Effect of nano fertilization on sugar beet

A. M. Hassnein, M. A. Azab, M. A. El-Hawary * and N. N. Darwish

Agronomy Department, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt

* Corresponding author E-mail: Alhawary20g@azhar.edu.eg (M. El-Hawary).

ABSRTRACT

Sugar beet (*Beta vulgaris* L.) ranks second important sugar crop in the world. The aim of the herein trial is to study the effect of mineral and nano-nitrogen fertilizer (Sissay) and a mix of three micro elements (boron, zinc and manganese) on growth and yield in sugar beet plants. Two greenhouse experiments were carried out at the experimental farm of the Faculty of Agriculture, Nasr city, Al-Azhar University, Cairo, Egypt during 2016/2017 and 2017/2018 seasons. The experiments were laid out in a complete randomized block design with four replications. The obtained results showed that the treatment had mineral nitrogen at a rate of 54 or 90 Kg N per feddan + nano Sissay (810 g/ feddan) + a mix of nano micro elements (200 ppm) gave the highest values of relative growth rate, net assimilation rate over 60 to 90 days from sowing date, root weight, sucrose percentage and sugar yield per plant at harvest time as compared with all other studied treatments in both seasons. Control treatment (without fertilization) gave the lowest values. In conclusion, using nano-nitrogen fertilizer (Sissay) and micronutrients (B, Zn and Mn) with mineral nitrogen fertilizer can save around 40% from recommended doses of mineral nitrogen fertilizer.

Keywords: Nanofertilization; Sugar beet; Nitrogen fertilization.

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) ranks as the second important sugar crop in the world. The great importance of sugar beet crop is not only from its ability to grow in the newly reclaimed areas as economic crop, but also for production of higher sugar yield under these conditions as compared with sugar cane. Also, its productivity makes it a good cash crop at this situation. There are many attempts to increase sugar beet productivity and quality. This increase is likely to be obtained by growing sugar beet crop in newly reclaimed soils and increased productivity of unit area. Increasing sugar beet production can be achieved through applying the optimizing agricultural practices i.e,. fertilization and cultivating high yielding varieties.

Recently, nanotechnology represents a new frontier for the research community. Nanotechnology works with the smallest possible particles which raise hopes for improving agricultural productivity through encountering problems unsolved conventionally. In the management aspects, efforts are made to increase the efficiency of applied fertilizers with the help of nano fertilization clays and zeolites and restore soil fertility by releasing fixed nutrients.

Jakiene *et al.* (2015), reported that bio-organic nano fertilizer at single 1 liter per hectare dose in sugar beet plants increased root biomass by 42.6%, net photosynthetic productivity by 15.8%, root yield by 12.6%, sucrose content by 1.03% and yield of white sugar by 19.2% in comparison with the untreated beets. Liu and Lal (2015) reported that the application of nano particles to sugar beet plants can be beneficial for growth and development due to its ability for greater absorbance and high reactivity. Barlog *et al* (2016) reported that utilization of micronutrient like manganese, zinc and iron with balance can enhance and increase productivity of sugar beet yield. Mekdad and Rady (2016) showed that adding micronutrient mixtures (Fe + Zn + Mn) improved yield and its attributes of sugar beet crop. Dewdar *et al.* (2018) found that the best results were obtained when sugar beet plants were treated with nano-microelements 200 mg/L + urea 1% and ranked as the first favorable treatment for root length and diameter, dry matter per plant as root, top and sugar yields in both seasons.

However, in Egypt there are few investigations concerning applying nano fertilizers on sugar beet plants, Therefore, this investigation was carried out to study the effect of mineral and nano nitrogen fertilizer (Sissay) and a mix of three micro elements (boron, zinc and manganese) on s growth and yield of sugar beet plants (*Beta vulgaris* L.) variety Gloria.

MATERIALS AND METHODS

Two cement lysimeter experiments were carried out at the greenhouse at the Experimental Farm in Faculty of Agriculture, Al-Azhar University, Nasr City, Cairo, Egypt, during 2016/2017 and 2017/2018 seasons to study the effect of mineral and nano nitrogen fertilizer (Sissay) and a mix of three micro-elements (boron, Zinc and Manganese) on growth and yield of sugar beet plants (*Beta vulgaris* L.) variety Gloria.

