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FOLIAR APPLICATION NUMBER OF MAGNESIUM AND IRON AND THEIR EFFECTS ON YIELD, QUALITY AND CHEMICAL CONSTITUENTS OF SUGAR BEET

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ABSTRACT: *Two field trials were carried out at Sakha Res. Station, Kafr EL-Sheikh Governorate in the two successive seasons (2012/2013 and 2013/2014) to find out the relative influence of spraying two important nutrients i.e. Mg and Fe with respect to date of application on sugar beet yield and quality.*

A split-plot design with three replicates was applied. The main plots were occupied by the foliar number (once and twice), the 1st spraying when the plant aged 60 days and the 2nd one at 90 days from sowing. Meanwhile, the combinations between Mg treatments (tap water "control", 0.5 and 1.0 kg/fed) and Fe treatments (tap water "control", 0.5 and 1.0 g/l) were distributed in the sub-plots. Magnesium was added as ($MgSO_4.7H_2O$ "9.8% Mg") and Fe as chelated iron (Fe-EDDHA "6%"). The obtained results revealed the importance of nutrients on root length and diameter and root fresh weight/plant, spraying higher doses (1.0 kg/fed and 1.0 g/l) from both Mg and Fe, resp., leaded to significant increment on previous characters and. Same attitude occurred with the chemical constituents and quality in the figure of impurities where spraying the two elements with higher doses significantly decreased Na, K and α- amino nitrogen% in the two spraying dates. Photosynthetic pigments positively affected by increasing doses of both fertilizers and number of spraying. Neither spraying once nor twice had a significant effect on the values of Mg and/or Fe percentages in sugar beet root. Fertilizing sugar beet by Mg and/or Fe attained positive response in sucrose and purity percentage in both seasons. The highest values of sucrose and purity percentages were recorded with the highest concentrations of Mg (1.0 kg/fed) and Fe (1.0 g/l). Concerning Mg and Fe effect on top, root and sugar yields, results revealed that concentration level of Mg and Fe-fertilizer increased root yield as well as sugar yield gradually and statistically in both growing seasons. In general, spraying sugar beet twice recorded an increment in most studied parameters. Our results emphasized on the importance of those nutrients i.e. Mg and Fe as foliar application by the rate 1.0 kg/fed and 1.0 g/l. resp., on yield quality and quantity for sugar beet canopy.

Key words: *Sugar beet, foliar application, magnesium, iron, yield.*

INTRODUCTION

Improving sugar beet yield and quality are the main goals of the Egyptian governmental policy to increase sugar production in order to face the gap between sugar consumption and production. Increasing the cultivated area horizontally and vertically is considered ones of the important national targets to minimize sugar's gap. Choosing the optimum rate, time and method of application for macro and micro nutrients will lead to maximum yield and quality for sugar beet crop. Micro elements became ones of the limited factors directly attributed by the high yield and quality of agricultural crop. Therefore, types and method of application of such element greatly affected on the expected benefit from these elements. Early foliar applications can make an already good crop better, either by stimulating more vigorous growth or maximizing the yield potential growth stage. The advantages of foliar feeding in accomplishing the desired crop responses are two-fold as it is a highly efficient and timely method of applying needed and/or critical plant nutrients also, it is a means of compensating for soil or environmentally induced nutrient deficiencies.

Micronutrients often act as co-factors in enzyme activity and participate in many of metabolic reactions, photosynthesis and respiration. It has essential role in promoting cell wall formation, carbohydrate metabolism, and has been associated with sugar translocation process (Yarnia *et al.,* 2008). In agricultural development programs role of micronutrients is very important to increase crop yield and quality. So balanced and efficient use of micronutrients fertilizers such as manganese, boron, zinc, and iron can improve agricultural production and quality (Mousavi *et al.,* 2007). El-Nour *et al.* (2003) studied the effect of Fe-EDDHA (6% Fe) levels (1.0, 1.5 and 2.0 g/l) on grown sugar beet, applied at 60 and 90 days after sowing, as a foliar spray. Application of the compound significantly increased both fresh and dry weights of plants. Total soluble solids concentration in roots was also found to respond positively to the Fe levels. The most efficient levels were 1.5 and 2.0 g Fe-EDDHA/l. Ciecko *et al.* (2004) studied the effect of Mg and micronutrients (B, Cu, Zn and Mn) application with the highest NPK rate. They mentioned that the elevated rates of fertilizers increased root yield, and chlorophyll "a" and "b" in leaves. In the same trend Zahradnicek *et al.* (2008) studied the effect of foliar fertilizer 2 % Mg and 0.4 % Fe in addition to other minerals and components. They found that within 10 days of application, the treated plants have higher chlorophyll contents (88.1 mg/100 g) than untreated control plants (81.8 mg/100 g). Gobarah, Mirvat *et al.* (2014) concluded that spraying micronutrients mixture twice (Fe + Zn + Mn + B) at 60 and 90 days from sowing had the highest productivity and quality of sugar beet under the environmental conditions of Dakahlia Governorate, Egypt.

Concerning magnesium, about 10 percent of the magnesium in plant leaves is associated with chlorophyll, the remainder is present in various forms, either in the ionic state or bound in complexes with organic constituents (Chalmers *et al.,* 1999). Usually, the first things to be noticed due to influence of Mg are chlorophyll level, photosynthesis (photosynthetic CO_2 fixation) and protein synthesis, however, recently, distribution of carbohydrates among shoot and root organs have been reported as well (Cakmak and Yazici, 2010). Hermans *et al.,* (2004) reported that a four-fold increase of sucrose in leaves of Mg-deficient sugar beets compared to the Mg-adequate sugar beet plants was reported and this affected quality of Mg-deficient sugar beets. This was attributed to inhibition of sucrose/sugar distribution from leaves to root organs in the Mg-deficient plants. Moustafa, Zeinab and Omran, Samia (2006) indicated that foliar spray with Mg significantly increased juice quality and some growth traits as length, diameter and fresh weight of root and yields of root, top and sugar.

Iron deficiency is a problem in many crops, especially in calcareous soils. In these soils, total Fe is high but not available to plant roots (Lindsay and Schwab, 1982). Plants respond to Fe limitation by inducing physiological and morphological changes in roots to facilitate the mobilization of sparingly soluble Fe compounds in the root environment. Aboushady *et al.* (2007) concluded that maximum dry matter was obtained when sugar beet fertilized with micronutrients. Application of high N- rate and micronutrients produced the highest root yield in sugar beet plant, on the other side, the high levels of nitrogen or micronutrients produce the lowest values of quality characters such as sucrose, total soluble solids and purity percentages as reported by (Nemeat-Alla *et al*., 2007 and Ramadan and Nassar 2004).

