EFFECT OF BALANCED FERTILIZATION OF NPK ON YIELD AND QUALITY OF SUGAR BEET

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Abstract

Two field trials were carried out at Sakha Research Station, Kafr El-Sheikh Governorate in 2001/2002 and 2002/2003 seasons, to study the effect of twenty seven treatments representing the combination between three levels of phosphorus (zero, 15 and 30 kg P_2O_5/fed), three nitrogen levels (60, 80 and 100 kg N/fed) and three potassium levels (zero, 24 and 48 kg K_2O/fed) on yield and quality of sugar beet. Gazella variety was used in both seasons. A split plot design in four replications was used. The results showed that N levels significantly increased root and sugar yields in the 1st and 2nd seasons. Sucrose percentage was statistically increased by P levels in the 2nd season. Root length, root and sugar yields were positively increased by K-fertilizer in both seasons, while sucrose percentage was significantly increased in the 2nd season only. Interaction of N x P levels significantly increased root fresh weight in both seasons while root length and sucrose% were markedly influenced in the 1st season.

INTRODUCTION

Nitrogen has a role in building up plant organs through synthesis of proteins and it is an integral part of the chlorophyll molecule. Also, it's important to the synthesis of sucrose and the reactions involving the utilization of sucrose as an energy source for plant growth and cell maintenance. However, An imbalance of nitrogen or an excess of this nutrient in relation to other nutrients such as phosphorus and potassium can prolong the growing period and delay crop maturity.

Phosphorus has a role in plant life through energy storage and transfer. It acts as a linkage unit and has a vital metabolic role and is considered an important structural component of a wide variety of biochemical including nuclic acids, coenzymes, phosphoproteins and sugar phosphates. It promotes root growth and is conductive for higher sugar accumulation through its role in the photothynthesis process.

Potassium is a mobile element in the plant tissues and it plays an important role in photosynthesis through carbohydrate metabolism, osmotic regulation, nitrogen uptake, protein synthesis, translocation of assimilates. Also, it's role in physiological processes in the plant such as respiration, transpiration, translocation of sugars and carbohydrates, energy transformation and enzyme actions. Many investigations proved an evidence of the role of potassium in improving juice quality and sugar recovery (Russell *et al.*,1971).

