TRANSPLANTING USING PAPER POTS TECHNIQUE AND MICRO NUTRITION WITH RELATION TO JUICE QUALITY AND CHEMICAL CONSTITUENTS OF SUGAR BEET AT DIFFERENT PLANTING DATES

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Abstract

Two field experiments were conducted in 2001/2002 and 2002/2003 seasons at Sakha Agricultural Research Station, Kafr–El Sheikh Governorate to study the effect of transplanting technique and soil application of boron and zinc on yield and its components of sugar beet crop sown at two dates.

The present work included twenty treatments represent the combination between five sowing technique of sugar beet (1.Sowing sugar beet by dried seeds-direct sown, 2. Transplanting by paper pots seedling of 15 days age, 3.Transplanting by paper pots seedling of 25 days age, 4.Transplanting by paper pots seedling of 35 days age, 5. Transplanting by seedling resulted from the permanent field at thinning time.) and four micro-nutrient treatments i.e. : Unfertilized treatment as control, 0.5 kg boron/fed "recommended dose", 4.0 kg zinc/fed " recommended dose" and 0.5 kg boron + 4.0 kg zinc/fed.). All treatments were applied for sugar beet sown at two sowing dates (15th September and 15th October).

Sowing sugar beet early on the 15th September significantly attained higher values of total soluble solids %, sucrose %, purity % compared with that obtained at the late sowing date, 15th October. On the contrary, sowing sugar beet on 15th September significantly reduced the values of potassium %, sodium %, juice impurities % in sugar beet roots compared with late sowing on 15th October. All of alpha-amino nitrogen %, zinc and boron concentrations in roots or leaves of sugar beet were unaffected by sowing dates.

The highest values of sucrose %, potassium %, TSS %, purity %. Was obtained from transplanting seedling of 15 days age and/or sowing beet seeds by the usual method (dry seeds). However, these two methods of planting lowered the values of potassium % in roots.

Application of zinc element alone or in combination with boron element significantly resulted in higher values of sodium and zinc contents in sugar beet roots and leaves compared with those recorded with the unfertilized or with boron alone.

Application of boron alone or in combination with zinc produced higher TSS %, sucrose %, boron concentration in sugar beet roots and leaves compared with those recorded by the unfertilized with zinc alone.

INTRODUCTION

Sugar beet is considered the second sugar crop in sugar production in the world and in Egypt as well. There are many factors affecting yield and quality of sugar beet such as some of agro practices, i.e. sowing dates, sowing methods and the application of micro-elements. Concerning sowing dates, determining the appropriate sowing date depends, to a great extent, on the prevailing climatic conditions along the growing season. In Egypt, sugar beet is sown during the period extends from August to November. As for sowing methods, transplanting is a practice commonly used for adjusting plant stand per unit area exposed to damage by agricultural practices as hoeing or by diseases or insects during growing season, leading to raising number of harvestable plants. Regarding trace elements which are essential for plant growth and metabolism, boron and zinc are the most important ones needed by sugar beet, where yield and quality of roots are severely depressed by its inadequate supply. (Draycott, 1993). In this respect, Ghandorah and Refay (1994), observed found that shoot yield, root yield, total soluble solids (T.S.S) and reducing sugars significantly differ at 4 different sowing dates. They concluded that the period from 15 October to 1 November was optimum for sowing sugar beet. Ahmed (2000), in Egypt studied the effect of planting dates from 1st of Sept, Oct, Nov. and Dec. in calcareous soils, on sugar beet yield and quality. He found that planting on the first of Nov. produced the highest emergence percentage value compared with the other planting dates. The highest number of plants at harvest resulted from Oct. and Nov. planting. Early planting in Sep. and Oct. decreased length and diameter of the root, but produced the highest yields of roots, sugar and top/fed. As well as the highest percentage of sucrose and juice purity. Al–Jbawi (2000), found that sowing date revealed significant effect on quality traits (T.S.S) %, sucrose and purity % and root traits (length, diameter and weight). Quality traits, or root traits in general, were reduced with the delay in planting. Shalaby (2003), found significant effect of sowing dates on sugar beet quality. The sowing in September gave the best root diameter, root length, and weight and also technological characteristics TSS %, Sucrose %, Purity %, Na, Sugar extractable and extractability percentages. The third date of sowing i.e. Nov. gave the highest values in Alpha amino-N percentage and sucrose loss to molasses percentage.

As for sowing methods, Vigoureux and Vreven (1986), noticed that transplanting of sugar beet increased sucrose yield by 22 % compared with drilled crop. Zhao *et al.* (1995), in China, noticed that sugar beet seedlings raised in paper pots and transplanted had a survival rate of 84.3–94.1 % compared with 74.5 % from direct sowing. Abd El-Gawad *et al.* (2000), cleared that transplanting of transplants at age of 5, 7 and 9 weeks as well as direct seedling markedly increased number of harvestable

plants and abnormal root % as compared with direct seedling. Root dimensions were considerably affected whereas length and root diameter of direct seedling treatments were greater than those of transplanting treatments. The average fresh weight of sugar beet roots of direct seedling planting was higher than those obtained from transplanting treatments.

