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EFFECT OF SOWING DATES, HILL SPACING AND POTASSIUM FERTILIZATION ON YIELD, YIELD COMPONENS AND QUALITY OF SUGAR BEET *(Beta vulgaris, L.)* UNDER EL-MINIA GOVERNORATE CONDITIONS

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ABSTRACT

Two field experiments were carried out at the experimental farm of El-Minia University during 2003/2004 and 2004/2005 seasons to study the effect of sowing dates (20th Sep., 10th Oct. and 1st Nov.), hill spacing (15,20 and 25 cm.) and Potassium-rates (0,24 and 48kg K2O/fad.) as well as their interactions on yield, yield components and quality of sugar beet, c.v. Raspoly. The experimental design was split-split plot with three replications

The main results could be summarized as follows. All characters for yield and its components and quality were significantly affected by sowing dates. Sowing beet plants on 10th Oct. gave the greatest values of root length, root diameter, root fresh weight, foliage fresh weight/plant, yields of root, top and sugar. as well as TSS% and sucrose% in both seasons, while purity % recorded adversely trend in both seasons. Sowing beet plants on 1st Nov. Produced the lowest averages from all traits, except purity % in the second season, while sowing beet plants on 20th Sept. gave the highest average of purity % in the first season and vice-versa in the second one.

Hill spacing of 20 cm. gave the highest value of root length and diameter, foliage fresh weight, yields f top, root and sugar as well as TSS % and sucrose % in both seasons, while purity % resulted the lowest one in both seasons. On the other hand hill spacing of 15cm. between beet plants produced the lowest averages from this traits in both seasons, except root yield/ fad and TSS % where the lowest values from this traits resulted from hill spacing of 25 cm. between plants the greatest values of root fresh weight as well as juice purity % obtained from 25cm. between hills in both seasons.

All characters significantly increased with increasing Potassium rate up to 48 kg K_2O /fad except purity % in the two seasons.

The interactions indicated that the highest yield from root and sugar /fad was obtained by sowing beet on 10th Oct. at 20th cm between hills with 48kg k_2o/fad.

INTRODUCTION

Sugar beet is one of the two crops (the other being sugar cane), which represent the important source of sucrose product. The importance of sugar beet crop to agriculture is not only confined to sugar production, but also it well known to be adopted to poor, saline, alkaline and calcareous soil.

The economic way of increasing sugar productivity could be achieved through developing appropriate new technology package for sugar beet crop that includes agronomic management to the yield and quality of sugar beet. This could be achieved through using the best cultivars and adapting cultural practices for this important crop for sugar production such as planting date,

density of planting, fertilization …etc. (Moursy and Taha (1986), Mokadem (1999), EL-Harriri and Gobrah (2001) and Kandil, *et al.* (2002).

Ghandora (1994), Badawi, *et al.* (1995), and Metwally (1998) found that sowing sugar beet during October markedly increased root length and diameter, root weight, sugar content as well as root and sugar yields than sowing during November. Mokadem (1999) found that root and suger yield as well as sucrose % were significantly affected by sowing date. Abo salama and EL-Sayed (2000), Hassanin (2001), Kandil, *et al*. (2002) and Seadh (2004) found that planting sugar beet on 1st Oct. gave significantly the greatest values of root length and diameter as well as root, top and sugar yield/ fad. Mohamed (2005) and Saad (2005) Mentioned that planting date of 1st Oct. resulted the highest root length, root diameter, foliage fresh weight/ plant, top yield /fad, Sucrose % and Purity %, while planting date of 15th Sept. produced the heaviest root fresh weight/plant, root and sugar yield as well as TSS % in both seasons.

