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RESPONSE OF SUGAR BEET TO DIFFERENT SEEDLING METHODS, PHOSPHORUS FERTILIZER MANAGEMENT AND SPRAYING WITH SOME NUTRIENTS

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ABSTRACT

Two field experiments were carried out at Sakha Agricultural Research Station Farm during the two successive winter seasons of 2004 and 2005 using sugar beet (*Beta vulgares*) to asses the effects of seedling methods, phosphorus fertilizer management and spraying with some nutrients on the yield. Split split plot design was used with four replicates. The plot area was 27 m^2. The main plots were assigned to two seedling methods 1- manual seedling, and 2- mechanical seedling. The sub plots were assigned to two regimes for phosphorus fertilizer application 1- application of the recommended phosphorus fertilizer as one dose before the seedling and 2- application of the phosphorus as two equal doses, the first before the seedling and the second one month after sowing. The sub sub plots were assigned to four nutrient spraying 1- water as control, 2- magnesium (300 mg L^{-1}) as $MgSO_4$, 3- boron, as boric acid and 4- boron + magnesium.

The obtained results can be summarized as follows:

1. The manual seedling gave higher root yield than the mechanical seedling, but the differences were not significant.
2. The highest top yield was obtained with the mechanical seedling. The increases were statistically highly significant.
3. The highest sugar percent was recorded with the manual seedling method and the increases were highly significant.
4. Splitting the phosphorus fertilizer caused insignificant increase in the root yield and significantly decrease in the top yield.
5. Spraying with boron significantly increased the root yield in the first season and highly significant in the second season. Meanwhile, spraying with $MgSO_4$ reduced the root yield and increased top yields in both seasons.
6. Splitting the phosphorus fertilizer significantly reduced Na% in the juice and insignificant reduce of K% in the juice.

INTRODUCTION

Sugar beet is becoming an important crop as a source of sugar, because it grows well in the new reclaimed soils, mature in short period compared to sugar cane and contain high sugar content. Many environmental and agronomic factors influence sugar beet quantity and quality.

Shortage of farm labour and high costs has become a major constraint to economical agricultural production in Egypt. Over the past years much works and development has gone into producing implements and machines that will reduce the amount of labour required to grow the crop as well as the required seeds for planting. In comparative study between manual and mechanical seedling of sugar beet Taieb (1990) reported that the density of plants in the mechanical seedling treatment was about 12 plants per square meter, while the density of plants in the manual seedling treatment was about 9 plants per square meter. He found that the yield of the harvested roots in the manual planting was 35.95 ton fed^{-1}, while the yield of the harvested roots in the mechanical planting was 42.34 ton fed^{-1}. Taieb (1997) stated that the mechanical planting of sugar beet saved 33% of seeds rate compared with the manual planting, decreased the costs of consumed energy (L.E/K.W.h) by to 58% and increased sugar beet yield form 29.22 to 34.38 ton fed^{-1} per manual and mechanical planting, respectively.

Fertilization is the most important limiting factor to manipulate for sugar beet production under Egyptian soil environmental conditions (El-Kammah, 1995). Adequate fertilization increased sugar beet root and white sugar yield (Sayed *et al.*, 1998, Abd El-Magid *et al.*, 1999, Abu El-Fotoh *et al.*, 2000, and Knany *et al.*, 2005).

Phosphate supply could be a major limiting factor for increasing plant growth. The vital role of phosphorus in reactions involving energy transfer and more specifically ATP in nitrogenase activity. Most Egyptian soils are alkaline in reaction, the available P level for plants is usually less since it rapidly converts to unavailable form and this becomes inaccessible by plants (Mahmoud and Abd El-Hafez, 1982). In such case the possible ways to increase plant available phosphorus are the use of phosphate solubilizing microorganisms (Hamissa *et al.*, 2000 and Knany *et al.*, 2004), by decreasing soil pH (Knany *et al.*, 2000, Atia 2005 and El-Saady, 2004) or/and by splitting the phosphorus fertilizer (Verma *et al.*, 1996; El-Far *et al.*, 2001; Mahmoud, 2001, Knany *et al.*, 2002 and Shafeek, 2003).

Many investigators studied response of sugar beet yield and its quality to spraying with some micronutrients. Voth (1978) found that boron fertilization significantly increased both sugar yield and quality. Boron fertilization significantly increased root yield, root/shoot ratio and migration coefficient with increments over the control by 4.53%, 11.42 and 1.3 at 3 kg B fed^{-1}. However, shoots yield declined by 5.54% (El-Kammah, 1995). Ghaly *et al.* (1984) observed that sugar beet yield and sugar beet content of sugar were affected by boron application.

