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EFFECT OF ORGANIC MANURE AND GA_3 ON FODDER BEET (*Beta vulgaris* L.) GROWN UNDER SALINE CONDITIONS.

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ABSTRACT

Two field experiments were carried out at Ras Sudr Research Station, DRC, during 1997/1998 and 1998/1999 growing seasons, to study the effect of organic manure rates and gibberellic acid (GA_3) application method on some growth parameters, growth analysis measurements and forage yield of fodder beet. The experiment was arranged in a split plot design with three replicates. Samples were taken after 100 and 212 day from sowing for determining the previous traits. The results can be summarized as follows:

1. Raising farmyard manure rates from zero up to 50 m^3/fed. led to gradual increment of most growth characters .Similar effect was achieved by applying GA_3 (100 ppm) as a foliar application.
2. Most of growth analysis as well as forage yield characters were responded positively by increasing organic manure levels and spraying the plants by GA_3 (100 ppm).
3. The interaction between the two main factors under study was significant only at the first season for some traits.

INTRODUCTION

Desert soil physical, chemical and biological properties can be improved by using the agricultural practices, which reflected positively on crop productivity under unfavorable conditions. This is usually attained through application of organic manures. Results associated with these practices were previously reported by Khalil et al. (1991); El-Sersawy and Khalil (1991), Abou-Deya (1991), Abou-Deya and Nassar (1994) and Ahmed (1997).

Wadi Sudr area suffered from poor structure, lack of adequate fertility, high mechanical surface strength, high salinity, high $CaCO_3$ content and unfavorable biological conditions, El- Sersawy and Khalil (1991).

Growth regulators had an important physiological role which altrate the plant growth, to adapt the unfavorable conditions. In this respect, El-Hendi et al. (1990) reported that soaking sugar beet seeds in 200 ppm GA_3 increased yield as compared with untreated control.

Fodder beet is one of the most promising winter forage crops for the new reclaimed soils in Egypt, which can tolerate saline conditions.

In this work improvement of soil physical properties or nutritional status and its effect on forage yield of fodder beet was carried out through application of organic manure and GA_3.

MATERIAL AND METHODS

The study was carried out at the Agricultural Research Station at Ras Sudr, South Sinai Governorate, Egypt during winter seasons of 1997/1998 and 1998/1999, using Beta Voroshenger cultivar of fodder beet (*Beta vulgaris* L.). The major aim is to study the effect of organic manure and GA_3 on fodder beet under saline irrigation water (3500 ppm). The soil of the experimental site having 52% $CaCO_3$ with EC of 8.3 mmhos/cm and pH 8.0. The experimental area was fertilized with 15 kg P_2O_5/fed. during tillage. Fodder beet seeds were sown on 30 October in the two growing seasons. Plot area was $6m^2$ with 50 cm between ridges and 20 cm within ridges. The experiment included twelve treatments which were arranged in a split plot design with three replicates. The main plots were devoted to four levels of organic manure (sheep dung) i.e. 0, 30, 40 and 50 m^3/fed and three application treatments of gibberellic acid (GA_3) i.e. 100 ppm was applied as seed soaking for 12 hr. prior to sowing, or as foliar application after 50 days from sowing in addition to the control (without GA3). Nitrogen fertilizer was added as an active dose at the rate of 50 kg N/fed. after thinning (after 45 days from sowing date to secure one plant per hill) in the form of ammonium sulfate (20.6% N).

The first sample (100 days from sowing) was taken to determine growth parameters throughout the two growing seasons as follows: root length (cm), root diameter (cm), top/root ratio, leaf area/ plant (dm^2), LAI, top fresh and dry weights of individual plant (gm) and root fresh and dry weights of individual plant (gm.).

The second sample (212 day from sowing) was taken to determine the above traits and yield parameters i.e. top fresh and dry forage yields (ton/fed.), root fresh and dry forage yields (ton/fed.) and total fresh and dry forage yields (ton/fed.). In addition, the following growth analysis measurements (100 - 212 day from sowing) were calculated,

1. Relative Growth Rate (RGR), gm/gm/week, according to the following equation:

$$RGR = \frac{Log_e W_2 - Log_e W_1}{t_2 - t_1}$$

Whereas :

W_1 = Plant weight at the beginning of the period.
W_2 = Plant weight at the end of the period.
t_1 = The beginning of the period.
t_2 = The end of the period.