Regarding the effect of micro-elements, Saif (1991), mentioned that soil application of 0.5 kg B/fed and 4 kg Zn/fed gave the highest values leaves number, tops fresh and dry weights/plant as well as fresh and dry weights of roots, both root length and diameter, sucrose, T.S.S and purity percentages, produced a significant increase in yields of tops, roots and sugar tons/fed. Gezgin, *et al.* (2000), studied the effect of four levels of boron fertilizer (zero, 5, 10 and 20 kg/ha.) and four levels of zinc fertilizer (zero, 10, 20 and 40 kg/ha.), they reported that boron levels had significant effect on sugar content. However, zinc application had no effect on sugar content %. They stated that there were significant differences between Zn x B interactions for sugar content values, the highest sugar content value (19.9%) was obtained with using 20 kg Zn/ha + 20 kg B/ha. Saif (2000), treated sugar beet Kawmera variety with four levels of boron (zero, 0.5, 1, and 1.5 kg B/fed). She found that the application of 0.5 kg B/fed was necessary to increase sucrose % and juice purity %. Nafei (2004), indicated that root length and total soluble solids percentage were significantly increased as boron level was increased from zero to 500 g boron /fed. However, sucrose percentage was significantly increased up to 750 g B/fed. Root fresh weight, purity percentage were significantly influenced by B rates added to sugar beet plants.

MATERIALS AND METHODS

Two field experiments were conducted in two successive seasons of 2001/2002 and 2002/2003 at Sakha Agricultural Research Station, (Kafr–El Sheikh Governorate), these experiments were conducted to study the effect of transplanting technique and soil application of boron and zinc on growth, yield and quality of sugar beet crop (*Beta vulgaris L.*)

Physical and chemical properties of the experimental soil are presented in (Table 1).

The presented experiment included twenty treatments, which were the combination between five sowing techniques of sugar beet, and four micro-element treatments (boron and zinc). These treatments were carried out in two sowing dates.

I. Sowing dates:

* 15th September.

* 15th October.

II. Transplanting techniques:

1. Sowing sugar beet by dried seeds (direct sown)
2. Transplanting by paper pots seedling of 15 days age
3. Transplanting by paper pots seedling of 25 days age
4. Transplanting by paper pots seedling of 35 days age
5. Transplanting by seedlings resulted from the permanent field at thinning time.

III. Micro-nutrient treatments:

1. Unfertilized treatments (control).
2. 0.5 kg boron/fed. (Recommended dose).
3. 4.0 kg zinc/fed. (Recommended dose).
4. 0.5 kg boron + 4.0 kg zinc/fed.

Boron was applied as sodium borate (11% B), and zinc was added as zinc sulfate (22% Zn).

The studied micro-nutrient treatments were applied once either singly or mixed with the 2nd dose of nitrogen fertilizer (one month later after the 1st dose of nitrogen fertilizer). As a soil application after complete mixing doses properly with appropriate amounts of sand.

A recommended dose of nitrogen fertilizer (80 kg N/fed.). in the form of urea (46 % N) was applied in two equal doses, 1st dose after thinning and the 2nd dose one month later. The "recommended dose" of potassium (48 kg K_2O/fed.) in the form of potassium sulphate 48 % K_2O was added once with the 1st dose of nitrogen. Meanwhile phosphorus fertilizer was applied as recommended at the rate of (30 kg P_2O_5/fed.) in the form of calcium super phosphate 15.5 % P_2O_5 during land preparation.

The twenty treatments among the studied factors, i.e. seedling age and trace elements were distributed in a complete randomized block design in three replications at each of the studied two sowing dates. Plot area was 15.4 m^2, which included 4 ridges, 7- meter in length and 2.2 meter in width.

Plants were thinned at 4-leaf stage (almost 45 days from sowing) to ensure one plant per hill. Other agronomic practices required for growing sugar beet were practiced as usual. The seeds and paper pots were sown at 20 cm. between hills, the commercial sugar beet variety Gazelle (imported from Denmark by Sugar Crops Inst.) was used in the two seasons. Beet plants were harvested at maturity after seven months in both seasons according sowing date.

Table 1. Physical and chemical properties of the site soil.

Analysis	Seasons	
	2001/2002	2002/2003
Mechanical analysis		
Coarse sand (%)	1.25	1.42
Fine sand (%)	14.52	17.0
Silt (%)	26.15	22.28
Clay (%)	57.78	59.30
Texture	Clay	Clay
$CaCo_3$	2.40	2.18
Chemical analysis		
Organic Matter (%)	1.53	1.75
Available nitrogen ppm	37.20	40.40
Available phosphorus ppm (Jackson ,1958)	19.2	20.8
Available potassium ppm	405.2	395.4
pH	8.2	8.2
E.C ds/m	1.45	1.40
Cations & Anions , meq/L		
Na^+	8.98	9.56
K^+	0.21	0.23
Ca^{++}	3.9	3.8
Mg^{++}	2.5	2.6
HCO_3^- meq/L	5.58	5.09
Cl^-	6.36	6.87
SO_4^{-2}	3.65	4.23
Determined micronutrients *(ppm)*		
Fe	15.2	14.5
Mn	18.3	17.6
Zn	1.21	1.02
B	0.41	0.45

The recorded data:

Juice quality:

1-Total soluble solids (TSS %) percentage in roots was measured by using hand refractometer.

2-Sucrose percentage was determined by using Sacharometer according to the method described by Le- Docte (1927).

3-Sugar recovery percentage.

3-Purity percentage was calculated according to Carruthers and Oldfield (1961) as follows:

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

4-Impurities

5-Potassium percentage.

6-Sodium percentage.

7-Alpha-amino nitrogen percentage.

Sodium and potassium were determined in the digested solution using Flame photometer according to the method described by Brown and Lilliland (1964). Alpha–amino–N was determined using Hydrogenation method according to the method of Carruthers *et al.* (1962).

Chemical constituents:

Roots and tops of sugar beet were chemically analyzed at harvest.

1-Boron percentage in root and leaves.

Boron (mg/100g dry matters) was determined calorimetrically using Azomethine-H method at 420 nm. According to John *et al* (1975).

