

RESPONSE OF SOME SWEET POTATO LINES TO BIOFERTILIZATION UNDER DRIP IRRIGATION IN NEWLY RECLIMED SOIL

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ABSTRACT

This work was carried out during the two summer seasons of 2004 and 2005 at Arab El-Awammer Research Station; Center (A.R.C.); Assiut Governorate, Egypt, to study the effect of using biofertilization to decreased the chemical fertilizer rates on sweet potato plants grown in newly reclaimed soil under drip irrigation. Four lines of sweet potato (Assiut 201,202,203 and 204) and five treatments of nitrogen zero, 25,50,75 and 100% from the recommended dose used with an equal amount of Biogen fertilizers (2Kg) in our study. The results indicated that the treatment of (100%N+2Kg Biogen) gave the best results in most studied characters and also lines Assiut 201 and 204 were the best lines under experiment condition for most studied characters. The 100% N level with Biogen fertilizer gave the best results in most characters. Also the interaction between (100%N +Biogen) and line Assiut 204 gave the highest plant height and highest number of branches while the interaction between 100%N+ Biogen and line Assiut 201 gave the best number of marketable storage root/plant, weight of marketable storage root/plant, root length and root diameter. While the high starch root percentage was obtained from interaction between 25 and 75%N+Biogen and line Assiut 201.

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is one of most popular vegetable crop in Egypt. It has been cultivated for both human food consumption and starch production, moreover the foliage are used for animal feed. For increasing its total productivity to meet the increment in the human population, that could be achieved through increasing cultivated area especially on sandy soil .The continuous increase in the costs of chemical fertilizers and environmental pollution problems restrict the application of sufficient amount. Thus, it has become essential to use untraditional fertilizers as substitutes or supplements for chemical fertilizers.

Previous workers had shown that nitrogen particularly in relatively high doses could enhance sweet potato tuber yield (Lee Hsinchen *et al.*,1996; Taufatofua *et al.*,1996; Hartemink *et al.*,2001; Marti and Mills, 2002; Arsenault *et al.*,2001 and Belanger *et al.*,2002), tuber size and weight (Arsenault *et al.*,2001 and Belanger *et al.*,2002).

Many investigators mentioned that using biofertilizers gave the best results in many vegetables. For instance, Pandey and Kumar (1989) found that biofertilizer application with and without application of NPK increased yield of several vegetables. Saber and Gomaa (1993) stated that application of 1/3 the recommended NPK rate and inoculation with a mixed biofertilizers increased plant dry weight in tomato plants. Sood *et al.* (1994) showed that

the tuber yield and dry matter increased significantly with application of FYM. Singh *et al.*, (1996) found that the application of 15 ton FAM+100Kg P₂ O₂ was more effective on tuber potato yield than using FAM alone. El-Gamal (1996) studied response of potato in the newly reclaimed areas to mineral nitrogen fertilizer levels and nitrogen fixing biofertilizer Halex2. He found that increasing N application rate or inoculation with Halex2 resulted in taller plants with higher leaf N contents. Dry matter, protein contents of tubers, exportable and total yield were generally increased with application of Halex2 or by increasing N application rate. Ashour and Sarhan (1998) reported that in potato plants application of organic with each other or with inorganic fertilizers increased yield, weight and number of potato tubers. Kamla (1999) studied the effect of bio-fertilizers on potato production. He found that tuber yield was highest with increasing biofertilizers. Abou El-Salehein *et al.*, (1999) found that in potato plants application of chicken manure significantly increased number of tuber/plant, average tuber weight, total yield and total carbohydrates and total sugars. El-Banna and Tolba (2000) found that using biofertilizers increased plant height, number and weight of tubers/plant, dry matter of tubers and total tuber yield as well as decreased the nitrate concentration in potato tubers. El-Banna and Abd El-Salam (2000) found that tuber potato weight increased with increasing farmyard manure. El-Banna *et al.*, (2001) studied the effect of bio-organic fertilization on potato plants. They found that application of organic fertilizer together led to significant increases in plant height, foliage fresh weight/plant, total tuber yield weight and number of tuber/plant. Awad *et al.*, (2002) studied the effect of used FYM in potato fertilizers. The results indicated that the application of FAM induced significant increases in vegetative growth parameters (plant height, foliage fresh weight/plant and foliage dry weight), total tuber yield, number of tubers/plant, tuber average weight, tuber dry matter and percentage of starch. El-Kader (2002) reported that plant height, foliage fresh and dry weight, number and weight of tubers/plant, dry weight and total tuber yield were increased due to FAM application. El-Seifi *et al.*, (2004) found that combination between N level 120kg and biofertilizer gave the best results in productivity and quality of Chinese garlic under sandy soil conditions.