2. Crop Growth Rate (CGR) gm/m^2/week, according to the following equation:
   CGR = Net Assimilation Rate (NAR) x Leaf Area Index (LAI).
3. Leaf Area Duration (LAD) "dm^2/week" according to the following equation.
   $LAD = (LA_2 + LA_1) (t_2 - t_1)$.
   LA_1 = Plant leaf area at the beginning of the period (t_1).

LA_2 = Plant leaf area at the end of the period (t_2)

The previous measurements (1, 2 and 3) were calculated according to the methods outlined by Radford (1967).

All obtained data were statistically analyzed according to Steel and Torrie (1984). LSD at 5% level of significance according to Waller and Duncan (1969) was used to compare means.

RESULTS AND DISCUSSION

I. Growth Measurements:

1. Effect of organic manure:

The effect of application organic manure on fodder beet growth measurements after 100 day from sowing (1st sample) as shown in Tables (1&2) evidently that increasing rate of organic manure from zero up to 50 m^3/fed, led to gradual increments of root length, root diameter, top/root ratio, root and top fresh weights/plant at the 1st and 2nd seasons,while leaf area/plant and top dry weight/plant were increased at the first and second seasons, respectively. The rate of 40 m^3/fed. organic manure gave the highest value of LAI at both seasons meanwhile, root dry weight/plant in the 2nd season was scored the heaviest weight. These increases could be explained on the fact that the presence of soil organic matter in high content improves physical, chemical and biological characteristics of soil, as well as being a source of nutritional elements. In this concern, Abd El-Kariem (1989), El-Sersawy and Khalil (1991) and Hussein and Abd El-Aziz (1992) reported that organic manuring increases root growth and penetration, which are reflected on having relatively health growth. These findings are in accordance with those obtained by Ahmed (1997) who recorded that fodder beet growth characters were superior at 60 m^3 organic manure/fed. under Ras Sudr conditions. Furthermore, data in Tables (1 & 2) indicated that raising organic manure levels up to 50 m^3/fed insignificantly increased root and top dry weights/plant and LA/plant at the first and second seasons, respectively.

All growth parameters were enhanced according to raising farmyard manure (FYM) rates at the second sample for both seasons. This enhancement was significant for root diameter, root fresh and dry weights at both seasons. Meanwhile, root length in the first season, top dry weight and LAI in the second one were significantly increased. These results are in harmony with those obtained by Abou-Deya and Nassar (1994) who found that supplying FYM increased fodder beet growth.

In general, it could be concluded that 50 m^3/fed organic manure was more favorable for obtaining the highest growth measurements.

2. Effect of gibberellic acid (GA_3)

Results in Tables (1 and 2) indicated that applying GA_3 as foliar application was superior for all growth parameters at the two samples of both seasons. Most of these characters were significantly affected by GA_3 treatments such as, root diameter, LA/plant, LAI and top fresh weight. This trend was fairly true at the first sample of both seasons.

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Whereas, in the second season top/root ratio and root fresh weight were significantly affected by GA_3 foliar application.

In the second sample, root length, root diameter, LA/plant, root dry weight were significantly affected by GA_3 application method at both seasons. In addition, root fresh weight exhibited a significant response according to foliar application method only at the first season nevertheless, LAI, top fresh weight/plant and top dry weight/plant were positively affected by the same treatment at the second one.

It could be concluded that adding GA_3 as a foliar application was the most favorable method which may be owe to the promotive effect of GA_3 on cell division and elongation which in turn had a stimulative effect on the absorption and development, (Bora and Selman 1969, Gaber 1979 and El-Hendi et al. 1990).

3. The interaction effect:

The interaction effect between organic manure and GA_3 treatments on growth characters had a significant effect only in 1997/1998 season (Table 3). It is noticeable that such interaction had significant effects on root diameter and root fresh & dry weights/plant. Such effect was true after 100 and 212 days from sowing. This significant response was also detected after 212 day for root length, top fresh weight/plant and LAI. It could be mentioned that the maximum values of the previous growth measurements were obtained by $50m^3$ organic manure/fed. with spraying fodder beet with 100 ppm GA_3 treatment.