The aim of this work was to investigate the importance of some nutrient in terms of Mg and Fe as a foliar application and number of application on the yield and quality of sugar beet.

MATERIALS AND METHODS

Two field trials were conducted at Sakha Res. Station, Kafr EL-Sheikh Governorate during the two successive seasons (2012/2013 and 2013/2014) to study the relative performance of sugar beet as affected by the quantity and number of Mg and Fe foliar application.

A split-plot design with three replicates was conducted. The main plots were occupied by the foliar application numbers (once and twice), the 1st spray when the plant aged 60 days and the 2nd one at 90 days after sowing. Meanwhile, the combinations between three Mg treatments (tap water "control", 0.5 and 1.0 kg/fed "fed = 0.42 ha^{-1}") and three Fe treatments (tap water "control", 0.5 and 1.0 g/l) were distributed in the sub-plots, magnesium treatment was added as ($MgSO_4.7H_2O$ "9.8% Mg") and Fe element as chelated iron (Fe-EDDHA "6%"). Plot area was 21 m^2 including 6 ridges of 50 cm in width; which were 7 meter in length; distance between hills was 20 cm. The preceding crop was rice in both seasons. Nitrogen fertilizer was applied at 80 kg N/fed as urea (46.5 % N) in two equal doses, the 1st one after thinning (45 days from sowing) and the 2nd one month later. Phosphorus fertilizer in form of calcium superphosphate (15.5 % P_2O_5) was applied at the level of 31 kg P_2O_5/fed during seedbed preparation, whereas, potassium fertilizer in form of potassium sulphate (48 % K_2O) was added at the level of 48 kg K_2O/fed with the 1st nitrogen application. Soil samples were taken before sowing at random from the experimental sites at a depth of 0 – 30 cm from soil surface. Soil physical and chemical properties of the experimental sites are presented in Table (1).

Table (1): Soil mechanical and chemical properties of the experimental sites in the two seasons of 2012/2013 and 2013/2014.

	2012/2013	2013/2014
Soil depth (cm)	0 – 30	0 - 30
Mechanical soil distribution		
Sand %	19.4	18.0
Silt %	24.4	23.6
Clay %	56.2	58.4
Texture Class	Clay	Clay
Chemical analysis in soil extraction		
a) Cations meq/l		
Ca^{++}	3.10	2.89
Na^{+}	4.86	4.65
K^{+}	0.40	0.53
Mg^{++}	1.3	1.8
b) Anions meq/l		
Cl^{-}	2.41	2.27
SO_4^{--}	3.45	4.00
HCO_3^{-}	3.8	3.6
$CaCO_3$	3.82	4.00
Fe (ppm)	2.02	2.26
Available N ppm	39.70	36.80
Available P ppm	15.20	16.00
Available K ppm	389	421
pH	8.2	8.0
EC ds/m	0.96	0.99

Sugar beet variety viz Heliospoly was sown on the 1st week of October in both seasons. Other agricultural practices were followed as usual in sugar beet field according Sugar Crops Res. Inst. (SCRI) recommendations.

Recorded data:

A. Root yield attributes:

At harvest (210 days after sowing), a sample of five guarded plants were randomly taken from each sub-plot to determine the following characteristics:

1. Root length (cm).
2. Root diameter (cm).
3. Root fresh weight/plant (g).

B. Juice quality and chemical constituents:

1. Photosynthetic pigments were determined in the fresh leaves after 10 days from the foliar application treatments according to Wettestien (1957).

   The following equations were used:

   Chl. "a" mg/l = 9.784 (A 662) – 0.99 (A 644).

   Chl. "b" mg/l = 21.426 (A 644) – 4.65 (A 662).

   Carot. mg/l = 4.695(A 440) – 0.268 (chl. "a" + chl. "b").

   Where; chl. "a", "b" and carot. = concentrations of chlorophylls "a", "b" and carotenoids (mg/l), respectively.

   A = optical density at the wave length indicated.

2. Magnesium and iron elements were determined according to (A.O.A.C.,1995).

3. Impurities percentages of potassium (K), sodium (Na) and alpha-amino nitrogen in roots were determined in Delta Sugar Company Laboratories at Kafre EL-Sheikh Governorate.

4. Sucrose percentage was determined as described by Le Docte (1927).

5. Purity percentage was calculated according to the following equation:

   Purity % = (sucrose % x 100) / TSS %

C. Top, root and sugar yields (ton/fed):

At harvest, plants of the four guarded rows of each sub-plot were uprooted topped, cleaned and weighed to estimate root and top yields (ton/fed). Sugar yield was calculated according to the following equation:

Theoretical sugar yield (ton/fed) = root yield (ton/fed) x sucrose %.

Statistical analysis:

The collected data were statistically analyzed according to Snedecor and Cochran (1981). Least Significant Difference (LSD) was used to compare the differences between means at 5% level of probability as mentioned by Waller and Duncan (1969).

RESULTS AND DISCUSSION

A. Root criteria:

A. 1. Root length:

Results in Table (2) revealed that spraying Mg-fertilizer had a significant effect on root length in both seasons. As Mg increased from zero up to 1.0 kg/fed, the root length significantly and positively increased. The highest value of root length was recorded with the highest concentration of magnesium (1.0 kg/fed). Concerning Fe-fertilizer, spraying sugar beet plants with Fe had significantly effect on root length however, the difference between the two doses *i.e.* 0.5 and 1.0 g/l did not reach the level of significance in the 2nd season. Meanwhile, both concentrations gave significant increment in comparison to control treatment (tap water) in both seasons.

As for, the influence of spraying number on root length, the collected data pointed out that spraying number had a significant positive effect on root length in the 2nd season, however, this effect was insignificantly in both season with respect to root diameter.

Interaction between the three factors attained a significant influence on root length in the 1st season only, the highest value of root length was recorded when the plant spraying twice by 1.0 kg Mg/fed and 1.0 g Fe/l. Whereas, Interaction between spraying number and Fe-concentration was statistically on root diameter in the 2nd season only, increasing the applied dose of Fe-fertilizer was followed by significant increase in the values of root diameter.

A. 2. Root diameter:

Data in Table (2) revealed that spraying Mg-fertilizer produced gradual increase in the values of root diameter in both growing seasons. The highest root diameter was recorded with the highest concentration of Mg (1.0 kg/fed).

Fe-spraying resulted a significant and continuous positive influence on root diameter. This finding was completely true in both seasons. Number of foliar application was insignificantly on root diameter in both seasons.

Interaction between spraying number and Mg concentration appeared a significant effect on root diameter in the 1st season only. This finding was fairly true under the two spraying numbers whether in the 1st and/or in the 2nd season. Regardless the significance influence, results cleared that under the two spraying treatments, increasing Fe dose was accompanies by increase in root diameter.