The present work aimed mainly to study the effect of using biofertilization to decrease the chemical fertilizer rates on sweet potato plants grown in sandy soil under drip irrigation.

MATERIALS AND METHODS

Two field experiments were performed during the two successive seasons of 2004 and 2005 at Arab El-Awammer Research Station; Center (A.R.C.); Assiut Governorate, Egypt, to study the effect of Biogen as biofertilization on vegetative characters and yield and its components of 4 sweet potato lines i.e., Assiut 201, Assiut 202, Assiut 203 and Assiut 204 under drip irrigation system in newly reclaimed soil. The physical and chemical properties of experimental soil are presented in Table1. Moreover,

the characters of four sweet potato lines in this study are presented in Table 2.

The experiment system was split-plot in randomized complete blocks design with four replicates. The main plots were assigned for biofertilization treatment while sweet potato lines occupied the sub-plot. Each experimental plot was 10.5m². It contains three dipper irrigation lines with 6 m long and 70 cm wide. One-dripper line was used for measuring the vegetative growth characters, while the other two lines were used for measuring the yield and its components. The planting date was on 25 April in both summer seasons. All experimental units received equal recommended amounts of potassium sulphate (48% k₂O) and calcium superphosphate (15.5% P₂O₅) with dose 200Kg k₂O/feddan and 300Kg P₂O₅/feddan. Both third of K₂O and all amounts of P₂O₅ was added at soil preparation while the two thirds of K₂O were added eight portion weekly beginning 15 day after transplanting. The recommended dose of N was 300Kg/feddan (Ammonium sulphate 20.6%). This experiment included five treatments as follow:-

- (1) 2Kg Biogen fertilizer/fed + 0% from recommended dose of N
- (2) 2Kg Biogen fertilizer/fed + 25% from recommended dose of N
- (3) 2Kg Biogen fertilizer/fed + 50% from recommended dose of N
- (4) 2Kg Biogen fertilizer/fed + 75% from recommended dose of N
- (5) 2Kg Biogen fertilizer/fed + 100% from recommended dose of N

Table 1: Some physical and chemical properties of a representative soil sample used in the experimental site

Season	PH	EC	Caco ₃ %	Soluble cations meq/100g soil				Soluble anions meq/100g soil	
				Ca ⁺²	Mg ⁺²	Na ⁺¹	K ⁺¹	CO ₃ +HCO ₃	CL
2004	8.21	0.59	27.33	0.30	0.24	0.11	0.01	0.32	0.28
2005	8.43	0.77	32.15	0.33	0.28	0.03	0.03	0.38	0.22
Season	Available nutrients			Mechanical analysis %			Soil texture		
	N%	P PPM	K	Sand	Silt	Clay			
2004	0.06	5.14	0.14	85.4	8.7	5.9	Sandy		
2005	0.04	4.88	0.12	87.2	7.2	5.6			

Table 2: Characters of four sweet potato lines in this study

No.	Lines	Description of storage root- color	
		Outside	Flesh
1	Assiut 201	Red	White
2	Assiut 202	White	White
3	Assiut 203	Pole red	Whitish
4	Assiut 204	Red	Whitish

During the two experimental seasons the following data were recorded

1-**Vegetative characters** i.e., number of branches/plant, the main stem length(cm)and weight of vines/plant (kg).

2-**Yield and its components** i.e., number of marketable storage root/plant, weight of marketable storage root/plant (Kg), root length(cm) and root diameter(cm).

3-Chemical characters i.e., Dry matter percentage, root crude fibers content (g/100g) and starch root percentage.