II. Growth analysis:

1. Effect of organic manure:

The results indicated clearly that there was a progressive and consistent increase in RGR and CGR by increasing levels of organic manure from zero up to 50 m^3/fed. (Table 4). These results were true in the 1st season only. Such effect may be due to increasing photosynthetic area by increasing organic manure levels and thereafter increased photosynthates. On this concern, Hussein and Abd El-Aziz (1992) mentioned that organic materials are a valuable source for agricultural soil nutrients and contain both macro and micronutrients which are essential for plant growth and development its organs. On the contrary, the increases in prementioned growth analysis measurements did not reach to 0.05 level of significance at the 2nd season.

2. Effect of gibberellic acid (GA_3):

Results in Table (4) indicated that spraying GA_3 (100ppm) surpassed that of soaking (100 ppm) and control treatments. Spraying with 100 ppm GA_3 caused the highest values of both CGR at the 1st and the 2nd seasons, RGR at the 1st season and LAD at the 2nd season. On the contrary, the increases in LAD at the 1st season and RGR at the second one were insignificantly affected by GA_3 treatments.

These increases may be due to the fact that GA_3 increased the activity of a-amylase and proteolytic enzymes, which transfer starch, and proteins to soluble states (Bora and Selman, 1969).

III. Yield and its components:

1. Effect of organic manure:

It was also noticed from Table (4) that root fresh yield was significantly increased by manure application at both seasons. Also, root and top dry forage yields were significantly affected at the first and second seasons, respectively. Generally, increasing manure rate from zero up to 50 m^3/fed. caused an increase in total fresh forage yield by 71.71 and 72.24% in the first and the second seasons, consequently. Total dry forage yield had the same trend of total fresh forage yield but the differences were only significant at the first season. These results are in accordance with those achieved by Maidl and Fischbeck (1989) who declared that 60 m^3 FYM/ha increased sugar beet root yield by 9 and 14% when applied in autumn and spring, respectively. Also, Ahmed (1997) found that application organic manure up to 60 m^3/fed. increased total fresh and dry fodder yield under saline conditions. Similar conclusion was achieved by El-Sersawy(1996) on fodder beet under saline conditions.

2. Effect of gibberellic acid (GA_3):

Data in Table (4) show the effect of GA_3 treatments on fodder beet yield in 1997/98 and 1998/99 growing seasons. In general, results of spraying GA_3 (100 ppm) was superior that of soaking (100 ppm) and control treatments. It was observed that GA_3 spraying method had significant effects on root fresh forage yields at both seasons, root dry forage yield in the first season and top dry forage yield at the second one. Although, foliar application of GA3 had a significant increase on total fresh forage yield in the first and second seasons, which accounted 68.8 and 49% over the control, total dry forage yield was significantly increased only in the first season. It is worthy to mention that the other traits associated with fodder yield were increased in relation to foliar application of GA_3 but the differences were not great enough to reach the significance level. These findings are in agreement with those obtained by El-Hendi et al. (1990) who concluded that GA_3 significantly increased root and top yield of sugar beet.

3. The interaction effect:

Results indicated that the interaction between organic manure and GA_3 treatments was not significant in the 2nd season. Whereas, data presented in Table (5) revealed that, the significant effect was achieved at the first season only with root fresh and dry forage yields and top fresh forage yield. The heaviest yields were obtained with adding 50m^3/fed. organic manure and spraying fodder beet plants by GA_3 at the concentration of 100 ppm.

From the above mentioned results, it is worthy to conclude that, in general, growth measurements, growth analysis and forage yield of fodder

beet reached to its maximum values by adding organic manure (sheep dung) at the rate of 50m^3/fed and spraying the plants by GA_3 at the concentration of 100 ppm. These results clearly appeared that adding organic manure have a favorable effect on the availability of soil nutritional status and improves physical, chemical and biological soil properties which are reflected on growth and forage yield of fodder beet. Also GA_3 have a promotive effect on cell division and enlargement which in turn had a stimulative effect on plant growth and yield specially when added as foliar application under desert conditions of Wadi-Sudr.

