PRODUCTIVITY AND QUALITY OF SUGAR BEET AS INFLUENCED BY NITROGEN FERTILIZER AND SOME MICRONUTRIENTS

MOUSTAFA, ZEINAB R., AMAL M. K. SOUDI AND KHALIL EL-SHENAWY M.

Physoil.& Chemi. Res. Sec., Sugar Crops Res. Inst., ARC, Giza, Egypt.

(Manuscript received 6 December 2010)

Abstract

Two field experiments were conducted during 2008/2009 and 2009/2010 seasons at Sakha Research Station, Kafr EL-Shaikh Governorate to study the influence of three nitrogen rates (75, 100 and 125%) of recommended rate (RR=80Kg N/fed), sprayed with Zn, Mn and Fe individually or in mixture, on some chemical composition, juice quality and yield of sugar beet plants.

Decreasing N dressing up to 60 Kg N/fed (75% of RR) significantly decreased photosynthetic pigments (chlorophyll a, b and carotenoids) at the age of 120 days from sowing in the two seasons, also a reduction in sucrose% and some technological parameters such as sugar extractable (SEX), sugar losses to molasses (SLM) and sugar coefficient (Sco), yield component (root length, diameter and fresh weight of tops in the two seasons have been recorded. Yields of roots and sugar, uptake of N, Mn and Zn had the same trend. On the other hand, increasing N dressing up to 100 Kg N /fed (125% of RR) significantly increased photosynthetic pigments i.e. chlorophyll a,b and carotenoids at the age 120 days from sowing in the two seasons, Na, K and α- amino N as impurities, sugar loss to molasses (SLM), yields of roots and sugar but juice purity was significantly decreased.

Foliar spray with Mn, Zn and Fe individually or in mixture significantly increased chlorophyll a, b and carotenoids in both samples in the two seasons. Sucrose% and impurities as K and α-amino N were significantly increased but juice purity was significantly decreased. Root length, diameter, fresh weight of roots and tops, sugar yield were significantly affected. Foliar spray with Zn, Mn and Fe significantly increased their uptake and N uptake. Foliar spray with the mixture of Zn, Mn and Fe exhibited the best treatment, where it gave the highest values of most traits under study.

The interaction between N at the high rate and the mixture of Zn, Mn and Fe was the superior treatment where, it gave the highest values for chl a, b and carotenoids, K, α- amino N, juice purity and N uptake.

Keywords: Nitrogen, Zn, Mn and Fe, sugar beet.

INTRODUCTION

Sugar beet is one of just two crops (the other being sugar cane) which constitute the only important sources of sucrose. In Egypt, sugar production is still insufficient to cover consumption therefore, many devoted attempts to improve beet

quality and quantity. These may be achieved via nutrition which had a great effect on beet productivity. Nitrogen management is one of the important keys to accomplish this goal. A sufficient nitrogen supply of sugar beet is decisive to a considerable extent both for root yield and its quality. Over supply as well as undersupply of nutrients, in particular of nitrogen, means a reduction of quality of the harvested product (Jozefyova et al, 2004). Nitrogen fertilization promotes vigorous early season growth thereby reducing the number of days to canopy closure. Early closure allows the sugar beet to make better use of sunlight and more sugar is produced. In this connection, nitrogen is the sensitive elements that affect the beet production and sugar content (Zhou, 1993). Franzen (2003) found that excess nitrogen reduced root sucrose content and higher impurity level as well as poor recoverable sugar yield.
(Cai, and Ge 2004) stated that the nitrogen content of sugar beet plant was significantly and positive correlated with nitrogen amount used and found that the study of nitrogen amount on beet production and sugar content will be important and significant

Micronutrients as foliar application are particularly useful under Egyptian soil conditions where, it suffers greatly from alkalinity, therefore, most micronutrients fixed and become unavailable to plant uptake (Shalaby, 1998).

Micronutrients deficiency is one of many factors that affect sugar beet production. This deficiency is particularly refered to many factors such as the intensive cropping system in Egyptian agriculture and the reduction in the amount of Nile alluvium after the construction of Aswan High Dam as will (Shalaby, 1998). Application of foliar Fe combined with Zn and Mn was very effective in increasing root and sugar yields as well as juice purity and sugar content, which in turn improve sugar extractability (Moustafa et al., 2006). Great attention to the response of sugar beet to micronutrients has been recorded by many workers (Moustafa et al., 2006 and Soudi and El-Guibali, 2008).

The aim of this work is to evaluate the effect of nitrogen rates and some micronutrients on growth, quality and quantity of sugar beet.