A. 3. Root fresh weight/plant:

Table (2) demonstrated that increasing the applied concentration of Mg and/or Fe significantly and gradually raised root fresh weight/plant.

Spraying sugar beet with the highest doses of Mg and Fe recorded the highest significant values of root fresh weight/plant, under both seasons. This finding is in agreement with Christian and Johnson (2004) who concluded that Mg supply to the roots is insufficient; recycling of Mg is required to cover the growth of newly developing organs.

Results in Table (2) showed that spraying sugar beet crop twice by the examined elements increased the values of root fresh weight in both growing seasons. This increment was significantly in the 1st season only.

Concerning the interaction effects between the studied factors, the results obtained in Table (2) pointed out that the 1st order interaction between spraying number of Mg and its concentration was statistically in respect to its influence on root fresh weight/plant. Increasing the applied doses of Mg attained a significant increase in root fresh weight; under the two spraying treatments. In the 2nd season, the interaction between the various combination of Mg and Fe concentration was statistically in the 2nd season only, it could be noted that both elements act together on root fresh weight. Increasing Mg concentration under the various concentration of Fe was accompanied by significant increase in root fresh weight.

Generally it could concluded that the increase in root dimensions and root fresh weight as a result of the examined elements are attributed to their role in photosynthesis and cell metabolism. These results are in agreement with those reported by Ouda, Sohier (2007) and Nemeat-Allah *et al.* (2009). Also those observation may be due to the role of micronutrients that often act as co-factors in enzyme activating and participate in redox reactions, photosynthesis and respiration. It has essential role in promoting cell wall formation, carbohydrate metabolism and has been associated with sugar translocation process (Yarnia *et al.,* 2008).

Table (2): Root length, root diameter and root fresh weight/plant as affected by Mg and Fe-fertilizer and their foliar number (2012/2013 and 2013/2014 seasons).

Treatments		Root length (cm)							
		1st Season (2012/2013)				2nd Season (2013/2014)			
		Iron levels (g/l)							
No. foliar	Magnesium levels (kg/fed)	control	0.5	1.0	Mean	control	0.5	1.0	Mean
once	Control	21.33	22.22	24.22	22.59	26.34	27.22	27.89	27.15
	0.5	23.67	26.78	25.22	25.22	26.00	28.56	28.34	27.63
	1.0	25.22	26.00	27.11	26.11	28.44	31.00	29.67	29.70
Mean		23.41	25.00	25.52	24.64	26.93	28.93	28.63	28.16
twice	Control	22.33	25.89	27.11	25.11	25.11	27.78	30.33	27.74
	0.5	25.33	26.55	27.89	26.59	28.33	29.78	30.22	29.45
	1.0	26.00	27.78	28.89	27.56	29.00	30.22	30.56	29.93
Mean		24.55	26.74	27.96	26.42	27.48	29.26	30.37	29.04
Magnesium x Iron	Control	21.83	24.06	25.67	23.85	25.72	27.50	29.11	27.45
	0.5	24.50	26.67	26.56	25.91	27.17	29.17	29.28	28.54
	1.0	25.61	26.89	28.00	26.83	28.72	30.61	30.11	29.82
Mean		23.98	25.87	26.74		27.21	29.09	29.50	
Control: tap water, fed = 0.42 ha^{-1}									
LSD at 0.05 level (1st and 2nd seasons) for:									
No. foliar (A)		NS		A x C	NS	A	0.791	A x C	NS
Magnesium level (B)		0.609		B x C	NS	B	1.025	B x C	NS
Iron level (C)		0.609		AxBxC	1.492	C	1.025	AxBxC	NS
A x B		NS				A x B	NS		
		Root diameter (cm)							
once	control	10.00	11.33	11.44	10.93	10.22	10.89	11.44	10.85
	0.5	11.11	11.67	12.00	11.59	11.00	11.78	11.89	11.56
	1.0	12.00	12.45	13.00	12.48	12.67	13.11	13.56	13.11
Mean		11.04	11.82	12.15	11.67	11.30	11.93	12.30	11.84
twice	control	9.55	10.78	11.67	10.67	10.78	11.78	12.22	11.59
	0.5	11.22	13.11	12.55	12.30	11.56	12.11	12.78	12.15
	1.0	11.78	13.37	13.90	13.02	12.00	13.67	14.14	13.27
Mean		10.85	12.42	12.71	11.99	11.44	12.52	13.05	12.34
Magnesium x Iron	control	9.78	11.06	11.56	10.80	10.50	11.34	11.83	11.22
	0.5	11.17	12.39	12.28	11.94	11.28	11.94	12.34	11.85
	1.0	11.89	12.91	13.45	12.75	12.33	13.39	13.85	13.19
Mean		10.94	12.12	12.43		11.37	12.22	12.67	
LSD at 0.05 level (1st and 2nd seasons) for:									
No. foliar (A)		NS		A x C	NS	A	NS	A x C	0.340
Magnesium level (B)		0.392		B x C	NS	B	0.240	B x C	NS
Iron level (C)		0.392		AxBxC	NS	C	0.240	AxBxC	NS
A x B		0.555				A x B	NS		
		Root fresh weight (g)							
once	control	797	863	948	869	926	1058	1123	1036
	0.5	926	961	1020	969	1049	1147	1130	1109
	1.0	1001	1048	1069	1039	1136	1168	1199	1168
Mean		908	957	1013	959	1037	1124	1151	1104
twice	control	1073	1115	1154	1114	912	1146	1159	1073
	0.5	1131	1161	1216	1169	1179	1216	1261	1219
	1.0	1177	1258	1266	1233	1229	1294	1311	1278
Mean		1127	1178	1212	1172	1107	1219	1244	1190
Magnesium x Iron	control	935	989	1051	992	919	1102	1141	1054
	0.5	1028	1061	1118	1069	1114	1182	1195	1164
	1.0	1089	1153	1168	1136	1183	1231	1255	1223
Mean		1017	1068	1112		1072	1172	1197	
LSD at 0.05 level (1st and 2nd seasons) for:									
No. foliar (A)		116.455		A x C	NS	A	NS	A x C	NS
Magnesium level (B)		16.744		B x C	NS	B	41.589	B x C	72.034
Iron level (C)		16.744		AxBxC	NS	C	41.589	AxBxC	NS
A x B		23.680				A x B	NS		

B. Juice quality and chemical constituents:

B. 1. Photosynthetic pigments (mg/l):

Plants require magnesium to harvest solar energy and to drive photochemistry. Because of the tendency of Mg to form octahedral complexes, resulting in strong electrophilic axial coordination, Mg is able to occupy a central position in chlorophyll, the pigment responsible for light absorption in leaves (Beale, 1999). It has been estimated that the Mg structural pool associated with chlorophyll represents between 15 and 20 % of the leaf content (Mengel and Kirkby, 1987 and Wilkinson *et al.*, 1990). Mg concentration in chloroplastic compartments is modulated by light transition (Wu *et al.,* 1991 and Igam-berdiev and Kleczkowski, 2001).

