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EFFECT OF FOLIAR FERTILIZATION WITH UREA AND GIBBERELLIC ACID ON SUGAR BEEt (*Beta vulgaris* L.).

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ABSTRACT

Two field experiments were carried out at EL-Serw Agricultural Station Dommiata Governorate North East Delta during the seasons of 2006//2007 and 2007/2008 to study the effect of foliar treatments with urea at concentration of (0,1%,2%) and GA_3 at concentration of (0,100,200ppm) on yield and quality of sugar beet cv. Sultany.

The important results could be summarized as follows:

1- Foliar application with urea at concentration of 1% and 2% significantly increased root length, TSS% in the first season , also increased root diameter ,root fresh weight and sucrose % in the second season ,root and sugar yields in both seasons.

2-GA_3 at 200ppm gave the highest significant results of root length in the first season ,root diameter ,root fresh weight ,purity % in the second season,also increased sucrose %,root and sugar yields in both seasons.

3-Interaction effect between urea foliar solution and GA3 was significant on sucrose %,TSS%, ,root fresh weigh in the second season and insignificant effect on root diameter ,root length,purity% and root and sugar yields in both seasons.

INTRODUCTION

Sugar beet is an important source for sugar production. About 45% sugar in the world wide is normally produced from beet.Recentaly sugar beet has become an important source for sugar in Egypt. Increasing sugar production from land unit is considered one of the important national target in Egypt to minimize sugar gap between production and consumption. Economically sugar beet was found to be a suitable source of sugar under Egyptian conditions especially in northern part of the country.

Foliar application of plant nutrient can be very efficient under certain condition.for minimizing these unfavourable conditions(costs)and hazard (pollution),leaves are only take up a relatively small quantities of nutrient in comparison with the plant demand.The common form application urea ,which is readily taken up and metabolized in the leaf tissue. In the world and Egypt very little researches has been conducted.In this connection many investigators has confirmed the importance of macro elements and GA_3 on yield and quality of sugar beet ,Lamb and Morghan (1993)found that 25kgN/ha as foliar application increased root yield by 2.5t/ha and extractable sugar by 0.9t/ha, Barsoum and Zeinab (1995) recorded that foliar application of fodder beet plants with 4% urea produced the highest values of each root length and diameter ,top ,root fresh weight and dry weight. Badawi(1996) found that using urea as foliar spray had significant effects on root diameter ,root and foliage fresh weight ,root and top yields as well as sugar yield/fad ,however root length,T.S.S%,sucrose%,purity % and harvest index did not affect, Mahasen,Fahmi(1999) found that foliar nutrition of urea had significant

effects on most of characters as, root fresh weight and dry weight ,foliage fresh weight and dry weight which markedly increased as urea concentration increased from 0 to1 and 2% of foliage weight and root/top ratio reached its maximal with foliar spraying of nitrogen as urea at 2%concentration. Root,sugar and top yields as well as harvest index were markedly affected by foliar of urea at 2% which gave the highest root and sugar yields t/fad as well as sugar percentage in roots,TSS% and juice purity were markedly affected by foliar nutrition. Urea at 2% increased sugar percentage ,while tap water recorded the lowest means of this trait.

On the response of the effect of GA_3 on growth ,yield and quality of sugar beet .Shehata,Mona(1989), found that GA_3 at 300ppm gave the highest root diameter ,root length ,root fresh weight ,TSS%, sucrose%, purity%, root and sugar yields .Moustafa Shafika,*et al* (2001) and Moustafa Zeinab,*et al* (2001) and El-Taweel,Fayza *et al*(2004) found that foliar application of GA_3 at 300ppm significantly produced the highest root diameter,root length ,root weight in g/plant,total soluble solids (TSS)%,sucrose ,juice purity percentage as well as root and sugar yields /fed in both seasons.

The aim of the present research was to study the response of sugar beet to foliar fertilization of Urea and gibberllic acid to maximixe sugar yield and reduce cost as well as pollution.

MATERIALS AND METHODS

Two field experiments were carried out at El-Serw Agricultural Station Dommiatta Governorate North East Delta during the winter growing seasons of 2006/2007and 2007/2008 to study the effect of foliar treatment with urea at concentration of (0,1%,2%) and GA_3 at concentration of (0,100,200ppm) on growth ,yield and quality of sugar bee t cv. Sultany.