MATERIALS AND METHODS

Two field trials were set up in Sakha Research Station (ARC) at Kafr EL-Shaikh Governorate to study the effect of three rates of nitrogen (60, 80 and 100 kg N/fed) along with foliar spray with five treatments control (without micronutrients), Zn, Mn, Fe and mixture of Zn+Mn+Fe and their interactions on growth, root quality and yield of sugar beet plants. Average mechanical and chemical properties of the experimental soil are illustrated in Table (1).

Table 1. Soil mechanical and chemical properties of the experimental site in the two seasons.

Soil properties										Available nutrients (ppm)					
Seasons	Coarse sand %	Fine sand %	Silt %	Clay %	Textural class	Ca CO_3 %	E.C.(1:5 dSm^{-1})	pH	Organic matter %	N	P_2O_5	K	Fe	Zn	Mn
2008/09	5.05	16.5	30.1	47.0	Silty clay	3.45	2.74	7.95	1.85	30.2	9.01	419	9.51	8.61	13.4
2009/10	4.73	15.1	28.0	49.3		2.60	3.35	8.13	1.89	31.1	9.63	398	12.6	7.81	14.5

A multigerm sugar beet variety kawemira was planted on 25th and27th of October 2008 and 2009 seasons respectively. The experimental design was split plot with three replications where, the three nitrogen rates 75, 100 and 125% of the recommended rate (80 kg N/fed) were allocated in the main plots which was assigned into five sub plots including control (without micronutrients), 2.5g Zn /L as zinc sulfate (40% Zn), 2.5 g Mn/L as manganese sulfate (36% Mn) and 1.5 Fe/L as Fe-EDTA (13.2 % Fe) and the mixture of Zn, Mn and Fe in 400 L water / fed. Nitrogen fertilizer was added as urea form (46%N) in two equal doses the first after thinning and the second after 30 days later. Foliar spraying with micronutrients was applied after 70 and 90 days from sowing. The sub plot size was 21 m^2 (1/200 fed). All cultural practices for growing sugar beet were done as recommended.

Random samples of leaves were taken from each plot after 85 and 105 days from sowing to determine photosynthetic pigments i.e. chlorophyll a, b and carotenoids (mg/g fresh weight) according to the method of Wettstein (1957).

On the other hand, samples were taken at harvest (after 210 days from sowing) to determine:

Root quality in the second season

- Sucrose (pol %), purity% and impurities (k, Na and α- amino N (meq/100g beet).

All traits were determined using automatic French system (Hycel)

-Some technological parameters: [sugar lost to molasses (SLM), sugar extractable (SEx) and alkalinity coefficient (AC) were calculated using an automatic French system (Hycel).

-Root and sugar yields (ton/fed).

Root elemental uptake in two seasons

- N as macro elements.
- Zn, Mn, and Fe as microelements

All elements were determined according to A.O.A.C. (1990)

Yield components in two seasons

- Average root length and root diameter/plant (cm).
- Average fresh weight of roots and tops/ plant (Kg).

Analysis of variance was computed for each trait in each season according to Steel & Torrie (1980). Least significant differences (LSD) at 5% level of probability were used to compare treatment means.

RESULTS AND DISCUSSION

Photosynthetic pigments

Effect of N fertilizer rates

Results of photosynthetic pigments i.e. chlorophyll a, b and carotenoids in 2008/09 (I) and 2009/10 (II) seasons are listed in Table (2). Data showed that decreasing N rate to 75% of RR significantly decreased chlorophyll a, b and carotenoids in the samples at 90 and 120 days from sowing in both seasons except chlorophyll a and carotenoids in the first season in sample at 90 days from sowing. On the other hand, increasing the rate of N to 125% of RR increased chlorophyll a, b and carotenoids in the two samples in both seasons. The increases were significant in the second sample at the age of 120 days in both seasons. This increase may be due to the positive effect of N fertilization on the vegetative growth of sugar beet plants and consequently increasing the photosynthetic area capable for solar energy conversion. Similar results were obtained by Moustafa and Omran (2006).

Effect of micronutrients

Foliar spray with Zn, Mn and Fe individually or in mixture significantly increased chlorophyll a, b and carotenoids in both samples in the two seasons as compared with control (without micronutrients).The mixture of micronutrients together was the best treatment where, it gave the highest value of chlorophyll a, b and carotenoids in both seasons in two samples ages. The positive effect of micronutrients may be due to its role as activator or coenzymes in all vital biosynthetic processes in plant such as chlorophyll synthesis. The same trend was obtained by Soudi and El-Guibali (2008) who found that Fe with Zn tended to show significantly an increase in photosynthetic pigments.