2-Zinc percentage in root and leaves.

Zinc (mg/100g dry matter) was estimated according to the method described in flam method manual of Atomic absorption model 22 Brooklyn AVE at 213 nm.

STATISTICAL ANALYSIS

Data collected were subjected to the proper statistical analysis of variance of complete randomized block design according to the procedures outlined by **Snedecor and Cochran (1967)**.

A combined analysis of the two sowing dates in the two years was done according to Le Clerg *et al* (1966).

All statistical analysis was performed by using analysis of variance technique of (MSTAT) Computer software package.

RESULTS AND DISCUSSION

Juice quality:

1. Total soluble solids percentage (TSS %).

Data presented in Table (2) revealed that early sowing date (15th September) produced a significant and positive response on the values of TSS % this finding may be due to that the early sowing date the early maturity, the high TSS %. This observation means that the plant grown in the early seasons reach to full growth and in turn full maturity earlier than that grown at late season. Ghandorah and Refay (1994).

The available data in Table (2) cleared that sowing sugar beet crop by using paper pots seedlings aged 15 days or using direct seed attained the highest significant values of TSS % (20.32 %, 20.26 % respectively). However, the transplanted seedlings of 25 or 35 days age (19.91 %, 19.40 % respectively) and/or seedlings produced from thinning gave less values of TSS % (19.20 %).

Table 2. Effect of transplanting and soil application of boron and zinc on total soluble solids and sucrose percentages in 2001-2002 and 2002-2003 seasons. *(Combined over two seasons)*

Sowing date	Sowing method	TSS %					Sucrose %				
		Fertilization					Fertilization				
		0	B	Zn	B+Zn	Mean	0	B	Zn	B+Zn	Mean
15 Sept	1	20.62	20.90	20.70	21.44	20.92	17.28	17.78	17.34	18.15	17.64
	2	20.32	20.86	20.60	21.27	20.76	17.14	17.94	17.22	18.16	17.61
	3	19.62	19.72	19.67	20.14	19.79	16.23	16.67	16.28	16.93	16.53
	4	19.47	19.65	19.13	19.95	19.55	15.88	16.13	15.56	16.27	15.96
	5	19.07	19.79	18.97	19.66	19.37	15.46	15.98	15.59	16.24	15.82
Mean		19.82	20.18	19.81	20.49	20.08	16.39	16.90	16.40	17.15	16.71
15 Oct.	1	19.30	20.02	19.05	20.08	19.61	15.23	15.92	15.23	16.15	15.63
	2	19.79	19.93	19.50	20.27	19.87	15.73	16.24	15.30	16.38	15.91
	3	20.01	19.95	19.79	20.39	20.03	15.41	16.01	15.17	16.17	15.69
	4	19.11	19.80	18.36	19.72	19.25	14.23	15.14	14.30	15.30	14.74
	5	18.82	18.92	19.15	19.26	19.04	14.34	14.72	14.36	14.92	14.58
Mean		19.41	19.72	19.17	19.94	19.56	14.99	15.61	14.87	15.78	15.31
Mean of sowing method	1	19.96	20.46	19.88	20.76	20.26	16.25	16.85	16.29	17.15	16.64
	2	20.05	20.40	20.05	20.77	20.32	16.43	17.09	16.26	17.27	16.76
	3	19.82	19.83	19.73	20.26	19.91	15.82	16.34	15.72	16.55	16.11
	4	19.29	19.73	18.75	19.83	19.40	15.05	15.64	14.93	15.78	15.35
	5	18.95	19.35	19.06	19.46	19.20	14.90	15.35	14.97	15.58	15.20
Mean		19.61	19.95	19.49	20.22	-	15.69	16.25	15.63	16.47	-

L.S.D at 0.05 % level for:		
Sowing date (D)	S	S
Transplanting seedling age (T)	0.244	0.217
Fertilization (F)	0.236	0.203
D X T	0.345	0.307
D X F	N.S	N.S
T X F	N.S	N.S
D X T X F	N.S	N.S

Note: In this table and similar succeeding tables 1, 2, 3, 4 and 5 refer to:

1. sowing sugar beet by dried seeds.
2- transplanting by paper pots seedling of 15 days age.
3- transplanting by paper pots seedling of 25 days age.
4- transplanting by paper pots seedling of 35 days age.
5- transplanting by seedling resulted from the permanent field at thinning time.

As for the effect of micro-elements application on the TSS % values, the results cleared that boron application alone or in combination with zinc element recorded the highest statistical effect on TSS % (19.95 %, 20.22 % successively). This result assured the important role of boron element in metabolic translocation. Nafei (2004)

The total soluble solid percentage was significantly affected by the interaction between sowing dates and transplanting (seedling aged). The differences between transplanting by paper pots seedling of 25 and/or 35 days age methods were insignificant when the plants grown on 15th of September. Meanwhile, the differences between the two methods reached the level of significance on 15th October. Moreover, the differences between transplanting by paper pots seedling of 15 and/or 35 days

age methods were significant when the plants grown on 15th of September, meanwhile, the differences between the same two methods were insignificant when the plants grown on 15th October.

The collected results indicated that TSS % attained the highest value when sugar beet plants sown by dried seeds in the 15th September (20.92 %) followed by the transplanted seedling aged 15 days (20.76 %). While in the 15th October was when sugar beet plants sown by transplanting paper pots seedling of 25 days (20.03 %) followed by the transplanting seedling aged 15 days method (19.87 %).

2. Sucrose percentage.

Sucrose percentage is considered one of the final goals for growers to gain more profit and for the sugar extraction processes to extract more sugar. Sowing date as well as fertilization program plays a direct effect on the values of sugar.