Split plot design with four replications adopted .The main plots were allocated with urea at concentration of (0,1%,2%) ,The sub plots were occupied GA_3 at rate of (0,100,200ppm).The experimental area were divided into the experimental unit included 5 ridges ,60 cm apart and 3.5 long occuping an area of $10.5m^2$i.e 1/400/fed.The date of sowing was 20 November in the two growing seasons 2006/2007 and 2007/2008 respectively.The preceeding crop was Rice(Oryza sativa L.) in both seasons,The texture of the experimental soils was heavy clay and poor in organic matter (1.8%) The aformentioned soil properties were determined according to the method described by Jackson(1967)

Four seeds were hand sown on one side of the ridge in hills 20cm apart using the dry method ,The plants were irrigated immediately after sowing . The plants were thinned to one plant for hill at thirty days from sowing. Weeds were controlled by hand pulling and hoeing during the growth period.Other agricultural practices were carried out in the manner prevailling in the region except for the factors under study .

Table(1): Mechanical and chemical analysis of the experimental site in surface (0- 30cm) for the two seasons

Mechanical and chemical analysis	Seasons	
	2006/07	2007/08
Clay%	62.2	63.6
Silt%	22.7	21.6
Sand%	13.3	13.0
Organic matter%	1.8	1.8
Available N(p.p.m)	62.0	60.3
Available P(p.p.m)	16.3	16.2
Exchangable K (p.p.m)	37.7	36.7
CaCo3%	1.9	2.5
PH	8.0	8.1

Calcium super phosphate (15.5% P_2O_5) at the rate of 100kg was applied during tillage operation Nitrogen at rate of 60kgN/fed in the form of urea (46.5%) were split in two equal doses ,one half being applied after thinning (two months from sowing).Aqueous solutions of urea were prepared using distilled water.The nutrient solution was sprayed two times at 60and 90 days after sowing as previously mentioned concentration (0.1 ,2% urea).The other cultural practices were kept the same as normally practiced in sugar beet fields.GA_3 at rate of 100 and 200ppm was used .Plants were sprayed twice with growth regulator (GA_3) at 60and 90 days after planting. At harvest (after 200 days from sowing a sample of ten plants were taken up at random from the two inner ridges in each experimental area and the following characteristics were recorded :

1-Root diameter(cm)
2-Root length(cm)
3- Root fresh weight g/plant
4- T.S.S % Total soluble solids was determined by hand refractometer
5- Sucrose % was determined as described by Le Docte (1927).
6- Purity percentage was calculated according to the following equation:

Purity % = Sucrose% x 100/T.S.S%

7- Root yield (t/fad) was estimated on the hole plot basis.
8- sugar yield (t/ fad) was calculated according to the following equation :

Sugar yield = Root yieldx Sucrose%

The collected data were statistically analized according to the method described by Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

1-Root diameter(cm)

Data presented in Table (2) clearly show that addition of urea as foliar solution at 1% or 2% significantly increased root diameter compared with zero concentration of urea in the second season. The highest values of root diameter were obtained with urea foliar 2% concentration(10.76 cm) compared with untreated of urea spray (9.35 cm) while there is insignificant effect in the first season . These increase may be due to increasing

photosynthetic area which resulted in increasing photosynthetic gains.These results are in good accordance with those obtained by Badawi(1996), Barsoum and Zeinab Nassar (1995) and Mahasen, Fahmi(1999) .

Using GA_3 significantly increased root diameter in the second season while it had insignificant effect in the first season. The highest values of root diameter(10.95cm) with the treated of GA_3 at concentration of 100 ppm in the second season , as shown in Table (2).The increase in root diameter may due to rapid growth by GA_3 and in turn vigorous plants .These results are in good agreement with El-Kassaby *et* al (1988) Moustafa,Zeinab *et al* (2001) and El–Taweel ,Fayza *et a l*(2004).

There was insignificant effect due to the interaction between (A) Urea concentration and (B) GA3 on root diameter in both seasons.

Table (2): Effect of urea and GA_3 foliar treatments on root diameter , root length and root fresh weight of sugar beet in seasons of 2006/2007 and 2007/2008.