Statistical analysis: all obtained data were subjected to statistical analysis of variances, and the least significant differences (L.S.D) at 5% level of probability were calculated as mentioned by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

I-Vegetative characters

1-Number of branches/plant

Data in Table 2 indicated that there are highly significant differences among the five levels of fertilizers in this character in both seasons. The treatment 5 gave the highest values in this trait. Line Assiut 204 was significant higher than other lines in this trait in both seasons. Also the interaction between fertilizer treatment 5 and line 204 was significantly higher than other interactions in this character.

2-The main stem length (cm)

Presented data in Table 2 indicate that there are significant differences among the five treatments of fertilizer in this trait. Also the high main stem length was obtained from treatment 5. There are significant differences between the four potato lines in this character and line Assiut 204 gave the highest values in the two seasons. The interaction between line Assiut 204 and treatment 5 fertilizer gave the highest values in both seasons in this character.

3- Weight of vines/plant (kg).

Results in table 2 illustrate that used the fertilizer of treatment 5 gave the highest values in this character and significantly higher than other fertilizers treatments. Line Assiut 202 was the best lines for weight of vines/plant. The interaction between treatment 5 and line 202 was highly significant higher than other interactions in this character.

Our results indicated that the high treatment of nitrogen with Biogen gave the best results in vegetative characters. These results are in accordance with those of (Lee Hsinchen *et al.*,1996; Taufatofua *et al.*,1996; Hartemink *et al.*,2001; Marti and Mills, 2002; Asrenault *et al.*,2001 and Belanger *et al.*,2002). Also, application the biofertilizer in sweet potato production gave the best results for vegetative characters and these results agree with those reported by Saber and Gomaa (1993), El-Banna and Tolba (2000), El-Banna *et al.*, (2001) and Awad *et al.*,(2002).

II-Yield and its components

1-Number of marketable storage root/plant

Results outlined in Table 3 declare that the highest value of this character was obtained from the fertilizer with treatment 5 in both seasons . Line Assiut 201 gave the highest values in this character. Also there were highly significant differences among the interactions between potato lines and the five treatments of fertilizers in this trait. The interaction between treatment 5 and line Assiut 201 gave the highest value for number of mar marketable storage root/plant.

2-Weight of marketable storage root/plant

Data in Table 3 elucidate that there are highly significant differences among the five treatments of fertilizer in this character and the highest value was obtained from treatment 5 in both seasons. There are high significant differences between the four potato lines in this trait and the line Assiut 201 gave the highest values in both seasons. Also there were highly significant differences among the interactions between potato lines and the five treatments of fertilizers in this trait. The interaction between treatment 5 and line Assiut 201 gave the best results in this character.

Table 3: Response of sweet potato lines to biofertilizer on vegetative characters during seasons 2004 and 2005.