The results obtained in Table (2) were as similar as that recorded for TSS %. It could be noticed that sowing sugar beet early on 15th September attained the highest significant value of sucrose. This sowing date increased sucrose percentage over the other sowing date (15th October) by 1.4 this figure is considerable value for growers and for Sugar Company. In this concern Abd El-Gawad *et al.* (2000) suggested that early sowing on the 20th September gave the best extractable sugar content when compared with late sowing date.

The pronounced influence of sowing date on sucrose percentage mainly due to that fact that the early sowing date where the condition is somewhat hot accelerates seed germination, closer canopy, more assimilation consequently good storage and in finally high sucrose value. The important effect of sowing date on sucrose percentage has been reported by Ahmed (2000) and Shalaby (2003).

Regarding the influence of transplanting seedling age, the available data appeared sowing sugar beet crop whether by transplanted seedling aged 15 days and/or by the direct seeds produced the best sucrose percentage (16.64 %, 16.76 % respectively). In the same line Vigourea and Vreven (1986) found that transplanting of sugar beet increased sucrose by 22 % compared with drilled crops. However, delaying the transplanted seedling to reach 25 and 35 day age caused a significant reduction in the value of sucrose percentage. The lowest sucrose percentage was recorded when the thinned seedling were used in sowing sugar beet crop (15.20 %). It is evidence to obtain this reduction in the value of sucrose percentage as a results of sowing sugar beet by delaying seedling of paper pots to 25 or 35 days age or by using the thinned seedling may be due to such condition caused branched shopped root.

As to the influence of fertilization on sucrose percentage, once more, it is clearly showed that application of boron alone or in combination with zinc element

recorded the highest values of sucrose percentages (16.25 % and 16.47 % respectively). These results reassure the important role of boron element in translocation process: Saif, (1991), Gezgin, *et al.* (2000) and Saif, (2000).

With regarded to the interactions influences of the studied factors on sucrose percentage. Results given in Table (2) pointed out that sucrose percentage was significantly affected by the interaction between sowing dates and methods. Results obtained showed that the differences between sowing sugar beet by traditional method (dried seeds) and/or by transplanted seedlings of 25 days age methods or between transplanted seedling of 15 and/or 25 days age methods were insignificant when plants grown on the 15th of October Meanwhile, the differences between them reached the level of significance under 15th September. The highest values of sucrose % were recorded by sowing sugar beet crop on 15th September by using the transplanted seedling aged 15 days.

3. Impurities percentage.

Results given in Table (3) showed that sowing sugar beet as early as the season (15th September) reduced juice impurities percentage of sugar beet at harvest, lowering of the impurities percentage as a result to early sowing date perfectly due to the lowering in the potassium, sodium percentages and alpha-amino nitrogen percentage. As for, the influence of transplanting seedling age, the presented data in (Table 3) cleared that using the transplanted of 15 days age significantly reduced impurities percentage (2.94 %) compared with the other seedling ages (3.00 %, 3.05 % and 3.14 %) and the thinned seedling too (3.15 %). However, the difference between this treatment and sowing by the direct seeds was insignificant. All micro-elements treatments surpassed check treatment (unfertilized) with respect to the low value of impurities percentage. However, this superiority was not significant. Once more, application of boron alone or in combination with zinc element produced the lowest values of impurities percentage. Concerning the interaction effects, the combination between transplanting seedling age and micro-element fertilization attained significant effect on the percentage of impurities percentage in sugar beet roots. No significant deference was detected in impurities % in the un-fertilized sugar beet using (transplanting by paper pots seedling of 25 days age and transplanting by paper pots seedling of 35 days age methods). Meanwhile, the difference was significant when sugar beet was fertilized with boron and/ or zinc under the two methods. Sowing sugar beet by the transplanted seedling of 15 days age with boron alone (2.81 %) or in combination with zinc (2.90 %) produced the lower values of impurities percentage.

4. Purity percentage.

The available results showed that sowing sugar beet on 15th September recorded the highest value of purity percentage (83.13 %) compared with 15th October (78.06 %). The pronounced effect of sowing date on juice purity may be due to the improvement in sucrose percentage Table (2) and the lowering in the values of impurities percentage

Table 3. Effect of transplanting and soil application of boron and zinc on impurities and purity percentages in 2001-2002 and 2002-2003 seasons.
(*Combined over two seasons*)

Sowing date	Sowing method	*Impurities %*					*Purity %*				
		Fertilization					*Fertilization*				
		0	B	Zn	B+Zn	Mean	0	B	Zn	B+Zn	Mean
15 Sept	1	2.80	2.65	2.81	2.80	2.77	83.75	85.09	83.74	84.57	84.28
	2	2.68	2.61	2.82	2.66	2.69	84.28	85.26	83.59	85.33	84.61
	3	2.80	2.64	2.80	2.60	2.71	82.70	83.96	82.71	84.57	83.49
	4	2.92	2.88	2.57	3.00	2.84	81.59	82.07	81.32	81.56	81.63
	5	2.93	3.07	2.77	2.82	2.90	81.04	80.76	82.17	82.60	81.64
Mean		2.83	2.77	2.75	2.78	2.78	82.67	83.43	82.71	83.73	83.13
15 Oct.	1	3.21	3.26	3.34	3.16	3.24	78.95	79.47	77.32	80.40	79.03
	2	3.32	3.00	3.29	3.14	3.19	78.57	81.47	78.44	80.77	79.81
	3	3.54	3.16	3.54	3.35	3.39	76.94	80.21	76.60	79.27	78.26
	4	3.63	3.55	3.16	3.42	3.44	74.44	76.43	77.88	77.61	76.59
	5	3.41	3.26	3.59	3.36	3.41	76.17	77.79	74.98	77.48	76.60
Mean		3.42	3.25	3.38	3.28	3.33	77.01	79.07	77.04	79.10	78.06
Mean of sowing method	1	3.00	2.95	3.07	2.98	3.00	81.35	82.28	80.53	82.48	81.66
	2	3.00	2.81	3.05	2.90	2.94	81.42	83.37	81.01	83.05	82.21
	3	3.17	2.90	3.17	2.97	3.05	79.82	82.09	79.65	81.92	80.87
	4	3.27	3.22	2.87	3.21	3.14	78.01	79.25	79.60	79.58	79.11
	5	3.17	3.16	3.18	3.08	3.15	78.60	79.27	78.58	80.04	79.12
Mean		3.12	3.01	3.07	3.03	-	79.84	81.25	79.87	81.41	-