The experiment treatments were as follows:

Control (foliar spraying with tap water).

Adding nitrogen fertilizer (top dressing) at the rate of 54kg N/fed. (60% of the recommended amount).

Adding nitrogen fertilizer (top dressing) at the rate of 90 kg N/fed. (100% of the recommended amount).

Foliar Spraying with Sissay (nano nitrogen fertilizer) at a rate of 810g / fed.

Foliar Spraying with mixed micro elements (boron, zinc and manganese) at a concentration of 200 ppm/fed.

Adding nitrogen fertilizer (top dressing) at the rate of 54 kg N /fed + foliar spraying with mixed micro elements (B, Zn and Mn) at a concentration of 200 ppm / fed.

Adding nitrogen fertilizer (top dressing) at the rate of 90 kg N/fed + foliar Spraying with mixed micro elements (B, Zn and Mn) at a concentration of 200 ppm/fed.

Foliar Spraying with Sissay (nano nitrogen fertilizer) at a rate of 810g / fed + foliar spraying with mixed micro elements (B, Zn and Mn) at a concentration of 200 ppm/fed.

Adding nitrogen fertilizer (top dressing) at the rate of 54 kg N /fed+ foliar spraying with Sissay (nano nitrogen fertilizer) at a rate of 810g / fed.

Adding nitrogen fertilizer (top dressing) at the rate of 90 kg N2/fed. + foliar spraying with Sissay (nitrogen nano-fertilizer) at a rate of 810g / fed.

Adding nitrogen fertilizer (top dressing) at the rate of 54 kg N /fed. + foliar spraying with Sissay (nitrogen nano-fertilizer) at a rate of 810g / fed. + foliar spraying with mixed micro elements (B, Zn and Mn) at a concentration of 200 ppm/fed.

Adding nitrogen fertilizer (top dressing) at the rate of 90 kg N /fed. + Foliar spraying with Sissay (nano nitrogen fertilizer) at a rate of 810g/fed. + Foliar spraying with mixed micro elements (B, Zn and Mn) at a concentration of 200 ppm/fed.

The experiments were laid out in a completely randomized block design with four replications for each treatment

The cement lysimeter dimensions of average (50 cm width) × (40cm length) × 40 cm deep were filled with 17 kg soil (air dried). Organic fertilization as compost, supper phosphate (15.5% P_2O_5) and potassium sulfate (48% K_2O) fertilizations were added at the recommended doses and mixed with the soil before filling the lysimeter and planting. The mechanical and chemical analyses of the experimental soil were determined and presented in Table (1). Sissay (nitrogen nano-fertilizer) is made of very fine crushed calcite minerals of sedimentary origin such as marine algae and fossilized ammonite. The calcite decomposed in microwave tirbomecanica with new technology, as new technology in formation of nano dots. The calcite mineral which has been added to zeolite minerals and spiraling algae. It is combination of minerals, zeolite calcite minerals, and delicate micro-enhilados with the supplement of dried extracts of nettle plants. The chemical analyses of Sissay are presented in Table (2). Nitrogen fertilizer in the form of Urea (46% N). Boron, zinc and manganese were mixed and added as solution at concentration of 200 ppm.Then, they were sprayed in 50 and 70 days from sowing date (200 L/fed). The seeds of sugar beet variety Gloria were obtained from Agriculture Research Centre (A.R.C.). Twenty seeds were planted on December 25th in each lysimeter in the two seasons at the depth of 2 cm, after 30 days from sowing date the plants were thinned to six plants per lysimeter. The second thinning was performed after 40 days as the plants were thinned to three plants per lysimeter.

Data recorded

Two samples were taken after 60 and 90 days from sowing date to measure the following data:

Growth attributes

Relative growth rate (RGR): It was calculated according to the following formula (Watson 1958).