Therefore, it was necessary to find out the optimal NPK-level resulting in the maximum yield and quality of sugar beet in the newly reclaimed soils. Many investigators found that sugar beet yield and quality are greatly influenced by the applied NPK levels. Khan, *et al.* (1990) stated that increasing rates of N and P increased root and sugar yields. Moreover, they mentioned that N decreased and P increased root sucrose content. They concluded that 120 kg N and 60-90 kg P_2O_5 were optimum for high yields and good quality sugarbeet. Oga, *et al.* (1990) fertilized sugar beet with 75-225 kg/ha each of N, P and K applied in different combinations. They found that the application of 150 kg/ha each of N, P and K gave the highest av. root yields of 42.3-43.7 t/ha and root sugar contents of 16.4-16.9%, compared with untreated control. Further increase in NPK rates decreased yields and reduced root technological qualities. Rabuffetti *et al.* (1993) applied NPK fertilizers to sugar beet. They obtained a significant increase in root yield. There was no K effect. Sugar content significantly increased with P fertilization and it tended to decrease with increased N fertilization. Sugar yields were affected by applied fertilizer. There were positive responses to N and P, the rate of N needed for maximum sugar yield was 15 to 20 kg/ha less than the rate required for maximum root yield. There was no K effect. El-Essawy (1996) showed that root, top and sugar yields and quality of sugar beet plants increased with the combination of 120 kg N + 30 kg P_2O_5 + 24 kg K_2O/fed. El- Maghraby *et al.* (1998) revealed that increasing N-level from 30 to 60 and 90 kg N/fed caused a significant increase in root weight/plant, root and sugar yields/fed. They concluded that applying 90 kg N/fed had superior effect on root and sugar yields. Ibrahim (1998) applied five N levels (0, 25, 50, 75 and 100 kg/fed), two levels of phosphorus (0 and 15 kg P_2O_5/fed) and three levels of potassium (0, 24 and 48 kg K_2O/fed). He found that 100 kg N + 15 kg P_2O_5 + 48 kg K_2O/fed gave significantly the maximum values of root length, diameter, fresh weight/plant, root and sugar yields while sucrose and purity percentages were significantly decreased. Jaszczolt (1998) tested sugarbeet in soils containing 110 mgN/dm^3, 160 mgK/dm^3 and 20 mgP/dm^3. Results showed that phosphorus fertilizer amounts (400-640 kg/ha) did not significantly affect the crop yield, sugar yield or sugar content of beet. Kurakov, *et al.*(1998), gave combinations of 45-190 kg N + 60-190 kg P_2O_5 + 45-190 kg K_2O/ha, or the lowest NPK rate with farmyard manure. Doubling or trebling the NPK rate only increased root yield by 5-15% and did not increase sugar yield. The technological quality of the roots was best with the lowest NPK rate or with increased P or K rates. Root sugar content was highest with increased K and sugar output was greatest (15.63-15.69%) with increased P or K. Odrekhovskii *et al.*(1998) applied diferent combinations of 40-160 kg N + 50-200 kg P_2O_5 + 50-200 kg K_2O/ha to sugar beet. They found that root yields 39.4 t/ha increased with increasing fertilizer rates. Sugar yields were highest with 80 kg N + 100 kg P_2O_5 + 100 kg K_2O/ha. Higher fertilizer rates increased the leaf:root ratio, were less effective in increasing root and sugar yields and reduced the technological quality of the roots. Shalaby (1998) found that root fresh weight/plant, root and sugar yields were gradually increased as the N-rate was increased from 60 to 75 and 90 kg/fed. However, purity percentage gradually decreased as N-level increased. Suwara *et al.*(1998) fertilizered sugarbeet with 200 kg N + 56 kg P + 200 kg K/ha and half rates of NPK. They found that root yields were 36.58 t/ha with no fertilizer and 54.98 t with NPK. EL-Shafai (2000) showed that increasing N-level up to 92 kg N/fed increased root fresh weight/plant, root and sugar yield significantly while sucrose percentage decreased. He added that purity percentage was not significantly affected by the applied N-level. This work aims to determine the optimum levels of NPK for the highest root and sugar yields of sugar beet crop in kafr El-sheikh Governorate.

MATERIALS AND METHODS

Two field trials were carried out at Sakha Research Station, Kafr El-Sheikh Governorate in 2001/2002 and 2002/2003 seasons to study the effect of twenty seven treatments represented the combination between three levels of phosphorus (zero, 15 and 30 kg P_2O_5/fed) and three nitrogen levels (60, 80 and 100 kg N/fed) and three potassium levels (zero, 24 and 48 kg K_2O/fed) on yield and quality of sugar beet. Gazella variety was used in both seasons. A split plot design in four replications was used where P levels (in the form of calcium super phosphate, 15.5% P_2O_5) were distributed in the main plots at land preparation while N x K combinations were applied in the sub plots. The previous crop was maize in both seasons. Nitrogen fertilizer levels (as Urea, 46% N) were added in two equal doses; immediately after thinning and one month later. Potassium levels were applied with the 2nd N-dose as potassium sulphate (48% K_2O). The physical and chemical analysis of the upper 30-cm of soil of the experimental site showed that the soil was clay loam containing 31.3 ppm available N, 19.97 ppm P and 183 ppm K. Other agricultural practices were done as recommended by Sugar Crops Research Institute.

At harvest, ten plants represent each treatment were randomly collected to determine the following traits:

1. Root dimensions (cm).
2. Root fresh weight (kg).
3. Sucrose % was determined as described by Le Docte (1927).
4. Purity % was calculated according to the following equation:

Purity % = sucrose % x 100 / total soluble solids %

Where: total soluble solids % was determined using hand refractometer.