L.S.D at 0.05 % level for:		
Sowing date (D)	S	S
Transplanting seedling age (T)	0.11	0.638
Fertilization (F)	N.S	0.584
D X T	N.S	0.826
D X F	N.S	N.S
T X F	0.22	N.S
D X T X F	N.S	1.848

Table (3), potassium and sodium percentages Table (4), and alpha-amino nitrogen Table (5). Ramadan and Hassanin (1999), Al-Jbawi (2000) and Shalaby (2003).

Concerning the effect of transplanting seedling old on juice purity percentage, the results obtained pointed out that by using the transplanted seedling aged 15 days or sowing sugar beet whether by direct seeds attained a statistical influence on the purity percentage of sugar beet roots, (82.21 %, and 81.66 % respectively), both seedling olds significantly surpassed the other transplanting seedling ages.

As to, the relative importance of micro-elements on juice purity percentage, the results obtained showed that using boron alone (81.25 %) or in combination with zinc elements (81.41 %) attained a superior effect over control unfertilized treatment (79.84 %) or application of zinc alone (79.87 %). This observation reassured that boron element play the major role with respect to juice purity percentage as a result to its effect on juice quality parameters. Saif, (1991), Saif, (2000).

With respect to the interaction effect on juice purity percentage, figures obtained showed that the most effective interaction on juice purity percentage was that between sowing dates and methods. Sowing sugar beet by dried seeds or transplanting seedling of 35 days age from one side or transplanting seedling resulted from the permanent field at thinning from the other side were more distinguished under 15th September sowing date than the differences between them under 15th October. Meanwhile, the differences between each of transplanting by paper pots seedling of 15 and/or 25 days age methods and transplanting by paper pots seedling of 15 and/or 35 days age methods were clearer under 15th October sowing date than 15th September.

This result was fairly true under the two sowing dates. Sowing sugar beet by using the transplanted seedling of 15 days age in addition boron application produced the highest significant influence on juice purity percentage (83.37 %).

5. Sodium percentage (Na %).

The available results in Table (4) showed there was a significant difference in the values of sodium percentage due to sowing dates effect. The earlier, the sowing date 15th September (1.48 %), the lower, the value of sodium percentage in sugar beet roots, the lower value of sodium percentage in sugar beet roots is considered a good indication for good juice quality and sugar extraction. The collected data revealed that the lowest value of sodium percentage (1.97 %) was recorded when sugar beet crop was sown by transplanted seedling aged 15 days compared with the other seedling age. The lowest significant value of sodium percentage (1.19 %) was recorded when sugar beet crops were sown by transplanted seedling age 25 days in the 1st sowing date (15th September).

With respect to the interaction between sowing date and transplanting seedling age the result showed that the differences between sowing sugar beet by dried seeds and/or transplanting by paper pots seedling of 35 days age methods or transplanting by paper pots seedling of 15 and/or 35 days age methods or between transplanting by paper pots seedling of 15 and/or 35 days age methods were insignificant when sugar beet plants were grown on 15th of September. Meanwhile, the differences between them reached the level of significance on 15th October. Moreover, the differences

between transplanting by paper pots seedling of 25 and/or 35 days age methods or between transplanting by paper pots seedling of 25 days age and / or transplanting by seedling thinned from the permanent field methods were insignificant when sugar beet was grown on 15th October. Meanwhile, the differences between them reached the level of significance on 15th of September.

On the other hand the interaction between sowing dates and fertilization treatments was insignificant. With respect to the interaction between transplanting seedling age and micro-element fertilization, the results obtained showed that transplanting by using paper pots seedling aged 25 days with boron application produced the lowest value of Na % (1.77 %). This result may be show to a specification for boron element on sodium absorption. Concerning the 2nd order interaction, the collected data pointed out that transplanting sugar beet seedling aged 25 days on 15th September and application boron element in combination with zinc or alone attained the lowest value of sodium percentage (1.13 % and 1.18 % respectively).

Table 4. Effect of transplanting and soil application of boron and zinc on sodium and potassium percentages in 2001-2002 and 2002-2003 seasons.