Effect of the interactions

Data in Table (2) showed that there was a significant difference among all interactions order on chlorophyll a, b and carotenoids in both samples except chlorophyll a in the first sample in both seasons and chlorophyll b in the second sample in the first season. In general, the interaction between N fertilizer at the high rate and the mixture of Zn, Mn and Fe was the superior treatment, where, it exhibited the highest chlorophyll a, b and carotenoids values.

Table 2. Effect of different rates of nitrogen fertilizer with some micronutrients on photosynthetic pigments.

Treatments N Kg/fed		First sample at 85 days from sowing						Second sample at 105 days from sowing					
		Chl A		Chl B		Carotienoids		Chl A		Chl B		Carotienoids	
		2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
N1 (60 kg/fed)	control	1.10	1.15	0.580	0.591	0.399	0.401	1.43	1.47	0.601	0.596	0.365	0.360
	Zn	1.16	1.18	0.605	0.611	0.412	0.410	1.55	1.60	0.719	0.710	0.510	0.512
	Mn	1.21	1.19	0.624	0.630	0.421	0.419	1.49	1.68	0.688	0.653	0.489	0.510
	Fe	1.33	1.32	0.629	0.635	0.442	0.441	1.61	1.71	0.720	0.712	0.546	0.553
	Zn+Mn+Fe	1.36	1.39	0.641	0.639	0.448	0.445	1.68	1.77	0.801	0.810	0.608	0.600
Means		1.23	1.25	0.616	0.621	0.424	0.423	1.55	1.65	0.706	0.696	0.504	0.507
N2 (80 kg/fed)	control	1.15	1.18	0.600	0.628	0.407	0.411	1.51	1.35	0.611	0.606	0.381	0.381
	Zn	1.23	1.23	0.621	0.619	0.418	0.420	1.59	1.62	0.725	0.719	0.499	0.508
	Mn	1.25	1.31	0.634	0.628	0.424	0.425	1.73	1.75	0.700	0.710	0.483	0.495
	Fe	1.40	1.45	0.651	0.655	0.438	0.440	1.82	1.88	0.741	0.749	0.566	0.555
	Zn+Mn+Fe	1.42	1.50	0.680	0.681	0.451	0.455	1.90	2.00	0.813	0.815	0.617	0.621
Means		1.30	1.33	0.637	0.642	0.428	0.430	1.71	1.76	0.718	0.720	0.509	0.512
N3 (100 kg/fed)	control	1.20	1.19	0.611	0.615	0.415	0.415	1.69	1.65	0.656	0.660	0.389	0.390
	Zn	1.33	1.31	0.628	0.630	0.422	0.429	1.85	1.90	0.778	0.775	0.523	0.532
	Mn	1.38	1.34	0.635	0.638	0.433	0.430	1.73	1.81	0.723	0.730	0.510	0.511
	Fe	1.55	1.48	0.660	0.664	0.443	0.438	1.96	1.98	0.752	0.761	0.581	0.576
	Zn+Mn+Fe	1.60	1.52	0.677	0.673	0.462	0.458	2.08	2.10	0.815	0.818	0.620	0.618
Means		1.41	1.37	0.642	0.644	0.435	0.434	1.86	1.89	0.745	0.749	0.525	0.525
Mean of micro-nutrients	control	1.15	1.17	0.597	0.611	0.407	0.409	1.54	1.55	0.623	0.621	0.378	0.377
	Zn	1.24	1.24	0.618	0.620	0.417	0.420	1.66	1.71	0.741	0.735	0.511	0.517
	Mn	1.28	1.28	0.631	0.632	0.426	0.425	1.65	1.75	0.704	0.698	0.494	0.505
	Fe	1.43	1.42	0.647	0.651	0.441	0.440	1.80	1.86	0.738	0.741	0.564	0.561
	Zn+Mn+Fe	1.47	1.47	0.666	0.664	0.454	0.453	1.89	1.96	0.810	0.814	0.615	0.617
L.S.D of 5%	(N)	0.14	0.06	0.006	0.009	0.007	0.004	0.07	0.04	0.006	0.005	0.003	0.005
	(M)	0.07	0.10	0.004	0.008	0.003	0.004	0.05	0.04	0.015	0.007	0.006	0.006
	N x M	N.S	N.S	0.007	0.014	0.007	0.007	0.08	0.07	N.S	0.012	0.010	0.011

