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Fodder Beet Productivity under Fertilization Treatments and Water Augmentation

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Abstract: In order to asses the effect of water saving in addition to organic and biofertilization treatments, a field trial was conducted at Tamiya, El Fayoum Governorate, Egypt. In the period (2004 -2006) on fodder beet plant using three irrigation intervals 14, 21 and 28 days in addition to three fertilization treatments (60kg N /fed as control, 20kg N /fed+ biofertilizer application and 40kg N /fed + biofertilizer application). Results showed that extension of irrigation to 21 and 28 days reduced the foliage fresh weight / plant although foliage dry weight and root diameter were not significantly affected by irrigation augmentation, but the root length /plant (cm) was seriously affected and showed a clear reduction reaching 23.9(cm). Among different N fertilizer doses in addition to biofertilization. It was proved that the ideal effective dose was for application of 40kg N /fed + biofertilizer where it led to a significant increase in fodder beet root length, diameter, fresh and weight and foliage fresh and dry weight, root and foliage yields ton / fed under extension of irrigation interval to 28 days. Also, N, P and K percentages increased at 21days irrigation interval and the uptake at 14days their percentages increased in shoots and roots when applying 40kg N /fed + biofertilizer at 14 days of irrigation interval followed by 21 and 28 days.

Key words: Fodder beet, growth parameters, yield, irrigation intervals, biofertilization, nutrient percentage and uptake

INTRODUCTION

The increasing needs, for the growing population in Egypt, for live- stock as a source for animal proteins to cover the demands of consumption is handicapped through the shortage of the carbohydrate components in animal feeds. Also, the horizontal expansion of new reclaimed areas requires the cultivation of crops offering a source for satisfying income to the farmer in there areas. Fodder beet can easily fulfill both aims Its high content of carbohydrate, in the average 71.69% in dry matter and production in some new regions ranging between 25 -30 tons/ feddan which is meaning 2000 pounds, at least as income from fodder beet followed by short season crop such as maize adding a further cash article for the growing.

The biofertilizers could replace 50% of chemical fertilizers recommended to the plant growth promoting substance produced by biofertilizers in addition to the reasonable quality of atmospheric nitrogen fixed (Gomaa, 1999).

Soil, together with water provides the basis for our life on earth. Water problems are emerging as the most compelling sets of issues facing agricultural production in the 1990's. Egypt hide acute water shortages in localties , result from rapid population increase or natural scarcity (World Resource Institute 1988).

Thus, the aim of the present research work to study the effect of water regime in addition to chemical and biofertilization treatments on growth, yield, N, P and K content and uptake in fodder beet plant.

MATERIALS AND METHODS

Field experiment was conducted at Tamiya area, El Fayoum Governorate, Egypt during two successive seasons of (2004-2005 and 2005 - 2006).

Fodder beat cultivar (voeroeshenger) was provided from the Department of Fodder Crops , Agricultural Research Center, Ministry of Agriculture, Egypt.

The experimental setup included experimental plots of 10.5 m^3 which were separated by ditches 1 m wide. Fodder beet seeds were planted on November 15th during both seasons at the rate of 3 kg / fed. Three seeds were planted in each hole, with a distance of 25 cm between holes. Thinning took place after 45 days from planting.

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Basal doses of phosphorus and potassium were added as superphosphate (150 kg fed.$^{-1}$ P2O5) and potassium sulphate (100kg fed.$^{-1}$ K2O) in two equal rates.

Three irrigation intervals were applied after the first normal irrigation which was categorized to 14, 21, and 28 day. Also, three fertilization treatments were applied in addition to irrigation intervals

- Control (recommended doses 60 kg/ N fed.$^{-1)}$
- 20 kg/ N fed.$^{-1}$ + biofertilizer)
- 40 kg/ N fed.$^{-1}$ + biofertilizer)

Agrispone biofertilizer was added to the soil before planting. Seeds were sown in clay soil Table 1 Plant vegetative response was estimated through the record of Root length (cm), diameter of roots (cm), fresh weight of leaves gm/ plant, dry weight of leaves gm/ plant, fresh weight of roots gm/ plant, and dry weight of roots gm/ plant. The experiment design was complete randomized factorial design. The collected data was subjected to statistical analysis of variance according Snedecor and Cochran (1980) and the combined analyses of the two seasons were calculated according to the method of Steel and Torrie (1980). The chemical analysis was determined for nitrogen, phosphorus, and potassium according to the method described by Cottenie et *al* (1982) The physical and chemical properties of the soil were determined according to Chapman and Pratt (1961)