Several experiments have been carried out to determine the best plant density to give the highest production. Taha, *et al.* (1991) reported that the 25 cm spacing gave the greatest root yield/plant, while 20 cm spacing produced the highest yield of top and root/fad. Abd Alla, *et al.* (1995) found that the top yield/fad was significantly decreased with increasing plant density. Yonts and Smith (1997) stated that sugar beet grown in 56 cm row width corresponded with the higher sugar yield than sugar beet grown in the wother row width (35,76 and 97 cm). Gobrah (2001) reported that the greatest root yield and recoverable sugar yield were obtained from plants planting at 20 cm between hills, while 15 cm between hills gave the highest top yield. Abo El- Wafa (2002) stated that increasing plant spacing from 20 to 30 cm between hills increased root and sugar yields. Ali (2005) reported that all growth characters significantly affected by planting spaces in both seasons. 10 cm hill spacing gave the tallest roots and greatest values of TSS %, while 25 cm hill spacing produced the highest values of root diameter, root fresh weight /plant and foliage fresh weight /plant and added that hill spacing 20 cm resulted the highest averages of root, top and sugar yields /fad as well as juice purity %. Abo-Bakr (2005) found that 15 cm hill spacing gave the greatest averages of root length as well as root and top yields/fad, while 20 cm hill spacing resulted the heaviest sugar yield /fad as well as TSS % and sucrose % and added that 25 cm hill spacing gave the highest values of root diameter and root fresh weight /plant.

Potassium plays a found mental role in sucrose synthesis and storage. The influence of potassium is not only on carbohydrates assimilation but also in nitrogen metabolism (Pardo and Guadali (1993) and Seif (2000) Abd EL-Rahman (1996), Ibrahim (1998), EL-Shafaie(2000), Gobrah (2001), Hassanin (2001), Mahmoud (2004), Ahmed (2005) and Saad (2005) mentioned that root length, root diameter, root fresh weight/ plant , foliage fresh weight /plant, root, top and sugar yields/ fad. as well as sucrose and TSS percentages significantly increased with increasing potassium level up to 48 kg/k_2o/fad. On the other hand EL-Tweel (1999) found that there was significant decrease in top and sugar yields by increasing potassium levels from 0 to 48 kg K_2O. and added that sucrose and purity percentages were not

significantly affected by potassium rates. Mean while Thalooth, *et a*l. (2001) and Omer, *et al*. (2002) showed that increasing k rate up to 72 or 96 kgk_2o /fad significantly increased root and sugar yields /fad as well as sucrose %.

Therefore this investigation was designed to study the effect of sowing date, hill spacing and Potassium fertilization on yield and quality of sugar beet under El-Minia Governorate conditions.

MATERIALS AND METHODS

Two field experiments were carried out in 2003/2004 and 2004/2005 at the experimental farm of EL-Minia University to investigate the effect of sowing dates, hill spacing, potassium fertilization and their interactions on yield and quality of sugar beet (*Beta vulgaris*, L) Cultivar Ras poly.

Maize (*Zea mays* L.) was the preceding crop for the two seasons, phosphorus was applied as calcium super phosphate 15.5% P_2O_5 (15 kg P_2O_5) during land preparation in both seasons. The texture of soil of the experiment sites was silt clay loam having silt 31.06, clay 41.41, sand 27.53, total N 0.08 %, organic matter 1.52 %, PH 8.01, available P (ppm) 14.32, exch K (meq/100gm) 1.97.

The experimental design was split-split plot with three replications. The sowing dates i.e 20^{th} Sept, 10^{th} Oct and 1^{st} Nov were occupied the main plots. Sugar beet seeds were sown at 15, 20 and 25 cm apart in the sub plots. Potassium was applied after 30 days from sowing at rates of zero, 24 and 48 kg k_2o/fad in the sub-sub plot consisted of 6 ridges, 55 cm between ridages and 3m long (plot area 9.9 m^2). Plants were thinned to one plant/hill after 30 days, Nitrogen fertilization (80 kgN/fad) was applied in the form of ammonium nitrate 33.5% N in two equal doses, the first after 30 days from sowing and the second at 50 days from sowing.

