilizer level at the rate of 45 kg/fed in the form of calcium super phosphate (15.5% P_2O_5) was added during land preparation. Potassium fertilizer level of 24 kg/fed in the form of potassium sulfate (48% K_2O) was applied in four equal doses with nitrogen fertilizer. Other agricultural practices for sugar beet field were carried out as recommended by Sugar Crops Research Institute.

Table (1): mean of temperature degree and relative humidity% in both seasons.

Year	2009-2010 season						2010-2011 season					
Months	Temperature (C°)			Relative humidity%			Temperature (C°)			Relative humidity%		
	Max	Min	Aver	Max	Min	Aver	Max	Min	Aver	Max	Min	Aver
September	34.2	21.4	27.8	87.0	35.0	61.0	34.5	20.3	27.4	83.0	29.0	56.0
October	33.1	19.4	26.2	86.0	32.0	59.0	32.8	19.3	26.1	82.0	28.0	55.0
November	28.7	16.5	22.6	89.0	41.0	63.0	29.1	14.7	21.9	81.0	30.0	55.5
December	23.4	10.3	16.9	81.0	37.0	59.0	22.2	9.2	15.7	82.0	37.0	59.5
January	22.2	9.8	16.0	83.0	36.0	59.5	22.1	8.6	15.3	78.0	34.0	56.0
February	24.8	9.6	17.2	86.0	36.0	61.0	22.0	7.9	14.9	87.0	36.0	61.5
March	28.2	13.4	20.8	82.0	32.0	57.0	26.2	10.4	18.3	79.0	29.0	54.0
April	30.7	14.1	22.4	81.0	24.0	52.5	31.1	14.0	22.5	77.0	25.0	51.0
May	31.2	15.7	23.5	80.0	23.0	51.5	32.7	15.6	24.2	76.0	23.0	49.5

Source: Agro-meteorological station, Agric. Res. Center, Giza, Egypt.

Table 2: Some physical and chemical analysis of the experimental soil.

Particle size			Soil textural	E.C. ds/m	Soil pH (1:2.5)	Organic matter %	$CaCO_3$ %
Sand %	Silt %	Clay %	Sand silty loam	2.75	8.1	1.10	3.00
27.0	61.0	12.0					

Soluble Cations (meq/l)				Soluble anions(meq/l)				available contents (ppm)		
Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}	N	P	K
2.02	3.00	4.20	0.10	0.11	0.10	5.75	2.85	16.9	19.2	58.3

Recorded data:

At harvest time (210 days from sowing) the three guarded ridges were topped: A sample of 10 roots was randomly taken and the following traits were recorded:

1. Root length (cm). 2. Root diameter (cm). 3. Root fresh weight (kg/plant).
4. Total soluble solids (TSS%) was determined by using Hand refractometer.
5. Sucrose% was determined according to the procedure of Le Docte (1927).
6. Purity% was calculated according to Purity % = Sucrose% x 100/TSS%.

7. Sulfate% was determined according to Johnson and Nishita (1952).
8. Nitrogen was determined according to A.O.A.C. (2005).
9. Root yields (ton/fed) was determined on the whole plot basis were harvested, topped and weighed to determine root yield. 10. Sugar yield which was calculated by multiply root yield (ton/fed) x sucrose%. Data statistically analyzed according to Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

I. Sowing dates effect:

Results in Table 3 revealed that different sowing dates significantly effected root length, diameter, fresh weight/plant, sucrose%, root and sugar yields/fed, SO_4% and N%, in both seasons. Early sowing date 1st October surpassed the other two sowing dates for root diameter, root fresh weight, root and sugar yields/fed in both seasons. While, the medium sowing date to 15th October was the best for root length and sucrose%. For, the late sowing date to 1st November, it gave the highest SO_4% and N%. It could be noted that early sowing date to 1st October gave the highest values for root and sugar yields/fed. These results may be attributed to favorable conditions which encountered within the early growth stage of seedlings that could boost their growth and yields, and/or the relatively cooler weather in the harvest. In respect to sucrose% significantly decrease to 1st November than the other two sowing dates 1st and 15th October, this result may be attributed to the unsuitable conditions at harvest as a result to late sowing where high temperature on May Table (1), which did not encourage accumulation of sucrose well in root and so purity% was decreased.

Table 3: Effect of sowing dates on growth, quality traits, yields and mineral contents at harvest during 2009/2010 and 2010/2011 seasons.

