VARIETAL RESPONSE OF SUGAR BEET TO FOLIAR APPLICATION TIME OF MICROELEMENTS MIXTURE

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ABSTRACT

The present investigation was carried out at Sakha Agricultural Research Station, Agricultural Research Center, Egypt during the two successive seasons 1998/99 and 1999/2000 seasons to study the response of seven sugar beet cultivars to number of foliar application with mixture of microelements. The seven cultivars were lola, Toro, Farida, Pleno, Oscar poly, Nejma and Betapoly. The mixture of the studied microelements consists of Zn, Fe, Mn, Cu, B and Mo. The plants spraied with the mixture of microelements once at 50 days from planting and twice at 50 and 65 days from planting. Cutlivars exhibited significantly differences in dry matter (g/plant), root yield, and sugar yield, in favour Toro and Farida cultivars combared with the cultivar Lola in both seasons. Foliar spraying twice with the mixture of microelements significantly increased root length and diameter, dry matter, root yield, Top yields, TSS %, sucrose percentage, sugar yield. On the other hand, repeating foliar spraying with of microelements signifiantly decreased root /top ratio in both seasons.

Foliar application with the mixture of microelements twice at 50 and 65 days from planting significantly increased root length and diameter, dry matter, root and top yields/fed, TSS%, sucrose percentage and sugar yield/fed. than spraying the mixture once at 50 days from planting or with water. On the other hand, raising the number of spraying with the mixture of microelements from zero to twice decrease root/top ratio in both seasons.

So, we can concluded that foliar application of the mixture of micronutrients twice, at 50 and 65 days from sowing for cultivars Toro and Farida gave the highest results from sugar root and sugar yields/fed.

INTRODUCTION

Most of the Egyption soil tended toward Alkline properties such condition negatively affected elements availability. Also, the cropping system and continuous use of the cultivated soils in most Egyption soil increased the problem (El-Mowelhi *et al*. 1973) furthermore, soil treatments with salts of the micronutraints may be are not the suitable method for plant nutrition specially that most of the unsuitable conditions of soil properties which soil cause element deficiency still exist.

Foliar application of these elements may has the beneficial effects especially under the unfavorable soil conditions.

Several investigators reported that foliar application of sugar beet plants with microelements singly (Zbarage *et al.,* 1968, Bedrinets *et al*., 1975 and Nishio *et al*., 1985) or in mixtures (Kalimeri and pellumbi, 1982 and Nemeat Alla 1997) increased the yield and its components. The present investigation was carried out to study the response of seven sugar beet cultivars to foliar application of some micronutrients.

MATERIALS AND METHODS

Two field experiments were conducted at Sakha Agricultural Research Station, Kafre El-Sheikh, Egypt in 1989/99 and 1999/2000 seasons. The preceding crops were cotton and maize in the first and second seasons, respectively.

Chemical properties of the experimental soil are presented in Table 1.

Table 1. Chemical analysis of experimental soils (0-30 cm depth) at farm of Sakha Research Station, Kafr El-Sheikh in 1998/99 and 1999/2000 seasons.

Season	Soil reaction pH	Microelements conc. ppm					
		Cu	Mn	Zn	Fe	B	Mo
1998/99	8.3	0.7	2.8	0.51	6.6	0.67	0.30
1999/2000	8.5	0.16	2.1	0.60	7.2	0.54	0.25

Each experiment induded 21 treatments which were the combination of seven multigerm sugar beet cultivar namely lola, Farida, Pleno, Oscar poly, Nejme and Bete poly and three application time of microelements mixtue namely 9, 1 and 2 as foliar spraying solution of microelements mixture which was contained 1 g from each of zinc sulphate, Iron sulphate, Manganese sulphate, Boric acid and Ammonium molybdate and 0.5 g of copper sulphate per letter water. The mixture of microelement was sprayed once