At harvest (195 days after sowing) five plants were chosen at random from the outer ridges of each sub-sub plot to estimate yield components and quality characters as follows:

1. Root length (cm).
2. Root diameter (cm).
3. Root fresh weight/plant (gm).
4. Foliage fresh weight/plant (gm).
5. Total soluble solids (TSS%) of roots, it was measured in juice of fresh root using hand refractometer.
6. Sucrose %, it was determined according to A.O.A.C (1995).
7. Juice purity %, it was calculated according to Sapronova, *et al.* (1972) using the following equation:-

$$\text{Juice purity \%} = \frac{\text{Sucrose \%}}{\text{TSS \%}} \times 100$$

At harvest sugar beet plants from the two inner ridges of each sub-sub plot were collected, roots and tops were separated and weight in kg, then converted to estimate:-

1. Root yield (ton/fad).
2. Top yield (ton/fad).
3. Sugar yield (ton/fad). It was computed according to the following formula

:

$$\text{Sugar yield} = \frac{\text{Recovery sugar} \times \text{root yield}}{100}$$

- Recovery sugar = S – 0.4 (B-S) × 0.73
- Where S = sucrose %, B = TSS %

Data in each season were statistically analyzed according to Snedecor and Cochran (1967) for the comparison between means using the least significant differences (LSD) at the 5% probability.

RESULTS AND DISCUSSION

A-Effect of sowing dates:

Data recorded in Tables 1 and 2 indicated that sowing beet on 10th of October was accompanied by a significant increase in all characters of yield components as well as yield and quality in both seasons except juice purity % in both seasons. Sowing data of Oct. gave the tallest roots (35.54 and 38.63 cm), thickest roots (13.41 and 14.71 cm), heaviest root fresh weight (693.38 and 814.29 gm), heaviest foliage fresh weight/plant (214.06 and 231.28 gm), highest root yield /fad (25.53 and 26.69 ton), maximum top yield/fad (7.92 and 7.54 ton), highest sugar yield/fad (4.17and4.45 ton), maximum TSS%(19.30 and 20.28%) and highest sucrose %(16.26 and 16.66) in the first and second seasons, respectively. Meanwhile purity % took adversely trend in first season and recorded a medium values in the second season. On the contrary sowing beet plants on the 1st Nov. resulted in the lowest averages from these characters, except purity % in both seasons and sucrose % in the second season, where planting date of 1st November produced the maximum average for purity % in the second season and recorded a second rank for purity % and sucrose % in the first and second seasons, respectively. On the other hand sowing date on 20th Sept. resulted in the highest value for purity % in the first season and lowest one in the second season. The superiority of Oct. sowing may be due to the suitable environmental conditions during this period such as day length, relative humidity, temperature, light intensity and longer growth period which play a vital role in activating growth and formotion more photosynthates products, translocation and accumulation carbohydrates and sucrose. Consequently increasing dry matter accumulation as well as root weight, root and sugar yield/fad. These results are in accordance with those obtained by Mokadem (1999), Hassanin (2001) and Seadh (2004).

B- Effect of hill spacing:

Data illustrated in Tables 1 and 2 showed that all estimated characters were significantly affected by hill spacing in both seasons. Hill spacing of 20 cm between beet plants produced the highest means from root length, root diameter, foliage fresh weight per plant, root, top and sugar yield/fad. as well as TSS % and sucrose % in both seasons, but purity % took adversely trend in the two growing seasons.

On the other hand, hill spacing of 25 cm between beet plants gave the lowest averages from root and sugar yield/fad. as well as TSS % in both seasons, mean while it gave the highest values for root fresh weight as well as purity % in both seasons. The distance of 15cm. between beet plants produced the lowest averages from root length and diameter, root fresh weight, foliage fresh weight /plant, top yield/fad and sucrose %, this was true in both seasons. The distance of 20 cm between beet plants out yielded the other hill spacing (25 and 15 cm) in root yield/fad by 1.93 and 3.61 ton in the first season and 2.26 and 3.57 ton in the second season. Such increase in root yield may be due to the reduction in the competition between beet plants for growth elements i.e nutrients, water and light which cause an increase in leaf area which it affects the amount of radiation percentage and reaching to all leaves reflected the increase in root yield per unit area. Also hill spacing of 20 cm surpassed the other hill spacing (25 and 15) in sugar yield/fad by 0.62 and 0.83 ton in the first season and by 0.56 and 0.73 ton in the second season. This increase may be due to the superior of 20 cm hill spacing in root yield and sucrose %. Similar results were obtained by Nassar (2001), Abo EL-Wafa (2002), Cakmakci and oral (2002) ,Omar *et al* (2002).