2009/2010 season										
Characters / Treatments	Root growth traits			Juice quality %			Yields (ton/fed)		Mineral contents	
Sowing dates	RL	RD	RFW	TSS	S	P	Root	Sugar	SO_4%	N%
1st Oct.	29.0	14.5	1.61	22.50	17.37	77.20	29.55	5.13	0.30	1.23
15th Oct.	33.0	12.8	1.34	21.30	18.13	85.12	26.56	4.82	0.42	1.38
1st Nov.	26.0	11.5	1.07	23.10	16.37	70.87	23.84	3.90	0.45	1.61
F. Test	**	**	**	--	**	--	**	**	**	**
LSD at 5%	1.12	0.33	0.16	NS	0.55	NS	0.22	0.13	0.02	0.05
2010/2011 season										
1st Oct.	25.0	13.7	1.49	22.00	17.20	78.18	30.36	5.22	0.27	1.30
15th Oct.	30.0	11.5	1.29	21.00	18.30	87.14	27.54	5.04	0.30	1.39
1st Nov.	22.0	10.5	1.08	23.30	16.60	71.24	26.20	4.35	0.38	1.60
F. Test	**	**	**	--	**	--	**	**	**	**
LSD at 5%	0.95	0.12	0.02	NS	0.11	NS	0.10	0.12	0.01	0.03

RL= Root length (cm), RD = Root diameter (cm), RFW = Root fresh weight Kg/plant, TSS = Total soluble solids%, S= Sucrose%, P = Purity%. Oct. = October and Nov. = November.

Otherwise, the medium sowing date, gave the highest sucrose%. In respect to decrease of minerals content, the results may be attributed to the early sowing which led to harvest at suitable conditions and consequently Table (1), root fresh weight and decrease in minerals content in juice as compared

with the sowing. Similar results were recorded by Allam *et al.* (2005), Ismail *et al.* (2006), El-Geddawy *et al.* (2007), Mosa (2009) and El-Hosry *et al.* (2010).

II. Effect of soil application with calcium poly sulfide $CaSO_4$ (30% sulphur):

Results in Table 4 indicated that soil application with sulphur ($CaSO_4$) at the level of 250 kg $CaSO_4$/fed significantly increased in root diameter, fresh weight, sucrose%, purity%, root and sugar yield/fed as compared with control (zero sulphur) in both seasons. The level of 125 kg $CaSO_4$/fed significantly increased root length in both seasons. It could be noted that soil application with 250 kg $CaSO_4$/fed gave the lest value for TSS% and highest values for SO_4% and N% in both seasons. This increase in growth traits might be principally due to that sulphur element may be oxidized by soil microorganisms to sulphuric acid which in turn lowers soil pH and increase the availability of certain plant nutrients notably phosphorus and several of micronutrients i.e. iron (Fe), manganese (Mn), zinc (Zn) and thus increasing plant uptake of these nutrients which led to increasing photosynthesis products which emigrate to storage sites in sugar beet (El-Kammah and Ali (1996). These findings are in the same line with those published by Nemeat Alla (2005) who reported that root length and diameter of sugar beet were gradually increased with increasing sulphur level. This increase in growth might be due to applying sulphur led to increasing the availability of plant nutrient from soil such as P, K, Mg, Fe, Mn and Zn and hence on root and sugar yields/fed (El- Kammah and Ali, 1996 and Hashem *et al.*, 1997). These finding confirmed the previous reports of Nemeat Allah (2005), Zeinab *et al.* (2006), Awad Allah *et al*. (2007) and Ferweez *et al*. (2011) found a positive and significant effect on root growth, quality traits and yields/fed due to mineral sulphur fertilization.

Table 4: Effect of sulphur on roots growth, quality traits, yields/fed and mineral contents at harvest during 2009/2010 and 2010/2011 seasons.

2009/2010 season										
Characters / Treatments	Root growth traits			Juice quality %			Yields (ton/fed)		Mineral contents	
$CaSO_4$ (kg/fed)	RL	RD	RFW	TSS	S	P	Root	Sugar	SO_4 %	N%
Zero	25.00	11.1	1.18	23.80	16.40	68.91	25.63	4.20	0.20	1.36
125	32.00	12.7	1.30	22.75	17.37	76.35	26.52	4.61	0.25	1.55
250	28.00	13.0	1.53	21.00	18.10	86.19	27.81	5.03	0.35	2.18
F. Test	**	**	**	--	**	--	**	**	**	**
LSD at 5%	2.10	0.40	0.02	NS	0.23	NS	1.55	0.24	0.02	0.65
2010/2011 season										
Zero	22.00	10.4	1.15	23.22	16.13	69.47	27.05	4.36	0.23	1.29
125	29.00	11.4	1.29	21.77	17.53	80.52	28.14	4.93	0.27	1.50
250	25.00	12.1	1.42	21.02	18.43	87.68	28.91	5.33	0.39	2.12
F. Test	**	**	**	--	**	--	**	**	**	**
LSD at 5%	1.12	0.14	0.01	NS	0.10	NS	1.12	0.11	0.01	0.55

RL= Root length (cm), RD = Root diameter (cm), RFW = Root fresh weight Kg/plant, TSS = Total soluble solids%, S= Sucrose%, P = Purity%.