Root quality and some technological parameters

Effect of N fertilizer rates

Root quality comprises several parameters i.e. sugar content, impurities or non sugar (such as potassium, sodium and α-amino N) and juice purity. Results in the second seasons are presented in Table (3) and indicated that, N dressing at the rate 60 kg N/fed (75% of RR) decreased all the root quality traits i.e. sucrose %, impurities (Na, K and α- amino N) and juice purity % as compared with RR. It is worth to mention that the reduction was significant for sucrose % only. Data also cleared that excess nitrogen (125 % of RR) increased root sucrose% but statistically was not significant. While, all impurities traits were significantly increased. On the other hand, juice purity was significantly decreased. From above mentioned results, it is important to note that underrate or overrate significantly decreased most root qualities. In this connection, Milford and Watson (1971) showed that excess nitrogen fertilizer increased the fraction of the assimilate entering the root that was used in growth at the expense of that stored as sugar. Thus, plants with more nitrogen had a smaller proportion of their root dry weight as sugar because more as used in growth. The reduction in purity % was defected from exceed N dose over rate may be due to the increase in non sugar contents such as α-amino N which affected sugar accumulation in roots and hence sugar extraction. The above results are partially in agreement with those recorded by Jozefyova et al, (2004) who found adjust N doses resulted in better quality due to decreasing amino-N concentration of sugar beet by about 30% and less residual nitrate after harvest. Oversupply as well as undersupply of soil nutrients, in particular of nitrogen, means a reduction of quality of the harvested product.

Dealing with the effect of the two N fertilizer levels (60 and 100 Kg N/fed) on some technological parameters i.e sugar loss to molasses (SLM), sugar extractable (SEX) and sugar coefficient (SCo) at harvest time as compared with RR (80 kg N /fed). Data in Table (3) showed a significant decrease in SLM, SEx and SCo as N application at 75 % of RR. While, overrate of N (125 % of RR) led to significant increase SLM only. Such effect may be due to that excess N significantly increased all impurities as mentioned especially α-amino N, which necessarily had to be taken into account in almost all calculations aimed at assessing the contribution of the non-sugar to potential loss of sugars into molasses (Van Geijn et al, 1983).

Table 3. Effect of different rates of nitrogen fertilizer with some micronutrients on root quality and some technological parameters.

Treatments N Kg/fed		Sucrose (Pol %)	Impurities (meq/100 g beet)			purity	Some technological parameters			Root yield (t/fed)	Sugar Yield (t/fed)
Nitrogen (N)	Micronutrients(M)		Na	K	α-amino-N		SLM	SEX	SCo		
N1 (60 kg/fed)	control	15.50	1.49	3.08	1.22	94.02	1.42	13.46	86.80	28.8	4.46
	Zn	16.50	1.44	3.33	1.29	94.12	1.49	14.41	87.33	29.6	4.89
	Mn	16.10	1.46	3.40	1.29	93.90	1.50	14.00	86.91	28.7	4.62
	Fe	16.80	1.43	3.44	1.38	94.05	1.53	14.67	87.33	28.9	4.85
	Zn+Mn+Fe	17.25	1.41	3.52	1.57	93.98	1.58	15.07	87.35	30.5	5.26
Means		16.43	1.45	3.35	1.35	94.02	1.51	14.32	87.14	29.3	4.82
N2 (80 kg/fed)	control	16.38	1.56	3.19	1.28	94.10	1.49	14.30	87.26	29.8	4.89
	Zn	17.56	1.49	3.34	1.34	94.34	1.51	15.45	87.97	29.9	5.25
	Mn	17.50	1.52	3.48	1.31	94.21	1.53	15.37	87.84	30.2	5.28
	Fe	17.82	1.45	3.67	1.42	94.12	1.57	15.65	87.81	31.9	5.69
	Zn+Mn+Fe	17.90	1.45	3.74	1.60	93.95	1.63	15.67	87.56	32.7	5.86
Means		17.43	1.49	3.48	1.39	94.15	1.54	15.29	87.68	30.9	5.39
N3 (100 kg/fed)	control	16.52	1.61	3.07	1.33	94.17	1.49	14.43	87.36	31.0	5.12
	Zn	17.74	1.53	4.09	1.40	94.52	1.50	15.64	88.17	31.6	5.60
	Mn	17.70	1.58	4.09	1.49	93.59	1.67	15.43	87.19	32.7	5.58
	Fe	17.90	1.53	4.25	1.59	93.48	1.71	15.59	87.11	32.3	5.79
	Zn+Mn+Fe	18.65	1.48	4.31	1.80	93.55	1.76	16.30	87.34	35.4	6.60
Means		17.70	1.55	3.76	1.52	93.86	1.62	15.48	87.44	32.4	5.74
Mean of micro-nutrients	control	16.13	1.55	3.11	1.28	94.10	1.47	14.06	87.14	29.9	4.82
	Zn	17.27	1.49	3.25	1.34	94.33	1.50	15.17	87.82	30.4	5.25
	Mn	17.10	1.52	3.66	1.36	93.90	1.57	14.93	87.31	30.1	5.16
	Fe	17.51	1.47	3.79	1.46	93.89	1.60	15.31	87.42	31.0	5.45
	Zn+Mn+Fe	17.93	1.45	3.86	1.66	93.83	1.66	15.78	87.42	32.9	5.91
L.S.D of 5%	(N)	0.44	0.06	0.14	0.07	0.14	0.02	0.44	0.35	1.12	0.21
	(M)	0.47	0.04	0.10	0.04	0.19	0.02	0.47	0.39	1.40	026
	N x M	N.S	N.S	0.17	0.07	0.33	N.S	N.S	N.S	N.S	N.S