Characters	Number of branches/plant		The main stem length(cm)		weight of vines/plant (kg).	
	2004	2005	2004	2005	2004	2005
N Levels						
(1) 0%N+2kg Biogen	5.250	4.563	162.9	167.4	2.756	2.756
(2) 25%N+2kg Biogen	6.938	6.813	161.3	161.9	3.813	3.881
(3) 50%N+ 2kg Biogen	7.063	7.313	164.2	165.2	3.921	3.909
(4) 75%N+2kg Biogen	6.750	7.563	165.7	166.4	4.095	4.089
(5) 100%N+2kg Biogen	8.313	8.250	175.8	176.0	5.712	5.756
L.S.D	0.774	0.745	1.586	5.400	0.070	0.062
Lines						
(L1) Assiut 201	7.200	7.300	124.5	127.5	3.277	3.268
(L2) Assiut 202	5.450	5.250	163.5	163.6	5.306	5.336
(L3) Assiut 203	6.300	6.550	184.3	186.0	4.262	4.319
(L4) Assiut 204	8.500	8.500	191.8	192.5	3.393	3.391
L.S.D	0.490	0.539	1.465	4.530	0.065	0.097
INTERACTIONS						
N1x L1	5.250	4.750	117.3	132.8	2.658	2.625
N1 x L2	4.000	3.500	167.4	167.3	3.838	3.825
N1x L3	4.750	4.250	176.4	180.1	2.565	2.625
N1x L4	7.000	5.750	187.5	189.6	1.963	1.950
N2x L1	7.000	7.500	123.1	122.1	2.963	2.958
N2x L2	6.000	5.750	158.6	159.0	4.915	5.048
N2x L3	6.000	6.000	177.0	178.6	4.190	4.355
N2xL4	8.750	8.000	186.6	187.9	3.183	3.165
N3x L1	7.500	7.250	126.1	125.8	3.258	3.250
N3x L2	5.250	5.500	158.4	160.4	5.113	5.125
N3xL3	7.000	7.500	182.1	184.1	4.013	4.038
N3xL4	8.500	9.000	190.3	190.5	3.273	3.225
N4xL1	7.500	8.500	123.1	123.6	3.300	3.255
N4xL2	5.750	5.750	162.1	160.9	5.563	5.533
N4xL3	6.250	7.500	185.5	188.9	4.218	4.253
N4xL4	7.500	8.500	192.1	192.4	3.300	3.318
N5xL1	8.750	8.500	133.0	133.3	4.178	4.250
N5xL2	6.250	5.750	170.8	170.3	7.100	7.150
N5xL3	7.500	7.500	197.4	198.1	6.323	6.325
N5xL4	10.750	11.250	202.3	202.3	5.248	5.298
L.S.D		1.206	3.275		0.146	0.217

3- Root length (cm) and Root diameter(cm).

Data in Table 3 demonstrate that there are significant differences among the five treatments of fertilizers in root length and the highest values were obtained from treatment 5 and there are no differences between this treatment and treatments 3 and 4. Line Assiut 201 gave higher value than the

other four potato lines in this trait. Also the differences due to the interaction between the fertilizer of treatment 5 and line Assiut 201 was significantly higher than other interactions in both seasons.

The results indicated that using biofertilizer in combination with of NPK increased yield characters in sweet potato production and these results agree with those reported by Pandey and Kumar (1989), Sood *et al.* (1994), Singh *et al.*, (1996), El-Gamal (1996), Ashour and Sarhan (1998), Kamla(1999) Abou El-Salehein *et al.*,(1999), El-Banna and Tolba (2000), El-Banna and Abd El-Salam(2000), El-Banna *et al.*, (2001), Arsenault *et al.*,2001 and Belanger *et al.*,2002.

III-Chemical characters

1- Dry matter percentage

Data in Table 4 indicated that there is no significant difference among the five treatment of fertilizer in this trait. Line Assiut 202 gave the highest values of dry matter percentage and was highly significant differences among other lines in this trait. The results of the interaction between the potato lines and five treatment of fertilizer indicated that the highest values were obtained from the interaction between line Assiut 201 and treatment 2 in both seasons.

2- Root crude fibers content (g/100g)

Data in Table 4 elucidate that there are highly significant differences among the five treatments of fertilizer in this character and the highest value was obtained from treatment 1 in both seasons. There are high significant differences between the four potato lines in this trait and the line Assiut 202 gave the highest values in both seasons. Also there were highly significant differences among the interactions between potato lines and the five treatments of fertilizers in this trait. The interaction between treatment 2 and line Assiut 202 gave the best results in this character.

3- Starch root percentage.

Presented data in Table 4 indicate that there are significant among the five treatments of fertilizer in this trait. Also the high value of starch root percentage was obtained from treatment 1. There are significant between the four potato lines in this character and line Assiut 201 gave the highest values in the two seasons. The interactions between line Assiut 204 and treatment 1 and Assiut 201 and treatment 4 fertilizer gave the highest values in both seasons in this character.

Our results are in harmony with those by Sood *et al.* (1994), El-Gamal (1996), Abou El-Salehein *et al.*,(1999) El-Banna and Tolba (2000), El-Kader (2002), El-Seifi *et al.*,(2004).

Table 4: Response of sweet potato lines to biofertilizer on yield and its components characters during seasons 2004 and 2005.