RGR = Loge W2- Loge W1 / T2-T1 (g/week)

Net assimilation Rate (NAR): It was calculated according to the following formula (Watson 1958).

NAR= (W2-W1) (LogeA2- Loge A1)/(T1-T2) (A2-A1) (g/ m^2/week)

Whereas: W1 and W2 refer to dry plant weight at first time T1 and second time T2 in days, respectively, A1 and A2 refer to leaf area at first time. T1 and second time T2, respectively.

Yield characters

The plants were harvested after 180 days from sowing date and the following data were determined.

Root fresh weight (g)

Sucrose percentage in roots

It was determined by using Saccharometer.

Sugar Yield per plant (g)

It is calculated as a percentage of sucrose × root fresh weight.

Data were statistically analyzed according to the technique of analysis of variance (ANOVA) and the least significant difference (LSD) method was used to test the difference among the treatment means as published by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Relative growth rate (g/day)

Average relative growth rate (g/day) at 60 – 90 days period from sowing date of sugar beet as affected by nitrogen, sissay and micro elements (boron, zinc and manganese) fertilization treatments in 2016/2017 and 2017/2018 seasons are shown in (Table 3).

Results recorded in Table 3 show clearly that relative growth rate (g/day) at 60 – 90 days period from sowing date significantly affected by nitrogen, Sissay and micro elements (boron, zinc and manganese) fertilization treatments in 2016/2017 and 2017/2018 seasons .Sugar beet plants received nitrogen fertilizer at the rate of 90 kg N/feddan surpassed control by 3.91 and 5.24 %, nitrogen fertilizer at a rate of 54kgN/feddan by 2.14 and 3.57 %, Sissay by 5.29 and 8.75 % as well as micro elements treatment by 3.02 and 11.6 % in relative growth rate (g/day) at 60 -90 days from sowing date in 2016/2017 and 2017/2018 seasons , respectively . On the other hand , sugar beet plants treated with nitrogen (90kg/feddan) + Micro nutrients exceeded control in relative growth rate (g/day) by 4.78 and 7.26 %, nitrogen fertilizer at the rate of 90 kg N/feddan by 0.84 and 1.92 % as well as micro elements by 3.88 and 13.19 % in 2016/2017 and 2017/2018 seasons, respectively. Whilesugar beet plants treated with nitrogen (90 kg/feddan) + Sissay increased relative growth rate (g/day) than those grown under the control by 5.65 and 8.06 %, nitrogen fertilizer at the rate of 90 kg N/feddan by 1.67 and 2.68 % and plants treated with sissay alone by 7.05 and 11.67 % in 2016/2017 and 2017/2018 seasons , respectively.

The obtained results show that applied nitrogen at a rate of 90 kg N/fed. + Sissay + micro nutrients was the best treatment whereas it gave the highest relative growth rate at 60 - 90 days period from sowing date 0.252 and 0.278 g/day compared to all other treatments in 2016/2017 and 2017/2018 seasons, respectively. This treatment increased relative growth rate (g/day) at 60 – 90 days period from sowing date over those of the control by 9.57 and 12.10 %, plants fertilized by 90 kg N/fed. By 5.44 and 6.51 %, Sissay treatment by 11.01. And 15.83 % as well as micro elements treatment by 8.62 and 18.30 % in 2016/2017 and 2017/2018 seasons, respectively. This treatment followed by added nitrogen at 54 kg N/ fed. + Sissay + micro elements which gave 0.249 and 0.271 g/day in 2016/2017 and 2017/2018 seasons, respectively. The different in relative growth rate (g/day) between nitrogen at a rate of 54 and 90kg N/fed. + Sissay + micronutrients were significant as compared with all other treatments in both seasons.

These results suggested that combined Sissay and micro elements with nitrogen increased utilization of nitrogen by sugar beet plants which led raising relative growth rate and production also may be saved 36 kg N/feddan.

The increase in relative growth rate according to treated sugar beet plants by nitrogen plus Sissay+ micro nutrients may be attributed to the encouragement growth and increasing total plant weight during growth period of 60 -90 days from sowing date which led to raising relative growth rate, These results are in agreement with those of Jakiene *et al*. (2015).