Effect of micronutrients

Data in Table (3) illustrated that in general, foliar spray with Zn, Mn and Fe individually or in mixture significantly increased sucrose %, impurities as K and α-amino N but significantly decreased Na as compared with control (without micronutrients). These results led to significant decrease in juice purity under Mn, Fe and the mixture of Zn+Mn+Fe. It is worth to mention that beet sprayed with the mixture of Zn, Fe and Mn gave the highest percent of sucrose and the lowest percent of purity. Such effect may be due to that the increase in impurities was much higher than the increase in sucrose%.

As for the effect of micronutrients on some technological parameters, the available data in Table (3) showed significant increase in SLM and SEx as compared with control (without micronutrients). From results, it is mentioned that in spite of micro-nutrients particularly, the mixture of Zn, Mn and Fe increased sugar loss to molasses, the extractable sugar increase may be due to the highest increase of sucrose%. These results coincide with those reported by Moustafa et al, (2006), Moustafa and Omran (2006) who stated that treating sugar beet plants with trace elements have a considerable influence on the metabolic activities and in turn exert an increase in its sugar content.

Effect of the interactions

The interactions between N rates and some micronutrients Mn, Fe individually or the mixture of Zn+Mn+Fe significantly affected K, α amino N and purity. Meantime the highest purity was obtained when beet treated with N at 125% of RR and foliar spray with Zn. Data also cleared that all interactions significantly affected both SLM, SEx or SCo.

Root and sugar yield

Effect of N fertilizer rates

Data in Table (3) revealed that decreasing the rate of N to 75% of RR significantly decreased roots and sugar yield. On the contrary, increasing N rate to 125% of RR significantly increased roots and sugar yield.

Effect of micronutrients

Treatment with Zn, Mn or Fe individually caused increase in root yield but this increase was not significant (Table, 3). Whereas, the mixture of them led to significant increase in roots yield. As for, sugar yield, it was significantly increased due to foliar sprays with Zn, Mn and Fe individually or in mixture. The present results are in harmony with those of Moustafa et al, (2006) who found that Fe, Zn and Mn significantly increased roots and sugar yields.

Effect of the interactions

The interactions between N fertilizer rate and micronutrients did not show any significant increase for roots or sugar yield.

Yield component

Effect of N fertilizer rates

Root length and root diameter as well as root and top fresh weights as affected by three rates of nitrogen are presented in Table (4).

Results cleared that growth traits mentioned above significantly decreased by decreasing the rate of N fertilizer from 100 to 75% of RR at harvest in both seasons except for fresh weight of root. On the other hand, the high N fertilizer (125% of RR) increased all growth traits in both seasons as compared with RR at 80 Kg N/fed. The stimulatory effect of N may be due to its effect on plant carbohydrates metabolism which, led to better growth and dry matter accumulation. Also these results may be attributed to the excess of N stimulate absorption of water which increased fresh weight of plants (Milford and Watson, 1971). In this connection, Selim et al (2009) found that foliar application with urea significantly increased root length, root diameter, root fresh weight and sugar yield.

Effect of micronutrients

Foliar spray with Zn, Mn and Fe individually or in mixture significantly affected root length and diameter as well as fresh weight of root and tops. Meantime, the increases were significant by using the mixture of Zn + Mn + Fe followed by Fe alone in both seasons as compared with control (without micronutrients). The pronounced effect of micronutrients is mainly due to their effect on growth hormone production which has a direct effect on plant growth. These results are in agreement with those obtained by Soudi et al, (2008) who found that the mixture of Mn+Zn+Fe has significantly increased all root and top growth parameters of sugar beet plants.

Effect of interactions

The interactions between N fertilizer rates and micronutrients affected positively but insignificantly all growth traits (Table 4).