Table 1: Some soil physical and chemical properties

Sand (%)			Silt (%)				Clay (%)				Texture	
25.13			19.76				55.11				Clay	
Available (mg/100gm)			Soluble anions(meq/L)				Soluble cations (meq/L)				ECDsm^{-1}	pH 1-2.5
N	P	K	SO4	Cl	HCO3	CO3	K	Na	Mg	Ca		
33.8	15.6	59.10	5.45	14.66	3.95	-	4.2	.10.58	3.80	5.22	2.41	8.23

Available micronutrients (ppm.)				
O.M (%)	CaCO3	Cu	Zn	Mn	Fe
1.53	2.29	2.86	10.6	26.43	42.67

RESULTS AND DISCUSSIONS

Vegetative Growth:

Data recorded in Table 2 presented the effect of nitrogen and biofertilizer application on vegetative growth of fodder beet under different irrigation treatments. Recorded data was taken after 120 days from planting data; it was obvious that extension of irrigation to 21 and 28 days reduced fresh weight of foliage / plant (g) although the foliage dry weight and root, diameter didn't show a significant reduction with irrigation extension. Moreover addition of 40kg N /fed + biofertilization treatment improved fresh and dry weight of foliage and root diameter.

Table 2: Effect of nitrogen and biofertilizer on vegetative growth of fodder beet under different irrigation intervals after 120day from planting (average two seasons).

Characters	Fresh weight of foliage/plant (g)				Dry weight of foliage/plant (g)				Diameter of roots/plant cm			
	Irrigation Intervals days				Irrigation Intervals days				Irrigation Intervals days			
	14	21	28	Mean	14	21	28	Mean	14	21	28	Mean
Control(60kgN	309.9	208.4	187.5	235.27	33.4	30.7	33.7	32.6	4.7	4.3	4.1	4.37
20kgN + bio	277.8	193.7	180.3	217.25	29.3	30.0	33.1	30.8	3.8	3.5	3.6	3.63
40kgN + bio	366.7	298.9	197.0	287.53	36.7	41.5	36.5	38.2	5.3	5.7	4.4	5.13
Mean	318.1	233.7	188.27		33.1	34.0	34.4		4.6	4.5	3.03	
L.S.D.0.05												
A			30.14				N.S				N.S	
B			18.13				2.99				0.74	
A x B			31.51				5.18				1.28	

A: irrigation B: fertilizer Ax B : interaction

The fresh weight exceeded that of the control by 13.8, 43.4 and 5.3 % at irrigation intervals 14,21 and 28 days respectively. Although the dry weight of foliage increased by 8.9% at 14 days irrigation intervals 35.1 % at 21 days irrigation interval. Also, the diameter of root exceeded that of the control by 12.7, 32.5 and 7.3 at irrigation levels of 14, 21 and 28 respectively. All interactions were significant except for irrigation intervals 21and 28 days for dry weight of foliage and diameter of root / plant.

However data presented in Table 3, recorded the length of roots / plant (cm) which proved to be significant for irrigation fertilizer application and their interaction, on the contrary the dry weight of root / plant showed insignificant results for all treatments and their interactions, also the fresh weight of roots showed an insignificant result for the irrigation treatments

Water stress condition have been found to disrupt several physiological processes leading to reduction in growth Bloch and Hoffmann (2005), restrict growth and alter the chemical composition of beet. Under drought conditions, with holding irrigation reduced leaf and taproot growth. Parameters fodder beet in Table 4 were evaluated at harvest where it was found that the fresh and dry weights of foliage / plant and their diameter of roots decreased as irrigation intervals extended to 28 days and showed a significant increase over the control where using 40kg N /fed + biofertilizer treatment. All treatments showed significant results

Table 3: Effect of nitrogen and biofertilizer on root growth of fodder beet under different irrigation intervals after 120day from planting (average two seasons).