at 50 days after sowing (DAS) and twice at 50 and 65 DAS. Foliar spraying with water was used as control.
The experimental desigen was a split-plot with four replications. The main plots were assigned to cultivars and the sub-plot to microelement treatments.
The sub-plot size was 21 m^2. Each sub-plot contained 6 ridges 50 cm apart and 7 m-long. Sowing took place on November, 15 and 2 in 1998 and 1999, respectively in hill spaced 20 cm apart with the ridge. Nitrogen fertilizer was applied at level of 90 kg N/fed. in the form of ammonium nitrate (33.3% N) in two equal doses, the first dose was added after thinning (40 days after sowing) and second one was applied 20 days later.
The commone agricultural practices were done as usual in commercial sugar beet field. At harvest, 4-guardid ridge were harvested topped and weighed to determine top and root yields. A sample of 10 sugar beet roots were randomely taken to determine root length, root diameter and juice quality (Sucrose percentage) which was determined polarimetrically according to the method of Le Docte (1927). The clear juice purity was determined according to the method of Silin and Silina (1977).
The collected data were subjected to standard analysis of variance and treatment means were compared by Duncan's multiple range test (Duncan, 1955). All statistical analysis were performed using analysis of variance technique by means of (IRRSTAT) computer software package.

RESULTS AND DISCUSSION

A- Growth characters :

A-1- Root length :

Root length of seven sugar beet cultivar as affected by number of foliar spraying with microelements mixture was presented in Table 2. Cultivars revealed no significant differences in root length at harvest in the two seasons. Two foliar spray of microelements mixture signifiantly increased root length compared to control in both seasons. This may be due to increase the rate of during applied micronutrients which provide beet plants with the necessary uptake growing season. In this connection, Nemeat Alla (1997) found that repeating foliar spraying with substaintially increased root length of sugar beet plants.
The interaction between cultivars and application number of microelements had a significant effect on root length at the first season only. Table 3 cultivar toro, Farida and Pleno plants sprayed twice with microelements mixture produced the highest root length while Lola plants sprayed with water and Beta poly plants sprayed with water or once produced the lowest.

A- 2- Root diameter :

Data in Table 2 showed that caltivar had no significant differences in root diameter at harvest in both seasons. Plants sprayed with mixture of microelements significantly exceeded those sprayed with water (control) in both seasons. A significant increase in root diameter was accompanied to each increment of foliar application. These findings were in line with those found by Saif (1991), Mohamed (1993) and Nemeat Alla (1997).
Root diameter was significantly influenced by the interaction between both factors in the first season, only. Table 4. Nejma plants sprayed twice with microelements mixture produced the highest root diameter while oscar plants sprayed with water produced the lowest.

Table 2. Root length and root diameter as affected by the cultivars and number of foliar application time of micronutrients mixture in 1998/99 and 1999/2000 seasons.

Factors	Root length cm		Root diameter cm	
	1998/99	1999/2000	1998/99	1999/2000
Cultivars				
Lola	28.16	28.73	14.78	15.74

Toro	29.92	29.32	14.58	15.53
Farida	30.05	29.86	14.43	14.75
Pleno	29.91	29.74	14.33	15.51
Oscar	29.22	28.58	13.63	14.09
Nejma	29.75	29.33	14.97	15.19
Beta poly	27.71	26.69	13.94	14.95
F. test	NS	NS	NS	NS
No. of spraying				
O	28.68b	28.36c	13.98c	14.85c
1	29.20ab	28.82b	14.39b	15.11b
2	29.86a	29.49a	14.78a	15.37a
F. test	**	**	**	**
Interaction	**	NS	**	NS

***, ** and NS indicate P<0.05, p<0.01 and not significant, respectively.**
Means of each factor designated by the same latter are not significantly different at 5% level using Dincan's Multiple Range Test.

Table 3. Root length as affect by the interaction between caltivars and foliar spraying of microellments in 1998/99 season.

No. of spraying	Cultivars						
	Lola	Toro	Farida	Pleno	Oscar	Nejma	Beta poly
0	27.20i	29.05g	29.55daf	29.35efg	28.88g	29.30fg	27.40i
1	28.00h	29.98cd	29.88g	29.93fg	29.18fg	29.78cde	27.65hi
2	29.28fg	30.73a	30.73a	30.45ab	29.60def	30.18bc	28.08h

Table 4. Root diamter as affect by the interaction between caltivars and foliar spraying of microellments in 1998/99 season.