(Combined over two seasons)

Sowing date	Sowing method	*Sodium%*					*Potassium %*				
		Fertilization					*Fertilization*				
		0	B	Zn	B+Zn	Mean	0	B	Zn	B+Zn	Mean
15 Sept	1	1.86	1.51	1.64	1.66	1.66	4.94	4.82	5.18	5.11	5.01
	2	1.72	1.55	1.56	1.31	1.53	4.77	4.76	5.32	5.10	4.98
	3	1.26	1.18	1.22	1.13	1.19	5.47	5.20	5.60	4.88	5.29
	4	1.38	1.49	1.65	1.72	1.56	5.76	5.48	5.44	5.59	5.57
	5	1.49	1.77	1.48	1.19	1.48	5.60	5.74	5.27	5.65	5.56
Mean		1.54	1.50	1.51	1.40	1.48	5.31	5.20	5.36	5.26	5.28
15 Oct.	1	2.29	2.60	2.83	2.40	2.53	5.63	5.43	5.38	5.28	5.43
	2	2.44	2.11	2.74	2.33	2.40	5.71	5.31	5.45	5.47	5.48
	3	3.09	2.36	3.27	2.75	2.87	5.69	5.45	5.47	5.60	5.55
	4	3.04	3.24	2.36	2.89	2.88	6.09	5.64	5.50	5.75	5.75
	5	2.48	2.30	3.28	2.69	2.69	6.04	5.83	5.71	5.66	5.81
Mean		2.67	2.52	2.90	2.61	2.67	5.83	5.53	5.50	5.55	5.60
Mean of sowing method	1	2.08	2.06	2.24	2.03	2.10	5.29	5.12	5.28	5.19	5.22
	2	2.08	1.83	2.15	1.82	1.97	5.24	5.03	5.38	5.28	5.23
	3	2.18	1.77	2.25	1.94	2.03	5.58	5.32	5.53	5.23	5.42
	4	2.21	2.37	2.01	2.30	2.22	5.92	5.56	5.47	5.67	5.66
	5	1.99	2.03	2.38	1.94	2.08	5.82	5.79	5.49	5.66	5.69
Mean		2.10	2.01	2.20	2.01	-	5.57	5.37	5.43	5.41	-

L.S.D at 0.05 % level for:		
Sowing date (D)	S	S
Transplanting seedling age (T)	0.152	0.205
Fertilization (F)	0.152	N.S
D X T	0.216	N.S
D X F	N.S	N.S
TX F	0.340	N.S
D X T X F	0.481	N.S

6. Potassium percentage (K %).

The results obtained revealed that sowing dates significantly affected potassium percentage in sugar beet roots. Sowing sugar beet in the early season (15th September) reduced the value of potassium percentage (5.28 %) compared with 15th October (5.60 %). It is well known that low value of K % improve juice purity consequently improved sugar extraction. Based on this fact, the early sowing date attained a lower value of K % (5.28 %) i.e., good condition for sugar extraction. This result may be due to that the earlier sowing date enhanced the active growth to reach the storage stage rapid than the late sowing date that allow the plant to grow slower consequently allow the plant to absorb more nutrients than the earlier one. Result given in Table (4) cleared that sowing sugar beet whether by the dried seeds or by the transplanted seedling aged 15 days let to a lower value of potassium percentage in sugar beet roots (5.22 %, 5.23 % respectively). However, increasing the age of the transplanted seedling to 25 and 35 days or sowing by the thinned seedling increased the value of potassium percentage (5.42 %, 5.66 % and 5.69 % respectively). This finding may be due to decreasing the transplanting process due to increasing the branched roots which consumptive more elements during their growth consequently increasing the value of the absorbed elements such as potassium.

It is worth mentioned that application of boron alone or in combination with zinc reduced the values of potassium percentage. As the matter of fact, the differences between fertilization treatments were insignificant, but the pronounced role of boron with respect to reducing the value of potassium percentage could be due to the relative influence of boron element on sugar translocation.

Once more, the various interactions between the studied factors had no significant effect on the values of potassium percentage.

7. Alpha-amino nitrogen percentage.

Data obtained in Table (5) revealed that neither sowing dates nor transplanting seedling age attained a significant effect on the values of alpha-amino nitrogen. Despite the insignificant effect of sowing dates and transplanting seedling age, it could be noticed that sowing sugar beet in the early date of the season by seedling aged (15 days age) reduced the value of alpha-amino nitrogen to (1.92 %), also sowing sugar beet crop by using the transplanted seedling aged 15 days gave the lowest value of this measurement (1.98 %).

Regarding the effect of fertilization treatments on the percent alpha-amino nitrogen, the results obtained appeared a negative response in the value of this measurement due to application of boron alone or in combination with zinc. This finding could be explaining the benefit role of boron in sugar accumulation. None of

the various combinations of the studied factors recorded a significant effect on alpha-amino nitrogen percentage. The above-mentioned results indicated that whether the single factors or the different interaction for them affected the values of alpha-amino nitrogen. It could be deduced that nitrogen fertilization is the major factor, which affect this measurement. This observation is considered a very important signal to rationalize the quantity of nitrogen fertilization to sugar beet.

Table 5. Effect of transplanting and soil application of boron and zinc on alfha– amino nitrogen percentage *(Combined over two seasons)*

Sowing date	Sowing method	*Alfa-amino nitrogen %*				
		Fertilization				
		0	B	Zn	B+Zn	Mean
15 Sept	1	2.00	2.11	2.13	2.12	2.09
	2	1.88	1.75	2.11	1.94	1.92
	3	2.23	1.89	2.04	2.23	2.10
	4	2.07	2.27	2.06	2.24	2.16
	5	2.28	2.27	1.97	2.05	2.14
Mean		2.09	2.05	2.06	2.12	2.08
15 Oct.	1	2.20	2.48	2.55	2.26	2.37
	2	2.09	1.95	2.16	1.97	2.04
	3	2.35	2.17	2.74	2.15	2.35
	4	2.30	2.40	1.92	1.91	2.13
	5	2.25	2.04	2.39	2.21	2.22
Mean		2.24	2.21	2.35	2.10	2.22
Mean of sowing method	1	2.10	2.30	2.34	2.20	2.23
	2	1.98	1.85	2.14	1.95	1.98
	3	2.29	2.03	2.39	2.19	2.22
	4	2.18	2.33	1.99	2.08	2.15
	5	2.27	2.16	2.18	2.13	2.19
Mean		2.16	2.13	2.20	2.11	-

L.S.D at 0.05 % level for:

Sowing date (D)	N.S
Transplanting seedling age (T)	N.S
Fertilization (F)	N.S
D X T	N.S
D X F	N.S
T X F	N.S
D X T X F	N.S

1. Boron concentration in roots and leaves (ppm).

Results given in Table (6) revealed that neither sowing dates nor transplanting seedling age attained a significant effect on the values of boron concentrations in root or leaf of sugar beet.