Net assimilation rate (mg/cm^2/week)

Average net assimilation rate (mg/cm2/week) at 60 – 90 days from sowing date of sugar beet as affected by nitrogen, Sissay and micro elements (boron, zinc and manganese) fertilization treatments in 2016/2017 and 2017/2018 seasons are shown in Table (3). Results recorded in Table (4) show clearly that net assimilation rate (mg/cm^2/week) at (60-90) days period from sowing date significantly affected by nitrogen, Sissay and micro elements (boron, zinc and manganese) fertilization treatments in 2016/2017 and 2017/2018 seasons . the lowest net assimilation rate 0.10 and 0.28 mg /cm^2/ week was recorded when sugar beet plants grown under the control (without fertilization) as compared with all other treatments at (60-90) days period from sowing date in 2016/2017 and 2017/2018 seasons, respectively.

Sugar beet plants received nitrogen fertilizer at the rate of 90 kg N/fed. with micro elements surpassed control by 910.00 and 178.57 %, while added nitrogen fertilizer at a rate of (90 kg N /fed) with Sissay exceeded control by 760.00 and 339.29 %, Sissay by 5.29 and 8.75 % in net assimilation rate (mg/ cm^2/week) at (60–90) days period from sowing date in 2016/2017 and 2017/2018 seasons, respectively. The results show also that sugar beet plants treated with nitrogen (90 kg N/fed.) + Sissay + micro nutrients exceeded control in net assimilation rate by 1360.00 and 360.71 %, nitrogen fertilizer at the rate of (90 kg N/fed.) by 111.59 and 143.40 %, Sissay by 210.63 and 168.75 % as well as micro elements by 711.11 and 230.77 % at (60-90) days period from sowing date in 2016/2017 and 2017/2018 seasons, respectively.

These results show clearly that combined Sissay and micro elements with nitrogen at the rate of 90 kg N/fed. gave the highest net assimilation rate as compared with all other treatments. These results might be attributed to enhancement photosynthetic rate and decreased plant respiration rate, therefore raising net assimilation rate. These results are in harmony with Jakiene *et al.* (2015) and Mekdad and Rady (2016).

Root fresh weight at harvest

Average root fresh weight (g) of sugar beet at harvest time as affected by nitrogen, Sissay and micro elements (boron, zinc and manganese) fertilization treatments in 2016/2017 and 2017/2018 seasons are shown in Table (3). Results recorded in Table 3 show that all treatments significantly increased root fresh weight compared to the control. Sugar beet plants received nitrogen fertilizer at the rate of 90 kg N/fed. Surpassed control by 207.69 and 204.47 %, nitrogen fertilizer at a rate of 54 kg N/fed. by 15.44 and 18.08 %, Sissay by 22.52 and 17.98 % as well as micro elements treatment by 29.03 and 35.78 % in root fresh weight at harvest in 2016/2017 and 2017/2018 seasons, respectively. While fertilized sugar beet plants with 54 kg N/fed. Increased root fresh weight by 166.52 and 158.10 compared to those of the control in 2016/2017 and 2017/2018 seasons, respectively. In this connection, spraying sugar beet plants by Sissay as a nano substance increased root fresh weight at harvest by 166.52 and 158.10 % compared to those of the control in 2016/2017 as well as 2017/2018 seasons, respectively. Also treated sugar beet plants with mixed nano micro elements (boron, zinc and manganese) caused 138.46 and 120.95 % increase in root fresh weight at harvest compared to those of the control in 2016/2017 as well as 2017/2018 seasons, respectively.

The results showed also that, sugar beet plants treated with nitrogen (90 kg/feddan) + Micro nutrients exceeded control in root fresh weight at harvest by 228.51 and 274 in season 2016/2017 and 2017/2018, while nitrogen fertilizer at the rate of (90 kg N/fed.) by 6.76 and 22.81 % as well as micro elements by 37.76 and 69.40 % in 2016/2017 and 2017/2018 seasons, respectively. While sugar beet plants treated with nitrogen (90 kg/fed.) + Sissay increased root fresh weight at harvest than those grown under the control by 266.97 and 371.43 %, nitrogen fertilizer at the rate of 90 kg N / fed. by 19.26 and 54.69 % and plants treated with Sissay alone by 46.13 and 85.39% in 2016/2017 and 2017/2018 seasons, respectively.