The objective of the present study is to investigate the effects of manual and mechanical seedlings, phosphorus fertilizer management and spraying with some nutrients on sugar beet yield and quality.

MATERIALS AND METHODS

Two field trials were conduced at Sakha Agricultural Research Station Farm during the two successive winter seasons of 2004 and 2005 on sugar beet crop (*Beta vulgares*) to assess seedling methods, phosphorus fertilizer management and spraying with some nutrients on sugar beet yield and quality. Split split plot design was used with four replicates. The main plots were assigned by two seedling methods, 1-manual seedling, and 2-mechanical seedling. The sub-plots were assigned by two times of phosphorus fertilizer placement of 1- placement of the recommended phosphorus fertilizer at one dose before seedling and 2- placement of the recommended phosphorus fertilizer at two equal doses, the first before seedling and the second after thinning (one month after seedling). The sub sub plots were randomly assigned by four nutrients spraying, 1- spraying with water as check treatment, 2- spraying with solution contain 300 mg L^{-1} Magnesium as magnesium sulphate, 3- spraying with solution contained 100 mg L^{-1} boron as boric acid and 4- spraying with solution contain 100 mg L^{-1} boron + 300 mg L^{-1} magnesium. The plot area was 27 square meter. The volume of spraying solution was two litters per plot. Phosphorus fertilizer was added as calcium super phosphate (15.5% P_2O_5). The recommended nitrogen and potassium fertilizers were added. Soil samples were taken before seedling for monitoring nutrients status and some chemical and physical properties according to Black *et al.* (1965). Root and top yields were noticed and migration coefficient was calculated as:

$$\text{Migration coefficient} = \frac{\text{Root weight kg}}{\text{Total plant weight kg}}$$

Table 1: Some physical and chemical properties of the experimental soils.

Variables	1st season	2nd season
Mechanical analysis		
Clay %	51.14	52.10
Silt %	25.61	24.20
Sand %	23.25	23.70
Texture	Clayey	Clayey
pH (1:2.5 soil: water suspension)	8.20	8.10
EC (soil paste extract) dSm^{-1}	2.92	3.05
Organic matter %	1.90	1.84
Available N (2 N K_2SO_4 extractable) mg kg^{-1}	25.2	22.4
Available P (0.5 N $NaHCO_3$ extractable) mg kg^{-1}	11.00	12.5
Available K (NH_4 acetate extractable) mg kg^{-1}	195.00	205.0

The obtained results were statistically analysed according to Gomez and Gomez (1984). Root samples were analyzed to sugar %, K%, Na%, α amino nitrogen and quality. These parameters were determined polarimetrically by means of an automatic sugar polarimeter (sacharometer) on a lead acetate extract of fresh roots according to Sach-Le Docte process as described by McGinnus (1971). Some properties of the experimental soils (Table 1). The spraying practice was repeated three times the first 45 days from sowing The second and the third sprays were one month between each other.

RESULTS AND DISCUSSION

Data presented in Table 2 show that there was insignificant increase in sugar beet root yield due to manual seedling comparing to mechanical seedling in both seasons. On contrary mechanical seedling led to highly significant increase in the top yield in both seasons. Migration coefficient values proved the previous results. Where the higher values (0.72 and 0.71) were recorded with manual seedling as compared to 0.66 and 0.64 with the mechanical seedling in the first and second seasons, respectively. Seedling method high significantly affected sugar percent. The higher values 20.0 and 19.95% were obtained with manual seedling in the first and second season, respectively. This may be due to plants density which was higher in the mechanical seedling than that obtained with manual seedling. These results could be enhanced with those obtained by Taieb (1990) who found that the density of plants in the manual seedling treatment was 9 plants per square meter. while the density of plants in the mechanical seedling treatment was about 12 plants per square meter.

Results in Table 2 show that splitting the phosphorus fertilizer into two doses led to insignificant increase in sugar beet root yield. It increased the root yield by about 1.2 and 2.2% in the first and second season, respectively. Splitting the phosphorus fertilizer significantly affected sugar beet top yield. The higher values (12.08 and 12.17 ton fed^{-1}) were obtained with placement of phosphorus fertilizer as one dose. These practices reflected on migration coefficient values. The higher value 0.70 was observed with splitting the phosphorus fertilizer into two doses. This may be due to splitting the phosphorus led to presence of available phosphorus in the root zone long period. Phosphorus plays a vital role in carbohydrate storage. Similar results were reported by Shafeek (2003) who found that application of P fertilizer as splits generally was more beneficial than the single dressing.