	Fresh weight of roots /plant (g)				Dry weight of roots /plant (g)				Length of roots/plant (cm)			
	Irrigation Intervals days				Irrigation Intervals days				Irrigation Intervals days			
characters	14	21	28	Mean	14	21	28	Mean	14	21	28	Mean
control	119.5	115.7	117.3	117.5	21.3	24.8	26.2	24.1	20.8	22.8	21.6	21.7
20kgN + bio	121.6	107.8	103.7	111.0	22.4	22.4	23.4	22.9	18.7	20.7	20.8	20.1
40kgN + bio	129.7	129.4	122.7	127.3	24.6	25.4	25.8	25.3	20.9	23.3	22.5	22.2
Mean	123.6	117.6	114.5			24.4	25.4		22.3	22.3	21.6	
L.S.D.0.05												
A			N.S				N.S				1.91	
B			11.09				N.S				1.95	
A x B			19.20				N.S				3.38	

A: irrigation B: fertilizer Ax B : interaction

Table 4: Effect of nitrogen and biofertilizers on vegetative growth of fodder beet under different irrigation intervals at harvesting (average of two seasons).

	Fresh weight of foliage/plant (g)				Dry weight of foliage/plant (g)				Diameter of roots/plant cm			
	Irrigation Intervals days				Irrigation Intervals days				Irrigation Intervals days			
Characters	14	21	28	Mean	14	21	28	Mean	14	21	28	Mean
Control	387.8	313.3	202.7	301.3	59.9	61.1	42.2	54.4	14.9	13.2	11.3	13.13
20kgN + bio	309.7	283.5	194.5	262.2	50.5	52.9	39.6	47.7	12.7	11.8	9.2	11.23
40kgN + bio	445.2	327.2	222.0	331.5	63.4	61.9	48.4	57.9	16.2	13.9	12.2	14.1
Mean	380.9	308.0	206.1		57.9	58.63	43.4		14.6	12.97	10.9	
L.S.D.0.05												
A			31.04				3.27				1.47	
B			30.13				7.23				1.43	
A x B			52.18				12.53				2.48	

A: irrigation B: fertilizer Ax B : interaction

Data recorded in Table 5 showed that increasing the length of irrigation interval to 28 days reduced the fresh and dry weights of root / plant (g) and also the length of\ root / plant were reduced to 23.9(cm). Application of 20kg/ N fed.$^{-1}$ in addition to biofertilizer treatment was not so effective in increasing root length fresh and dry weights of plants compared to that of the control under different irrigation intervals. Although increasing the dose of nitrogen fertilizer to 40kg N /fed under different irrigation intervals in addition to biofertilizer treatment increased root fresh and dry weight plants and its length compared to the control, reaching maximum at irrigation interval of 14 days. The interaction between irrigation intervals and fertilization treatment was significant for previously mentioned parameters, although fertilization treatment showed no significant result for root length / plant (cm). According to above mentioned results El– Monayeri *et al* (1983) Azzay (1998) and Mona et al (2000). Explained the vital roles of water supply at adequate amount for different physiological processes such as photosynthesis respiration, transpiration translocation, enzyme reaction and cells turgidity. Reduction of plant size and growth under water stress my be attributed to a decrease in the activity of meristemic tissues responsible for elongation. As well as the inhibition photosynthetic efficiency under insufficient water condition Siddique *et al* (1999).

Effect of nitrogen and biofertilization treatment on foliage and root yield ton / fed of fodder beet grown under different irrigation intervals at harvest was listed in Table 6 For the root highest yield ton / fed it was attained at irrigation interval of 14 days and 40 kg/ N fed in addition to biofertilizer treatment reaching 38.73 ton/ fed compared to the control. Extension of irrigation interval affected root yield leading to a marked

Table 5: Effect of nitrogen and biofertilizer on roots growth of fodder beet under different irrigation intervals at harvest (average of two seasons).

	Fresh weight of roots /plant (kg)				Dry weight of roots /plant (g)				Length of roots/plant (cm)			
	Irrigation Intervals days				Irrigation Intervals days				Irrigation Intervals days			
characters	14	21	28	Mean	14	21	28	Mean	14	21	28	Mean
Control	2.43	2.01	1.64	2.03	400.7	390.6	350.8	380.7	28.7	26.7	23.9	26.43
20kgN + bio	1.93	1.73	1.05	1.57	343.2	329.4	289.3	320.6	27.5	23.2	22.1	24.3
40kgN + bio	2.73	2.25	1.89	2.28	470.8	370.6	361.8	401.1	30.3	26.9	24.2	27.2
Mean	2.36	1.99	1.52		404.4	3693.6	333.9		28.8	25.6	23.4	
L.S.D.0.05												
A			0.54				38.70				1.86	
B			0.44				39.93				N.S	
A x B			0.77				69.16				5.97	

A: irrigation B: fertilizer Ax B : interaction

Table 6: Effect of nitrogen and biofertilizer on yield (Foliage and roots ton / fed) of fodder beet under different irrigation intervals at harvesting (average of two seasons).