Characters	Number of storage root/plant		Weight of storage root/plant		Root length		Root diameter	
	2004	2005	2004	2005	2004	2005	2004	2005
N Levels								
(1) 0%N+2kg Biogen	1.688	1.813	0.294	0.326	11.16	11.18	3.363	3.331
(2)25%N+2kg Biogen	3.428	3.813	0.809	0.805	14.54	14.44	3.831	3.838
(3)50%N+ 2kg Biogen	4.875	4.813	1.073	1.116	15.16	15.20	4.013	4.050
(4) 75%N+2kg Biogen	5.500	5.313	2.238	2.288	15.33	15.48	4.006	4.006
(5)100%N+2kg Biogen	5.813	5.625	2.509	2.524	15.74	15.71	4.144	4.194
L.S.D	0.474	0.360	0.050	0.029	0.163	0.112	0.075	0.079
Lines								
(L1) Assiut 201	5.250	5.200	1.988	2.023	15.17	15.19	5.860	5.850
(L2) Assiut 202	3.650	3.850	0.769	0.802	12.77	12.85	2.370	2.355
(L3) Assiut 203	4.700	4.850	1.636	1.667	14.74	14.74	4.275	4.310
(L4) Assiut 204	3.450	3.200	1.146	1.156	14.88	14.85	2.980	3.020
L.S.D	0.396	0.408	0.035	0.030	0.098	0.115	0.056	0.061
INTERACTIONS								
N1x L1	2.250	2.500	0.575	0.725	11.03	11.15	5.050	5.000
N1 x L2	1.500	2.250	0.175	0.175	9.10	9.08	2.075	2.050
N1x L3	1.500	1.250	0.215	0.223	12.08	12.10	3.575	3.575
N1x L4	1.500	1.250	0.210	0.180	12.43	12.40	2.750	2.700
N2x L1	3.750	4.000	1.100	1.050	16.10	16.08	5.600	5.650
N2x L2	3.500	3.750	0.650	0.625	13.40	13.50	2.450	2.470
N2x L3	4.000	5.250	0.750	0.825	15.30	15.13	4.325	4.300
N2xL4	2.500	2.250	0.738	0.720	13.38	13.08	2.950	2.925
N3x L1	5.500	5.250	1.100	1.153	16.00	16.05	6.000	6.000
N3x L2	4.500	4.250	0.650	0.700	13.45	13.45	2.500	2.450
N3xL3	5.500	5.500	1.788	1.860	15.13	15.15	4.475	4.625
N3xL4	4.000	4.250	0.753	0.753	16.08	16.16	3.075	3.125
N4xL1	7.000	6.750	3.550	3.563	16.18	16.18	6.150	6.125
N4xL2	4.500	4.500	1.050	1.175	13.83	14.18	2.300	2.300
N4xL3	6.000	6.000	2.325	2.363	15.18	15.33	4.500	4.500
N4xL4	4.500	4.000	2.025	2.050	16.13	16.25	3.075	3.100
N5xL1	7.750	7.500	3.613	3.625	16.53	16.48	6.500	6.475
N5xL2	4.250	4.500	1.320	1.335	14.08	14.03	2.525	2.500
N5xL3	6.500	6.250	3.100	3.063	16.00	16.00	4.500	4.550
N5xL4	4.750	4.250	2.003	2.075	16.38	16.35	3.050	3.250
L.S.D	0.886	0.915	0.078	0.067	0.219	0.256	0.125	0.134

Table 5: Response of sweet potato lines to biofertilizer on chemical characters during seasons 2004 and 2005.