B. 1. 1. Chlorophyll "a" (mg/l):

Data in Table (3) showed that spraying sugar beet twice by the examined elements attained a significant increment on chlorophyll "a". This result was fairly true in the first season only.

Spraying sugar beet canopy by Mg and/or Fe-fertilizer significantly increased the values of chlorophyll "a", this increase was accompanied to the increase in Mg fertilizer up to 0.5 kg/fed and up to the highest dose of Fe fertilizer (1.0 g/l). It could be noted the differences between the middle dose of both element were insignificantly in both growing seasons.

B. 1. 2. Chlorophyll "b" (mg/l)

Table (3) pointed out that the values of chl. "b" was not enough to attain the significant effect in both seasons as affected by number of sprays.

The values of chl."b" increased significantly with increasing Mg and Fe-fertilizer in both seasons, also, it is distinctly show that the highest value of this trait was recorded with the highest concentration of both elements.

B. 1. 3. Carotenoids (mg/l):

Data in Table (3) revealed that increasing spraying number of the two elements attained a relative increase in the values of carotenoids (mg/l). This increase was statistically in the 2nd season only.

Table (3) cleared that spraying both Mg and Fe elements attained a significant effect on carotenoids (mg/l) of sugar beet leaves. However, the difference between the two concentrations of Mg and/or Fe did not reach the level of significance with respect to their effect on the values of carotenoids (mg/l).

As for the interactions effects between the studied factors, the results obtained demonstrated that non of the various combination of the studied factors had a significant effect on the values of leaves pigments of sugar beet, except that between spraying number and Fe doses for chl."a" and carotenoids (mg/l) in the 2nd season was significant. Spraying Mg-fertilizer twice by 0.5 kg /fed attained the best values of chl."a" and carotenoids (mg/l).

B. 2. Magnesium and ferric percentages:

Results given in Table (4) revealed that spraying neither once nor twice times had a significant effect on the values of Mg and/or Fe percentage in sugar beet root, however, it could be noted that spraying the examined elements attained a somewhat increase in the values of Mg and Fe in juice root.

Magnesium and iron fertilizers had significant effect on the values of Mg % and Fe % in sugar beet root. This finding was true in both seasons, where, increasing the dose of Mg and/or Fe gradually increased the values of Mg and Fe percentages.

Except the interaction between spraying number and Mg fertilizer for Fe %, the 1st and 2nd interactions were insignificant with respect their influence in Mg and Fe percentages.

Table (3): Chlorophyll "a", chlorophyll "b" and carotenoids as affected by Mg and Fe–fertilizer and their foliar number (2012/2013 and 2013/2014 seasons).

Treatments		Chlorophyll "a"							
		1st Season (2012/2013)				2nd Season (2013/2014)			
No. foliar	Magnesium levels (kg/fed)	Iron levels (g/l)							
		control	0.5	1.0	Mean	control	0.5	1.0	Mean
once	Control	5.21	5.43	5.82	5.49	5.52	6.19	6.30	6.00
	0.5	5.19	5.69	5.51	5.46	7.16	6.03	7.60	6.93
	1.0	5.45	4.91	6.50	5.62	6.14	6.66	6.82	6.54
Mean		5.28	5.34	5.94	5.52	6.27	6.29	6.91	6.49
twice	Control	4.60	5.78	4.93	5.10	5.39	6.55	6.20	6.05
	0.5	5.22	5.74	6.24	5.73	5.96	6.26	6.21	6.14
	1.0	5.54	7.08	6.92	6.51	5.96	6.85	7.31	6.71
Mean		5.12	6.20	6.03	5.78	5.77	6.55	6.57	6.30
Magnesium x Iron	Control	4.91	5.60	5.38	5.29	5.46	6.37	6.25	6.03
	0.5	5.20	5.72	5.88	5.60	6.56	6.15	6.91	6.54
	1.0	5.49	5.99	6.71	6.07	6.05	6.75	7.07	6.62
Mean		5.20	5.77	5.99		6.02	6.42	6.74	
Control: tap water, fed = 0.42 ha^{-1}									
LSD at 0.05 level (1st and 2nd seasons) for:									
No. foliar (A)		0.212		A x C	NS	A	NS	A x C	NS
Magnesium level (B)		0.514		B x C	NS	B	0.405	B x C	NS
Iron level (C)		0.514		AxBxC	NS	C	0.405	AxBxC	NS
A x B		NS				A x B	0.572		
		Chlorophyll "b"							
once	Control	1.27	1.36	1.89	1.51	2.21	2.39	2.54	2.38
	0.5	2.10	2.14	2.00	2.08	2.41	2.19	2.48	2.36
	1.0	2.61	2.68	2.71	2.67	2.68	3.18	2.95	2.93
Mean		1.99	2.06	2.20	2.08	2.43	2.58	2.65	2.56
twice	Control	1.79	1.44	1.81	1.68	2.70	3.09	2.93	2.91
	0.5	2.12	2.16	2.29	2.19	2.52	2.81	3.16	2.83
	1.0	2.75	2.65	2.84	2.74	2.92	2.87	3.78	3.19
Mean		2.22	2.08	2.31	2.20	2.71	2.92	3.29	2.97
Magnesium x Iron	Control	1.53	1.40	1.85	1.59	2.46	2.74	2.73	2.64
	0.5	2.11	2.15	2.14	2.13	2.46	2.50	2.82	2.59
	1.0	2.68	2.66	2.78	2.71	2.80	3.02	3.36	3.06
Mean		2.11	2.07	2.26		2.57	2.75	2.97	
LSD at 0.05 level (1st and 2nd seasons) for:									
No. foliar (A)		NS		A x C	NS	A	NS	A x C	NS
Magnesium level (B)		0.127		B x C	NS	B	0.301	B x C	NS
Iron level (C)		0.127		AxBxC	NS	C	0.301	AxBxC	NS
A x B		NS				A x B	NS		
		Carotenoids							
Once	Control	1.17	1.37	1.47	1.34	0.85	1.04	0.89	0.93
	0.5	1.41	2.15	1.84	1.80	1.15	1.20	1.13	1.16
	1.0	1.85	1.37	2.10	1.77	1.60	1.61	1.67	1.63
Mean		1.48	1.63	1.80	1.64	1.20	1.28	1.23	1.24
Twice	Control	1.10	1.18	1.12	1.13	1.47	1.56	1.58	1.54
	0.5	1.61	2.14	2.03	1.93	1.96	2.11	2.17	2.08
	1.0	1.74	1.98	2.02	1.91	2.01	2.07	2.16	2.08
Mean		1.48	1.77	1.72	1.66	1.81	1.91	1.97	1.90
Magnesium x Iron	Control	1.14	1.28	1.29	1.24	1.16	1.30	1.24	1.23
	0.5	1.51	2.15	1.94	1.86	1.55	1.66	1.65	1.62
	1.0	1.80	1.68	2.06	1.84	1.81	1.84	1.92	1.85
Mean		1.48	1.70	1.76		1.51	1.60	1.60	
LSD at 0.05 level (1st and 2nd seasons) for:									
No. foliar (A)		NS		A x C	NS	A	0.619	A x C	NS
Magnesium level (B)		0.213		B x C	NS	B	0.179	B x C	NS
Iron level (C)		0.213		AxBxC	NS	C	NS	AxBxC	NS
A x B		NS				A x B	0.253		