No. of spraying	Cultivars						
	Lola	Toro	Farida	Pleno	Oscar	Nejma	Beta poly
0	14.48efg	14.08igk	14.00igk	13.90kl	13.08n	14.55ef	13.75lm
1	14.80cd	14.65de	14.40fg	14.30gh	13.65m	14.98bc	13.95gkl
2	15.08bc	15.00bc	14.90bc	14.80cd	14.18hi	15.38a	14.13hid

A-3- Dry matter accumulation :

Cultivars varied significantly in dry matter accumulation (g/plant) at harvest in the two seasons (Table 5). The two cultivars Toro and Farida accumulated the largest dry matter (g/plant), while the cultivar Beta poly accumulated the lowest dry matter.

Table (5): Dry matter (g/plant), root yield top yield and root/top ratio as affected by the cultivars and foliar application time of micronutrients mixture in 1998/00 and 1999/2000 seasons.

Factors	Dry matter g/plant		Root yield ton/fed		Top yield ton/fed.		Root/top ratio %	
	1998/99	1999/2000	1998/99	1999/2000	1998/99	1999/2000	1998/99	1999/2000
Cultivars								
Lola	196.07b	190.09b	26.94d	26.92de	7.68	8.00	5.76	5.78
Toro	211.03a	204.63a	30.45a	32.14a	7.21	7.36	5.78	5.75
Farida	210.36a	205.51a	29.96ab	31.42b	6.53	7.11	5.84	5.71
Pleno	196.34b	189.47bc	28.37c	26.76e	6.95	7.29	5.72	5.71
Oscar	196.28b	187.03b	28.53c	28.63d	7.09	7.37	5.67	5.65
Nejma	198.42b	185.94c	26.77d	26.26e	7.35	7.63	5.69	5.71
Beta poly	180.55c	178.48d	29.83b	30.24c	7.08	8.53	5.87	5.84
F. test	**	**	*	*	NS	NS	NS	NS
No.ofspraying								
O	197.14c	190.59b	28.39c	28.64c	6.95c	7.50c	5.81a	5.80a
1	198.46b	191.43ab	28.69b	28.91b	7.12b	7.62b	5.75b	5.73b
2	199.71a	192.70a	29.00a	29.18a	7.31a	7.73a	5.73c	5.68c
F. test	**	**	**	**	**	**	*	**
Interaction	*	NS	*	NS	*	NS	NS	NS

***, ** and NS indicate P<0.05, P<0.01 and not significant, respectively.**
Means of each factor designated by the same latter are not significantly different at 5% level using Dincan's Multiple Range Test.

Foliar spray of microelements had a significant effect on dry matter accumulation (g/plant) at harvest in the two seasons. Plants sprayed with mixture of microelements produced the greatest dry weight/plant

compared with control plants. Similar results were obtained by Ibrahim *et al*. (1988), Saif (1991), Mohamed (1993) and Nemeat Alla (1997).
The interaction between both factors had a significant effect in the first season only. Table 6. Toro plants sprayed Once or Twice and Farida sprayed twice with miroelements mixture produced the highest dry matter g/plant while Beta poly plants sprayed with water or Once and Twice produced the lowest.

Table 6. Dray matter (g/plant) as affect by the interaction between caltivars and foliar spraying of microellments in 1998/99 season.

No. of spraying	Cultivars						
	Lola	Toro	Farida	Pleno	Oscar	Nejma	Beta poly
0	196.18ef	208.28cd	206.23d	195.90ef	196.17ef	197.69ef	179.52g
1	196.48ef	211.44abc	210.24bc	196.25ef	196.44ef	198.21ef	180.20g
2	195.56f	213.37ab	214.63a	196.86ef	196.24ef	199.37e	181.93g

A-4- Root/top ratio :
Cultivars revealed no significant differences in root/top ratio at harvest in both seasons Table 5.
Foliar application of micronutrients misture significantly decreased root/top ratio compared with control in both seasons. In this conection, Nemeat All (1997) found that foliar application of microelements exhabited insignificant effect on root/top ratio.

