Effect of Planting Dates, Nitrogen Levels and Biofertilization Treatments on 1: Growth Attributes of Sugar Beet (*Beta vulgaris*, L.)

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Abstract:

This study was carried out during 1998/99 and 1999/2000 at El-Serw region in Northen Faraskour district, Damitta Governorate to investigate the effect of planting dates, nitrogen levels and bio-fertilizatiopn treatments as well as their interaction on growth of sugar beet (*Beta vulgaris,* L.) variety Top. Each planting date was conducted in a separate experiment, laid-out in split plot design with four replicates. The main plots were occupied by five nitrogen levels, while the sub-plots were devoted to three bio-fertilization treatments. The main findings obtained from this investigation could be summarized as follows:

- Root fresh and dry weights, foliage fresh and dry weights and leaf area index (at 120 and 150 days from planting), crop growth rate, relative growth rate and net assimilation rate significantly affected by planting dates in both seasons. The highest values for growth characters were obtained by planting beet on 15th of October.
- Raising nitrogen fertilizer levels from 0 to 45, 90, 135 and 180 kg N/ha significantly improved all growth characters (root fresh and dry weights, foliage fresh and dry weights, LAI, CGR, RGR and NAR) at the two samples in both seasons. Increasing nitrogen fertilizer levels up to 180 kg N/ha resulted in the highest means of all growth measurements as previously mentioned. Vice versa, sugar beet plants growing without nitrogen fertilization (control treatment) were induced the lowest ones of two samples in both seasons.
- The obtained results showed that root fresh and dry weights, foliage fresh and dry weights, LAI, CGR, RGR and NAR in both samples and seasons had a significant effect by bio-fertilization treatments and the results showed that the highest measurements were achieved from treating beet seeds with Rhizobacterin.

Introduction:

Sugar beet (*Beta vulgaris,* L.) has several advantages as suitable complementary crop for increasing local sugar production in Egypt. It is considered as an industrial crop to produce various products as alcohol, forage and other many products. Planting dates, nitrogen fertilization and

bio-fertilization are considered among the important agricultural practices to improve sugar beet productivity.

Planting date is considered among the most important factor for all field crops generally, and sugar beet specially. It has an active role for growth, yield and root quality. The suitable date for sugar beet planting mainly depends on many factors such as the previous crop, weathering conditions, contract conditions with sugar factories and cultivated cultivar. Lopez and Castillo (1982) reported that crop growth rate (CGR) and relative growth rate (RGR) did not show great differences according to the date of sowing. Net assimilation rate (NAR) was higher in November and December sowing compared with October sowing. While October sowing presented the highest accumulation of dry matter compared with November and December sowing. Badawi (1985) and Badawi *et al.* (1995) reported that planting dates markedly affected leaf area index, biological plant weight, root weight and foliage weight. Ghonema (1998) found that planting dates markedly affected all growth characters under study, except foliage weight and root/top ratio in the second season. Planting sugar beet during October recorded the highest leaf area index, root length, root diameter, root and foliage fresh weights, sucrose and purity percentages and root yield as well as sugar yield compared with other planting dates.

Nitrogen is referred as balance wheel of sugar beet nutrition because of the fact that the efficiency of other nutrients is based on it. Sayed (1988) showed that increasing nitrogen application of sugar beet increased root and top dry weights, LAI, CGR. El-Shafei (1991) reported that increasing nitrogen fertilizer level up to 75 kg N/fad led to a significant and gradual increase in root and top fresh weights/plant, root dry matter accumulation compared with the control (Unfertilized plants). Sorour *et al.* (1992) and Neamat-Alla (1997) reported that increasing nitrogen rates increased dry weight/plant, crop growth rate (CGR), net assimilation rate (NAR) and leaf area index (LAI). Sharief *et al.* (1997) reported that increasing nitrogen fertilizer rate up to 180 kg N/ha significantly increased leaf area index, fresh and dry weights of roots, foliage per plant compared with applying 90 kg N/ha. Seaada (1998) and Mahasen-Fahmi (1999) showed that raising nitrogen fertilizer levels improved all growth characters.