Table (4): Magnesium and iron in root % as affected by Mg and Fe–fertilizer and their foliar number (2012/2013 and 2013/2014 seasons).

Treatments		Magnesium in root %							
		1st Season (2012/2013)				2nd Season (2013/2014)			
		Iron levels (g/l)							
No. foliar	Magnesium levels (kg/fed)	control	0.5	1.0	Mean	control	0.5	1.0	Mean
Once	control	0.34	0.37	0.37	0.36	0.36	0.37	0.41	0.38
	0.5	0.35	0.38	0.37	0.36	0.37	0.39	0.50	0.42
	1.0	0.37	0.39	0.42	0.39	0.39	0.41	0.48	0.43
Mean		0.35	0.38	0.39	0.37	0.37	0.39	0.46	0.41
Twice	control	0.35	0.38	0.40	0.37	0.34	0.36	0.39	0.36
	0.5	0.36	0.38	0.40	0.38	0.37	0.41	0.43	0.40
	1.0	0.36	0.40	0.44	0.40	0.43	0.43	0.55	0.47
Mean		0.35	0.38	0.41	0.38	0.38	0.40	0.45	0.41
Magnesium x Iron	control	0.34	0.37	0.39	0.37	0.35	0.36	0.40	0.37
	0.5	0.35	0.38	0.38	0.37	0.37	0.40	0.46	0.41
	1.0	0.37	0.39	0.43	0.40	0.41	0.42	0.51	0.45
Mean		0.35	0.38	0.40		0.37	0.39	0.46	

Control: tap water, fed = 0.42 ha^{-1}

LSD at 0.05 level (1st and 2nd seasons) for:

No. foliar (A)	NS	A x C	NS	A	NS	A x C	NS
Magnesium level (B)	0.013	B x C	NS	B	0.022	B x C	NS
Iron level (C)	0.013	AxBxC	NS	C	0.022	AxBxC	NS
A x B	NS			A x B	0.030		

Treatments		Iron in root %							
Once	control	0.23	0.26	0.24	0.24	0.30	0.38	0.37	0.35
	0.5	0.25	0.26	0.26	0.26	0.27	0.37	0.39	0.34
	1.0	0.25	0.27	0.32	0.28	0.31	0.37	0.43	0.37
Mean		0.24	0.26	0.27	0.26	0.29	0.37	0.39	0.35
Twice	control	0.24	0.29	0.29	0.27	0.32	0.35	0.32	0.33
	0.5	0.26	0.28	0.30	0.28	0.26	0.34	0.54	0.38
	1.0	0.28	0.30	0.33	0.30	0.41	0.41	0.57	0.46
Mean		0.26	0.29	0.31	0.28	0.33	0.36	0.48	0.39
Magnesium x Iron	control	0.24	0.28	0.26	0.26	0.31	0.36	0.34	0.34
	0.5	0.26	0.27	0.28	0.27	0.26	0.35	0.46	0.36
	1.0	0.26	0.28	0.32	0.29	0.36	0.39	0.50	0.42
Mean		0.25	0.28	0.29		0.31	0.37	0.43	

LSD at 0.05 level (1st and 2nd seasons) for:

No. foliar (A)	NS	A x C	NS	A	NS	A x C	NS
Magnesium level (B)	0.012	B x C	0.021	B	NS	B x C	NS
Iron level (C)	0.012	AxBxC	NS	C	0.075	AxBxC	NS
A x B	NS			A x B	NS		

B. 3. Impurities percentages:

Increasing the impurities in sugar beet roots have a bad results in sugar extraction. Table (5) indicates the influence of spraying number, Mg and Fe–fertilizer on the percentages of sugar beet juice impurities (Na %, K % and α- amino nitrogen). Results pointed out that spraying number Mg and/or Fe-fertilizer did not exists a significant influence on Na %, K % and α- amino nitrogen %. Regardless the insignificant effect of spring number of the tested elements, it could be noticed that spring sugar beet plant twice by Mg and/or Fe attained better results where reduced the percent of impurities.

Concerning the influence of Mg and Fe-fertilizer, data cleared that there were significant differences in the percentages of Na, K and α- amino nitrogen due to the applied concentrations of Mg and/or Fe-fertilizer. Actually, spraying sugar beet plants by the two elements attained positive results, whereas the applied doses of both elements increased the percentages of Na, K and α- amino nitrogen decreased. This finding was fairly true in both seasons.

Except the interaction between Mg and Fe-fertilizer for K % in the 1st seasons, the different combination of the studied factors were insignificant on the percentages of Na, K and α- amino nitrogen in both growing seasons. Christian and Johnson (2004) found that Mg deficiency has a direct effect on K and Na contents, where Potassium content increased slightly in all organs, except in the youngest parts of the plant, where the K content was similar to the control value. The content of sodium (the substitution cation) rapidly increased by up to as much as 10-fold the control content. Those results emphasized our obtained ones.

B. 4. Sucrose percentage:

Data presented in Table (6) showed that sucrose % was affected by spraying treatments. Foliar application twice by Mg and/or Fe–fertilizer increased the values of sucrose %. This effect was statistically in the 1st season only. Fertilizing sugar beet by Mg and or Fe-fertilizer attained a positive response in sucrose % in both growing seasons. The highest values of sucrose % were recorded with the highest levels of Mg (1.0 kg/fed) and Fe (1.0 g/l).