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تأثير التسميد العضوى وحامض الجبريليك على نباتات بنجر العلف النامية تحت الظروف الملحية

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أقيمت تجربتان بمحطة بحوث رأس سدر التابعة لمركز بحوث الصحراء خلال موسمى ١٩٩٨/١٩٩٧ و ١٩٩٩/١٩٩٨، وذلك لدراسة أثر التسميد العضوى والمعاملة بحامض الجبريليك على بعض معايير النمو وقياسات تحليل النمو وكذلك المحصول العلفى لبنجر العلف ، وقد صممت التجربة فى تصميم قطع منشقة مرة واحدة فى ثلاثة مكررات ، وقد تم أخذ عينتين بعد ١٠٠ ، ٢١٢ يوم من الزراعة وذلك لتقدير القياسات المشار إليها سابقاً .

ويمكن تلخيص أهم النتائج المتحصل عليها كالآتى :

١- أدت زيادة التسميد العضوى من صفر إلى ٥٠ م٣/ فدان إلى زيادة تدريجية فى معظم صفات النمو المدروسة لنبات بنجر العلف ، كما كان لإضافة الجبريلين عن طريق الرش تأثيراً محسناً مشابهاً لتأثير التسميد العضوى .

٢ - تأثرت كل من قياسات تحليل النمو وكذلك صفات المحصول العلفى تأثراً إيجابياً بزيادة التسميد العضوى وبإضافة الجبريلين عن طريق الرش بمعدل ١٠٠ جزء فى المليون.

٣ - تلاحظ وجود تأثيراً معنوياً للتفاعل بين عاملى الدراسة على بعض الصفات المدروسة وذلك فى الموسم الأول فقط .

Table (1): Some growth parameters of fodder beet as affected by organic manure and GA_3 application method during 1997/1998 growing seasons.

Treatments	First sample (100 days)									Second sample (212 days)								
	R.L. (cm)	R.D. (cm)	Top/ Root Ratio	L.A. per Plant (dm^2)	L.A.I.	Fresh wt./plant (g)		Dry wt./plant (g)		R.L. (cm)	R.D. (cm)	Top/ Root Ratio	L.A. per Plant (dm^2)	L.A.I.	Fresh wt./plant (g)		Dry wt./plant (g)	
						Root	Top	Root	Top						Root	Top	Root	Top
Organic manure (m^3)																		
0	15.1	10.2	2.2	5.1	0.6	34.4	94.3	7.1	12.5	19.1	25.0	0.12	7.3	0.6	499.2	65.6	86.3	9.1
30	15.2	10.6	2.5	11.3	1.1	52.8	115.1	7.6	13.7	19.8	27.4	0.09	8.6	0.6	808.0	61.3	135.7	9.1
40	15.2	10.6	2.6	13.7	1.6	62.7	144.4	7.7	14.2	20.8	28.3	0.10	8.8	0.6	859.9	65.2	141.4	9.1
50	18.2	12.4	19.1	14.9	1.4	69.2	165.1	9.9	14.6	22.6	30.6	0.15	8.8	0.6	871.6	69.6	138.9	9.2
L.S.D	2.8	1.9	16.5	9.6	1.0	33.7	60.4	N.S	N.S	3.5	4.4	N.S	N.S	N.S	289.1	N.S.	41.3	N.S.
GA_3 application method																		
Soaking	16.2	10.0	2.9	9.4	1.0	57.7	118.4	7.5	13.8	21.0	28.8	0.10	9.6	0.7	821.4	66.4	140.4	9.8
Spraying	14.2	13.5	10.3	16.7	1.9	65.5	179.3	9.6	14.0	22.4	33.2	0.18	11.1	0.6	1104.7	72.8	165.4	10.4
Control	16.2	8.8	2.1	6.7	0.9	44.9	103.4	7.2	13.5	18.4	21.5	0.07	5.5	0.4	352.9	57.8	71.0	7.3
L.S.D.	N.S	4.6	N.S	9.9	0.9	N.S	72.5	N.S.	N.S.	2.4	4.8	N.S	5.7	N.S.	221.7	N.S.	13.5	N.S.