	Root yield tons/ fed				Foliage yield tons/ fed			
	Irrigation Intervals days				Irrigation Intervals days			
character	14	21	28	Mean	14	21	28	Mean
Control	32.86	30.85	22.73	28.81	6.35	5.23	4.02	5.20
20kgN + bio	26.66	25.17	18.17	23.33	5.03	4.78	3.19	4.33
40kgN + bio	3873	31.97	22.98	31.23	7.04	5.56	4.13	5.58
Mean	32.75	29.33	21.29		6.14	5.19	3.78	
L.S.D.0.05								
A			4.15				0.67	
B			1.94				0.88	
A x B			3.35				1.53	

A: irrigation B: fertilizer Ax B : interaction

decrease at 28 days. Similar trend was observed for the foliage yield ton / fed where the maximum yield was attained at the 14 days irrigation interval and 40 kg/ N fed.$^{-1}$ + biofertilizer treatment reaching 7.04 ton / fed. The interaction between treatments were all significant for root and foliage yield ton / fed this result may be due to the reduction in metabolic products which can be explained on the assumption that the reduction in photosynthstic rate similar results was obtained by Ibrahim *et al* (2000)

Effect of Nitrogen and Biofertilizer on Chemical Composition of Fodder Beat:

It was evident from obtained data in Table 7 that the nitrogen percentage increased in shoot and root of fodder beat when irrigation interval was at 21 day following by 14 and 28 day. The decrease in nutrients in shoot and root at 28 day may be due to redacting the solubility of mineral in the soil the films are thin and path length of movement increase; hence movement of cations to root is reduced. High tension exerts a physiological effect on the root, elongation, turgidity and number of root hairs decrease with increasing tension, the decrease nutrients uptake by water stress also has been supported by Nelson 1982.

Table 7: Effect of nitrogen and biofertilizer on N content (%) and uptake (kg fed^{1})of fodder beet under different irrigation intervals at harvesting (average of two seasons).

	N content (%)								N uptake (kg fed^{1})							
	shoot				root				shoot				root			
	Irrigation Intervals days				Irrigation Intervals days				Irrigation Intervals days				Irrigation Intervals days			
character	14	21	28	Mean	14	21	28	Mean	14	21	28	Mean	14	21	28	Mean
Control	1.91	2.14	1.82	1.95	0.97	1.31	0.81	1.30	131.2	111.9	73.2	105.4	319.0	404.1	184.1	302.4
20kgN + bio	2.21	2.49	2.14	2.28	1.67	1.78	1.53	1.66	111.1	119.0	68.3	99.47	445.2	448.8	278.0	390.6
40kgN + bio	2.35	2.58	2.21	2.38	1.87	1.91	1.74	1.84	165.4	143.4	91.3	133.4	724.2	610.6	399.8	558.2
Mean	2.16	2.40	2.06	.	1.50	1.67	1.36		135.9	124.6	77.6		469.1	487.8	287.9	

On the other hand, the decrease in the nutrient content at irrigation interval 14 day my be attributed to the decrease in aeration caused by filling all pores with water which increased anaerobic respiration (conditions). N uptake in shoot and root increased at irrigation interval14 day as compared with 21 and 28 days these result my be due to the dry matter production.

With respect to the effect of irrigation intervals combined with fertilizer addition it was clear that N content and uptake in shoot and root increased with 40N/ kg fed + biofertilizers application as compared with 20 kg N/ kg fed + biofertilizers and control . The increases in N uptake were obtained with irrigation interval (14 days following 21 and 28 days). This might be attributed to the increase in the root surface per unit of soil volume and the rate of nutrients uptake or may be due to the high capacity of the plans supplied with N fertilizer in building metabolites, which might contribute much to the increase of the dry matter. (Kalane *et al* 1998)

Phosphorus content increased at irrigation interval 14 days as compared with and 28 days in shoot and root of fodder beat whereas P uptake increased at 21 day. It has been suggested that increasing soil moisture increase P uptake .Possibly the soluble nitrogen form is leached under the effect of sufficient water, particularly if CO2 from the root respiration is increased, this may be an agent for solubilization of P salts. furthermore ,the effect of reduced soil water level include an increase in the solution concentration of non absorbed nutrients and that of exchangeable cations which tend to reduce the concentration of absorbed anions like phosphate. Raddy and Shastry 1983 and Parihar and Tiwari (2003).