C. Effect of Potassium fertilization:

Data presented in Tables 1 and 2 revealed that all characters of yield and quality were significantly affected by Potassium-rates in both seasons. A gradual increase in root length, root diameter, root fresh weight, foliage fresh weight per plant, root, top and sugar yields/fad as well as TSS % and sucrose % increased as K- rate raised from 0 to 48 kg K_2O/fad, this was true in both season. On the other hand, purity % increased with no significance differences as K- rate raised from 0 to 24 kg K_2O/fad in the first season, but purity % decreased significantly by increasing K- rate to 48 kg K_2O/fad in both seasons. Such increase in root yield/fad mounted to 0.75 and 1.51 ton/fad in the first season, being 0.68 and 1.31 ton/fad in the second season, as K-rate raised from 0 to 24 and 48 kg K_2O/fad. Similar significant increases in sugar yield/fad amounted to 0.21 and 0.40 ton in the first season, being 0.20 and 0.35 ton in the second season. These results could be attributed to the important role of potassium in physiological process in plant such as translocation of sugar and carbohydrates of assimilates from the top to the under ground part (root). (Tisdal and Nelson 1985) Also its role in nutritional balance, which increase organic compounds through phytosynthesis (EL-Harriri and Gobrh 2001). These results are in harmony with those obtained by EL-moursy *et al.* (1998), Seif (2000), Hassanin (2001) and Ahmed (2005).

Effect of interaction:

I. A significant interaction between sowing dates and hill spacing was found on all traits in both seasons except root diameter in the first season. The treatment of 20 cm between beet plants and sown on 10th Oct. produced the highest averages from all characters in both seasons, except root fresh weight which gave the highest means from sowing on 10th Oct x 25 cm between hills in both seasons as well as juice purity % which resulted the highest values from planting on 20th Sept x 25 cm between hills in the first season and sowing on 1st Nov x planting at 25 cm between hills in the second season (Table 3).

Table (3): The obtained significant interaction effect of sowing dates x hill spacing during the two seasons

Characters	Treatments	Highest values
2003/2004 season		
Root length (cm)	Sowing on 10th Oct. x planting at 20 cm between hills	36.78
Root fresh weight (gm)	Sowing on 10th Oct. x planting at 25 cm between hills	748.93
Foliage fresh weight/plant (gm)	Sowing on 10th Oct. x planting at 20 cm between hills	237.38
Root yield (ton/fad)	Sowing on 10th Oct. x planting at 20 cm between hills	27.51
Top yield (ton/fad)	Sowing on 10th Oct. x planting at 20 cm between hills	10.40
Sugar yield (ton/fad)	Sowing on 10th Oct. x planting at 20 cm between hills	4.76
TSS %	Sowing on 10th Oct. x planting at 20 cm between hills	20.94
Sucrose %	Sowing on 10th Oct. x planting at 20 cm between hills	17.28
Purity %	Sowing on 20th Sept. x planting at 25 cm between hills	88.62
2004/2005 season		
Root length (cm)	Sowing on 10th Oct. x planting at 20 cm between hills	40.36
Root diameter (cm)	Sowing on 10th Oct. x planting at 20 cm between hills	15.51
Root fresh weight (gm)	Sowing on 10th Oct. x planting at 25 cm between hills	882.73
Foliage fresh weight/plant (gm)	Sowing on 10th Oct. x planting at 20 cm between hills	247.30
Root yield (ton/fad)	Sowing on 10th Oct. x planting at 20 cm between hills	28.96
Top yield (ton/fad)	Sowing on 10th Oct. x planting at 20 cm between hills	9.38
Sugar yield (ton/fad)	Sowing on 10th Oct. x planting at 20 cm between hills	5.01
TSS %	Sowing on 10th Oct. x planting at 20 cm between hills	22.02
Sucrose %	Sowing on 10th Oct. x planting at 20 cm between hills	17.42
Purity %	Sowing on 1st Nov. x planting at 25 cm between hills	86.01