The obtained results show that applied nitrogen at a rate of 90 kg N/fed. + Sissay + micronutrients gave the highest root fresh weight at harvest 1081 and 1190 g compared to all other treatments in 2016/2017 and 2017/2018 seasons, respectively. This treatment raising root fresh weight at harvest than those of the control by 389.14 and 466.67 %, plants fertilized with 90 kg N/fed. by 58.97 and 85.93 %, Sissay treatment by 94.77 and 122.85 % as well as micro elements treatment by 105.12 and 156.47% in 2016/2017 and 2017/2018 seasons, respectively. This treatment followed by added nitrogen at 54 kg N/ fed. + Sissay + micro-elements which gave 1070 and 1180 gm in 2016/2017 and 2017/2018 seasons, respectively. The different in root fresh weight at harvest between applied nitrogen at a rate of 54 or 90kg N/fed. + Sissay + micronutrients were insignificant and were significant compared to all other treatments in both seasons.

The increase in root fresh weight according to fertilizing sugar beet plants with nitrogen at the rate of 90 kg N/feddan plus Sissay and micro elements may be attributed to the favourable effect of this treatment on net assimilation rate and relative growth weight

(Table 3), which led to raising root fresh weight. These results are in harmony with those obtained by Jakiene *et al.* (2015) and Mekdad and Rady (2016).

Sucrose percentage

Average sucrose percentage of sugar beet at harvest time as affected by nitrogen, Sissay and micro elements (boron, zinc and manganese) fertilization treatments in 2016/2017 and 2017/2018 seasons are shown in Table (4). Results recorded in Table (4) show that sucrose percentage at harvest date significantly affected by nitrogen, Sissay and micro elements (boron, zinc and manganese) fertilization treatments in 2016/2017 and 2017/2018 seasons .Sugar beet plants did not received nitrogen fertilizer (control) gave the highest sucrose percentage 20.39 and 20.49 % followed by plants treated by micro elements 20.06 and 20.16% compared to all other treatments in 2016/2017 and 2017/2018 seasons, respectively. While fertilized sugar beet plants with 90 kg N/feddan gave the lowest sucrose percentage 17.09 and 17.04% compared to all other treatments in 2016/2017 and 2017/2018 seasons, respectively.

The differences in sucrose percentage were insignificant between Sissay, nitrogen (54 kg N/fed.) + Micro nutrients, Sissay + Micro nutrients, nitrogen (54 kg N/fed) + Sissay, nitrogen (90 kg N/fed.) + Sissay, nitrogen (54 kg N/fed.) + Sissay + Micro nutrients and nitrogen (90 kg N/fed.) + Sissay + Micro nutrients treatments in both seasons.

The increase in sucrose percentage under the unfertilized (control) sugar beet plants may be attributed to the sugar beet plants grown without receiving fertilizers had the lowest net assimilation rate (Table 3) as well as according to the fact that sugar beet plants had the negative correlation between root volume and sucrose percentage, therefore increased concentration of sucrose. These results are in harmony with those of Jakiene *et al.* (2015) and Dewdar *et al.* (2018).

