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COMPARATIVE STUDY OF THREE DIFFERENT FERTILIZERS TYPES ON YIELD AND TUBERS QUALITY OF POTATO GROWN IN LOAMY SAND SOIL

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ABSTRACT

The present study was carried out at the Experimental Farm of Fac. Agric., South Valley University, Qena Governorate, Egypt during the two successive seasons of 2004/2005 and 2005/2006. In loamy sand soil, Potato cv. "Diamant" was cultivated to study the effect of nitrogen fertilizer (37.5, 75, 112.5 kg N/fed.), biofertilizers (*Azotobacter* sp., *Azospirillum* sp. and mixture of both inoculants) and organic fertilizer at the rates of 10, 15 or 20 tons of compost/fed. on yield and quality of potato. The obtained results indicated that applying three fourth of the recommended dose of N+ *Azotobacter* sp. + 15 tons compost/fed. increased potato vegetative growth expressed as plant height, number of aerial stems/plant and dry weight of aerial stems/plant. Tubers dry matter percentage was increased with the combined application of one fourth of the recommended dose of N/fed. + mixture of dual inoculants and 10 tons compost/ feddan. However, there were no significant differences on specific gravity trait. The results of this study indicated also that N and K percentage were increased with half of the recommended N dose + mixture of *Azotobacter sp* plus *Azospirillum* sp. and 20 ton/fed + 15 tons/fed compost, respectively. However, there was no significant effect on P percentage. NO_3 concentration was decreased by applying one fourth of the recommended N dose + *Azotobacter* sp. + 15 tons/fed., compost. When applying one fourth of the recommended dose of N, *Azospirillum sp* + 10 tons/fed compost, led to decrease NO_2 concentration in tuber. Moreover, the most favourable treatment was applying half of the recommended N dose + *Azotobacter* + 10 tons/fed compost which achieved significant increments in total tuber yield (tons/fed.) and weight of tubers/plant (g) and recorded low values of NO_3 and NO_2 in tuber tissues in both seasons.

Keywords: Fertilizers, potato, loamy sand soil, yield, tubers quality, vegetative growth.

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INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important food crops in thc world including Egypt. Potato tubers are important source of carbohydrates, dietary fiber, vitamin C and some necessary minerals. Nitrogenous chemical fertilizers are commonly added to soil to produce high yield of potato especially in sandy soil. With the application of such fertilizers, some problems could be arise; e.g., some nitrogen is expected to be lost via nitrate reduction, denitrification and/or ammonia volatilization. In addition, some N-fertilizers can be leached to the sub-surface soil and under ground water causing environmental pollution (Attia, 1990 and Khaled, 2002).Nitrite ion is a well-known environmental pollutant because of its potential role as an infant's methmoglobinemia associated with the consumption of some vegetables (Alexander, 1977). In addition, nitrate can be reduced to nitrite in the gastrointestinal tract of the human infants and by micro flora of the human mouth. The formed nitrite presents a toxic hazard both because of the direct toxicity of nitrite and by the formation of carcinogenic N-nitrose compound by the reaction with amino compounds (Swann, 1975). Therefore, it becomes essential to use the untraditional fertilizers (organic and biofertilizers) as a substitute or supplement for chemical fertilizers. Nitrogenous chemical fertilizers markedly affected potato growth and yield (Belanger *et al.*, 2000; El-Banna *et al.*, 2000; Patel *et al.*, 2000; El-Banna *et al.*, 2001;Shingrup *et al.*, 2001; Malik *et al.*, 2002; Shahi *et al.*, 2003; Sparrow and Chapman 2003; Sarhan *et al.*, 2004 and Singh *et al.* 2004. Bio-fertilization is generally based on altering the rhizosphere flora by seed or soil inoculation with certain organisms, which are capable of inducing beneficial effects on a compatible host (El-Haddad *et al.*, 1993). In such sandy soil, applying bio-fertilizer increased microorganisms in the soil, which convert the ability of mobilizing the unavailable forms of nutrients elements to available forms (Ishac, 1989). Many investigators reported the importance of biofertilizers in potato yield and quality such as Abdel-Ati *et al.* (1996); Sidorenko *et al.* (1996); Hammad and Abdel-Ati (1998); Ghosh *et al.* (2000); Kamla-Singh (2000) and Kawthar *et al.* (2002). Compost is a key element in the transition from conventional to biological agriculture. Organic fertilizers such as compost reduced plant and soil contamination with different elements as well as reduced mineral fertilizers, is considered a well-known tool recently .Moreover, compost had an important role in potato production specially under sandy soil condition. Organic fertilizers improve soil structure, which encourage the plant to produce good roots and improve aeration in sandy soil (Abou-Hussein *et al.*, 2002a). The necessity of organic fertilizers were assured by several researchers such as Romero *et al.* (2000); Baziramakenga and Simard (2001); Abou-Hussein *et al.* (2002a); Kleinhenz and Cardina (2003) and Abou-Hussein (2005). The interactions among various studied factors were studied by many authors such as Acharya and Kapur (2001); Abou-Hussein *et al.* (2002b); Kushwash and Banafar (2003) and Abou-Hussein (2005).