5. Root yield (tons/fed) was estimated on plot area basis.
6. Sugar yield (tons/fed) was calculated according to the following equation:

Sugar yield = root yield x sucrose % x purity %

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

RESULTS AND DISCUSSION

1. Root dimensions:

The results in Table (1) show that both N and P levels did not significantly affect root length in the 1st and 2nd growing seasons.

Potassium levels significantly increased root length in the 1st and 2nd growing seasons. Application of 48 and 24 kg K_2O/fed gave the highest values of root length of sugar beet being 27.4 and 28.5 cm in the 1st and 2nd season, respectively. This increase in root length may be due to potassium role in physiological processes in the plant such as respiration, transpiration, translocation of sugars and carbohydrates, energy transformation and enzyme actions.

Except the interaction between P x N, all the interactions insignificantly affected root length in both seasons. However, application of 80 kg N with zero kg P_2O_5/fed gave the maximum root length of sugar beet in the 2[nd] season. This result is in agreement with that reported by Ibrahim (1998).

Table (1): Root length (cm) of sugar beet as affected by NPK fertilization levels and their interactions in 2001/2002 and 2002/2003 seasons.

Nitrogen level (kg N/fed)	Phosphorus level (kg P_2O_5/fed)	Potassium level (kg K_2O/fed)							
		2001-2002 season				2002-2003 season			
		zero	24	48	Mean	24	48	zero	Mean
60	Zero	24.3	30.5	26.0	26.9	24.8	30.8	24.5	26.7
	15	26.3	30.0	25.5	27.3	28.0	30.5	30.0	29.5
	30	22.5	25.8	23.8	24.0	26.5	28.5	23.3	26.1
Mean		24.3	28.8	25.1	26.1	26.4	29.9	25.9	27.4
80	Zero	25.0	27.5	31.0	27.8	28.3	31.0	32.8	30.7
	15	25.0	26.3	26.8	26.0	23.3	28.0	26.5	25.9
	30	25.0	27.0	28.0	26.7	25.8	26.3	29.0	27.0
Mean		25.0	26.9	28.6	26.8	25.8	28.4	29.4	27.9
100	Zero	23.3	23.0	27.0	24.4	23.8	28.3	30.0	27.3
	15	22.0	26.3	27.3	25.2	23.3	26.0	28.5	25.9
	30	25.0	28.5	31.3	28.3	24.5	27.0	28.0	26.5
Mean		23.4	25.9	28.5	25.9	23.8	27.1	28.8	26.6
P x K	Zero	24.2	27.0	28.0	26.4	25.6	30.0	29.1	28.2
	15	24.4	27.5	26.5	26.1	24.8	28.2	28.3	27.1
	30	24.2	27.1	27.7	26.3	25.6	27.3	26.8	26.5
Mean		24.3	27.2	27.4	26.3	25.3	28.5	28.1	27.3
LSD at 5%									
N					NS				NS
P					NS				NS
K					2.3				1.9
NP					NS				3.3
NK					NS				NS
PK					NS				NS
NPK					NS				NS

Also, the results revealed that root diameter was not significantly influenced by the different levels of N, P and K fertilization as well as its combinations in both seasons, so data were not included.

2. Root fresh weight:

Data in Table (2) point out that the used levels of N, P and K fertilizers as well as their interactions insignificantly affected root fresh weight except the interaction between nitrogen and phosphorus levels where statistically affected root fresh weight in 1[st] and 2[nd] seasons. Application of 100 kg N with zero and 30 kg P_2O_5/fed produced the highest root fresh weight in the 1st and 2nd season, respectively. This increase in root fresh weight may be due to nitrogen role in building up plant organs through the synthesis of proteins and it is an integral part of the chlorophyll molecule and to the phosphorus role in promotion root growth and is conductive for higher sugar accumulation through its role in the photothynthesis process. This result is in agreement with those reported by Ibrahim (1998).

Table (2): Root fresh weight (g/plant) of sugar beet as affected by NPK fertilization levels and their interactions in 2001/2002 and 2002/2003 seasons.