Sugar yield per plant

Average sugar yield per plant (g) of sugar beet at harvest time as affected by nitrogen, Sissay and micro elements (Boron, Zinc and Manganese) fertilization treatments in 2016/2017 and 2017/2018 seasons are shown in (Table 4). Results recorded in (Table 4) show that sugar yield per plant at harvest date. significantly affected by nitrogen, Sissay and micro elements (boron, zinc and manganese) fertilization treatments in 2016/2017 and 2017/2018 seasons. sugar beet plants received nitrogen fertilizer at the rate of 90 kg N/fed. surpassed control by150.64 and 153.45%, nitrogen fertilizer at a rate of 54 kg N/fed. by 4.02 and 14.28%, Sissay by 9.61 and 9.16% as well as micro elements treatment by 9.69 and 16.59% in sugar yield per plant in 2016/2017 and 2017/2018 seasons, respectively. While fertilized sugar beet plants with 54 kg N/fed. increased sugar yield per plant by 140.96 and 121.57% compared to the control in 2016/2017 and 2017/2018 seasons, respectively. In this connection, spraying sugar beet plants with Sissay as a nano fertilizer increased sugar yield per plant by 1128.67 and 131.49% compared to those of the control in 2016/2017 as well as 2017/2018 seasons, respectively. Also treated sugar beet plants with mixed nano fertilizer and micro-elements (Boron, Zinc and Manganese) caused 134.93 and 117.38% increase in sugar yield per plant as compared with those of the control in 2016/2017 as well as 2017/2018 seasons, respectively. On the other hand, sugar beet plants treated with nitrogen (90 N kg/fed) + micro nutrients exceeded control in sugar yield per plant by 189.60 and 227.52%, nitrogen fertilizer at the rate of 90 kg N/fed. by 15.54 and 29.22% as well as micro elements by 23.27 and 50.66% in 2016/2017 and 2017/2018 seasons, respectively. While sugar beet plants treated with nitrogen (90 N kg/fed) + Sissay increased sugar yield per plant than those grown on the control by 240.09 and 308.83%, nitrogen fertilizer at the rate of 90 kg N/fed. by 35.69 and 61.31% and plants treated with Sissay alone by 48.73 and 85.3976.08% in 2016/2017 and 2017/2018 seasons, respectively.

The obtained results show that applied nitrogen at a rate of 90 kg N/ fed. + Sissay + micro nutrients was the best treatment because it gave the highest sugar yield per plant (202.04 and 229.67 g) compared to all other treatments 2016/2017 and 2017/2018 seasons, respectively. This treatment raised sugar yield per plant than those of the control by 348.98 and 433.74%, plants fertilized with 90 kg N/fed. by 79.13 and 110.59%, Sissay treatment by 96.35 and 129.88 % as well as micro elements treatment by 91.11 and 145.53% in 2016/2017 and 2017/2018 seasons, respectively. This treatment followed by adding nitrogen at 54 kg N/fed. + Sissay + micro elements which gave 201.69 and 228.92 g in 2016/2017 and 2017/2018 seasons, respectively. The different in sugar yield per plant between applied nitrogen at a rate of 90kg N/fed. + Sissay + micronutrients and added nitrogen at the rate of 54 kg N/fed. + Sissay + micro elements was insignificant and was significant as compared with all other treatments in both seasons.

The highest root fresh weight under the application of nitrogen at the rate of 90 kg N/fed. plus Sissay and micro elements may be attributed to their effect on increasing relative growth rate, net assimilation rate (Table 3), these treatment gave the highest root yield per plant (Table 3), These results are in harmony with those of Jakiene *et al.* (2015) and Dewdar *et al.* (2018).

Conclusion

Generally it could be recommended that using nano nitrogen fertilizer (Sissay) and micronutrients (B, Zn and Mn) with mineral nitrogen fertilizer can save 40% from recommended dose of mineral nitrogen fertilizer without insignificant differences in root and sugar yield per plant of sugar beet plants under greenhouse conditions of Cairo

REFERENCES

Barlog, P., Nowacka, A., Blaszyk, R., 2016.Effect of zinc band application on sugar beet yield, quality and nutrient uptake. Plant Soil Environ. 62 (1), 30-35.

Dewdar, M.D.H., Abbas, M.S., El-Hassanin, A.S., Abdel-Aleem, H.A., 2018. Effect of nano Micronutrients and nitrogen foliar applications on sugar beet (*Beta vulgaris* L.) of quantity and quality traits in marginal soils in Egypt. J. Curr. Microbiol. Appl. Sci., 7 (8), 4490-4498.

Gomez, K.A., Gomez, A.A., 1984. Statistical Procedures for Agricultural Research. 2nd Ed., John Wiley & sons, West Sussex, UK.