Table 2: Effect of seedling methods, phosphorus management and spraying with some nutrients on sugar beet yields.

Treatments	Root yield ton fed^{-1}		Top yield ton fed^{-1}		Sugar %		Sugar yield ton fed^{-1}		Migration coefficient	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Manual seedling (S_1)	25 47	25.68	10.15	10 33	20.0	19.95	5.03	5.11	0 72	0.71
Mechanical seedling (S_2)	24.82	25.01	12.98	13.18	19.19	19.10	4 76	4.78	0.66	0 64
F-test	N.S	N S	**	**	**	**	*	*		
P as one dose	24.95	25.07	12.08	12.17	19.74	19.69	4.93	4 91	0.67	0.67
P as two doses	25 26	25.63	11.05	11.18	19 45	19.39	4.87	4 96	0.70	0.70
F-test	N S	N.S	*	*	N.S	N.S	N.S	N S		
Foliar spraying treat.										
Check	25 50	25.61	11.26	11 48	19.54	19.50	4.88	5.03	0 69	0 69
Mg	23.73	23.99	12.38	12.35	19.49	19.44	4.63	4 61	0 66	0.66
B	25 64	25 81	11 65	11 84	19 67	19 56	5 05	5 01	0 69	0 68
Mg + B	25.60	25.98	10.95	11.03	19.69	19.61	5.04	5.09	0.70	0.70
F-test	*	**	N.S	N.S	N.S	N.S	N.S	*		
L S.D. 0 05	1.71	1.48	-	-	-	-	-	0.43		

With regard to the effect of spraying sugar beet with some nutrients data recorded in Table 2 show that Mg significantly reduced the root yield in both seasons (23.73 and 23.99 ton fed^{-1}). On the other hand, it increased the top yield (12.38 and 12.35 ton fed^{-1}) compared to the other treatments. This may be due to Mg enhanced the shoot growth and decreased the migration coefficient, where the lowest value (0.66) was recorded with Mg treatment. Boron treatment increased root and top yields compared to check treatment. Magnesium + boron treatment had the highest root yield (25.60 and 25.98 ton fed^{-1}) and the lowest top yield (10.95 and 11.03 ton fed^{-1}) in the first and second season, respectively. These are clear from the migration coefficient values, where the highest value (0.70) was obtained with Mg + B treatment in both seasons. These results could be supported by those obtained by Voth (1978) and El-Kammah (1995) who reported that boron fertilization significantly increased roots yield, root/shoot ratio and migration coefficient. It is clear form the data presented in Table 2 that no significant differences in sugar beet yields due to seedling methods or the spraying treatments, except the sugar yield in the second season, where it was significant. The highest sugar yield of 5.09 ton fed^{-1} was observed with Mg + B treatment.

Table 3: Effect of the interaction between seedling methods and spraying with some nutrients on sugar beet yield.

Treatments	Root yield ton fed^{-1}		Top yield ton fed^{-1}		Sugar %		Sugar yield ton fed^{-1}		Migration coefficient	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
S_1 Manual seedling	26.35	26.39	10.41	10.55	20.09	20.09	5.09	5.30	0 72	0.71
S_1 x Mg	23.35	23.85	9 66	9.75	19.75	19.68	4.61	4.70	0 71	0.71
S_1 x B	26.65	26.81	11.27	11 44	19.92	19.86	5.31	5 25	0.70	0.70
S_1 x Mg + B	26.31	25.67	9.34	9.59	20.23	20.16	5.18	5.18	0.74	0.73
S_2 Mechanical seedling	24.69	24.83	12.11	12.40	18.98	18.90	4.67	4.76	0.67	0.67
S_2 x Mg	24.12	24 14	15 18	14.96	19.23	19.02	4.64	4 52	0.61	0 62
S_2 x B	24 62	24.81	12 03	12.84	19 43	19.26	4.78	4.78	0.67	0.66
S_2 x Mg + B	25 90	26 23	12.58	12.47	19.14	19.06	4 96	5 00	0.67	0.69
F-test	N.S	*	**	**	N S	N.S	N.S	N.S		
L.S.D. 0.05	-	1.2	3.11	2.66	-	-	-	-		

Data in Table 3 show that sugar beet root yield significantly affected by the interaction between seedling methods and spraying with some nutrients in the second season. The highest root yield value of 26.81 ton fed^{-1} was obtained with manual seedling and spraying with boron. On the other hand the lowest value of 23.85 ton fed^{-1} was recorded with manual seedling and spraying with magnesium.