The present investigation was designed as an attempt to replace or reduce of mineral nitrogen fertilizer through using bio and organic fertilizers for potato in loamy sand soil under south valley conditions in order to obtain best tuber quality, in order to reduce nitrate and nitrite content, reduce environment pollution and reduce potato production costs.

MATERIALS AND METHODS

Two field experiments were conducted at the Experimental Farm of Fac. Agric., South Valley University, Qena Governorate, Egypt. The experiments were carried out during the two successive autumn seasons of 2004/2005 and 2005/2006. The whole tuber seed of Cv. "Diamant" were planted, on the 9th and 11th of October, respectively. The isolates of *Azotobacter* and *Azospirillum* bacteria were obtained from the Department of Microbiology, Faculty of Agriculture, Minia University.

The physical and chemical properties of the experimental site are presented in Table 1. The analysis of used compost are shown in Table 2. while, the analysis of used water in irrigation are shown in Table 3.

The treatments were arranged in a split split plot design in complete randomized blocks with three replicates. Nitrogen fertilizer treatments (A) were distributed at random in the main plots. Bio-fertilizers (B) and compost levels, (C) were randomly assigned in the sub and sub- sub plots, respectively.

Table 1. Chemical and physical properties of the experimental site

Soil Texture				pH	EC m.mohs	$CaCo_3$ %	Cations			Anions		
Sand %	Silt %	Clay %	Texture grade				N %	P %	K %	HCo_3	Cl	SO_4
77.2	18.8	4.00	Loamy sand	8.07	6.28	7.74	0.19	2.70	0.74	0.24	0.15	1.12

Table 2. Analysis of compost components

Organic fertilizer	C %	O.M %	C/N Ratio	Macro elements					Micro elements	
				N %	P %	K %	Ca %	Mg %	Fe ppm	Mn ppm
Compost	30	35.03	10.66	1.91	0.54	1.40	0.20	0.18	2456	2356

Table 3. Analysis of irrigation water

	pH	EC	RSC*	SAR**	Ca	Mg	Na	K	Cl	HCO_3	SO_4	NO_3
					Meq/l							ppm
Water sample	7.94	5.53	0	14.48	10.7	10.5	47.15	0.9	31	3.2	15.5	57.4

RSC* = Residual Sodium Carbonate.
SAR** = Sodium Adsorption Ratio

The experimental treatments included different levels of nitrogen, bio-fertilizers and compost are shown in schedule 1

Schedule 1. Different used levels of nitrogen, biofertilizers and compost

N fertilizer (A)	Biofertilizer (B)	Organic fertilizer (C)
37.5Kg/fed.	*Azotobacter spp*	Compost at the rate of 10 ton/fed.
75 kg/fed.	*Azospirillum spp*	Compost at the rate of 15 ton/fed.
112.5 Kg/fed.	Mixture of *Azotobacter* plus *Azospirillum*	Compost at the rate of 20 ton/fed.

The experimental units were prepared and shaped to ridges. Each experimental plot was 3 × 3.5 m (1/400 fed.) contained five ridges 70 cm wide and 3.5 m long. The tubers seed of potato cultivar "Diamant" were planted on the middle of the ridges in hills at 25 cm. apart. Biofertilizers; i.e., (*Azotobacter* sp., *Azospirillum* sp.and mixture of *Azotobacter* + *Azospirillum*) used in this experiment as a suspension were added directly to the soil during planting, at a rate of 200 ml/ridge. Nitrogen fertilizer used in the form of ammonium nitrate (33.5% N) was added in four equal doses, the first at full germination and the others at 10 days intervals up to 70 days age, compost was applied at 21 days just before planting. Each plot received equivalent amount of phosphorus at a rate of 60 kg P_2O_5/fed in the form of calcium superphosphate (15.5 P_2O_5) during soil preparation, potassium sulphate (48% K_2O) was applied to the soil at the rate of 100 kg K_2O/fed at two batches; one during the soil preparation and the other after eight weeks from planting. The normal culture procedures known for commercial potato production other than the applied treatments were conducted. Ten plants were randomly taken at ten days before harvesting from each experimental unit to determine plant height (cm) and number of aerial stems per plant. Each experimental plot was harvested individually after 120 days and the following data were recorded:

1. Dry weight of aerial stems/plant (g).
2. Dry weight of whole plant (g).
3. Specific gravity (g/cm3): tuber specific gravity was calculated from samples weights measured in air and water.
4. Tubers dry matter (%), dry matter percentage was determined after drying potato tuber samples at 65° C for 72 hr using the standard methods as illustrated by A.O.A.C (1990).
5. Average tubers weight/plant (g).
6. Average tuber weight (g).
7. Total yield (tons/fed).
8. The nitrate NO_3 content and nitrite NO_2 in tubers (mg/kg) were determined as illustrated by Pearson (1973).