Biological fertilization of non-legume crops by N_2-fixing bacteria had a great importance in recent years. The effect of inoculation had marked influence on the growth of plant, which reflects to increase yield. This increase might be due to the effect of N which was produced by bacteria species, in addition of some growth regulators like IAA and GA_3 which stimulated growth. Hill *et al.* (1983) indicated that N_2-fixing bacteria (Azospirillum) have been found associated with roots of sweet potato plants for period 1 to 3 months. Therefore, N-fixing and plant growth were increased. Pacovsky (1988) stated that inoculation with *Azospirillum brasilense* on sorghum increased total plant and dry weight. Sprenat (1990) found that solubilization of mineral nutrients synthesis of vitamins, amino acids, auxins and gibberellins, which stimulate plant growth, comes as result of inoculation by *Azotobacter spp*. Abdulla (1999) found that applying the N-bio-fertilizer (Rizobacterin) combined with poultry manure gave the best results for vegetative growth traits of potato plants represented as plant height and number of main stems/plant. Abo-El-Goud (2000) reported that root fresh and dry weights, foliage fresh and dry weights as well as LAI of fodder beet significantly responded to 5% level of significant due to bio-fertilizer treatments. El-Zeiny *et al.* (2001) found that bio-fertilization improved plant growth characters expressed as number of leaves, leaf area and vegetative fresh and dry weights. They also revealed that bio-fertilizer is a biological technique for reducing the dose of mineral fertilizer.

Therefore, this investigation was carried out to study the effect of planting dates, nitrogen fertilization levels and bio-fertilization treatments on the growth characters of sugar beet plants.

Materials and Methods

The present investigation was conducted at El-Serw region in Northern Faraskour district, Damitta Governorate during the two growing seasons of 1998/1999 and 1999/2000 to study the effect of planting dates, nitrogen fertilization levels and bio-fertilization treatments as well as their interaction on the growth, yield, yield components and quality of sugar beet cultivar (cv. Top).

This study included four planting dates (15th Sept., 1st Oct., 15th Oct. and 1st Nov.). Each planting date was conducted in a separate experiment. A split-plot design with four replicates was used in each planting dates. The

main plots were occupied by five nitrogen levels (0, 45, 90, 135 and 180 kg N/ha), while the sub-plots were devoted to three bio-fertilization treatments, i.e. untreated seeds (control), treated seeds with Cerialine (1.35 kg/ha) and treated seed with Rhizobactrein (1.35 kg/ha). The experimental basic unit area included five ridges, each of 60 cm width and 3.5 m length, occupying an area of 10.5 m^2. The preceding summer crop was rice (*Oryza sativa*) in both seasons.

The experimental field was well prepared through two ploughing and leveling. Calcium super phosphate (15.5 % P_2O_5) was applied during tillage operations at the rate of 240 kg/ha. Potassium sulfate (48 % K_2O) at a rate of 120 kg/ha was applied before the first and second watering. Nitrogen fertilizer in the form of ammonium sulphate (20.5 % N) was applied as a side dressing at the previously mentioned rates in two equal parts, one half after thinning (before the first irrigation) and the other half before the second irrigation. Sugar beet (cv. Top) was obtained from the Dakahlia Sugar Company at Belkass to which the author is indebted. Seed balls were hand sown as the usual dry sowing (after inoculation seed with bacterial suspension) on one side of the ridge in hills, 20 cm apart at the rate of 3-5 seed balls per hill during the aforementioned dates in both seasons. Each planting date was irrigated immediately after sowing. Beet plants were thinned in two times, the last one was done at 30 days after sowing masdone to let one plant/hill.

Two samples were taken during the growth period, i.e. 120 and 150 days from sowing of each planting date. Five guarded plants were chosen at random from each sub-plot to determine root fresh weight (g/plant), root dry weight (g/plant), foliage fresh weight (g/plant) and foliage dry weight (g/plant). Where, each sample plants were separated into foliages and roots. The roots and foliage were cut to small pieces. All plant fractions were air dried, then oven dried to constant weight for 72 hours at 70 °C.

5 - Leaf area index (LAI):

$$LAI = \frac{\text{Unit leaf area per plant } (cm^2)}{\text{Plant ground area } (cm^2)}$$

For leaf area measurement, the disk method was followed using 10 disks of 0.91 cm diameter according to Watson (1958).