Top yield was high significantly affected by the interaction between seedling methods and spraying with some nutrients in both seasons. The highest values of 15.18 and 14.96 ton fed^{-1} in the first and second season, respectively were obtained with mechanical seedling and spraying with magnesium. While the lowest values of 9.34 and 9.59 ton fed^{-1} were observed with manual seedling and spraying with Mg + B in the first and second season respectively. These results were reflected on migration coefficient values, where the highest values of 0.74 and 0.73 were obtained with the manual seedling and spraying with Mg + B. While the lowest values of 0.61 and 0.62 were observed with mechanical seedling and spraying with Mg. No significant effects on sugar percent and sugar yield was detected due to the interaction between seedling methods and spraying with Mg or B or Mg + B in both seasons.

Data tabulated in Table 4 show that there was a significant effect of the interaction between seedling methods, phosphorus fertilizer management and spraying with some nutrients on sugar beet top yield in the first season and high significant in the second season. The highest values of 17.59 and 17.39 ton fed^{-1} were obtained with the mechanical seedling, application of the phosphorus fertilizer on one dose and spraying with magnesium in the first and second season, respectively. On the other hand, the lowest values of 9.27 and 9.52 ton fed^{-1} were observed with the manual seedling, application of the phosphorus fertilizer on two doses and spraying with Mg + B. No significant effects were detected on roots yield, sugar % and sugar yield. The migration coefficient values show that the bestest treatment which had the highest values of 0.74 and 0.73 was the manual seedling, splitting the phosphorus fertilizer in two doses and without spraying.

Table 4: Effect of the interaction between seedling methods, phosphorus fertilizer management and spraying with some nutrients on sugar beet yields.

Treatments		Foliar spraying treat.	Root yield ton fed^{-1}		Top yield ton fed^{-1}		Sugar %		Sugar yield ton fed^{-1}		Migration coefficient	
			1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Manual seedling	P-one dose	Check	24.97	25.01	10.97	10.98	20.22	20.30	5.05	5.08	0.69	0.69
		Mg	23.27	23.77	9.44	9.59	20.27	20.18	4.71	4.80	0.73	0.71
		B	26.34	26.60	12.35	12.63	20.03	20.00	5.28	5.21	0.68	0.68
		Mg + B	25.53	26.16	9.40	9.57	20.52	20.46	5.24	5.35	0.73	0.73
(S_1)	P-two doses	Check	27.74	27.78	9.84	10.13	19.97	19.88	5.13	5.52	0.74	0.73
		Mg	23.43	23.94	10.75	11.00	19.23	19.17	4.51	4.59	0.69	0.69
		B	26.97	27.01	10.19	10 25	19.80	19.72	5.35	5.19	0.73	0.72
		Mg + B	25.08	25.18	9.27	9 52	19.95	18.87	5.01	5.00	0 73	0.72
Mechanical seedling	P-one dose	Check	24.64	24.37	12.25	12.52	19.00	18.92	4.67	4.74	0.67	0.66
		Mg	25.11	24.57	17.59	17.39	19.59	18.58	4.90	4.52	0 59	0 59
		B	24.50	24 29	12 74	12 98	19.35	18.30	4 74	4.64	0.66	0 65
		Mg + B	25.49	25.73	12.87	12.72	19.02	18.93	4.83	4.86	0.66	0.67
(S_2)	P-two doses	Check	24.64	25.29	11.98	12.28	18.97	18.88	4 67	4.78	0.67	0.67
		Mg	23.13	23.70	12.76	12.52	18.93	18.65	4.38	4.51	0.64	0.65
		B	24.74	25.32	11.32	11.50	19.50	19.42	4.82	4.91	0.69	0.69
		Mg + B	26.31	26.83	12.31	12.23	19.27	19.18	5.09	5.15	0.68	0.69
F-test			N.S	N.S	*	**	N.S	N.S	N.S	N.S		
L.S.D. 0.05			-	-	4.41	3.76	-	-	-	-		

Data in Table 5 show that the seedling methods high significantly affected Na % in the roots. The higher values of 1.97 and 2.08 were obtained with the mechanical seedling in the first and second season, respectively. This my be due to the density of plants in the mechanical seedling was higher. Similar results were reported by Taieb (1990). Also, seedling methods significantly affected sugar beet juice quality in the first season and highly significant in the second season. The higher quality values (86.5 and

86.3) were obtained with the manual seedling. This may be due to plant density in the mechanical seedling which causes shading. The mechanical seedling high significantly decreased the extractable sugar in the first season.