III. Interaction effects:

Results in Table (5) found that the interaction between sowing dates and soil $CaSO_4$ application led to a significant effect on sucrose%, root and sugar yields/fed in both seasons.

Table 5: Interaction between sowing dates and soil application with $CaSO_4$ in both seasons.

2009/2010 seasons									
Traits	**Sucrose%**			**Root yield**			**Sugar yield**		
Sowing	**Sulphur ($CaSO_4$ kg/fed)**								
Dates	**Zero**	**125**	**250**	**Zero**	**125**	**250**	**Zero**	**125**	**250**
1st October	16.80	17.30	18.00	28.23	29.00	31.43	4.74	5.02	5.66
15th October	17.40	18.00	19.00	25.96	26.66	27.06	4.52	4.80	5.14
1st November	15.00	16.80	17.30	22.70	23.90	24.93	3.41	4.02	4.31
LSD at 5%	1.50			2.02			0.13		
2010/2011 season									
1st October	16.20	17.80	18.60	31.15	32.13	30.63	5.05	5.72	5.70
15th October	17.20	18.60	19.10	26.60	27.73	28.30	4.58	5.16	5.41
1st November	15.00	16.20	17.60	23.40	24.56	27.80	3.51	3.98	4.89
LSD at 5%	0.23			0.27			0.12		

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تاثير مواعيد الزراعة والتسميد المعدنى الكبريتى على محصول وجودة بنجر السكر تحت ظروف الاراضى حديثة الاستصلاح

عادل محمود حسن عثمان
معهد بحوث المحاصيل السكريه - مركزالبحوث الزراعيه - الجيزة.

اقيمت تجربتان حقليتان في موسمي ٢٠٠٩/٢٠١٠ و ٢٠١٠/٢٠١١ بكوم اوشيم بمحافظة الفيوم لدراسة تاثير ثلاثة مواعيد الزراعة وهى الاول من اكتوبر والنصف الثانى من اكتوبر والاول من نوفمبر والاضافة الارضية للسماد الكبريتي المعدنى فى صورة كالسيوم بولى سلفيد ٣٠% كبريت بثلاثة معدلات (صفر و ١٢٥ و ٢٥٠ كجم كالسيوم بولى سلفيد/فدان) مرتين بعد ٤٥ و ٧٥ يوم من الزراعة علي بنجر السكر صنف (كاوميرا).

واوضحت النتائج مايلي:

- سجل ميعاد الزراعة المبكر الاول من اكتوبر زياده معنويه لقطر الجذر ووزن الجذر الطازج ومحصولى الجذور والسكر بينما انخفضت عنويا محتوى الجذور من الكبريت والنيتروجين فى كلا الموسميين مقارنة بمواعيد الزراعة الاخرى بينما ادت الزراعة فى ١٥ من اكتوبر لاعلى طول جذر والنسبة المئوية للسكروز فى كلا الموسميين على التوالى.
- ادت الاضافة الارضية لسماد الكبريت المعدنى عند مستوى ٢٥٠ كجم/فدان الى زيادة معنوية بالنسبة لقطر الجذر والوزن الطازج للجذر والنسبة المئوية للسكروز ومحصولى الجذور والسكر طن/فدان كما اعطت اعلى نسبة كبريت ونيتروجين فى كلا الموسميين مقارنة بالكونترول او الاضافة الارضية ب ١٢٥ كجم/فدان.
- ادى التفاعل بين ميعاد الزراعة المبكر الاول من اكتوبر مع زيادة معدل اضافة السماد المعدنى الكبريتى حتى ٢٥٠ كجم/فدان الى زيادة معنوية لكلا من محصولى الجذور والسكر طن/فدان بينما سجل ميعاد الزراعة المتوسط ١٥ من اكتوبر مع ٢٥٠ كجم كبريت/فدان لزيادة معنوية فى النسبة المئوية للسكروز فى كلا الموسميين.
- تحت ظروف منطقة كوم اوشيم بالفيوم ينصح بزراعة البنجر فى الميعاد الاول من اكتوبر مع اضافة السماد المعدنى الكبريتى بمعدل ٢٥٠ كجم كالسيوم بولى سلفيد/فدان للحصول على اعلى محصول جذور وسكر طن/فدان.

قام بتحكيم البحث

أ.د / محسن عبد العزيز بدوى	**كلية الزراعة – جامعة المنصورة**
أ.د / شفيقه نصر مصطفى	**مركز البحوث الزراعيه**