6 - Crop growth rate (CGR) in (g/week):

$$CGR = \frac{W_2 - W_1}{T_2 - T_1}$$

According to Radfords (1967), where W_1 and W_2 refer to dry weight of plant at time T_1 and T_2, respectively.

7 - Relative growth rate (RGR) in (g/g/week)

$$RGR = \frac{\log_e W2 - \log_e W1}{(T2 - T1)}$$ according to Watson (1958)

8 - Net assimilation rate:

$$NAR = \frac{(W_2 - W_1)(\log_e A_2 - \log_e A_1)}{(T_2 - T_1)(A_2 - A_1)}$$ in $mg/m^2/day$

According to Radfords (1967), where W_1, A_1 and W_2, A_2, respectively refer to dry weight to plant and leaf area at time T_1 and T_2, respectively.

All data of each sowing date in each season were statistically analyzed according to the technique of Analysis of Variance (ANOVA) of the split plot design. Then the combined analysis for the four evaluated planting dates was done in each season according to the method stated by Gomez and Gomez (1984). Treatment means were compared using the least significant difference (LSD) method.

Results and discussion

1- Effect of planting dates:

Data presented in Tables (1, 2 and 3) show that better performance due to planting beet on 15th October than all planting dates. All growth characters, root fresh and dry weights (at 120 and 150 days), foliage fresh and dry weights (at 120 and 150 days), leaf area index (at 120 and 150 days), crop growth rate, relative growth rate and net assimilation rate significantly affected by planting dates in both seasons. The superiority of 15th October planting may be attributed to the suitable climatic conditions for sugar beet growth. These results are in good agreement with those stated

by Lopez and Castillo (1982), Badawi (1985), Badawi *et al.* (1995) and Ghonema (1998).

Table (1)

Averages of root fresh weight (g/plant) and root dry weight (g/plant as affected by planting dates, nitrogen levels and bio-fertilization treatments at 120 and 150 days from sowing during 1998/99 and 1999/2000 seasons

Characters	Root fresh weight (g /plant)				Root dry weight (g /plant)			
Seasons	98/1999		1999/2000		98/1999		1999/2000	
Treatments	120 days	150 days	120 days	150 days	120 days	150 days	120 days	150 days
A- Planting dates								
15 Sept	393.7	477.7	346.2	458.8	79.7	109.2	69.5	89.7
1 Oct	385.7	470.6	383.9	447.5	78.9	106.8	78.3	86.7
15 Oct	468.1	606.2	447.2	567.5	97.6	138.8	88.1	109.4
1 Nov	376.3	486.9	343.6	460.7	77.9	107.4	70.8	88.4
F test	**	**	**	**	**	**	**	**
LSD 5%	6.5	14.8	12.4	7.5	3.0	4.6	2.6	1.3
B- Nitrogen levels								
0 kg N/ha	198.6	258.1	186.6	234.9	41.1	58.2	38.1	49.6
45 kg N/ha	306.7	385.5	266.9	363.9	64.5	88.7	53.3	73.9
90 kg N/ ha	408.0	469.9	355.2	476.0	84.4	105.0	71.3	92.9
135 kg N/ha	487.9	619.0	482.1	605.5	101.8	140.5	96.1	114.1
180 kg N/ha	628.6	811.8	610.3	737.5	125.8	185.4	124.7	137.2
F test	**	**	**	**	**	**	**	**
LSD 5%	7.3	16.5	13.9	8.4	3.4	5.2	2.9	1.5
C- Bio-fertilization treatments								
Control	354.9	451.6	337.6	437.6	72.3	102.7	69.1	85.0
Cerialine	396.6	502.4	373.6	481.6	82.0	112.9	75.3	93.2
Rhizobacterin	466.3	572.6	429.4	531.6	96.3	131.1	85.7	102.5
F test	**	**	**	**	**	**	**	**
LSD 5%	5.6	9.9	6.8	4.1	2.5	2.4	1.2	0.8

2- Effect of nitrogen levels:

Data listed in Tables (1,2 and 3) clearly show that all growth characters under study were proved to be significantly increased as a result to increasing nitrogen fertilizer after 120 and 150 days from planting in both seasons of this investigation. Raising nitrogen fertilizer levels from 0 to 45, 90, 135 and 180 kg N/ha significantly increased all growth characters (root

fresh and dry weights, foliage fresh and dry weights, LAA, CGR, RGR, and NAR) at the two samples in both seasons.