Characters	Dry matter content		root crude fibers content (g/100g)		starch root percentage	
	2004	2005	2004	2005	2004	2005
N Levels						
(1) 0%N+2kg Biogen	28.80	28.81	1.641	1.641	10.99	10.99
(2) 25%N+2kg Biogen	28.59	28.58	1.631	1.635	10.96	10.96
(3)50%N+ 2kg Biogen	28.35	28.44	1.632	1.630	10.96	10.96
(4) 75%N+2kg Biogen	28.36	28.38	1.623	1.625	10.94	9.69
(5)100%N+2kg Biogen	27.94	27.91	1.609	1.613	10.92	9.74
L.S.D	0.010	0.056	0.006	0.006	0.007	
Lines						
(L1) Assiut 201	29.25	29.30	1.356	1.358	12.23	11.74
(L2) Assiut 202	29.37	29.37	1.877	1.874	9.23	8.78
(L3) Assiut 203	26.35	26.36	1.473	1.476	10.58	10.09
(L4) Assiut 204	28.67	28.67	1.804	1.810	11.76	11.26
L.S.D	0.05	0.066	0.004	0.006	0.005	1.137
INTERACTIONS						
N1x L1	29.25	29.23	1.363	1.368	12.31	12.34
N1 x L2	29.53	29.50	1.888	1.880	9.23	9.22
N1x L3	27.18	27.23	1.498	1.503	10.61	10.61
N1x L4	29.25	29.30	1.818	1.823	11.80	11.80
N2x L1	29.45	29.43	1.355	1.363	12.22	12.23
N2x L2	29.58	29.60	1.890	1.890	9.25	9.25
N2x L3	26.43	26.43	1.483	1.484	10.59	10.59
N2xL4	28.93	28.88	1.798	1.808	11.76	11.77
N3x L1	29.08	29.28	1.363	1.360	12.22	12.21
N3x L2	29.40	29.45	1.893	1.890	9.25	9.25
N3xL3	26.23	26.35	1.473	1.473	10.59	10.59
N3xL4	28.70	28.68	1.800	1.798	11.76	11.77
N4xL1	29.35	29.40	1.355	1.353	12.22	12.22
N4xL2	29.43	29.40	1.865	1.868	9.23	9.23
N4xL3	26.10	26.10	1.465	1.468	10.57	8.08
N4xL4	28.55	28.60	1.805	1.813	11.75	9.25
N5xL1	29.13	29.18	1.343	1.345	12.20	9.70
N5xL2	28.93	28.88	1.848	1.845	9.21	6.96
N5xL3	25.80	25.68	1.448	1.453	10.56	10.56
N5xL4	27.93	27.90	1.798	1.808	11.73	11.72
L.S.D	0.120	0.148	0.009	0.013	0.012	

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استجابة بعض سلالات البطاطا للتسميد الحيوى تحت ظروف الري بالتنقيط فى الأراضي المستصلحة الحديثة

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**** كلية الزراعة بسوهاج-قسم البساتين**

اجرى هذا البحث خلال المواسم ٢٠٠٤ و ٢٠٠٥ وذلك بمزرعة عرب العوامر-مركز البحوث الزراعية-محافظة أسيوط وذلك لدراسة تأثير استخدام التسميد الحيوى على سلالات من البطاطا بعرض تقليل استخدام الأسمدة المعدنية وذلك فى الأراضي المستصلحة الحديثة مع الري بالتنقيط. واستخدم فى البحث أربعة سلالات من البطاطا هى أسيوط ٢٠١، ٢٠٢، ٢٠٣، و ٢٠٤ مع خمسة مستويات من التسميد النتروجينى وهى صفر، ٢٥%، ٥٠%، ٧٥%، و ١٠٠% من الموصى به مع إضافة التسميد الحيوى البيوجين بتركيز ٢كجم. أظهرت النتائج أن المستوى (١٠٠نتروجين+بيوجين) كان افضل المستويات المستخدمة فى معظم الصفات المدروسة وكانت السلالة أسيوط ٢٠١ و ٢٠٤ كانت افضل السلالات فى معظم الصفات المدروسة تحت ظروف التجربة. كما أظهرت النتائج ايضا أن التفاعل بين المستوى (١٠٠نتروجين+بيوجين) مع السلالة أسيوط ٢٠٤ أعطت افضل النتائج بالنسبة إلى طول النبات وعدد الأفرع بينما التفاعل بين المستوى (١٠٠نتروجين+بيوجين) مع السلالة أسيوط ٢٠١ أعطت افضل النتائج بالنسبة إلى الصفات المحصولية. أما ارتفاع نسبة النشا فى جذور البطاطا فقد ظهرت من خلال التفاعل بين كلا من المستويان (٢٥،٧٥%نتروجين+بيوجين) مع السلالة أسيوط ٢٠١.

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