Jakienė, E., Spruogis, V., Romaneckas, K., Dautartė, A., avižienytė, D., 2015. The bio-organic nano fertilizer improves sugar beet photosynthesis process and productivity. Zemdirbyst., 102, 141–146.

Liu, R., Lal, R., 2015. Potentials of engineered nanoparticles as fertilizers for increasing agronomic productions. A review. Sci. Total Envir., 514, 131-139.

Mamyandi, M.M, Pirzad, A., Zardoshti, M.R., 2012. Effect of Nano-iron spraying at varying growth stage of sugar beet (*Beta vulgaris* L.) on the size of different plant parts. J. Agric. Crop Sci., l4 (12), 740-745

Mekdad, A.A., Rady, M.M., 2016. Response of *Beta vulgaris* L. to nitrogen and micronutrients in dry environment. Plant Soil Environ., 62 (1), 23-29.

Page, A.L., Miller, R.H., Keeny, D.R., 1982. Methods of Soil Analysis (Part 2). In: Chemical and Microbiological Properties. Agron, vol. 9. SSSA, Madison.

Qaswar, M., Hussain, S., Rengel, Z., 2017. Zinc fertilisation increases grain zinc and reduces grain lead and cadmium concentrations more in zinc-biofortified than standard wheat cultivar. Sci. Total Environ., 605, 454-460. Watson, D.J., 1958. The dependence of net assimilation rate on leaf area index. Ann. Bot. London, N.S. 22, 37- 45.

Table 1. Mechanical and chemical properties of the experiment soil in 016/2017 and 2017/2018 seasons.

Item	Seasons	
	2016/17	2017/18
Mechanical properties		
Sand	14.27	13.44
Silt	22.31	22.76
Clay	63.42	63.80
Soil texturae class	Clay	Clay
Chemical properties		
PH	7.12	6.98
Ec	2.07	2.14
Organic matter%	1.96	2.02
N ppm	22.30	23.03
P ppm	7.20	6.90
K ppm	27.27	28.00

Table 2. Sissay fertilizer chemical component.

Chemical content %						
$CaCO_3$	MnO	SiO_2	P	K	S	Organic N
35.00	1.90	11.10	0.28	0.10	0.52	15

Table 3. Average relative growth rate(g/week), net assimilation rate (g/week) and root fresh weight (g) at 60 -90 days from sowing (DFS) at harvest date as affected by nitrogen, Sissay and mixed micro elements (B, Zn and Mn) in 2016/2017 and 2017/2018 seasons.

Fertilization treatments	Relative growth rate (g/week) at 60-90 DFS		Net assimilation rate (g/week) at 60-90 DFS		Root fresh weight (g) / plant at harvest	
	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
Control	0.230	0.248	0.10	0.28	221	210
Nitrogen (54kg/feddan)	0.234	0.252	0.37	0.59	589	542
Nitrogen (90kg/feddan)	0.239	0.261	0.69	0.53	680	640
Sissay(810g/ feddan)	0.227	0.240	0.47	0.48	555	534
Micro nutrient (200ppm)	0.232	0.235	0.18	0.39	527	464
Nitrogen (54kg/feddan)+ Micro nutrients(200ppm)	0.237	0.258	0.41	0.57	644	625
Nitrogen (90kg/feddan)+ Micro nutrients(200ppm)	0.241	0.266	1.01	0.78	726	786
Sissay(810g/ feddan)+ Micro nutrients(200ppm)	0.230	0.263	0.39	0.46	617	603
Nitrogen (54kg/feddan)+ Sissay(810g/ feddan)	0.240	0.262	1.02	1.23	794	812
Nitrogen (90kg/feddan)+ Sissay(810g/ feddan)	0.243	0.268	0.86	1.23	811	990
Nitrogen(54kg/feddan)+Sissay(810g/ feddan)+ Micro nutrients(200ppm)	0.249	0.271	1.20	1.18	1070	1180
Nitrogen(90kg/feddan)+Sissay(810g/ feddan)+ Micro nutrients(200ppm)	0.252	0.278	1.46	1.29	1081	1190
L.S.D 0.5	0.001	0.001	0.15	0.20	24.65	13.78

Table 4. Average sucrose percentage (%) and sugar yield per plant (g) of sugar beet at harvest time as affected by nitrogen, sissay and micro elements (Boron, Zinc and Manganese) fertilization treatment in 2016/2017 and 2017/2018 seasons.