II. The interaction between sowing dates x K-rates had a significant effect on root fresh weight and TSS % in both season as well as purity % in the first season and top yield /fad in the second season. Sowing beet plants on 10th with 48 kg K_2O/fad gave the highest values for this trait except purity %, where sowing on 20th Sept with 24 kg K_2O/fad resulted in the maximum mean in the first season (Table 4).

III. Concerning the interaction between hill spacing x K-rates, significant effects were obtained on sugar yield/fad, TSS % and sucrose % in both seasons as well as foliage fresh weight/plant, root yield/fad and purity % in the first season and top yield/fad in the second season. Hill spacing of 20cm with 48 kg K_2O produced the greatest values for this characters except purity % where hill spacing 25 cm with zero K-rate resulted the highest one in the first season (Table 5).

IV. The interaction among the three factors under studies significantly affected root fresh weight in both seasons as well as foliage fresh weight/plant, root yield/fad, sugar yield/fad and sucrose percentage in the first season and TSS % in the second season. The highest averages from these traits resulted by sowing beet plants on 10th Oct at hill spacing 20 cm between hills with 48 kg K_2O (Table 6).

VI. Finally, it could be concluded that under the condition of this study the highest root and sugar yields/fad produced by sowing beet on 10th Oct at 20 cm between hills with 48 kg K_2O/fad.

Table (4):The obtained significant interaction effect of sowing date x K rates during the two seasons.

Characters	Treatments	Highest values
2003/2004 season		
Root fresh weight (gm)	Sowing on 10th Oct. with 48 kg K_2O /fad.	708.64
TSS %	Sowing on 10th Oct. with 48 kg K_2O /fad.	19.80
Purity %	Sowing on 20th Sept. with 24 kg K_2O /fad.	86.88
2004/2005 season		
Root fresh weight (gm)	Sowing on 10th Oct. with 48 kg K_2O /fad.	834.70
TSS %	Sowing on 10th Oct. with 48 kg K_2O /fad.	20.88
Top yield (ton/fad)	Sowing on 10th Oct. with 48 kg K_2O /fad.	7.88

Table (5): The obtained significant interaction effect of hills pacing x K rates during the two seasons.

Characters	Treatments	Highest values
2003/2004season		
Foliage fresh weight /plant (gm)	Hill spacing 20 cm with 48 kg k_2o /fad.	227.74
Root yield (ton/fad)	Hill spacing 20 cm with 48 kg k_2o /fad.	27.04
Sugar yield (ton/fad)	Hill spacing 20 cm with 48 kg k_2o /fad.	4.65
TSS %	Hill spacing 20 cm with 48 kg k_2o /fad.	20.47
Sucrose %	Hill spacing 20 cm with 48 kg k_2o /fad.	17.20
Purity %	Hill spacing 20 cm with 48 kg k_2o /fad.	87.71
2004/2005 season		
Top yield (ton/fad)	Hill spacing 20 cm with 48 kg k_2o /fad.	9.64
Sugar yield (ton/fad)	Hill spacing 20 cm with 48 kg k_2o /fad.	4.72
TSS %	Hill spacing 20 cm with 48 kg k_2o /fad.	21.47
Sucrose %	Hill spacing 20 cm with 48 kg k_2o /fad.	16.88

Table (6): The obtained significant interaction effect of sowing date x hill spacing x K rates during the two seasons.