Nitrogen level (kg N/fed)	Phosphorus level (kg P_2O_5/fed)	Potassium level (kg K_2O/fed)							
		2001-2002 season				2002-2003 season			
		Zero	24	48	Mean	zero	24	48	Mean
60	Zero	404.3	413.5	468.0	428.6	837.3	902.5	776.8	838.8
	15	556.8	520.5	536.8	538.0	870.0	838.8	1426.3	1045.0
	30	389.0	505.0	633.0	509.0	694.3	786.8	666.3	715.8
Mean		450.0	479.7	545.9	491.9	800.5	842.7	956.4	866.5
80	Zero	386.5	579.8	510.5	492.3	835.5	822.3	1157.5	938.4
	15	458.8	750.5	663.8	624.3	833.8	943.8	866.3	881.3
	30	533.5	543.8	609.3	562.2	832.5	976.3	943.3	917.3
Mean		459.6	624.7	594.5	559.6	833.9	914.1	989.0	912.3
100	Zero	542.3	702.5	672.5	639.1	760.0	854.3	935.5	849.9
	15	533.8	554.3	496.8	528.3	865.5	1007.5	908.5	927.2
	30	397.5	339.3	482.8	406.5	1180.0	1108.0	1192.8	1160.3
Mean		491.2	532.0	550.7	524.6	935.2	989.9	1012.3	979.1
P x K	Zero	440.0	462.7	575.0	492.6	810.9	859.7	956.6	875.7
	15	516.4	608.4	565.8	563.5	856.4	930.0	1067.0	951.1
	30	444.4	565.3	550.3	520.0	902.3	957.0	934.1	931.1
Mean		466.9	545.4	563.7	525.3	856.5	915.6	985.9	919.3
LSD at 5%									
N					NS				NS
P					NS				NS
K					NS				NS
NP					166.3				257.4
NK					NS				NS
PK					NS				NS
NPK					NS				NS

3. Sucrose percentage:

The results in Table (3) show that the applied N did not markedly affect sucrose percentage in both seasons.

Sucrose percentage was appreciably influenced by the studied levels of phosphorus in 2nd season. The results clarified that the highest value of sucrose % (19.21) was obtained by applying 15 kg P_2O_5/fed in the 2nd season. This increase is about (0.93 and 0.77%) over the other levels of phosphorus in the 2nd season, respectively. This result coincides with those reported by Rabuffetti *et al.* (1993).

Potassium levels increased significantly sucrose % in the 2nd season. Application of 48 kg K_2O_5/fed produced the maximum sucrose % compared with the other levels of potassium. This increase in sucrose % may be due to potassium role in physiological processes in the plant such as respiration, transpiration, translocation of sugars and carbohydrates, energy transformation and enzyme actions.

The interaction between N and P levels markedly influenced sucrose percentage in the 2nd season. The highest values of sucrose percentage (19.96) was recorded by applying 60 kg N/fed with 15 kg P_2O_5/fed in the 2nd season. This result coincides with those reported by El-Essawy (1996) and Ibrahim (1998), Kurakov, *et al.*(1998) Odrekhovskii *et al.*(1998) and Suwara *et al.*(1998).

Table (3): Sucrose percentage of sugar beet as affected by NPK fertilization levels and their interactions in 2001/2002 and 2002/2003 growing seasons.