Treatment		Root diameter cm		Root length cm		Root fresh weight g/plant	
		2006/2007	2007/2008	2006/2007	2007/2008	2006/2007	2007/2008
Urea foliar concentration	A1: zero	10.33	9.35	22.82	20.06	531.69	530.69
	A2: 1%	10.99	10.46	22.73	23.27	847.44	796.24
	A3: 2%	12.86	10.76	24.24	22.70	937.98	863.89
F.Test		N.S	**	*	N.S	N.S	**
LSD0.05			0.44	1.23			14.22
GA3	B1:Zero ppm	10.38	9.42	22.57	21.16	720.88	664.23
	B2: 100ppm	12.40	10.95	23.23	22.65	769.51	758.76
	B3: 200 ppm	11.40	10.20	24.00	22.22	826.72	767.85
F.Test		N.S	**	*	N.S	N.S	**
LSD0.05%			0.64	0.93			16.22
A X B Interactions		N.S	N.S	N.S	N.S	N.S	**

2- Root length(cm)

Illusrated data in Table(2) show that applying of urea as foliar solution at 1% or 2% significantly increased root length compared with zero concentration of urea in the first season while it had insignificant effect in this trait in the second season. The highest values of root length were obtained with urea foliar spraying at 2% concentration (24.24 cm) compared with untreated which resulted (22.82 cm).These increase may be due to increasing photosynthetic area .These results are in good accordance with those obtained by Barsoum and Zeinab Nassar (1995), and Mahasen, Fahmi(1999) .

Applying GA_3 at the rate of 200 ppm as foliar solution on sugar beet plants gave the highest values of root length (24.00 cm) compared with (22.57 cm) for the untreated control (zero ppm) in the first season as shown in Table (2). while it had insignificant effect in this trait in the second season. The increase in root length may due to rapid growth by GA_3 to plants .These results are in good agreement with those obtained by El-Kassaby, *et al* (1988), and Moustafa,Zeinab *et al*(2001).

There was insignificant effect due to the interaction between (A) Urea concentration and (B) GA3 on root length in both seasons.

3-Root fresh weight(g/plant)

Data detected in Table (2) show that applying of urea as foliar solution at 1% or 2% markedly increased root fresh weight(g) compared with untreated control of urea. The highest values of root fresh weight were obtained with urea foliar 2% concentration in the second season which resulted(863.89 g) compared with utreated of urea which gives (530.69g) however it had insignificant effect in the first season .These increase in the second season may be due to increasing photosynthetic area.These results are in good accordance with those obtained by Barsoum and Zeinab Nassar (1995) and, Mahasen,Fahmi (1999).

Using GA_3 at the rate of 200 ppm as foliar solution on sugar beet plants gave the highest values of root fresh weight (767.85g) compared with untreated with GA_3 (664.23 g) as shown in Table (2),while there is insignificant effect on this trait in the first season , The increase in root fresh weight may due to rapid growth of plants treated with GA_3 .These results are in good agreement with El-Kassaby, *et al.* (1988)and Ramadan (1999).

There was significant effect due to the interaction between (A) Urea concentration and (B) GA_3 on root fresh weight in the second season.The highest value was (871.57 g) as result of the interaction between urea foliar solution at 2% and GA_3 at 200 ppm as shown in Table (3).

Table (3): Effect of interaction between (A)urea and (B)GA_3 foliar treatments on root fresh weight(g/plant) in the season of 2007/2008.

Treatments	2007/2008		
	B1	B2	B3
A1	469.67	542.77	579.65
A2	669.67	866.73	852.33
A3	853.33	866.77	871.57
F.test	**		
LSD5%	13.22		

4-Sucrose percentage

Tabulated data in Table (4) calrify that applying of urea as foliar solution at 1% or 2% increased sucrose percentage compared with untreated with urea. The highest values of sucrose percentage were obtained with urea foliar spraying at 1% concentration(17.46%) while the lowest results (16.64% resulted from untreated with urea foliar solution .The results in the first season did not achieve a significant effect on sucrose %.These increase may be due to increasing photosynthetic area which resulted in increasing photosynthetic gains.These results are in good accordance with those obtained by Barsoum and Zeinab Nassar (1995) and Mahasen, Fahmi(1999)

Using GA3 at 200ppm concentration gave sucrose%of (17.26%) in the first season , using GA_3 at the rate of 100ppm as foliar solution on sugar beet plants gave the highest significant results of sucrose percentage,the result was (18.45%) while the untreated of GA_3 gave (15.62 %) in the second season. The increase in sucrose percentage may be due to rapid

growth of plants due to the effect of GA_3 and in turn vigorous.These results are in agreement of El-Kassaby, *et al.* (1988),Ramadan (1999) and Moustafa Shafika ,*et al* (2001).

Table (4): Effect of urea and GA3 foliar treatments on Sucrose%,Total Soluble Solids and purity percentage of sugar beet in 2006/2007 and 2007/2008 seasons.