Characters	Treatments	Highest values
2003/2004 season		
Root fresh weight (gm)	Sowing date 10th Oct. at 20 cm with 48 kg K_2O /fad.	762.45
Foliage fresh weight (gm)	Sowing date 10th Oct. at 20 cm with 48 kg K_2O /fad.	248.30
Root yield (ton/fad)	Sowing date 10th Oct. at 20 cm with 48 kg K_2O /fad.	28.47
Sugar yield (ton/fad)	Sowing date 10th Oct. at 20 cm with 48 kg K_2O /fad.	5.10
Sucrose %	Sowing date 10th Oct. at 20 cm with 48 kg K_2O /fad.	17.20
2004/2005 season		
Root fresh weight (gm)	Sowing on 10th Oct. at 20 cm with 48 kg K_2O /fad.	909.00
TSS %	Sowing on 10th Oct. at 20 cm with 48 kg K_2O /fad.	22.70

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تأثير ميعاد الزراعة ومسافات الزراعة والتسميد البوتاسي على المحصول ومكوناته وصفات الجودة لمحصول بنجر السكر تحت ظروف محافظة المنيا.

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*** قسم البيئة كلية الزراعة جامعة المنيا**

**** قسم المحاصيل كلية الزراعة جامعة الأزهر بأسيوط***

أقيمت تجربتان حقليتان في المزرعة البحثية لجامعة المنيا خلال موسمي (٢٠٠٣/٢٠٠٤، ٢٠٠٤/٢٠٠٥) وذلك لدراسة تأثير ميعاد الزراعة (٢٠سبتمبر، ١٠أكتوبر، أول نوفمبر) ومسافات الزراعة (١٥، ٢٠، ٢٥ سم بين النباتات) والتسميد البوتاسي (صفر، ٢٤، ٤٨ كجم بو٢أ) على صفات المحصول ومكوناتة وجودة محصول بنجر السكر صنف راس بولي وقد استخدم تصميم القطع المنشقة مرتين فى ثلاث مكررات.

وقد أظهرت النتائج أن جميع الصفات تحت الدراسة تأثرت معنوياً بميعاد الزراعة، ولقد أعطت الزراعة في ١٠ أكتوبر أعلى القيم لكل من صفة طول الجذر، قطر الجذر، الوزن الطازج للجذر/نبات، الوزن الطازج للعرش /نبات، محصول الجذور، العرش، السكر للفدان، النسبة المئوية للمواد الصلبة الكلية –النسبة المئوية للسكروز في كلا الموسمين .ينما أعطت أقل قيمة لصفة النقاوة في كلا الموسمين، بينما أعطت زراعة البنجر في أول نوفمبر أقل المتوسطات لهذه الصفات فيما عدا النقاوة في كلا الموسمين ونسبة السكروز في الموسم الثاني أما زراعة البنجر في ٢٠ سبتمبر أعطت أعلى المتوسطات لصفة النقاوة في الموسم الأول بينما أعطت العكس في الموسم الثاني .

أما مسافات الزراعة فقد أثرت معنوياً على الصفات وأعطت المسافة ٢٠سم بين الجور أعلى المتوسطات لجميع الصفات باستثناء نقاوة العصير في كلا الموسمين بينما أعطت المسافة ١٥سم بين الجور أقل المتوسطات باستثناء النسبة المئوية للمواد الصلبة الكلية ومحصول الجذور للفدان حيث أعطت المسافة ٢٥ سم بين الجور أقل المتوسطات لهاتين الصفتين وعلى العكس أعطت المسافة ٢٥ سم بين الجور أعلى المتوسطات لصفة الوزن الطازج للجذر، والنسبة المئوية لنقاوة العصير في كلا الموسمين.

ولقد أثرت معدلات التسميد البوتاسي معنوياً على صفات المحصول والجودة وأعطت المعاملة ٤٨كجم بو٢أ فدان أعلى القيم لجميع الصفات تحت الدراسة باستثناء نقاوة العصير في كلا الموسمين.

كما أظهرت التفاعلات تأثيراً معنوياً على صفات المحصول والجودة ووجد أن أعلى محصول سواء من الجذور أو السكر للفدان نتج عن زراعة البنجر في١٠ أكتوبر ومسافة ٢٠ سم بين الجور والتسميد بمعدل ٤٨ كجم بو٢أ /فدان.