Nitrogen level (kg N/fed)	Phosphorus level (kg P_2O_5/fed)	Potassium level (kg K_2O/fed)							
		2001-2002 season				2002-2003 season			
		zero	24	48	Mean	zero	24	48	Mean
60	Zero	17.71	18.20	18.50	18.14	17.81	18.32	18.23	17.99
	15	18.45	18.61	18.66	18.57	20.58	20.46	18.36	19.96
	30	18.46	18.92	18.05	18.48	19.03	18.20	18.77	18.38
Mean		18.21	18.58	18.40	18.40	18.20	19.14	18.99	18.78
80	Zero	18.96	19.39	18.27	18.87	18.48	18.45	17.87	18.39
	15	18.45	17.30	17.19	17.65	18.53	18.88	19.03	18.59
	30	18.71	18.37	17.55	18.21	18.63	19.35	17.52	18.92
Mean		18.71	18.35	17.67	18.24	18.45	18.55	18.89	18.63
100	Zero	18.05	18.90	18.05	18.33	19.20	18.28	17.85	18.45
	15	18.90	18.40	19.29	18.86	18.17	20.00	18.84	19.07
	30	17.98	19.53	18.86	18.79	18.02	18.50	17.90	18.01
Mean		18.31	18.94	18.73	18.66	18.14	18.46	18.93	18.51
P x K	Zero	18.24	18.83	18.27	18.45	17.98	18.50	18.35	18.28
	15	18.60	18.10	18.38	18.36	18.74	19.09	19.78	19.21
	30	18.38	18.94	18.15	18.49	18.06	18.56	18.68	18.44
Mean		18.41	18.62	18.27	18.43	18.26	18.72	18.94	18.64

LSD at 5%	2001-2002	2002-2003
N	NS	NS
P	NS	0.83
K	NS	0.61
NP	NS	1.06
NK	NS	NS
PK	NS	NS
NPK	NS	NS

4. Purity percentage:

The results revealed that N, P and K fertilizers and their interactions insignificantly affected purity percentage in both seasons, so, data were not included. However, purity % was ranged from (81.18 to 82.45% for N application), (80.47 to 82.60%) for P application and (80.82 to 82.56%) for K application in the 1st season while in the 2nd season, purity % ranged from 82.98 to 83.73% for N application, 82.84 to 84.37% for P applicatiom and 83.35 to 83.82 for K application, respectively.

5. Root yield:

Data presented in Table (4) show that the differences in root yield due to the applied N levels reached the significant level in the 1st and 2nd seasons. Application of 100 kg N/fed gave the highest mean values of root yield (29.100 and 25.933 tons/fed) in the 1st and 2nd season, respectively. This increase in root yield may be due to that nitrogen has an important role in building plant organs through the synthesis of proteins and it is an integral part of the chlorophyll molecule. Similar results were obtained by Gezgin *et al.* (1996); Maghraby *et al.* (1998); Shalaby (1998); Suwara *et al.*(1998) and EL-Shafai (2000).

Phosphorus fertilizer did not significantly affect root yield in both seasons.

Table (4): Root yield (tons/fed) of sugar beet as affected by NPK fertilization levels and their interactions in 2001/2002 and 2002/2003 seasons.

Nitrogen level (kg N/fed)	Phosphorus level (kg P_2O_5/fed)	Potassium level (kg K_2O/fed)							
		2001-2002 season				2002-2003 season			
		Zero	24	48	Mean	Zero	24	48	Mean
60	Zero	23.520	25.500	28.500	25.840	21.900	26.400	23.700	24.000
	15	23.880	26.040	29.700	26.540	18.000	21.000	21.600	20.200
	30	26.340	30.000	31.200	29.180	20.400	23.700	23.700	22.600
Mean		24.580	27.180	29.800	27.187	20.100	23.700	23.000	22.267
80	Zero	25.200	27.600	29.400	27.400	20.100	24.300	23.400	22.600
	15	24.300	28.200	27.600	26.700	22.500	23.700	23.700	23.300
	30	24.300	25.500	27.300	25.700	22.500	25.500	25.800	24.600
Mean		24.600	27.100	28.100	26.600	21.700	24.500	24.300	23.500
100	Zero	27.300	28.500	31.200	29.000	23.100	27.900	30.900	27.300
	15	26.700	28.800	30.600	28.700	22.800	27.300	24.600	24.900
	30	27.900	30.900	30.000	29.600	23.400	26.400	27.000	25.600
Mean		27.300	29.400	30.600	29.100	23.100	27.200	27.500	25.933
P x K	Zero	25.340	27.200	29.700	27.413	21.700	26.200	26.000	24.633
	15	24.960	27.680	29.300	27.313	21.100	24.000	23.300	22.800
	30	26.180	28.800	29.500	28.160	22.100	25.200	25.500	24.267
Mean		25.493	27.893	29.500	27.628	21.633	25.133	24.933	23.899