Concerning interaction effects of the studied factors, results in Table (6) revealed that concentrations of Mg and Fe-fertilizer act together to produce the highest significant effect on sucrose in the two seasons. It could be noted that increasing the concentration of Mg fertilizer was accompanied by the gradual increase in sucrose percentage in both seasons. This observation was completely true in both seasons. This finding may be assured to the critical role of both element in plant metabolism which reflected on sucrose %. Interaction between spraying number of Fe-fertilizer and the concentration of Fe appeared that increasing the applied concentration of Fe improved sucrose percentage. This result was true under the different spraying number of both seasons and significant in the 2nd season only. Our results were in coincide with those of Moustafa, Zeinab and Omran, Samia (2006) and Moustafa, Zeinab *et al.* (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.

B. 5. Purity percentage:

Table (6) pointed out that purity % of sugar beet juice increased as number of spraying increased from once to twice. Spraying the plant twice attained relative increase in the values of purity %, and that increase was significant in the 2nd season only.

As for, the influence of spraying any of Mg and/or Fe-fertilizer, results clearly the positive effect of both element on the values of purity %. This result may be due to the positive effect of both elements on sucrose percentage which plays a principal role in the values of purity percentage. The values of purity % almost tended to increase significantly up to the dose of Mg (1.0 kg/fed) and Fe (1.0 g/l) fertilizers. The difference between middle and the highest dose of Mg and/or Fe was almost insignificant with respect to purity percentage.

Table (5): Impurities percentages(Sodium, potassium and alpha-amino-N in roots) as affected by Mg and Fe–fertilizer and their foliar number (2012/2013 and 2013/2014 seasons).

Treatments		Sodium in root %							
		1st Season (2012/2013)				2nd Season (2013/2014)			
No. foliar	Magnesium levels (kg/fed)	Iron levels (g/l)							
		control	0.5	1.0	Mean	control	0.5	1.0	Mean
Once	control	2.96	2.63	2.63	2.74	2.34	1.96	1.97	2.09
	0.5	2.33	2.11	2.00	2.15	1.54	1.78	1.59	1.64
	1.0	1.95	1.88	1.98	1.93	1.51	1.46	1.46	1.47
Mean		2.41	2.21	2.20	2.27	1.80	1.73	1.67	1.73
Twice	control	2.36	2.19	2.11	2.22	2.03	1.49	1.43	1.65
	0.5	1.82	1.55	1.89	1.75	1.47	1.43	1.41	1.44
	1.0	2.17	1.78	1.45	1.80	1.40	1.47	1.45	1.44
Mean		2.11	1.84	1.82	1.92	1.64	1.46	1.43	1.51
Magnesium x Iron	control	2.66	2.41	2.37	2.48	2.19	1.73	1.70	1.87
	0.5	2.08	1.83	1.94	1.95	1.51	1.61	1.50	1.54
	1.0	2.06	1.83	1.72	1.87	1.46	1.46	1.45	1.46
Mean		2.26	2.02	2.01		1.72	1.60	1.55	
Control: tap water, fed = 0.42 ha^{-1}									
LSD at 0.05 level (1st and 2nd seasons) for:									
No. foliar (A)		0.281		A x C	NS	A	NS	A x C	NS
Magnesium level (B)		0.185		B x C	NS	B	0.176	B x C	NS
Iron level (C)		0.185		AxBxC	NS	C	NS	AxBxC	NS
A x B		NS				A x B	NS		
		Potassium in root %							
Once	control	5.71	5.05	4.77	5.18	5.29	5.14	5.06	5.16
	0.5	5.00	5.00	4.67	4.89	5.04	4.68	4.77	4.83
	1.0	4.99	4.94	5.13	5.02	4.73	4.62	4.53	4.63
Mean		5.23	5.00	4.86	5.03	5.02	4.82	4.79	4.87
Twice	control	5.63	5.16	5.14	5.31	4.74	4.68	4.77	4.73
	0.5	4.88	4.98	3.99	4.62	4.57	4.55	4.34	4.49
	1.0	5.18	4.74	4.93	4.95	4.47	4.36	4.05	4.29
Mean		5.23	4.96	4.69	4.96	4.60	4.53	4.39	4.50
Magnesium x Iron	control	5.67	5.11	4.95	5.24	5.02	4.91	4.91	4.95
	0.5	4.94	4.99	4.33	4.75	4.81	4.61	4.56	4.66
	1.0	5.09	4.84	5.03	4.99	4.60	4.49	4.29	4.46
Mean		5.23	4.98	4.77		4.81	4.67	4.59	
LSD at 0.05 level (1st and 2nd seasons) for:									
No. foliar (A)		NS		A x C	NS	A	NS	A x C	NS
Magnesium level (B)		0.223		B x C	0.385	B	0.111	B x C	NS
Iron level (C)		0.223		AxBxC	NS	C	0.111	AxBxC	NS
A x B		NS				A x B	NS		
		alpha-amino-N %							
Once	control	2.91	2.64	2.13	2.56	3.78	3.70	3.32	3.60
	0.5	2.79	2.56	1.50	2.28	3.58	3.55	3.08	3.40
	1.0	2.68	2.30	1.70	2.22	3.62	3.52	2.77	3.31
Mean		2.79	2.50	1.77	2.35	3.66	3.59	3.06	3.43
Twice	control	3.43	2.06	1.38	2.29	3.37	3.09	3.09	3.18
	0.5	2.47	2.27	2.18	2.30	3.06	3.04	2.79	2.96
	1.0	1.94	1.70	1.38	1.67	3.27	2.98	2.08	2.78
Mean		2.61	2.01	1.65	2.09	3.23	3.04	2.65	2.97
Magnesium x Iron	control	3.17	2.35	1.75	2.42	3.57	3.39	3.21	3.39
	0.5	2.63	2.41	1.84	2.29	3.32	3.29	2.93	3.18
	1.0	2.31	2.00	1.54	1.95	3.45	3.25	2.43	3.04
Mean		2.70	2.25	1.71		3.45	3.31	2.85	
LSD at 0.05 level (1st and 2nd seasons) for:									
No. foliar (A)		NS		A x C	NS	A	NS	A x C	NS
Magnesium level (B)		0.361		B x C	NS	B	NS	B x C	NS
Iron level (C)		0.361		AxBxC	NS	C	0.302	AxBxC	NS
A x B		NS				A x B	NS		

Table (6): Sucrose and purity percentages as affected by Mg and Fe–fertilizer and their foliar number (2012/2013 and 2013/2014 seasons).