Table 6. Effect of transplanting and soil application of boron and zinc on boron concentration in roots and leaves (ppm). *(Combined over two seasons)*

Sowing date	Sowing method	*Roots*					*Leaves*				
		Fertilization					*Fertilization*				
		0	B	Zn	B+Zn	Mean	0	B	Zn	B+Zn	Mean
15 Sept	1	9.55	13.14	11.66	13.40	11.94	24.48	30.88	25.90	31.70	28.24
	2	9.59	13.32	11.77	13.47	12.04	23.62	31.79	26.82	32.23	28.61
	3	9.75	13.08	11.30	13.26	11.85	23.48	31.45	27.48	31.93	28.59
	4	9.35	13.14	12.07	13.29	11.96	23.43	30.98	26.62	31.83	28.22
	5	9.11	12.74	11.52	13.04	11.60	23.68	30.38	26.63	31.76	28.11
Mean		9.47	13.08	11.66	13.29	11.88	23.74	31.09	26.69	31.89	28.35
15 Oct.	1	9.30	12.68	11.45	13.11	11.64	23.57	30.82	26.29	32.20	28.22
	2	9.39	12.89	11.33	13.35	11.74	23.00	30.56	26.90	31.77	28.06
	3	9.86	12.51	11.51	12.82	11.68	23.35	30.65	27.32	31.56	28.22
	4	9.48	12.67	11.58	13.24	11.74	23.82	30.70	26.00	31.39	27.98
	5	9.54	12.47	11.40	12.75	11.54	23.77	29.94	25.98	30.84	27.63
Mean		9.51	12.64	11.45	13.05	11.67	23.50	30.53	26.50	31.55	28.02
Mean of sowing method	1	9.43	12.91	11.56	13.26	11.79	24.03	30.85	26.10	31.95	28.23
	2	9.49	13.10	11.55	13.41	11.89	23.31	31.17	26.86	32.00	28.34
	3	9.81	12.80	11.40	13.04	11.76	23.42	31.05	27.40	31.75	28.40
	4	9.41	12.90	11.82	13.26	11.85	23.62	30.84	26.31	31.61	28.10
	5	9.33	12.61	11.46	12.90	11.58	23.72	30.16	26.30	31.30	27.87
Mean		9.49	12.86	11.56	13.17	-	23.62	30.81	26.59	31.72	-

L.S.D at 0.05 % level for:		
Sowing date (D)	NS	NS
Transplanting seedling age (T)	NS	NS
Fertilization (F)	0.231	0.431
D X T	NS	NS
D X F	NS	NS
TX F	NS	NS
D X T X F	NS	NS

Concerning the influence of micro-elements fertilization on boron concentration in sugar beet roots or leaves, the collected data cleared that these measurements significantly affected by micro-elements application.

recorded the highest values of boron concentration in sugar beet plants (roots 12.86 ppm, 13.17ppm and leaves 30.81 ppm, 31.72 ppm respectively), followed by zinc application treatment.

Table 7. Effect of transplanting and soil application of boron and zinc on zinc concentration in roots and leaves (ppm). *(Combined over two seasons)*

Sowing date	Sowing method	*Roots*					*Leaves*				
		Fertilization					*Fertilization*				
		0	B	Zn	B+Zn	Mean	0	B	Zn	B+Zn	Mean
15 Sept	1	10.22	12.84	15.17	15.81	13.51	12.10	16.68	23.08	24.24	19.03
	2	10.43	13.25	15.58	15.82	13.77	12.52	16.66	23.80	24.50	19.37
	3	10.35	12.95	14.85	15.15	13.33	12.44	16.50	23.88	24.68	19.38
	4	9.94	13.23	14.64	15.17	13.25	12.05	17.47	23.46	24.38	19.34
	5	10.21	12.64	15.05	15.38	13.32	11.79	16.50	23.48	23.93	19.93
Mean		10.23	12.98	15.06	15.46	13.43	12.18	16.76	23.54	24.35	19.21
15 Oct.	1	10.18	12.82	14.90	15.08	13.25	12.28	16.72	23.42	24.18	19.15
	2	10.00	12.88	14.79	15.60	13.32	12.42	16.37	23.25	24.30	19.08
	3	10.08	13.02	14.66	15.22	13.24	12.58	16.45	23.64	24.18	19.21
	4	10.33	12.63	14.58	15.18	13.18	12.16	16.83	23.50	24.29	19.20
	5	9.93	12.76	15.10	14.90	13.17	11.71	15.13	23.37	24.17	18.60
Mean		10.10	12.82	14.80	15.20	13.23	12.23	16.30	23.43	24.22	19.05
Mean of sowing method	1	10.20	12.83	15.04	15.45	13.38	12.19	16.70	23.25	24.21	19.09
	2	10.22	13.06	15.18	15.71	13.54	12.47	16.52	23.52	24.40	19.23
	3	10.21	12.98	14.76	15.18	13.28	12.51	16.48	23.76	24.43	19.30
	4	10.14	12.93	14.61	15.18	13.22	12.11	17.15	23.48	24.34	19.27
	5	10.07	12.70	15.08	15.14	13.25	11.75	15.82	23.43	24.05	18.76
Mean		10.17	12.90	14.93	15.33	-	12.20	16.53	23.49	24.29	-
L.S.D at 0.05 % level for:											
Sowing date (D)						N.S					N.S
Transplanting seedling age (T)						N.S					N.S
Fertilization (F)						0.235					0.316
D X T						N.S					N.S
D X F						N.S					N.S
TX F						N.S					N.S
D X T X F						N.S					N.S