Application of phosphorus fertilizer at two doses significantly reduced K% in the second season, Na% in both seasons and α amino nitrogen in the second season. In contrary it highly significant increased the juice quality in the second season. This may be due to the calcium content in the phosphorus fertilizer (calcium super phosphate 15.5% P_2O_5) may compete K and Na uptake by sugar beet plants. Similar results were obtained by Voth (1978), Ghaly *et al.* (1984) and Sobh *et al.* (1992).

Table 5: Effect of seedling methods, phosphorus fertilizer management and spraying with some nutrients on sugar beet K%, Na%, α-amino nitrogen, quality % and extractable sugar ton fed^{-1}.

Treatments	Potassium %		Na%		α-amino N		Quality %		Extractable	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Manual seedling	5.07	4.99	1.65	1.68	1.13	1.28	86.5	86.3	4.36	4.42
Mechanical seedling	5.35	5.33	1.97	2.08	1.40	1.56	84.9	84.9	4.07	4.05
F-test	N.S	N.S	**	**	N.S	N.S	*	**	**	N.S
P in one dose	5.25	5.17	1.93	1.99	1.32	1.47	85.2	85.3	4.22	4.19
P in two doses	5.16	5.15	1.69	1.77	1.21	1.37	86.2	85.9	4.20	4.27
F-test	N.S	N.S	*	*	N.S	*	N.S	**	N.S	N.S
Foliar spraying treat.										
Check	5.33	5.27	1.97	2.04	1.35	1.50	84 7	85.2	4.18	4.28
Mg	5.28	5.31	1.83	1.91	1.38	1.51	85.9	85.5	3 97	3.94
B	5.09	5.00	1.75	1.80	1.17	1.35	85.8	85 6	4.34	4.31
Mg + B	5.13	5.06	1.69	1.78	1.15	1.32	86.3	86.1	4.35	4.38
F-test	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N S	*	*
L.S.D 0.05	-	-	-	-	-	-	-	-	0.36	0.32

Spraying sugar beet plants with Mg + B significantly increased the extractable sugar in both seasons. On the other hand, spraying with Mg significantly decreased the extractable sugar in both season. This results are in agreement with those obtained by Ghaly *et al.* (1984) and El-Kammah (1995) who stated that boron fertilization significantly increased sugar beet yields.

Data in Table 6 show that α-amino nitrogen significantly affected by the interaction between the seedling methods, phosphorus fertilizer management and the spraying with some nutrients in both seasons. The highest α amino nitrogen values of 1.82 and 1.97% were detected with the mechanical seedling, application of the phosphorus fertilizer on two doses without spraying. On the other hand the lowest values of 0.91 and 1.11% were observed with the manual seedling, application of the phosphorus fertilizer on two doses and spraying with Mg + B in the first and second season, respectively. No significant effects were detected on K%, Na%, quality% and the extractable sugar ton fed^{-1} in both seasons.

Table 6: Effect of the interaction between seedling methods, phosphorus fertilizer management and spraying with some nutrients on sugar beet K%, Na%, α-amino-N, quality % and extractable sugar ton fed^{-1}.