Root nutrients uptake:

Effect of N fertilizer rates:

Application of N at the rate 60 kg N/fed (75% of RR) significantly decreased N uptake (macronutrient) as well as Mn and Zn (micronutrients) but insignificantly decreased Fe (Table, 5). Contrary results, were obtained when sugar beet plants treated with N at 125% of RR, Where it gave significant increase in N, Zn and Fe in both seasons. Such effect may be duo to that N enhanced the uptake of other minerals, which finally was reflected as better growth. In this connection (Cai, and Ge, 2004) found that the nitrogen content of sugar beet plant was significantly and positively correlated with nitrogen amount used.

Table 4. Effect of different rates of nitrogen fertilizer with some micronutrients on growth parameters.

Treatments N Kg/fed		Fresh weight of root (kg/plant)		Fresh weight of Top(kg/plant)		Root Length (cm)		Root Diameter (cm)	
		2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
N1 (60 kg/fed)	control	0.900	0.927	0.513	0.547	27.0	29.0	13.4	14.0
	Zn	0.918	0.933	0.551	0.535	28.2	29.5	13.7	14.3
	Mn	0.911	0.941	0.523	0.551	28.0	29.0	13.5	13.9
	Fe	0.935	1.033	0.567	0.593	27.8	30.5	14.0	14.5
	Zn+Mn+Fe	0.954	1.038	0.578	0.605	28.0	30.6	14.2	14.6
Means		0.924	0.974	0.546	0.572	27.9	29.7	13.8	14.3
N2 (80 kg/fed)	control	0.918	0.943	0.531	0.587	30.8	31.0	14.0	15.0
	Zn	0.937	0.948	0.561	0.590	31.5	32.5	14.9	15.5
	Mn	0.930	0.965	0.537	0.601	30.3	31.5	14.2	15.0
	Fe	0.967	1.043	0.599	0.623	31.8	32.5	15.0	15.5
	Zn+Mn+Fe	0.991	1.150	0.653	0.625	33.6	33.8	15.2	15.7
Means		0.949	1.010	0.576	0.605	31.6	32.3	14.7	15.3
N3 (100 kg/fed)	control	0.977	0.980	0.627	0.623	29.8	32.0	14.8	16.0
	Zn	0.993	0.983	0.638	0.637	33.0	34.0	15.5	16.0
	Mn	0.986	0.991	0.643	0.641	33.2	33.5	15.1	16.0
	Fe	1.019	1.126	0.698	0.679	33.5	34.0	15.8	16.5
	Zn+Mn+Fe	1.040	1.246	0.696	0.690	33.8	34.0	15.8	16.6
Means		1.003	1.065	0.660	0.654	32.7	33.6	15.4	16.2
Mean of micro-nutrients	control	0.932	0.950	0.557	0.586	29.2	30.7	14.1	15.0
	Zn	0.949	0.955	0.583	0.597	30.9	32.0	14.7	15.3
	Mn	0.942	0.966	0.568	0.598	30.5	31.3	14.3	15.0
	Fe	0.974	1.057	0.621	0.632	31.0	32.3	14.9	15.5
	Zn+Mn+Fe	0.995	1.155	0.642	0.640	32.0	32.9	15.1	15.6
L.S.D of 5%	(N)	0.026	0.054	0.012	0.013	0.845	0.589	0.713	0.567
	(M)	0.015	0.045	0.012	0.012	1.050	0.939	0.601	0.332
	N x M	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Table 5. Effect of different rates of nitrogen fertilizer with some micronutrients on root nutrients uptake.