B- Root and Top yields :
B-1- Root yield :
Root yield per feddan as affected by cultivars and microelements are presented in Table 5. Cultivars exhibited significant differences in root yield per feddan in both seasons. Toro and Farida cultivar produced the highest root yield per feddan, while Nejma cultivar produced the lowest one in both seasons. Farida and Toro cultivars did not differ in root yield in the first season.
Foliar spraying with microelements mixture signifiantly increased root yield per feddan compared to spraying with water in both seasons.
Plants sprayed twice with mixture of microelements significantly surpassed those sprayed once in this respect. The increase in root yield with application of microelements mixture may be attributed to the increase in root size. Similar results were obtained by Ibrahim *et al*. (1988), Mohamed (1993) and Nemeat Alla (1997), who found that application of micronutrients mixture resulted in the highest root yield.
The interaction between cultivars and foliar spraying of microelements was significant in the first season only. (Table 7). Toro plants sprayied once or twice with microelements mixture produced the highest root yield/feddan, while Nejma plants sprayed with water produced the lowest one.

Table 7. Root yield (ton/fed.) as affect by the interaction between caltivars and foliar spraying of microellments in 1998/99 season.

No. of spraying	Cultivars						
	Lola	Toro	Farida	Pleno	Oscar	Nejma	Beta poly
0	26.42L	30.19b	29.71de	28.15h	28.19h	26.49L	29.59e
1	26.93fk	30.47a	29.97bc	28.37gh	28.46g	26.77k	29.85cd
2	27.49i	30.68a	30.22b	28.59g	28.95f	27.05j	30.05bc

B-2- Top yield :
The studied sugar beet cultivars revealed no significant effect on top yield at harvest in both seasons, Table 5.
Top yield per feddan was significantly influenced by foliar application of microelements mixture compared with control in both seasons. Repeating foliar spray with microelement mixture significantly increased top yield per feddan in the two seasons. Such increment in top yield obtained from spraying with microelements mixture is due to more dry weight. Saif, (1991) found that top yield was increased by increasing the rate of Zn from 0 to 4 kg/fed. in soil application. Nemeat Alla (1997) found that repeating foliar application of micronutrients mixture exert a significant effect on top yield.
The interaction between cultivars and number of spraying with microelements had a significant effect on top yields at harvest in the first season, only. Table 8. Beta poly plants sprayed Once and Twice with microelements mixture produced the highest top yield/fed. while Farida plants sprayed with water produced the lowest.

Table 8. Top yield (ton/fed.) as affect by the interaction between caltivars and foliar spraying of microellments in 1998/99 season.

No. of spraying	Cultivars						
	Lola	Toro	Farida	Pleno	Oscar	Nejma	Beta poly
0	7.46cd	6.99h	6.36p	6.77m	6.94L	7.22fg	6.93L
1	7.68b	7.19g	6.55o	6.96kl	7.09i	7.35e	7.05j

2	7.89a	7.44d	6.70n	7.14h	7.25f	7.49c	7.26f

C- Quality parameters :

C-1- Total soluble solids percentage (TSS %) :

Data in Table 9 showed that sugar beet cultivars exhibeted no significant difference in TSS % in both seasons.

Table (9): TSS %, sucrose %, Juice purity % and sugar yield as affected by the cultivars and foliar application time of micronutrients mixture in 1998/00 and 1999/2000 seasons.

Factors	TSS %		sucrose %		Juice purity %.		sugar yield ton/fed	
	1998/99	1999/2000	1998/99	1999/2000	1998/99	1999/2000	1998/99	1999/2000
Cultivars:								
Lola	21.33	20.89	17.85	17.42	83.70	83.38	4.80d	4.69d
Toro	22.37	22.22	18.82	19.00	84.13	85.50	5.73a	6.10a
Farida	21.30	20.73	18.68	16.92	87.69	81.62	5.59ab	5.31ab
Pleno	21.39	21.20	18.14	17.51	84.80	82.59	5.14b	4.68c
Oscar	21.78	21.66	18.44	17.58	84.63	81.16	5.26b	5.03b
Nejma	21.91	21.28	18.88	17.66	86.19	82.98	5.05c	4.63cd
Beta poly	21.56	21.28	17.67	16.89	81.88	77.40	5.27b	5.10b
F. test	NS	NS	NS	NS	NS	NS	*	*
No. of spraying:								
O	21.38c	21.01c	18.02c	17.30c	84.41	82.34	5.11c	4.95c
1	21.68b	21.35b	18.21b	17.58b	83.94	82.34	5.22b	5.08b
2	21.93a	21.61a	18.39a	17.83a	83.76	82.50	5.33a	5.20a
F. test	**	**	**	**	NS	NS	**	**
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

***, ** and NS indicate P<0.05, P<0.01 and not significant, respectively.**

Means of each factor designated by the same latter are not significantly different at 5% level using Dincan's Multiple Range Test.