Table (1): Effect of sowing dates, hill spacing and potassium on root length, root diameter, root fresh weight, foliage fresh weight/plant and root yield/fad. of sugar beet in 2003/2004 and 2004/2005 seasons. .

Characters	Root length (cm)		Root diameter (cm)		Root fresh weight (gm)		Foliage fresh weight/plant (gm)		Root yield (ton/fad)	
Treatments	**2003/2004**	**2004/2005**	**2003/2004**	**2004/2005**	**2003/2004**	**2004/2005**	**2003/2004**	**2004/2005**	**2003/2004**	**2004/2005**
Sowing dates										
20th Sept.	32.66	36.65	11.25	12.77	669.91	750.63	208.33	210.65	24.69	25.43
10th Oct.	35.54	38.63	13.41	14.71	693.38	814.29	214.06	231.28	25.53	26.69
1st Nov.	30.89	34.37	10.36	11.59	561.75	688.15	199.64	203.44	23.15	24.64
L. S. D. .05	0.18	0.25	0.15	0.21	6.05	5.89	3.47	1.75	0.15	0.11
Hill spacing										
15	31.90	35.37	10.77	12.14	572.43	662.64	201.05	206.88	24.37	25.27
20	34.35	37.90	12.55	13.70	667.10	760.01	217.14	223.66	26.30	27.53
25	32.84	36.39	11.70	13.23	685.52	830.43	208.85	214.33	22.69	23.46
L. S. D. .05	0.14	0.16	0.21	0.18	5.36	5.38	2.26	1.27	0.08	0.12
Potassium levels K_2O Kg/fad										
0	32.07	35.59	10.82	12.29	623.43	730.44	199.11	205.36	23.70	24.92
24	33.07	36.62	11.67	13.09	642.53	753.01	209.39	215.64	24.45	25.60
48	33.95	37.44	12.52	13.69	659.09	769.62	218.58	224.37	25.21	26.23
L. S. D. .05	0.16	0.12	0.17	0.50	2.17	3.82	1.12	0.35	0.10	0.21

Table (2): Effect of sowing dates, hill spacing and potassium levels on top yield / fad, sugar yield /fad, TSS %, sucrose % and purity % of sugar beet in 2003/2004 and 2004/2005 seasons.

Characters	Top yield (ton/fad)		Sugar yield (ton/fad)		TSS %		Sucrose %		Purity %	
Treatments	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
Sowing dates										
20th Sept.	7.44	7.46	3.99	3.99	18.66	19.65	16.13	15.68	86.45	79.97
10th Oct.	7.92	7.54	4.17	4.45	19.30	20.28	16.26	16.66	84.65	82.21
1st Nov.	7.07	7.15	3.60	3.90	17.98	18.89	15.52	15.82	85.74	83.57
L. S. D. .05	0.13	0.08	0.02	0.04	0.11	0.20	0.11	0.13	1.15	0.60
Hill spacing										
15	5.96	6.17	3.78	3.98	18.26	19.30	15.49	15.69	85.17	81.45
20	9.57	9.21	4.40	4.54	19.94	20.89	16.71	16.51	83.84	79.07
25	6.91	6.78	3.57	3.81	17.74	18.63	15.70	15.95	87.83	85.24
L. S. D. .05	0.27	0.08	0.04	0.04	0.16	0.15	0.13	0.10	0.75	0.67
Potassium levels K_2O Kg/fad.										
0	7.15	7.05	3.71	3.93	18.15	19.15	15.64	15.74	85.82	82.26
24	7.48	7.41	3.92	4.13	18.61	19.58	15.98	16.09	86.13	82.23
48	7.80	7.70	4.11	4.28	19.19	20.09	16.29	16.33	84.89	81.27
L. S. D. .05	0.43	0.03	0.02	0.03	0.10	0.11	0.08	0.10	0.78	0.11