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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 biofertilizatiopn treatments as well as their interaction on growth of sugar beet (*Beta vulgaris*, L.) variety Top. The main finding obtained from this investigation could be summarized as follows:

- Root fresh and dry weights, foliage fresh and dry weight and leaf area index (at 120 and 150 days from planting), crop growth rate, relative growth rate and net assimilation rate had significant effect 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 20, 40, 60 and 80 kg N/fad significantly improved all growth characters (root fresh and dry weight, foliage fresh and dry weight, LAI, CGR, RGR and NAR) at the two samples in both seasons. Increasing nitrogen fertilizer levels up to 80 kg N/fad resulted in the highest means of all growth measurement 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 obvious 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 biofertilization treatments and the results showed that the highest measurements were achieved from treating beet seeds with Rhizobacterin.
- The interaction between planting dates and nitrogen levels had significant on root fresh and dry weights, foliage fresh and dry weights and leaf area index. The interaction between planting dates and biofertilization treatments had significant effect on fresh and dry weights of foliage fresh and dry weight (at 120 and 150 days from planting) and leaf area index.

INTRODUCTION

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

Planting dates, nitrogen fertilization and biofertilization 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 of sugar beet plants. The suitable date for sugar beet planting mainly depends on many factors such as the previous crop, weathering conditions, contorting conditions with sugar factories and cultivated cultivar.

Lopez and Castillo (1982) in Spain reported that crop growth rate (CGR) and relative growth rate (RGR) did not show grate differences according to the date of sowing. Net assimilation rate (NAR) was higher in November and December sowing as compared with October sowing. While,

October sowing presented the highest accumulation of dry matter as as compared with November and December sowing. Eraky *et al.* (1983) reported that early planting had always the superior relative growth rate (RGR) and net assimilation rate (NAR) at the early growth, while the above mentioned traits were increased at the late sowing date during the late stage of growth. Badawi (1985) and Badawi *et al.* (1995) in Egypt, 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 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.

Fertilization is among the vital factors affecting growth, yield and quality of sugar beet especially nitrogen.

Due to the variation of soil fertility, the most difficult problem in sugar beet nutrition in deciding the amount of nitrogen application required. Sugar beet, like other plants, require a number of mineral nutrients for proper growth and development. 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) in Egypt, showed that increasing nitrogen application of sugar beet increased root and top dry weights, LAI, CGR, while NAR, RGR had no significant effect. Mahmoud *et al.* (1990) in Egypt, stated that increasing nitrogen fertilization rates up to 80 kg N/fad increased dry matter (DM) and leaf area index (LAI). On the other hand, relative growth rate (RGR) and net assimilation rate (NAR) were significantly decreased. El-Shafei (1991) reported that increasing nitrogen fertilizer level up to 75 kg N/fad led to significant and gradual increase in root and top fresh weights/plant root dry matter accumulation as compared with the control (plants unfertilized). Sorour *et al.* (1992) reported that increasing nitrogen rates from 60 to 120 kg N/fad increased dry weight/plant, crop growth rate (CGR), net assimilation rate (NAR) and leaf area index (LAI).

Neamat-Alla (1997) reported that increasing nitrogen fertilization rates from 60 to 105 kg N/fad significantly increased dry weight/plant and LAI. He also recorded that no significant difference between 90 and 105 kg N/fad in these characters. Moreover, crop growth rate (CGR) and net assimilation rate (NAR) were significantly increased by increasing nitrogen rates up to 105 kg N/fad. Meanwhile, root/top ratio, relative growth rate (RGR), total soluble solids (TSS) and juice purity percentages of sugar beet were significantly decreased by incrementing nitrogen rates from 60 to 105 kg N/fad. Sharief *et al.* (1997) reported that increasing nitrogen fertilizer rate up to 80 kg N/fad significantly increased leaf area index and fresh as well as dry weights of roots, foliage per plant compared with applying 40 kg N/fad. Seaada (1998) showed that raising nitrogen fertilizer levels from 0 to 20, 40 and 60 kg N/fad significantly improved all growth characters (root fresh and dry weights, foliage fresh and dry weights, LAI, SLA, CGR, RGR, NAR, HI) at all sampling dates in both seasons. Mahasen-Fahmi (1999) in Egypt, reported that nitrogen fertilizer levels exerted significant effects on all estimated characters.

Raising nitrogen levels from 50 to 70 and 90 kg N/fad enhanced vegetative growth characteristics.

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 reflect to increase yield. This increase might 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) in Egypt, found that applying the N-biofertilizer (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 weight as well as LAI of fodder beet significantly responded to 5% level of significant due to biofertilizer treatments. El-Zeiny *et al.* (2001) found that biofertilization improved plant growth characters expressed as number of leaves, leaf area and vegetative fresh and dry weights. They also revealed that biofetilizer 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 biofertilization 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 biofertilization 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. Each planting date was conducted in a separate experiment. The planting dates were the 15th of September, 1st of October, 15th of October and 1st of November in the first and second seasons, respectively.