LSD at 5%	2001-2002	2002-2003
N	1.320	1.473
P	NS	NS
K	1.320	1.473
NP	2.286	NS
NK	NS	NS
PK	NS	NS
NPK	NS	NS

Root yield was statistically increased by potassium application in both seasons. Applying 48 and 24 kg K_2O/fed recorded the maximum root yield (29.500 and 25.133 tons/fed) compared with the other levels of potassium in the 1st and 2nd season, respectively. This increase of root yield may be due to that potassium is a mobile element in the plant tissues and it plays an important role in photosynthesis through carbohydrate metabolism, osmotic regulation, nitrogen uptake, protein synthesis, translocation of assimilates. This result is in agreement with those obtained by Odrekhovskii *et al.*(1998).

The interaction between N x P fertilizers significantly affected root yield in the 1st season. The combination between N and P fertilizers at the rate of 100 kg N/fed + 30 kg P_2O_5/fed recorded the maximum value of root yield (29.600 tons/fed). This increase in root yield may be due to that nitrogen has a role in building up plant organs through the synthesis of proteins and it is an integral part of the chlorophyll molecule and the reactions involving the utilization of sucrose as an energy source for plant growth and cell maintenance. As well as phosphorus element promotes root growth and is conductive for higher sugar accumulation through its role in the photothynthesis process. This result is in agreement with those obtained by Khan, *et al.* (1990); El-Essawy (1996); Ibrahim (1998) and Suwara *et al.* (1998).

6. Sugar yield:

Data collected in Table (5) point out that the used N levels fertilizer significantly affected sugar yield in the 1st and 2nd seasons. Application of 100 kg N/fed gave the highest quantity of sugar yield (4.491 and 3.991 tons/fed in the 1st and 2nd season, respectively, compared with the other levels of nitrogen. This finding could be attributed to the increase in root yield as N-level was increased up to the highest level (table 7). This result is in agreement with those reported by Gezgin *et al.* (1996); Maghraby *et al.* (1998); Shalaby (1998) and EL-Shafai (2000).

Sugar yield was not markedly influenced by phosphorus fertilizer in both seasons.

Potassium fertilizer significantly influenced sugar yield in both seasons. Application of 48 kg K_2O/fed recorded the maximum value of sugar yield(4.373 and 3.937 tons/fed) in the 1st and 2nd season, respectively, compared with the other levels of potassium. Increasing of sugar yield may be due to the role of potassium in physiological processes in the plant such as translocation of sugars and carbohydrates, energy transformation and enzyme actions. Similar results were obtained by Odrekhovskii *et al.*(1998).

The interaction between N and P fertilizers significantly affected sugar yield in the 1st season. Application of 100 kg N/fed + 30 kg P_2O_5/fed attained the maximum quantity of sugar yield (4.620 tons/fed) in the 1st season. This result is in accordance with that obtained by El-Essawy (1996) and Ibrahim (1998); Kurakov, *et al.*(1998) Odrekhovskii *et al.*(1998) and Suwara *et al.*(1998).

Table (5): Sugar yield (tons/fed) of sugar beet as affected by NPK fertilization levels and their interactions in 2001/2002 and 2002/2003 seasons.