Treatments N Kg/fed		Macronutrient		Micronutrients					
Nitrogen (N)	Micronutrients (M)	N(g/plant)		Mn(mg/plant)		Zn(mg/plant)		Fe(mg/plant)	
		2008/09	2009/10	2008/09	2009/10	2008/09	2009/10	2008/09	2009/10
N1 (60 kg/fed)	control	1.66	2.04	4.98	6.01	3.14	3.62	7.26	8.13
	Zn	2.21	2.46	5.77	6.14	3.95	4.85	7.80	8.42
	Mn	2.46	2.62	8.85	7.93	3.32	4.04	8.03	8.33
	Fe	2.73	2.95	6.33	6.91	3.49	4.34	10.65	12.29
	Zn+Mn+Fe	3.07	3.28	9.04	7.50	4.83	5.20	9.68	9.87
Means		2.43	2.67	7.00	6.90	3.75	4.41	8.68	9.41
N2 (80 kg/fed)	control	2.66	2.83	6.25	6.55	3.79	3.77	8.02	8.50
	Zn	3.12	3.05	6.49	7.09	4.80	5.50	8.32	8.72
	Mn	3.03	3.18	9.16	9.27	4.16	4.63	8.49	8.77
	Fe	3.39	3.75	8.42	7.63	4.67	5.00	11.43	12.81
	Zn+Mn+Fe	3.73	4.63	10.19	8.50	5.80	6.65	9.21	11.50
Means		3.19	3.49	8.10	7.81	4.64	5.11	9.09	10.06
N3 (100 kg/fed)	control	3.13	3.19	6.61	7.95	4.77	5.19	9.07	9.17
	Zn	3.53	3.48	6.84	8.29	5.68	5.90	9.23	9.33
	Mn	3.37	3.35	10.48	10.62	5.16	5.25	9.26	9.52
	Fe	4.08	4.26	9.01	8.42	4.99	5.52	12.49	14.18
	Zn+Mn+Fe	5.02	5.84	12.45	9.50	6.49	7.98	10.11	12.80
Means		3.82	4.02	9.08	8.95	5.42	5.97	10.03	11.00
Mean of micro-nutrients	control	2.48	2.69	5.95	6.83	3.90	4.20	8.12	8.60
	Zn	2.95	3.00	6.37	7.17	4.81	5.42	8.45	8.82
	Mn	2.96	3.05	9.50	9.27	4.21	4.64	8.60	8.87
	Fe	3.40	3.66	7.92	7.66	4.39	4.95	11.52	13.09
	Zn+Mn+Fe	3.94	4.58	10.56	8.50	5.71	6.61	9.67	11.39
L.S.D of 5%	(N)	0.07	0.23	0.97	0.64	0.24	0.46	0.55	0.94
	(M)	0.18	0.22	1.03	0.78	0.36	0.47	0.27	0.64
	N x M	0.31	0.39	N.S	N.S	N.S	N.S	N.S	N.S

Effect of micronutrients

Foliar application of micronutrients i.e. Mn, Zn and Fe significantly increased their uptake and also N uptake. Data also found that spray with the mixture of Mn, Zn and Fe was the best treatment where, it gave the highest values for N, Mn, Zn and Fe uptake.

Effect of interactions

The interactions between N rates and studied micronutrients gave significant increase for N uptake only. Treatment with N at the rate 125% of RR along with foliar spray with the mixture of Zn, Mn and Fe gave the best values of N uptake than other interactions under study.

REFERENCES

1. O. A. C. 1990. "Official Methods of Analysis". Association of Official Analysis Chemists, 15 th Ed. Washington, USA.
2. Cai Baiyan and Ge Jingping. 2004. The Effect of Nitrogen Level on mMain Nutrient of sugar beet. Nature and Science, 2 (4) 79-83.
3. Franzen. 2003. Fertilizing sugarbeet North Dakota State University Fargo, North Dakota 58105.
4. Jozefyova Lucie, Josef Pulkrabek and Jaroslav Urban. 2004. Effect of harvest time on sugar beet fertilized with increased nitrogen. Food, Agriculture & Environment Vol.2 (1): 232-237.
5. Milford, C. F. and D. J. Watson. 1971. The effect of nitrogen on the growth and sugar content of sugar beet. Ann. Bot. 35,287.
6. Selim, E. H. H., M.A. Abdou, H. M. Sarhan and I. H. Dalia. El. Geddawy. 2009. Effect of Foliar fertilization with urea and gibberellic acid on sugar beet (Beta vulgaris L) J. Agric. Sci. Mansoura Univ., 34(3). 1829- 1837.
7. Shalaby, S. A. 1998. The response of sugar beet to micro-nutrients as foliar application. Egypt J. Appli. Sci., 13:320-331.
8. Soudi, Amal K.M. and H. El-Guibali, Amal. 2008. Effect of foliar application with some micronutrients on yield and quality of sugar beet. J. Appl. Sci., 23(3):41-51.
9. Soudi, Amal K. M., Sama E. H. Omran and Kh. A. Aboushady. 2008. The response of sugar beet to nitrogen and phosphor mineral and partial biofertilization using some micronutrients foliar application. Egypt. J. Appl. Sci. 23 (4-B) 502-516.
10. Steel R. G. and H. H. Torrie. 1980. Principles and Procedures of statistic 2nd Ed. McGeaw-Hill, New York.