Treatments		Foliar spraying treat.	Potassium %		Na %		α-amino N		Quality %		Extractable sugar	
			1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Manual seedling	P-one dose	Check	5.12	5.03	1.76	1.79	1.34	1.47	86.4	86.2	4.37	4.38
		Mg	4.94	4.90	1.59	1.64	1.04	1.13	87.0	86.9	4.10	4.18
		B	5.02	4.85	1.92	1.93	1.21	1.42	88.1	85.9	4.54	4.56
		Mg + B	5.07	4.99	1.65	1.68	1.14	1.27	86.8	86.6	4.55	4.63
(S_1)	P-two doses	Check	4.91	4.87	1.46	1.50	0.99	1.13	87.2	86.9	4.47	4.80
		Mg	5.44	5.36	1.81	1.85	1.36	1.47	84.9	84.7	3.83	3.88
		B	5.09	5.04	1.54	1.59	1.02	1.23	86.6	86.3	4.63	4.56
		Mg + B	4.95	4.90	1.45	1.49	0.91	1.11	86.1	86.9	4.36	4.35
Mechanical seedling	P-one dose	Check	5.40	5.35	2.50	2.58	1.27	1.42	80.2	83.2	3.90	3.95
		Mg	5.61	5.56	2.06	2.17	1.80	1.95	85.5	84.8	4.18	3.83
		B	5.34	5.29	1.98	2.04	1.33	1.48	84.0	83.8	4.03	3.90
		Mg + B	5.48	5.40	1.95	2.11	1.45	1.60	83.3	85.1	4.12	4.14
(S_2)	P-two doses	Check	5.89	5.84	2.17	2.28	1.82	1.97	85.0	84.6	3.97	4.04
		Mg	5.12	5.40	1.84	1.97	1.33	1.48	86.3	85.6	3.79	3.86
		B	4.91	4.81	1.59	1.66	1.11	1.28	86.6	86.3	4.18	4.24
		Mg + B	5.01	4.96	1.70	1.82	1.10	1.27	86.0	85.7	4.38	4.41
F-test			N.S	N.S	N.S	N.S	*	*	N.S	N.S	N.S	N.S
L.S.D. 0.05			-	-	-	-	0.90	0.86	-	-	-	-

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استجابة بنجر السكر لطرق الزراعة وإدارة السماد الفوسفاتي والرش ببعض المغذيات

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أجريت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بسخا خلال الموسمين الشتويين المتتاليين ٢٠٠٤ ، ٢٠٠٥م على محصول بنجر السكر لدراسة تأثير طرق الزراعة وإدارة السماد الفوسفاتي والرش ببعض العناصر المغذية على المحصول ومكوناته.

استخدم تصميم القطع المنشقة المنشقة في أربع مكررات وكانت مساحة القطعة التجريبية ٢٧م^2.
حيث شغلت القطع الرئيسية بطريقتين للزراعة هما: ١- الزراعة اليدوية ، ٢- الزراعة الميكانيكية. وشغلت القطع الشقية بطريقتين لإضافة السماد الفوسفاتي.

١- إضافة السماد الفوسفاتي الموصى به على دفعة واحدة قبل الزراعة (الطريقة الشائعة).

٢- إضافة السماد الفوسفاتي الموصى به على دفعتين الأولى قبل الزراعة والثانية بعد شهر من الزراعة (بعد خف النباتات).

كما شغلت القطع تحت الشقية بأربع معاملات رش هي:

١- الرش بالماء (معاملة المقارنة).

٢- الرش بالماغنيسيوم بتركيز ٣٠٠ مللي جرام/لتر في صورة كبريتات الماغنيسيوم.

٣- الرش بالبورون بتركيز ١٠٠ مللي جرام/لتر في صورة حامض البوريك.

٤- الرش بالماغنيسيوم بتركيزه وصورته والبورون بتركيزه وصورته.

ويمكن تلخيص النتائج في الآتي:

١- أعطت الزراعة اليدوية أعلى محصول جذور بالمقارنة بالزراعة الميكانيكية ولكن الفروق لم تكن معنوية عند مستوى الاحتمال ٠,٠٥.

٢- أعطت الزراعة الميكانيكية أعلى محصول للمجموع الخضري بالمقارنة بالزراعة اليدوية وكانت الفروق عالية المعنوية عند مستوى الاحتمال ٠,٠١.

٣- أعلى نسبة مئوية للسكر كانت مع الزراعة اليدوية وكانت الفروق عالية المعنوية.

٤- أدى تقسيم السماد الفوسفاتي إلى دفعتين إلى زيادة محصول الجذور بينما تسبب في خفض محصول المجموع الخضري بالمقارنة بإضافته على دفعة واحدة.

٥- أدى الرش بالبورون إلى زيادة معنوية في محصول الجذور في الموسم الأول وزيادة عالية المعنوية في الموسم الثاني.

٦- الرش بالماغنيسيوم أدى إلى نقص في محصول الجذور بينما تسبب في زيادة المجموع الخضري في الموسمين.

٧- أدى تقسيم السماد الفوسفاتي إلى دفعتين إلى تقليل النسبة المئوية للصوديوم والبوتاسيوم في العصير وكان النقص عالي المعنوية في حالة الصوديوم.