Fertilization treatments	Sucrose percentage (%) at harvest time		Sugar yield /plant (g) at harvest time	
	2016/2017	21017/2018	2016/2017	2017/2018
Control	20.39	20.49	45.00	43.03
Nitrogen (54kg/feddan)	18.41	17.59	108.43	95.34
Nitrogen (90kg/feddan)	17.09	17.04	112.79	109.06
Sissay(810g/ feddan)	18.54	18.71	102.90	99.91
Micro nutrient (200ppm)	20.06	20.16	105.72	93.54
Nitrogen (54kg/feddan)+ Micronutrients(200ppm)	18.91	18.91	121.78	118.19
Nitrogen (90kg/feddan)+ Micronutrients(200ppm)	17.95	17.93	130.32	140.93
Sissay(810g/ feddan) Micro nutrients(200ppm)	18.78	18.68	115.87	112.64
Nitrogen (54kg/feddan)+ Sissay(810g/ feddan)	18.19	18.97	144.43	154.04
Nitrogen (90kg/feddan)+ Sissay(810g/ feddan)	18.87	17.77	153.04	175.92
Nitrogen (54kg/feddan)+ Sissay(810g/ feddan)+ Micro nutrients(200ppm)	18.85	19.40	201.69	228.92
Nitrogen (90kg/feddan)+ Sissay(810g/ feddan)+ Micro nutrients(200ppm)	18.69	19.30	202.04	229.67
L.S.D 0.5	0.87	0.94	0.65	0.82

تاثير التسميد بالنانو على بنجر السكر

عبد الحميد محمد حسانين، عزب محمد عزب، محمد الأسمر الهواري *، ناضر ناير درويش

قسم المحاصيل، كلية الزراعة بالقاهرة، جامعة الأزهر، مصر

* البريد الإليكتروني للباحث الرئيسي: Alhawary20g@azhar.edu.eg

الملخص العربي

يأتي محصول بنجر السكر في المرتبة الثانية من حيث الأهمية كمحصول سكر في العالم. أجريت التجربة الحالية لدراسة تأثير السماد النيتروجيني المعدني والتسميد بالنأنو نيتروجين (سيزاي) وخليط من ثلاثة عناصر صغرى نانو (البورن والزنك والمنجنيز) على النمو والمحصول لبنجر السكر. تم إجراء تجربتين في صوبة المزرعة التجريبية لكلية الزراعة جامعة الأزهر بمدينة نصر بالقاهرة في موسمي 2017/2016 و2017/ 2018 وقد صممت التجربة بإستخدام طريقة القطاعات الكاملة العشوائية في أربع مكررات لكل معاملة. وقد أظهرت النتائج أن التسميد بإستخدام النتروجين المعدني بمعدل 54 أو 90 كجم نيتروجين للفدأن + السيزاي (نانو) + خليط من العناصر الصغرى (نانو) أعطى أعلي القيم لمعدل النم والنسبي وصافي معامل التمثيل الضوئي عند الفترة من 60 إلي 90 يوم من الزراعة وكذلك سجلت أعلي القيم لكلاً من وزن الجذر غض ومحصول السكر للنبات مقارنةً بباقي المعاملات في موسمي الدراسة، كما سجلت نباتات بنجر السكر النامية في معاملة الكنترول (بدون تسميد) أقل القيم و ختاماً فأن إضافة سماد النانو سيزاى وخليط العناصر الصغرى مع سماد النيتروجين المعدني توفر 40% من الجرعة الموصى بها من سماد النيتروجين المعدني.

الكلمات المفتاحية: التسميد النانوي، بنجر السكر، تسميد النيتروجين.