11. Moustafa, Zeinab R. and. Samia E. H. Omran. 2006. Effect of Foliar Spray with Boron or Magnesium in Combination with Nitrogen Fertilization on Sugar Beet Plants.Egypt.j.soil sci.46(.2):115-129.
12. Moustafa, Zeinab R., H.W.A. Wahba and Samia H. Ashmawy. 2006. Effect of injected ammonia gas and applied potassium rates with or without some micronutrients on sugar beet productivity Annals Of Agric. Sc.,Moshtohor, Vol. 44(4): 1447-1460.
13. Zhou, J. C. 1993. The study on nitrogen nutrients of sugar beet. China. Beet 2:25-9.
14. Van Geijn, N. J., L. C. Giljam and L. H. De Nie. 1983. œ-amino nitrogen in sugar processing. In proceeding of the symposium (Nitrogen and Sugar Beet), international Institute for sugar beet research, Brussels, PP. 13-25.
15. Wettstein, D. 1957. Chlorophyll-lethal und der submikrostopiche formwechel der plastiden. Exptl. Cell Res., 12: 427-433.

تأثير التسميد النيتروجينى وبعض العناصر الصغرى على انتاجية وجودة بنجر السكر

زينب رمضان مصطفي ، أمل محمد كامل سعودي ، خليل الشناوى محمد

قسم بحوث الفسيولوجي و الكيمياء - معهد بحوث المحاصيل السكرية - مركز البحوث الزراعية

أقيمت تجربتان حقليتان فى موسمى ٢٠٠٨/٢٠٠٩ و ٢٠٠٩/٢٠١٠ بمحطة بحـوث سـخا (محافظة كفر الشيخ) لدراسة تأثير ثلاث معدلات من النيتروجين ٧٥و ١٠٠و ١٢٥% من المعـدل الموصى به وهو ٨٠ كجم نيتروجين للفدان على بعـض المركبـات الكيميائيـة وجـودة العـصير والمحصول في نبات بنجر السكر الذى تم رشه بالعناصر الصغرى مثل المنجنيز والزنك والحديد اما مفرده او خليط بينهم.

- قد وجد أن نقص معدل النيتروجين إلى (٧٥% من المعدل الموصى به) أدى إلى إنخفاض معنـوى فى كل من الصبغات النباتية مثل كلورفيل ا ، ب والكاروتينات عند عمر ١٢٠ يوم من الزراعة فى كلا الموسمين. وأيضا ادى إلى انخفاض معنوى لجوده العصير مثل الـسكروز وبعـض القياسـات التكنولوجيه (السكر المستخلص والسكر المفقود فى المولاس ومعامـل الـسكر) وبعـض صـفات المحصول كطول وعرض الجذر والوزن الطازج للاوراق فى كـلا الموسـمين، أيـضا إنخفـض محصول الجذر والسكر.كما أدى انخفاض النيتروجين عن الموصى به الى نقص النيتروجين ، الزنك والمنجنيز الممتص .

- من ناحية أخرى أدى ارتفاع التسميد النيتروجينى إلى ١٠٠ كجم نيتروجين للفـدان (١٢٥% مـن المعدل الموصى به) إلى زيادة معنويه للصبغات النباتية مثل كلورفيل ا ، ب والكاروتينات عند عمر ١٢٠ يوم من الزراعة فى كلا الموسمين كما أدى الى زيادة الصوديوم وألفا امينو نيتروجين كشوائب وبالرغم من انه ادى الى زيادة معنويه للسكر المفقود فى المولاس وانخفاض معنوى للنقاوة الا انـه ادى الى زيادة معنويه فى محصول الجذر والسكر.

- أدى الرش الورقى بالعناصر الصغرى (المنجنيز، الزنك والحديد) منفرده أو مجتمعه الى زيـادة معنويه لكل من كلورفيل ا ، ب والكاروتينات فى كلا العينتين عند عمر ٩٠ و١٢٠ يوم من الزراعة فى كلا الموسمين وأيضا الى زيادة السكروزوالبوتاسيوم وألفا امينو نيتروجين ولكنه خفض معنويـا الصوديوم. وقد تأثرت معنويا صفات المحصول مثل طول وعرض الجذر والوزن الطازج لكل مـن الجذر والمجموع الخضرى ، كما أدى الرش الورقى بالعناصر الصغرى الى زيادة معنويه لمحصول السكر (طن/فدان) وزيادة الممتص من النيتروجين ، الزنك ، المنجنيز والحديد

كانت افضل معامله هى الرش الورقى للخليط بين العناصر الصغرى (المنجنيز، الزنـك والحديـد) حيث أعطت أعلى قيم لمعظم الصفات المدروسه بالنسبه للكنترول(الغير معامل بالعناصر الصغرى).

- التفاعل بين النيتروجين عند المعدل الاعلى (١٠٠ كجم / فدان) والخليط بين العناصر الـصغرى أعطى أعلى قيم بالنسبه لكلورفيل ا ، ب والكاروتينات والبوتاسيوم وألفا امينو نيتروجين كـشوائب وأعلى نقاوة للعصير والنيتروجين الممتص.