Nitrogen level (kg N/fed)	Phosphorus level (kg P_2O_5/fed)	Potassium level (kg K_2O/fed)							
		2001-2002 season				2002-2003 season			
		zero	24	48	Mean	Zero	24	48	Mean
60	Zero	3.357	3.665	4.177	3.733	3.239	3.839	3.630	3.570
	15	3.649	4.089	4.419	4.052	2.826	3.818	3.865	3.503
	30	4.074	4.665	4.581	4.440	3.091	3.773	3.433	3.432
Mean		3.693	4.140	4.393	4.075	3.052	3.810	3.643	3.502
80	Zero	3.822	4.439	4.364	4.209	3.182	3.746	3.574	3.501
	15	3.725	3.930	3.816	3.824	3.393	3.601	3.715	3.570
	30	3.885	3.771	3.650	3.768	3.566	3.951	4.244	3.920
Mean		3.811	4.047	3.943	3.933	3.381	3.766	3.844	3.664
100	Zero	4.013	4.308	4.474	4.265	3.449	4.512	4.663	4.208
	15	4.266	4.340	5.146	4.584	3.703	4.030	4.187	3.973
	30	4.123	5.008	4.729	4.620	3.333	3.922	4.119	3.791
Mean		4.134	4.552	4.783	4.490	3.495	4.155	4.323	3.991
P x K	Zero	3.731	4.138	4.338	4.069	3.290	4.032	3.956	3.759
	15	3.880	4.120	4.460	4.153	3.307	3.817	3.922	3.682
	30	4.027	4.481	4.320	4.276	3.330	3.882	3.932	3.715
Mean		3.879	4.246	4.373	4.166	3.309	3.910	3.937	3.718

LSD at 5%	2001-2002	2002-2003
N	0.322	0.345
P	NS	NS
K	0.558	0.345
NP	0.322	NS
NK	NS	NS
PK	NS	NS
NPK	NS	NS

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تأثير التسميد المتوازن للنتروجين والفوسفوروالبوتاسيوم على محصول وجودة بنجر السكر

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أقيمت تجربتان حقليتان بمحطة بحوث سخا بكفر الشيخ خلال موسمى٢٠٠١/ ٢٠٠٢ ، ٢٠٠٢/٢٠٠٣ واشتملت الدراسة على ثلاثة مستويات للتسميد النتروجينى هى٦٠،٨٠ و١٠٠ كجم ن/فدان وثلاثة مستويات للتسميد الفوسفاتىهى صفر،١٥ و٣٠ كجم فو٢أ٥/فدان وثلاثة مستويات من التسميد البوتاسى هى صفر ، ٢٤ و٤٨ كجم بو٢أ/فدان .

أستخدم تصميم القطع المنشقة مرة واحدة فى أربع مكررات وكان الصنف المستخدم فى التجربة جازيلا وقد أوضحت نتائج التجربة مايلى:

تأثرت صفتى محصول الجذور و محصول السكر معنويا بمعدلات التسميد النتروجينى فى كلا الموسمين فى هذا البحث وقد حقق مستوى ١٠٠ كجم نتروجين للفدان أعلى محصول من الجذور والسكر فى الفدان.

تأثرت صفة النسبة المئوية للسكروز معنويا بإضافة التسميد الفوسفاتى فى الموسم الثانى وقد كان أنسب معدل من الفوسفور ١٥ كجم فو٢أ٥ للفدان.

تأثرت صفات طول الجذر ومحصولى الجذور والسكر فى كلا الموسمين بينما تأثرت صفة النسبة المئوية للسكروز فى الموسم الثانى فقط بإضافة التسميد البوتاسى وقد كان أنسب معدل من التسميد البوتاسى ٤٨ كجم بو٢أ للفدان.

وكان للتفاعل بين التسميد النتروجينى والفوسفاتى تأثير معنوى على الوزن الطازج للجذر فى كلا الموسمين بينما تأثرت صفتى طول الجذر و النسبة المئوية للسكروز بالتفاعل بين النتروجين والفوسفور فى الموسم الأول فقط وقد كان أنسب معدل البوتاسيوم ٤٨ كجم بو٢أ للفدان.

يوصى هذا البحث باضافة ١٠٠ كجم نتروجين + ٤٨ كجم بو٢أ للفدان للحصول على أعلى محصول جذور بنجر فى حين يوصى بإضافة ١٠٠ كجم نتروجين +١٥ كجم فو٢أ٥ + ٤٨ كجم بو٢أ للفدان للحصول على أعلى محصول سكر للفدان.