R.L. = Root length **L.A. = Leaf area** **R.D. = Root diameter** **L.A.I. = Leaf area index.**

Table (2): Some growth parameters of fodder beet as affected by organic manure and GA_3 application method during 1998/1999 growing seasons.

Treatments	First sample (100 days)									Second sample (212 days)								
	R.L. (cm)	R.D. (cm)	Top/ Root Ratio	L.A. per Plant (dm^2)	L.A.I.	Fresh wt./plant (g)		Dry wt./plant (g)		R.L. (cm)	R.D. (cm)	Top/ Root Ratio	L.A. per Plant (dm^2)	L.A.I.	Fresh wt./plant (g)		Dry wt./plant (g)	
						Root	Top	Root	Top						Root	Top	Root	Top
Organic manure (m^3)																		
0	11.7	3.0	1.7	7.84	0.7	3.2	23.8	0.6	1.5	28.2	30.4	0.024	6.06	0.6	730.0	28.9	129.1	3.3
30	14.3	7.5	1.7	13.80	1.4	17.6	96.1	2.2	4.5	27.6	33.6	0.034	6.22	0.6	1084.0	37.7	173.1	4.1
40	15.8	8.4	2.2	19.81	2.1	31.7	131.2	4.6	6.4	28.2	35.9	0.046	6.90	0.7	1100.8	37.8	205.9	4.4
50	17.4	10.4	2.6	18.31	1.9	47.5	192.5	4.4	7.1	28.6	38.6	0.135	11.34	1.1	1167.2	38.1	216.2	5.4
L.S.D	2.4	3.7	0.6	N.S.	1.2	19.0	70.4	3.5	4.7	N.S.	8.2	N.S.	N.S.	0.7	434.2	N.S.	81.7	1.6
GA_3 application method																		
Soaking	15.3	7.7	2.0	13.00	1.3	23.3	114.2	3.0	4.3	29.2	33.3	0.044	7.83	0.8	964.7	37.7	176.7	4.8
Spraying	15.1	8.2	2.5	20.05	2.0	35.5	140.5	3.5	6.2	29.9	37.9	0.112	10.95	1.1	1152.6	43.2	218.9	5.5
Control	13.9	6.1	2.0	11.77	1.2	16.2	77.9	2.4	4.2	25.2	32.3	0.024	4.10	0.4	959.8	28.1	157.7	3.4
L.S.D.	N.S.	1.8	0.5	7.37	0.7	17.2	51.6	N.S	N.S	4.7	5.5	N.S	6.14	0.6	N.S.	14.8	59.9	2.0

R.L. = Root length **L.A. = Leaf area** **R.D. = Root diameter** **L.A.I. = Leaf area index.**

Table (4): Forage yield and growth analysis of fodder beet as affected by organic manure and GA_3 application method during 1997/1998 and 1998/1999 growing seasons.

Treatments	1997/1998 1st season									1998/1999								
	Fresh forage Yield (Ton/fed.)		Dry forage yield (Ton/fed.)		Total forage Yield (Ton./fed.)		RGR g/g/ week	CGR g/m^2/ week	LAD dm^2/ week	Fresh forage yield (Ton/fed.)		Dry forage yield (Ton/fed.)		Total forage yield (Ton./fed.)		RGR g/g/ week	CGR g/m^2/ week	LAD dm^2/ week
	Root	Top	Root	Top	Fresh	Dry				Root	Top	Root	Top	Fresh	Dry			
Organic manure(m^3)																		
0	13.035	1.724	2.255	0.241	14.759	2.496	6.6	3.1	225.9	6.069	0.252	1.262	0.034	6.321	1.296	20.1	12.9	222.3
30	22.099	1.643	3.698	0.245	23.742	3.943	11.1	6.5	287.5	7.521	0.286	1.194	0.035	7.807	1.229	24.5	18.8	402.2
40	23.440	1.779	3.730	0.249	25.219	3.979	23.3	18.1	310.3	8.213	0.255	1.285	0.038	8.468	1.323	28.6	19.4	427.3
50	23.572	1.870	3.864	0.254	25.342	4.118	25.0	18.7	418.8	10.556	0.331	1.416	0.096	10.887	1.512	28.8	36.3	392.5
L.S.D	7.858	N.S.	1.131	N.S.	7.887	0.829	4.2	6.7	N.S.	4.413	N.S.	N.S	0.054	4.470	N.S.	N.S.	N.S.	N.S.
GA_3 application method																		
Soaking	21.937	1.740	3.737	0.257	23.677	3.994	16.8	10.3	283.3	7.504	0.276	1.382	0.033	7.780	1.415	24.7	20.4	383.3
Spraying	30.388	1.987	4.549	0.290	32.375	4.839	21.7	18.2	387.1	8.988	0.324	1.255	0.065	9.312	1.320	29.6	35.8	446.1
Control	9.286	1.535	1.875	0.194	10.821	2.069	11.0	6.3	261.5	6.028	0.243	1.231	0.020	6.271	1.251	22.2	9.4	253.9
L.S.D.	6.658	N.S.	0.489	N.S.	7.039	1.027	5.0	7.7	N.S.	2.813	N.S.	N.S.	0.041	2.892	N.S.	N.S.	24.7	149.9