Treatment		Sucrose %		TSS%		Purity%	
		2006/2007	2007/2008	2006/2007	2007/2008	2006/2007	2007/2008
Urea foliar	A1:Untreated control	17.26	16.64	20.17	19.26	85.57	86.40
	A2 1%	17.37	17.46	20.73	20.68	83.79	84.43
	A3 2%	17.28	76	21.47	21.22	82.68	81.20
F.Test		N.S	*	**	N.S	N.S	N.S
LSD0.05			0.43	0.69			
GA_3	B1: Untreated control	17.19	15.62	20.54	20.32	83.69	76.87
	B2 100ppm	17.25	18.45	20.90	20.22	82.68	91.45
	B3 200 ppm	17.47	17.26	20.93	20.62	83.47	83.71
F.Test		**	**	N.S	N.S	N.S	**
LSD0.05%		0.10	0.62				6.21
A X B interaction		*	N.S	*	N.S	N.S	N.S

There was significant effect due to the interaction between (A) Urea concentration and (B) GA_3 on sucrose %,the highest value was (17.57%) as result of interaction between urea foliar solution at 2% and GA_3 at 200 ppm in the first season as shown in Table (5).

5-TSS%

Data presented in Table (4) indicated that treatments of urea as foliar solution at 1% increased total soluble solids percentage and the results are 20.73 % compared with 20.17% of (untreated with urea) in the first season. While the results did not reach a significant level in the second season . These increase may be due to increasing photosynthetic area which resulted in increasing photosynthetic gains.These results are in good accordance with those obtained by Barsoum and Zeinab Nassar (1995). However, Badawi (1996) found that TSS% did not affected by urea foiar solution.

Using GA3 as foliar solution insignificantly affected TSS% in both seasons (Table 4)

There was significant effect due to the interaction between (A) Urea concentration and (B) GA_3 on TSS% .The highest value was (21.43%) as result of the interaction between urea foliar solution at 2% and GA_3 at 200 ppm in the first season as shown in Table (6).

Table (5): Effect of interaction between urea and GA3 foliar treatmentsin on sucrose % of sugar beet 2006/2007 season.

Treatment	2006/2007		
	B1	B2	B3
A1	17.20	17.23	17.33
A2	17.20	17.40	17.50
A3	17.17	17.10	17.57
F.test	*		
LSD5%	0.174		

Table (6): Effect of interaction between (A)urea and (B)GA_3 onTSS% of sugarbeet in season of 2006/07

Treatment	2006/2007		
	B1	B2	B3
A1	20.37	19.80	20.33
A2	19.93	21.20	21.04
A3	21.31	21.70	21.43
F.test	*		
LSD5%	0.62		

6-Purity percentage:

Data presented in Table (4) showed that there was insignificant effect due to applying urea foliar solution on purity % in both seasons.

Untreated of urea foliar solution resulted the highest values of purity% (85.57and 86.40%) In both seasons.These results are in accordance with those obtained by Badawi (1996).

Using GA_3 at the rate of 100 ppm as foliar solution on sugar beet plants gave the highest results of purity percentage (91.25%) in the second season however it did not reach to significant level in the first season. The increase in purity percentage may be due to rapid growth and in turn vigorous plants. These results are in agreement of El-Kassaby *et al.*(1988) and Ramadan (1999).

There was insignificant effect due to the interaction between (A) Urea concentration and (B) GA_3 on purity% in both seasons(Table 4).

7-Root yield(t/fed):

Data presented in Table (7) showed that there was significant effect due to applying urea foliar solution on root yield in both seasons.

Applying of urea foliar solution 1% or 2% significantly increased root yield (t/fed) compared with untreated control of urea. The highest values of root yield were obtained with urea foliar 2% concentratin which resulted(24.57 and 19.75 t/fed) compared with untreated with urea solution which resulted (18.62, 17.57 t/ed) in both seasons respectively .These increase may be due to increasing photosynthetic area which resulted in increasing photosynthetic gains.These results are in good accordance with those obtained by Lamb and Morghan (1993) Barsoum and Zeinab Nassar (1995), Badawi (1996) and Mahasen, Fahmi(1999).

Using of GA_3 at 100 or 200 ppm markedly significantly increased root yield (t/fed) compared with untreated with GA_3. The highest values of root yield were obtained with 200ppm GA_3 (24.14 and 19.40 t/fed) compared with untreated GA_3 (18.34 and 17.42t/ed) in both seasons .These increase may be due to the effect of GA_3 in increasing growth of the plant. These results are in agreement of those obtained by El-Kassaby, *et al* (1988) and Ramadan (1999)

There was insignificant effect due to the interaction between (A) Urea concentration and (B) GA_3 on root yield in the first and second seasons. It could be stated that foliar spraying of Urea at 2% and GA_3 at 200ppm recorded maximum root yield.