Treatments		Sucrose percentage							
		1st Season (2012/2013)				2nd Season (2013/2014)			
No. foliar	Magnesium levels (kg/fed)	Iron levels (g/l)							
		control	0.5	1.0	Mean	control	0.5	1.0	Mean
Once	control	19.50	20.40	20.66	20.19	19.04	19.35	20.04	19.48
	0.5	19.77	20.52	20.76	20.35	19.90	20.40	20.87	20.39
	1.0	20.34	20.99	21.43	20.92	20.40	20.97	21.30	20.89
Mean		19.87	20.64	20.95	20.49	19.78	20.24	20.73	20.25
Twice	control	19.73	21.61	21.77	21.04	19.57	20.16	20.44	20.06
	0.5	20.87	21.82	22.29	21.66	20.13	20.96	21.25	20.78
	1.0	21.56	22.03	22.20	21.93	20.65	22.74	22.03	21.81
Mean		20.72	21.82	22.08	21.54	20.12	21.29	21.24	20.88
Magnesium x Iron	control	19.62	21.01	21.21	20.61	19.31	19.76	20.24	19.77
	0.5	20.32	21.17	21.52	21.01	20.02	20.68	21.06	20.59
	1.0	20.95	21.51	21.82	21.43	20.53	21.85	21.66	21.35
Mean		20.30	21.23	21.52		19.95	20.76	20.99	

Control: tap water, fed = 0.42 ha^{-1}

LSD at 0.05 level (1st and 2nd seasons) for:

No. foliar (A)	0.635	A x C	NS	A	NS	A x C	0.346
Magnesium level (B)	0.213	B x C	0.368	B	0.245	B x C	0.424
Iron level (C)	0.213	AxBxC	NS	C	0.245	AxBxC	NS
A x B	NS			A x B	NS		

Treatments		Purity percentage							
		control	0.5	1.0	Mean	control	0.5	1.0	Mean
Once	control	78.05	81.75	82.65	80.82	80.90	83.70	84.70	83.10
	0.5	81.72	84.00	84.38	83.37	82.76	85.80	86.48	85.01
	1.0	82.50	84.60	84.50	83.87	84.89	87.86	87.67	86.80
Mean		80.76	83.45	83.84	82.68	82.85	85.79	86.28	84.97
Twice	control	77.92	83.30	83.57	81.59	82.23	84.80	84.83	83.96
	0.5	82.43	85.40	85.05	84.29	84.85	87.42	87.31	86.53
	1.0	85.27	85.48	86.30	85.68	87.95	88.91	89.47	88.78
Mean		81.87	84.73	84.97	83.86	85.01	87.04	87.21	86.42
Magnesium x Iron	control	77.98	82.53	83.11	81.21	81.57	84.25	84.77	83.53
	0.5	82.08	84.70	84.72	83.83	83.80	86.61	86.90	85.77
	1.0	83.88	85.04	85.40	84.78	86.42	88.38	88.57	87.79
Mean		81.31	84.09	84.41		83.93	86.41	86.74	

LSD at 0.05 level (1st and 2nd seasons) for:

No. foliar (A)	NS	A x C	NS	A	0.663	A x C	0.675
Magnesium level (B)	1.032	B x C	1.788	B	0.477	B x C	NS
Iron level (C)	1.032	AxBxC	NS	C	0.477	AxBxC	NS
A x B	NS			A x B	NS		

Interaction between spraying number and Fe doses was significantly in the 1st season only, however, the highest value of purity was recorded when the plant spraying twice by 0.5 and 1.0 g Fe/l. Also, the combination between spraying Mg-fertilizer twice attained a significant effect on purity % in the 1st season only.

C. Top, root and sugar yields (ton/fed):

C. 1. Top yield (ton/fed):

Data Table (7) showed that spraying sugar beet plants twice by Mg and Fe-fertilizer increased the values of tops fresh yield; this increase was significant in the 2nd season only.

As to, the effect of Mg-fertilizer on tops yield, the results obtained appeared a significant increase in this trait due to Mg treatment. The increasing rate in tops yield positively and continued up to 1.0 kg Mg/fed in the 2nd season, however, 0.5 kg Mg/fed was enough to produce the highest tops yield.

Interaction between spraying number and Mg-fertilizer levels significantly effected on tops yield. Increasing Mg concentration lead to continuous increment in the values of tops fresh yield when the plants sprayed twice a season, the highest value of top fresh yield noticed with the combination between 1.0 kg/fed and spraying twice. Whereas, the highest value of top yield in the 1st season was recorded with spraying sugar beet plant once with 0.5 kg Mg/fed. The others 1st and 2nd order interaction insignificantly affected on top fresh yield.

C. 2. Root and sugar yields (ton/fed):

Results in Table (7) indicated that spraying sugar beet plants twice times with Mg and Fe-fertilizer statistically raised root fresh yield as well as sugar yield/fed. This result was true in both seasons, amounted by 2.80 % and 7.23 % for root fresh yield corresponding 7.98 % and 10.54 % for sugar yield in the 1st and 2nd seasons, respectively, compared to check treatment.

Concerning Mg and Fe-fertilizer effect on root fresh yield and sugar yield, results revealed that concentration of Mg and Fe-fertilizer increased the values of root fresh yield as well as the values of sugar yield statistically in the growing seasons. This result was in agreement with Moustafa, Zeinab *et al.* (2006) who found that iron, zinc and manganese significantly increased root and sugar yields.

The increment of root fresh yield as a result to Mg-fertilizer amounted 2.52 % and 4.48 % in the 1st season corresponding 6.77 % and 11.12 % in the 2nd season when the plants received 0.5 and 1.0 kg Mg/fed, respectively. Also, the increase in sugar yield as a result to Mg-fertilizer amounted by 4.43 % and 8.65 % in the 1st season corresponding by 11.27 % and 20.04 % in the 2nd season when the plants fertilized by 0.5 and 1.0 kg Mg/fed, respectively, compared to check treatment.

The increment root fresh yield/fed amounted by 1.47 % and 3.19 % in the 1st season corresponding 3.33 % and 5.70 % in the 2nd season, when plant sprayed by 0.5 and 1.0 g Fe/l, respectively, compared to check treatment. However, the increase in sugar yield amounted by 5.95 % and 9.34 % in the 1st season corresponding 7.63 % and 11.25 % in the 2nd season when the plant sprayed by 0.5 and 1.0 g Fe/l, respectively, compared to check treatment.

Table (7): Top, root and sugar yields (ton/fed) as affected by Mg and Fe–fertilizer and their foliar number (2012/2013 and 2013/2014 seasons).