The high values of boron concentration in the two parts of plants as a result of boron application alone or in combination with zinc element may be indicate to the role of zinc in boron absorption.

Regarding the interactions effect, the results obtained showed that none of the various combination betweens the studied factors attained a significant influence on boron concentration in root and leaves of sugar beet.

2. Zinc concentration in roots and leaves (ppm).

Results given showed that neither sowing dates nor transplanting seedling old affected on the values of zinc concentration in roots and leaves of sugar beet plants.

However, it could be noted that sowing sugar beet on 15th September attained a relative Regarding the influence of micro-elements fertilization on zinc concentration, it is clearly show that application of zinc treatment alone or in combination with boron element recorded the highest value of zinc content of sugar beet root (14.93 ppm and 15.33 ppm) and leaves (23.49 ppm and 24.29 ppm) in (Tables 22 and 23). These results and the results of (Table 6) give a good indication about the enhanced influence of boron and zinc element with respect to the concentration of each other in the plant organs.

Once more, the collected data in Tables (7) revealed that the various combinations between the studied factors insignificantly affected the concentration of zinc in roots and leaves of sugar beet plants.

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الشتل باستخدام تقنية الأصص الورقية والتغذية بالعناصر الصغرى وعلاقة ذلك بجودة العصير والمكونات الكيماوية لبنجر السكر المنزرع في مواعيد مختلفة

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أقيمت تجربتان حقليتان خلال موسمي الزراعة ٢٠٠١/٢٠٠٢ ، ٢٠٠٢/٢٠٠٣ بمحطة البحوث الزراعية بسخا بمحافظة كفر الشيخ لدراسة تأثير الشتل باستخدام الأصص الورقية والإضافة الأرضية للبورون والزنك علي جودة العصير والمكونات الكيمائية لبنجر السكر المنزرع في مواعيد مختلفة.

اشتملت كل تجربة علي عشرين معاملة تمثل التوافق بين خمسة طرق لزراعة بنجر السكر [الزراعة بالبذرة الجافة (الطريقة المعتادة) ، الزراعة بشتلات عمرها ١٥ ، ٢٥ ، ٣٥ يوما باستخدام الأصص الورقية والزراعة بشتل بادرات ناتجة من عملية الخف] ، أربعة معاملات للتسميد بعنصري البورون والزنك [بدون تسميد (مقارنة) ، إضافة ٠,٥ كجم بورون/فدان (الموصي به) في صورة بورات صوديوم ١١% بورون ، إضافة ٤ كجم زنك/فدان (الموصي به) في صورة كبريتات زنك ٢٢% زنك و إضافة مخلوط من ٠,٥ كجم بورون + ٤ كجم زنك/فدان] – وتم تنفيذ تلك المعاملات في موعدين للزراعة (١٥ سبتمبر و١٥ اكتو بر).

وزعت التوافقات العشرين بين عاملي الدراسة في تصميم قطاعات كاملة العشوائية في ثلاثة مكررات في كل من ميعادي الزراعة ١٥ سبتمبر ، ١٥ أكتوبر.

* أظهرت النتائج أن زراعة بنجر السكر فى١٥ سبتمبر قد حققت زيادة معنوية في النسبة المئوية لكل من المواد الصلبة الذائبة الكلية ، السكروز و النقاوة مقارنة بتلك المتحصل عليها في ١٥ أكتوبر – وعلى العكس من ذلك فقد انخفضت النسبة المئوية لكل من البوتاسيوم والصوديوم والشوائب في جذور بنجر السكر – في حين لم تتأثر كلا من الألفا أمينو نيتروجين ، تركيز البورون والزنك في الجذور والأوراق بمواعيد الزراعة.

* أعطت طريقة زراعة بنجر السكر شتلا باستخدام الأصص الورقية علي عمر ١٥ يوما أعلي قيم معنوية للنسبة المئوية لكل من المواد الصلبة الذائبة الكلية ، السكروز و النقاوة – تلتها طريقة الزراعة بالبذرة الجافة – إلا أن هاتين الطريقتين قد خفضتا النسبة المئوية للبوتاسيوم في الجذور.

* دلت النتائج علي أن إضافة عنصر الزنك منفردا أو مضافا لعنصر البورون قد نتج عنها زيادة معنوية في النسبة المئوية للصوديوم ، ومحتوى الأوراق والجذور من الزنك مقارنة بتلك المتحصل عليها من بنجر السكر غير المسمد أو المسمد بالبورون منفردا.

* أوضحت النتائج أن إضافة عنصر البورون منفردا أو مضافا لعنصر الزنك قد نتج عنها زيادة معنوية في النسبة المئوية لكل من المواد الصلبة الذائبة الكلية ، والسكروز و تركيز البورون في جذور وأوراق بنجر السكر مقارنة بتلك المتحصل عليها من بنجر السكر غير المسمد أو المسمد بالزنك منفردا.