8-Sugar yield(t/fed)

The obtained Data presented in Table (7) shows that adding of urea as foliar solution at 1% or 2% significantly increased sugar yield (t/fed) compared with untreated of urea. The highest values of sugar yield were obtained with urea at 2% concentration (4.25 and 3.34 t/fed) compared with untreated urea solution which resulted (3.28 and 2.92 t/fed) in the first and second seasons respectively . These increase may be due to increasing photosynthetic area which resulted in increasing photosynthetic gains.These results are in good accordance with those obtained by Lamb and Morghan (1993) Badawi (1996) and Mahasen, Fahmi(1999) they found that Urea at 2% gave the highest sugar yields.

Treated of GA3 at 100 or 200 ppm significantly increased sugar yield (t/fed) compared with untreated GA_3.The highest values of sugar yield were obtained with 200 ppm GA_3 which resulted (4.28 and 3.26 t/fed) compared with untreated control with GA_3 (3.15 and 2.72 t/fed) in the first and second seasons.These increase may be due to the effect of GA_3 in increasing growth of the plant.These results are in agreement with El-Kassaby *et al.* (1988), Ramadan(1999), Moustafa Shafika, *et al* (2001), Moustafa Zeinab,*et al* (2001) and El-Taweel,Fayza(2004).

There was insignificant effect due to the interaction between (A) Urea concentration and (B) GA_3 on sugar yield (Table 7).

Table (7): Effect of urea and GA3 foliar treatments on root and sugar yields (t/fed) of sugar beet in seasons of 2006/2007 and 2007/2008.

Treatment		Root yield (t/fed)		Sugar yield(t/fed)	
		2006/2007	2007/2008	2006/2007	2007/2008
Urea	A1: Untreated control	18.62	17.57	3.21	2.92
	A2 1%	21.79	18.46	3.78	3.22
	A3 2%	24.57	19.75	4.25	3.40
F.Test		**	**	**	**
LSD0.05		2.54	2.40	0.48	0.23
GA_3	B1: Untreated control	18.34	17.42	3.15	2.72
	B2 100ppm	22.50	18.96	3.87	3.50
	B3 200 ppm	24.14	19.40	4.22	3.35
F.Test		**	**	**	**
LSD0.05%		0.81	0.73	0.15	0.42
A X B		N.S	N.S	N.S	NS

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تأثيرالتسميد الورقي باليوريا والمعاملة بالجبرلين على بنجر السكر

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أجرى هذا البحث خلال موسمي ٢٠٠٦/٢٠٠٧و ٢٠٠٧/٢٠٠٨ في محطة التجارب الزراعية بالسرو في تربة طينية لدراسة تأثيراستخدام اليوريا كسماد ورقي بتركيز (صفر،١%،٢%)وحامض الجبريلك بتركيز (صفر،١٠٠،٢٠٠جزء في المليون) على النمو والمحصول والجودة في بنجر السكر

أظهرت النتائج أن:

١– التسميد الورقي باليوريا ١% و٢% ادى الى زيادة معنوية في طول الجذر ونسبة الموادالصلبة الذائبةفي الموسم الاول وكذلك قطر الجذر وزن الجذر غض ونسبة السكروزفي الموسم الثاني وكذلك محصول الجذور والسكر في كلا الموسمين.

٢–ادى الرش الورقي بالجبرلين الى الحصول على اعلى القيم لطول الجذر في الموسم الاول وقطر الجذروزن الجذر غض ونسبة النقاوة في الموسم الثاني وكذلك نسبة السكروزومحصول الجذور والسكر في كلا الموسمين.

٣– كان التفاعل معنويا بين كلا العاملين للصفات نسبة السكروزونسبة المواد الصلبة الذائبةوالنقاوةومحصول السكر في الموسم الاول ووزن الجذر غض في الموسم الثاني وغير معنوي لصفات قطر الجذروطول الجذر ونسبة النقاوة%ومحصول الجذوروالسكر في كلا الموسمين.

ويمكن التوصيةبالرش بمحلول اليوريا ٢% ومحلول الجبريلين بتركيز ٢٠٠ جزء في المليون للحصول على أعظم محصول وجودة من بنجر السكر.