RGR = Relative growth rate **CGR = Crop growth rate** **LAD = Leaf area duration.**

Table (3): Effect of interaction between organic manure and GA_3 application method on some growth parameters of fodder beet during 1997/1998 growing season.

After 100 days from sowing																		
Traits	**Root length (cm)**			**Root diameter (cm)**			**Fresh weight of root/Pl. (g)**			**Fresh weight of top/pl (g)**			**Dry weight of root/pl. (g)**			**LAI**		
Treatments	Soaking	Spraying	Control	Soaking	Spraying	Control	Soaking	Spraying	Control	Soaking	Spraying	Control	Soaking	Spraying	Control	Soaking	Spraying	Control
Organic manure (m^3)																		
0				10.1	8.3	8.4	55.4	89.3	24.9				8.3	11.7	3.0			
30				10.0	9.3	8.0	42.0	56.9	25.4				7.5	7.5	3.4			
40				9.9	12.3	11.9	38.3	36.1	58.7				7.4	6.0	8.0			
50				9.9	13.3	13.3	43.7	112.2	89.2				6.7	14.7	12.8			
L.S.D					1.5			27.7						3.5				
After 212 days from sowing																		
0	19.2	17.8	15.9	21.1	24.6	15.0	320.6	444.8	139.2	73.6	49.7	30.9	67.9	90.4	35.4	0.7	0.4	0.2
30	17.9	16.2	25.2	23.3	33.7	21.3	406.6	304.0	732.2	35.4	60.8	87.7	71.7	71.4	180.6	0.5	0.6	0.7
40	20.8	22.8	23.8	29.2	35.6	34.3	1259.8	1277.1	1163.3	73.6	81.6	83.1	100.7	219.0	169.9	0.3	0.8	0.7
50	20.7	27.1	19.9	26.4	37.5	31.6	545.0	1713.2	810.0	71.9	89.9	47.0	109.1	264.0	126.9	0.7	0.9	0.5
L.S.D.		2.9			3.6			238.4			21.7			34.0			0.2	

Table (5) : Effect of interaction between organic manure and GA_3 application method on some forage yield parameters of fodder beet during 1997/1998 growing seasons.

After 210 days from sowing.									
Traits	**Fresh yield of roots (ton/fed.)**			**Fresh yield of tops (ton/fed.)**			**Dry yield of roots (ton/fed.)**		
Treatments	**Soaking**	**Spraying**	**Control**	**Soaking**	**Spraying**	**Control**	**Soaking**	**Spraying**	**Control**
Organic manure (m^3)									
0	8.426	11.564	3.662	1.989	1.291	0.809	1.802	2.352	0.921
30	10.641	7.687	34.014	0.949	1.526	1.941	1.894	1.805	4.877
40	19.117	34.482	32.572	1.891	2.202	2.327	2.611	5.912	4.758
50	14.414	47.970	21.893	2.395	2.455	1.275	2.881	7.394	3.431
L.S.D		6.479			0.588			0.932	