Repetition of foliar spraying with microelements mixture signifiantly increased TSS % compared with control in both seasons. Saif (1991) who found that TSS % was increased by increasing Zn from 0 to 4 kg/fed. Mohamed (1993) and Nemeat Alla (1997) who stated that TSS % was increased by application of micronutrients mixture.

C-2- Sucrose percentage:

cultivars had no significant effect on sucrose % in both seasons (Table 9).

Foliar spraying with mixture of microelemets significantly increased sugar percentage compared with control. Similar results were obtained by Genaidy (1988) and Saif (1991) who reported that application of boron raised sugar percentage in sugar beet roots.

C- Juice purity :

Data in Table 9 revealed no significant differences among cultivars in juice purity % in the two seasons. Micronutrients application had no significant effect on juice purity percentage. Saif (1991) stated that juice purity was increased by increasing the rate of B. up to 1 kg B/fed.

D- Sugar yield :

Sugar beet cultivar varied significantly in sugar yield per feddan in both seasons Table 9. Cultivar Toro surpassed, Pleno, Nejma, Beta poly, Oscar and Lola in this respect. The two cultivars Toro and Farida did not differ in sugar yield per feddan in both seasons. The greatest increase in sugar yield for Toro and Farida cultivars may be due to their superiority in root yield.

Sugar yield was significantly increased by foliar application of microelements compared with control in both seasons. Increasing sugar yield with foliar application of microelements mixture may be due to the increase in sucrose % and root yield per feddan. Similar results were obtained by Mohamed (1993) who found that the highest sugar yield from application of microelements mixture.

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إستجابة بعض أصناف بنجر السكر لعدد مرات الرش الورقى بمخلوط العناصر الصغرى

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أقيمت تجربتان حقليتان بمزرعة محطة البحوث والتجارب الزراعية بسخا – مركز البحوث الزراعية خلال موسمى ١٩٩٨/١٩٩٩ و١٩٩٩/٢٠٠٠ وذلك لدراسة استجابة سبعة أصناف من بنجر السكر Lola, Toro, Farida, Pleno, Oscar, Nejma, Beta poly للرش بمخلوط من العناصر الصغرى ١جم من كل من (سلفات الزنك – سلفات الحديدوز – سلفات المنجنيز – حمض البوريك – موليبيدات الأمونيوم، ٠,٥جم من كبريتات النحاس).
وقد تم الرش بمخلوط هذه العناصر مرة واحدة بعد ٥٠ يوم من الزراعة ثم مرتين بعد ٥٠، ٦٥ يوم من الزراعة علاوة على الرش بالماء كمعاملة للمقارنة.
إتبع فى تنفيذ التجربة القطع المنشقة مرة واحدة فى أربع مكررات حيث وضعت الأصناف فى القطع الرئيسية بينما شغلت القطع الشقية عدد مرات الرش بمخلوط العناصر الصغرى.
ولقد أوضحت النتائج المتحصل عليها ما يلى :

1- اختلفت الأصناف فيما بينها فقد تفوق الصنفان Toro, Farida فى الوزن الجاف للنبات ومحصول العرش والجذور ومحصول السكر عن باقى الأصناف.

2- أدى رش نباتات بنجر السكر بمخلوط العناصر الصغرى مرتين عند عمر ٥٠ يوم ثم عند عمر ٦٥يوم من الزراعة أفضل النتائج من حيث طول وقطر الجذور والوزن الجاف ومحصول الجذور للفدان ونسبة المادة الصلبة الذائبة ومحصول السكر للفدان تحت ظروف محافظة كفرالشيخ.

3- لم يظهر التفاعل بين الأصناف والعناصر الصغرى فروقاً معنوية على الصفات المدروسة ما عدا طول الجذر وقطره والمادة الجافة ومحصول العرش والجذور فى العام الأول فقط.