A split-plot design with four replicates was used for each planting dates. The main plots were occupied by the five nitrogen levels:

N1- Zero kg N/fad (control) N2- 20 kg N/fad
N3- 40 kg N/fad N4- 60 kg N/fad
N5- 80 kg N/fad

Nitrogen fertilizer was added 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.

While, the sub-plots were devoted to the following three biofertilization treatments:

b1- Untreated seeds (control)
b2- Treated seeds with Cerialine (600 g/fad)
b3- Treated seed with Rhizobactrein (600 g/fad)

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 (1/400 fad). The preceding summer crop was rice in both seasons.

The experimental field well prepared through two ploughing and leveling. Calcium super phosphate (15.5 % P_2O_5) was applied during tillage operations at the rate of 100 kg/fad. Potassium sulfate (48 % K_2O) at a rate of 50 kg/fad was applied before the first and second watering.

Sugar beet cultivar (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 hill 20 cm apart at the rate of 3-5 seed balls per hill during the aforementioned dates in both seasons. Each planting date were irrigated immediately after sowing directly. Beet plants were thinned in two time, the last one was done 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 the following characters:

1. Root fresh weight (g/plant).
2. Root dry weight (g/plant).
3. Foliage fresh weight (g/plant).
4. 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.

Statistical analysis:

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 studied 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 October than all planting dates treatments. 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 day), crop growth rate, relative growth rate and net assimilation rate had significant effect by planting dates in both seasons. The superiority of 15th of October 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), Eraky *et al.* (1983), 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 biofertilization 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/fad	198.6	258.1	186.6	234.9	41.1	58.2	38.1	49.6
20 kg N/fad	306.7	385.5	266.9	363.9	64.5	88.7	53.3	73.9
40 kg N/fad	408.0	469.9	355.2	476.0	84.4	105.0	71.3	92.9
60 kg N/fad	487.9	619.0	482.1	605.5	101.8	140.5	96.1	114.1
80 kg N/fad	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- Biofertilization 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 as two samples after 120 and 150 day from planting in both seasons of this investigation. Raising nitrogen fertilizer levels from 0 to 20, 40, 60 and 80 kg N/fad significantly increased all growth characters (root fresh and dry weights and foliage fresh and dry weights, LIAA, CGR, RGR, and NAR) at the two samples in both seasons. Vice versa, sugar beet plants growing without nitrogen fertilization (control treatment) were induced the lowest ones for two samples in both seasons. Thus it can be stated that adding 80 kg N/fad was the recommended treatment for fertilizing sugar beet. Similar results were recorded by other workers including Sayed (1988), Mahmoud *et al.* (1990), El-Shafei (1991), Sorour *et al.* (1992) Neamat-Alla (1997), Shareif *et al.* (1997), Seaada (1998) and Mahasen-Fahmi (1999).

Table 2: Averages of foliage fresh weight (g /plant) and foliage dry weight (g /plant) as affected by planting dates, nitrogen levels and biofertilization 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/fad	185.3	240.3	150.3	211.4	29.9	38.7	22.3	32.7
20 kg N/fad	269.9	324.4	269.6	303.8	40.8	49.3	38.4	44.3
40 kg N/fad	364.9	427.8	385.4	421.4	52.4	61.7	51.1	56.9
60 kg N/fad	463.6	558.2	487.9	533.4	64.0	78.1	62.1	67.7
80 kg N/fad	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- Biofertilization 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

3- Effect of biofertilization treatments:

The results presented in Tables (1, 2 and 3) show the effect of biofertilization treatments on growth characters indicate that treated sugar beet seeds with biofertilzation i.e. Cerialine and Rhizobacterin caused

significant increase of 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), Sultan *et al.* (1999), Abo El-Goud (2000) and El-Zeiny *et al.* (2001).

Table 3: Averages of leaf area index, CGR, RGR and NAR as affected by planting dates, nitrogen levels and biofertilization 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/fad	3.3	4.2	2.4	3.3	1.191	1.147	0.121	0.126	4.39	4.39
20 kg N/fad	4.2	5.0	3.7	4.2	1.420	1.360	0.137	0.140	4.57	4.59
40 kg N/fad	4.8	5.3	4.5	4.9	1.594	1.546	0.147	0.150	4.73	4.77
60 kg N/fad	5.5	6.1	4.9	5.3	1.764	1.680	0.155	0.161	4.83	4.90
80 kg N/fad	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- Biofertilization 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

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