The interaction between applied N and bio fertilizer with irrigation intervals data in Table 8 shows that application 40kgN/ fed + bio gave increased P content and uptake in shoot and roots. It was noticed increased P percentage at 35% in shoot and 47% in root as compared with the control. Also, in P uptake was about 25% in shoot and 66% in roots.

It could be noticed that in Table 9. Potassium content increased at irrigation intervals of 21day as compared with 14 and 28 day in shoot and roots. On the other hand K uptake increased with irrigation interval 14 day in shoot and 21 day in roots. The interaction between fertilizer and irrigation data showed that application 40kgN/ fed + bio gave the highest values in K content and uptake in shoot and roots as compared with the other treatments.

Table 8: Effect of nitrogen and biofertilizer on P (%) and uptake (kg fed^{1}) of fodder beet under different irrigation intervals at harvesting (average two seasons).

	P (%)								P uptake (kg fed^{1})							
	shoot				root				shoot				root			
	Irrigation Intervals days				Irrigation Intervals days				Irrigation Intervals days				Irrigation Intervals days			
character	14	21	28	Mean	14	21	28	Mean	14	21	28	Mean	14	21	28	Mean
Control	0.60	0.59	0.51	0.56	0.47	0.45	0.40	0.44	31.4	37.5	20.5	29.8	144.9	147.9	90.9	127.9
20kgN + bio	0.68	0.65	0.59	0.64	0.53	0.49	0.46	0.49	32.5	32.7	18.8	28.0	133.4	130.6	83.6	115.8
40kgN + bio	0.77	0.63	0.65	0.68	0.57	0.53	0.50	0.53	42.8	44.4	26.8	38.0	182.2	205.2	114.9	166.4
Mean	0.68	0.62	0.57		0.52	0.49	0.45		35.6	38.2	22 .0		153.5	161.2	96.5	

Table 9: Effect of nitrogen and biofertilizers on K (%) and uptake (kg fed^{1}) of fodder beet under different irrigation intervals at harvesting (average two seasons).

	K (%)								K uptake (kg fed^{1})							
	shoot				root				shoot				root			
	Irrigation Intervals days				Irrigation Intervals days				Irrigation Intervals days				Irrigation Intervals days			
character	14	21	28	Mean	14	21	28	Mean	14	21	28	Mean	14	21	28	Mean
Control	4.88	5.31	4.50	4.89	3.77	4.8	3.51	4.02	309.8	277.7	180.9	256.1	1238.8	1480.8	797.8	1172.5
20kgN + bio	5.30	6.00	4.78	5.36	4.70	5.43	4.58	4.90	266.6	286.8	152.5	235.3	1253.0	1366.7	832.2	1150.6
40kgN + bio	5.44	6.31	5.00	5.58	4.91	5.79	4.70	5.13	382.9	350.8	206.5	313.4	1901.6	1851.1	1080.1	1610.9
Mean	5.20	5.87	4.76		4.46	5.34	4.26		319.8	305.1	179.9		1464.5	1566.2	903.4	

Effect of Nitrogen and Biofertilizer on Carbohydrate Percentage on Fodder Beet:

Data in Table 10 showed that increasing irrigation intervals to 28days increased total carbohydrate percentage (%) in shoot and roots as compared with 14 and 21 day. the increase was 18% in root and 57% in shoot at irrigation interval at 28 days as compared with the control . The interaction between fertilizer and irrigation intervals data show that application 40kgN/fed + biofertilizers increased total carbohydrate at 28 days following control and 20kgN/ fed + biofertilizers these result are in agreement with Abdel Gawad *et al* (1997) they found that increasing total carbohydrate with increasing fertilizer rate

Table 10: Effect of nitrogen and biofertilizer on total carbohydrate (%) of fodder beet under different irrigation intervals at harvesting (average of two seasons).

character	Root				Foliage			
	Irrigation Intervals days				Irrigation Intervals days			
	14	21	28	Mean	14	21	28	Mean
Control	40.44	45.93	50.33	45.56	13.22	18.11	20.88	17.40
20kgN + bio	43.11	40.77	49.44	44.44	11.33	12.33	21.66	15.10
40kgN + bio	44.33	42.55	51.77	46.21	14.77	16.66	19.44	16.95
Mean	42.62	43.08	50.51		13.10	15.70	20.66	

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