Table (2)

Averages of foliage fresh weight (g /plant) and foliage dry weight (g /plant as affected by planting dates, nitrogen levels and bio-fertilization treatments at 120 and 150 days from sowing during 1998/99 and 1999/2000 seasons

Characters	Foliage fresh weight (g /plant)				Foliage dry weight (g /plant)			
Seasons	98/1999		1999/2000		98/1999		1999/2000	
Treatments	120 days	150 days	120 days	150 days	120 days	150 days	120 days	150 days
A- Planting dates								
15 Sept	279.5	395.7	323.7	381.5	39.8	55.4	41.6	50.9
1 Oct	415.7	469.2	415.5	471.1	57.5	66.1	52.7	62.6
15 Oct	448.4	515.1	436.5	485.3	65.2	73.1	57.7	62.7
1 Nov	371.3	429.1	317.3	364.8	52.4	62.2	41.9	50.0
F test	**	**	**	**	**	**	**	**
LSD 5%	6.3	7.9	9.3	9.5	0.8	1.0	1.2	1.2
B- Nitrogen levels								
0 kg N/ha	185.3	240.3	150.3	211.4	29.9	38.7	22.3	32.7
45 kg N/ha	269.9	324.4	269.6	303.8	40.8	49.3	38.4	44.3
90 kg N/ ha	364.9	427.8	385.4	421.4	52.4	61.7	51.1	56.9
135 kg N/ha	463.6	558.2	487.9	533.4	64.0	78.1	62.1	67.7
180 kg N/ha	609.9	711.1	572.9	658.4	81.5	93.2	68.6	81.2
F test	**	**	**	**	**	**	**	**
LSD 5%	7.0	8.8	10.4	10.7	0.9	1.1	1.3	1.3
C- Bio-fertilization treatments								
Control	338.7	405.8	327.6	391.8	48.1	58.3	44.1	53.0
Cerialine	379.4	450.9	371.0	417.1	54.3	64.3	48.2	55.4
Rhizobacterin	418.1	500.4	410.9	468.0	58.7	69.9	53.3	61.2
F test	**	**	**	**	**	**	**	**
LSD 5%	5.3	5.2	5.5	5.3	0.8	0.8	0.7	0.8

Table (3)
Averages of leaf area index, CGR, RGR and NAR as affected by planting dates, nitrogen levels and bio-fertilization treatments during 1998/99 and 1999/2000 seasons

Characters	Leaf area index				CGR		RGR		NAR	
Seasons	98/1999		1999/2000		98/99	99/2000	98/99	99/2000	98/99	99/2000
Treatments	120 days	150 days	120 days	150 days	120 days	150 days	120 days	150 days	120 days	150 days
A- Planting dates										
15 Sept	3.7	4.9	3.7	4.5	1.499	1.420	0.136	0.144	4.70	4.79
1 Oct	5.2	5.6	4.6	5.0	1.649	1.546	0.150	0.153	4.72	4.75
15 Oct	5.7	6.0	4.6	5.1	1.783	1.734	0.152	0.156	4.80	4.83
1 Nov	4.9	5.3	3.6	4.3	1.465	1.436	0.142	0.143	4.62	4.61
F test	**	**	**	**	*	*	*	*	*	*
LSD 5%	0.1	0.07	0.08	0.06	0.036	0.040	0.002	0.002	0.02	0.02
B- Nitrogen levels										
0 kg N/ha	3.3	4.2	2.4	3.3	1.191	1.147	0.121	0.126	4.39	4.39
45 kg N/ha	4.2	5.0	3.7	4.2	1.420	1.360	0.137	0.140	4.57	4.59
90 kg N/ ha	4.8	5.3	4.5	4.9	1.594	1.546	0.147	0.150	4.73	4.77
135 kg N/ha	5.5	6.1	4.9	5.3	1.764	1.680	0.155	0.161	4.83	4.90
180 kg N/ha	6.4	6.8	5.3	6.0	2.027	1.941	0.164	0.169	5.02	5.07
F test	**	**	**	**	*	*	*	*	*	*
LSD 5%	0.14	0.08	0.17	0.07	0.040	0.045	0.002	0.002	0.02	0.02
C- Bio-fertilization treatments										
Control	4.5	5.2	3.9	4.5	1.513	1.446	0.141	0.146	4.65	4.68
Cerialine	5.0	5.5	4.2	4.7	1.606	1.535	0.145	0.149	4.70	4.74
Rhizobacterin	5.1	5.7	4.4	5.0	1.679	1.624	0.149	0.153	4.79	4.82
F test	**	**	**	**	*	*	*	*	*	*
LSD 5%	0.05	0.09	0.05	0.04	0.027	0.029	0.001	0.001	0.01	0.01