Treatments		Top yield (ton/fed)							
		1st Season (2012/2013)				2nd Season (2013/2014)			
No. foliar	Magnesium levels (kg/fed)	Iron levels (g/l)							
		control	0.5	1.0	Mean	control	0.5	1.0	Mean
once	control	8.94	10.62	11.36	10.30	10.47	10.97	11.53	10.99
	0.5	10.67	11.47	11.88	11.34	11.10	12.07	12.83	12.00
	1.0	11.16	11.89	12.36	11.80	12.20	12.84	12.90	12.65
Mean		10.26	11.32	11.87	11.15	11.26	11.96	12.42	11.88
twice	control	9.38	10.98	11.67	10.68	10.13	11.53	12.23	11.29
	0.50	11.57	12.82	12.43	12.27	12.06	12.93	12.63	12.54
	1.0	11.02	11.87	12.12	11.67	13.13	13.94	14.51	13.86
Mean		10.66	11.89	12.07	11.54	11.77	12.80	13.12	12.56
Magnesium x Iron	control	9.16	10.80	11.51	10.49	10.30	11.25	11.88	11.14
	0.50	11.12	12.14	12.16	11.81	11.58	12.50	12.73	12.27
	1.0	11.09	11.88	12.24	11.74	12.66	13.39	13.70	13.25
Mean		10.46	11.61	11.97		11.51	12.38	12.77	

Control: tap water, fed = 0.42 ha^{-1}

LSD at 0.05 level (1st and 2nd seasons) for:

No. foliar (A)	NS	A x C	NS	A	0.633	A x C	NS
Magnesium level (B)	0.396	B x C	NS	B	0.320	B x C	NS
Iron level (C)	0.396	AxBxC	NS	C	0.320	AxBxC	NS
A x B	0.560			A x B	0.453		

Treatments		Root yield (ton/fed)							
once	control	21.65	22.96	23.28	22.63	23.07	23.53	24.43	23.68
	0.50	22.97	23.19	23.50	23.22	22.97	25.10	25.80	24.62
	1.0	23.39	23.83	24.03	23.75	25.60	26.00	26.47	26.02
Mean		22.67	23.33	23.60	23.20	23.88	24.88	25.57	24.77
twice	control	22.81	23.12	24.14	23.36	24.67	24.10	25.53	24.77
	0.50	23.97	24.06	23.72	23.92	26.04	27.91	27.37	27.11
	1.0	24.21	23.89	24.77	24.29	27.17	27.84	28.41	27.81
Mean		23.66	23.69	24.21	23.85	25.96	26.62	27.10	26.56
Magnesium x Iron	control	22.23	23.04	23.71	22.99	23.87	23.82	24.98	24.22
	0.50	23.47	23.62	23.61	23.57	24.50	26.50	26.59	25.86
	1.0	23.80	23.86	24.40	24.02	26.39	26.92	27.44	26.91
Mean		23.17	23.51	23.91		24.92	25.75	26.34	

LSD at 0.05 level (1st and 2nd seasons) for:

No. foliar (A)	0.285	A x C	NS	A	1.781	A x C	NS
Magnesium level (B)	0.362	B x C	NS	B	0.550	B x C	NS
Iron level (C)	0.362	AxBxC	NS	C	0.550	AxBxC	NS
A x B	NS			A x B	0.778		

Treatments		Sugar yield (ton/fed)							
once	control	4.22	4.68	4.81	4.57	4.39	4.55	4.90	4.61
	0.50	4.54	4.76	4.88	4.73	4.57	5.12	5.38	5.03
	1.0	4.76	5.00	5.15	4.97	5.22	5.45	5.64	5.44
Mean		4.51	4.81	4.94	4.76	4.73	5.04	5.31	5.03
twice	control	4.50	5.00	5.25	4.92	4.83	4.86	5.22	4.97
	0.50	5.00	5.25	5.29	5.18	5.24	5.84	5.82	5.64
	1.0	5.22	5.26	5.50	5.33	5.61	6.33	6.26	6.07
Mean		4.91	5.17	5.35	5.14	5.23	5.68	5.77	5.56
Magnesium x Iron	control	4.36	4.84	5.03	4.74	4.61	4.71	5.06	4.79
	0.50	4.77	5.01	5.08	4.95	4.91	5.48	5.60	5.33
	1.0	4.99	5.13	5.32	5.15	5.42	5.89	5.95	5.75
Mean		4.71	4.99	5.15		4.98	5.36	5.54	

LSD at 0.05 level (1st and 2nd seasons) for:

No. foliar (A)	0.200	A x C	NS	A	0.307	A x C	NS
Magnesium level (B)	0.098	B x C	0.170	B	0.129	B x C	0.223
Iron level (C)	0.098	AxBxC	NS	C	0.129	AxBxC	NS
A x B	NS			A x B	NS		

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عدد مرات رش الماغنسيوم والحديد وتأثيرهما علي المحصول والجوده والمكونات الكيميائية لبنجر السكر

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الملخص العربى

أقيمت تجربتان حقليتان في محطة سخا للبحوث الزراعية بمحافظة كفر الشيخ خلال موسمي ٢٠١٢/٢٠١٣ ، ٢٠١٣/٢٠١٤ لدراسة تأثير التسميد بالماغنسيوم والحديد وعدد مرات الرش علي محصول وجوده بنجر السكر.

اشتملت الدراسة علي ١٨ معاملة عبارة عن عدد مرات الرش (مرة ، مرتين) وثلاث معاملات للرش بالماغنسيوم (الرش بماء الصنبور "الكنترول" ، ٠.٥ ، ١ كجم/ف) في صورة سلفات ماغنسيوم وثلاث معاملات للرش بالحديد (الرش بماء الصنبور "الكنترول" ، ٠.٥ ، ١ جم/لتر) في صورة حديد مخلبي وذلك في تصميم قطع منشقة مرة واحدة وثلاث مكررات حيث وضع عدد مرات الرش في القطع الرئيسية بينما وزع التوافق بين مستويات الماغنسيوم والحديد في القطع الشقية.

تمثلت اهم النتائج المتحصل عليها في النقاط التالية:

١. زاد طول وقطر الجذر ووزن الجذر الطازج/نبات معنويا بزيادة تركيز رش الماغنسيوم والحديد محل الدراسة في كلا الموسمين.

٢. أدي استخدام المستويات المختلفة من التسميد بالماغنسيوم والحديد الي زياده معنوية في محتوي الصبغات الضوئيه متمثله في الكلوروفيل أ و ب والكاروتينيدات، وذلك في كلا الموسمين.

٣. زادت النسبة المئوية للسكروز والنقاوة بزيادة مستويات رش الماغنسيوم والحديد محل الدراسة مع انخفاض معنوي للشوائب متمثله في نسبه الصوديوم والبوتاسيوم والألفا أمينو نيتروجين.

٤. كان للرش بالتركيزات المرتفعة من الماغنسيوم والحديد أثار معنوية علي المحصول من حيث وزن الجذر ووزن العرش ومحصول السكر طن/ فدان في كلا الموسمين.

توصى الدراسة بالاهتمام بهذه العناصر لما لها من فائدة مباشرة علي محصول وجودة بنجر السكر وذلك بالرش مرتين بتركيز ١ كجم سلفات الماغنسيوم /فدان و ١ جرام حديد مخلبي/لتر.