Sugar beet plants growing without nitrogen fertilization (control treatment) were induced the lowest growth characters for the two samples in both seasons. Similar results were recorded by other workers including Sayed (1988), El-Shafei (1991), Sorour *et al.* (1992), Neamat-Alla (1997), Shareif *et al.* (1997), Seaada (1998) and Mahasen-Fahmi (1999).

3- Effect of bio-fertilization treatments:

The results presented in Tables (1, 2 and 3) show the effect of bio-fertilization treatments on growth characters indicate that treated sugar beet seeds with bio-fertilzation, i.e. Cerialine and Rhizobacterin caused a significant increase in all growth characters, i.e. root fresh and dry weights, LAI, CGR, RGR and NAR in both samples and both seasons. Also, results showed that the highest measurements were achieved from treating seeds with Rhizobacterin. Such superiority in growth characters by treating seeds by Rhizobacterin inoculation may be attributed to N_2-fixation which reduce the soil pH especially in the rhizosphere, thereby increase the availability of most essential macro- and micro-nutrients. The results of the present investigation are in harmony with those obtained by Sprenat (1990), Abdulla (1999), Abo El-Goud (2000) and El-Zeiny *et al.* (2001).

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تأثير مواعيد الزراعة ومستويات النيتروجين والتسميد الحيوي ١. صفات النمو في بنجر السكر

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الملخص :

أجريت هذه الدراسة خلال موسمي ٩٩/١٩٩٨ و ٢٠٠/١٩٩٩ بمنطقة السرو، محافظة دمياط وذلك بهدف دراسة تأثير مواعيد الزراعة ومستويات النيتروجين والتسميد الحيوي والتفاعل بينهم على صفات النمو في بنجر السكر (صنف Top) . وقد تم تنفيذ كل موعد زراعة كتجربة مستقلة صممت في قطع منشقة، حيث وزعت عشوائيا مستويات النيتروجين على القطع الرئيسية والتسميد الحيوي على القطع الشقية. وقد أجري التحليل التجميعي (Combined) لتحديد تأثيرات عوامل الدراسة، ويمكن تلخيص أهم نتائج الدراسة في الآتي:

١. أثرت مواعيد الزراعة معنويا على الوزن الرطب والجاف للجذر والعرش ودليل مساحة الأوراق (بعد ١٥٠ يوما من الزراعة)، معدل نمو المحصول ومعدل النمو النسبي ومعدل التمثيل الصافي خلال موسمي النمو. وقد أدت الزراعة في ١٥ أكتوبر إلى الحصول على أعلى المتوسطات للصفات سالفة الذكر .
٢. أدت زيادة مستويات النيتروجين من صفر إلى ٤٥، ٩٠، ١٣٥ و ١٨٠ كجم/هكتار إلى زيادة كل صفات النمو (الوزن الرطب والجاف للجذر والعرش ودليل مساحة الأوراق ومعدل نمو المحصول ومعدل النمو النسبي ومعدل التمثيل الصافي خلال موسمي الدراسة. وأن إضافة ١٨٠ كجم ن/هكتار قد سببت أعلى زيادة في متوسطات الصفات سالفة الذكر، على النقيض من هذا فإن عدم إضافة النيتروجين لنباتات نبجر السكر نتج عنها أقل المتوسطات خلال موسمي الدراسة.
٣. أثرت معاملات التسميد الحيوي معنويا على الوزن الرطب والجاف للجذر والعرش ودليل مساحة الأوراق، معدل نمو المحصول ومعدل النمو النسبي ومعدل التمثيل الصافي خلال موسمي الدراسة وأن أعلى قيم للصفات سالفة الذكر نتجت من معاملة البذور بلقاح الريزوباكترين.