Each sample of plant dry weight was grinded and taken to determine N, P and K percentages as follow:

1. Nitrogen percentage was determined according to the A.O.A.C (1965).
2. Phosphorus percentage was determined colorimetrically according to Jackson (1958).

3. Potassium percentage was determined by flame photometer system as described by Jackson (1967).

The obtained data were subjected to analysis of variance procedures and means were compared using the L.S.D methods described by Gomez and Gomez (1984).

RESULTS

Plant Height (cm), Number of Aerial Stems per Plant and Dry Weight of Aerial Stems/Plant (g)

Data in Table 4 indicate that application of three/fourth of the recommended dose of N/fed. *Azotobacter* and 15 tons/fed compost gave the highest values of plant height (36.8 and 37.0 cm); number of aerial stems per plant (5.4 and 5.6) and Dry weight of aerial stems/plant (178.5 and 180.7 g) in the first and second seasons, respectively.

Specific Gravity (g/cm^3)

Data in Table 5 show that N rates, biofertilizer and compost rates slightly influenced specific gravity in both seasons. Nevertheless, the difference failed to be significant from the statistical point of view.

Tubers Dry Matter (%)

Data in Table 5 show that when applying one/fourth of the recommended dose of N/fed. and mixture of *Azotobacter* plus *Azospirillum* and 10 tons/fed. compost gave the highest value (29.0 and 25.5%) of potato tubers in the first and second seasons, respectively.

Average Tubers Weight per Plant (g)

Results in Table 6 indicate that the highest value (707.2 and 661.0 g/plant) were obtained when applying the combined treatments of half of the recommended dose of N/fed, *Azotobacter* sp. and 10 tons/fed. compost in the first and second seasons, respectively.

Average Tuber Weight (g)

Results in Table 6 indicate that the highest values (87.5 and 71.6) were obtained when potato plants were fertilized with 1/2 RD of N/feddan + Azotobacter + 15 tons/fed. compost in the first and second seasons, respectively.

Total Yield (ton/fed)

Data in Table 6 indicate that the highest values (12.9 and 11.5 tons/fed) in the first and second seasons, respectively.

Table 4. Effect of interaction among mineral nitrogen, biofertilizers and compost rates on vegetative growth parameters of potato in 2004/2005 and 2005/2006 seasons

Seasons	2004/2005			2005/2006		
Characters / Treatments RD* x Bio** x Compost***	Plant height (cm)	No. of aerial stems	Dry weight of aerial stems /plant (g)	Plant height (cm)	No. of aerial stems	Dry weight of aerial stems /plant (g)
1/4 RD × Azt × 10T	31.8	4.4	167.3	29.5	3.4	157.1
1/4 RD × Azt × 15T	30.4	5	153	29.6	5	157.3
1/4 RD × Azt × 20T	32.3	4.5	164.8	26	5.5	153.3
1/4 RD × Azo × 10T	28	3.9	163.3	28.1	4.8	159.3
1/4 RD × Azo × 15T	27.6	3.7	151.8	28.3	4.5	162.6
1/4 RD × Azo × 20T	29.8	3.9	161	25	4.5	153
1/4 RD × M × 10T	29.4	4.2	159	28.2	3.9	161.6
1/4 RD × M × 15T	28.9	4.3	151.1	28	4	159.4
1/4 RD × M × 20T	31.4	4.9	160.6	23.3	4	151.1
1/2 RD × Azt × 10T	34.8	4.8	168.8	34.8	4.8	165.1
1/2 RD × Azt × 15T	33.3	4.7	172.6	31.4	4.2	163.9
1/2 RD × Azt × 20T	35.1	4.5	173.6	31	5.2	170.9
1/2 RD × Azo × 10T	30.6	4.3	169.3	33.1	3.3	168.5
1/2 RD × Azo × 15T	30.7	3.9	166.6	30.5	4.3	175.5
1/2 RD × Azo × 20T	33.5	3.9	167	31.4	4.3	168.5
1/2 RD × M × 10T	33.1	4.4	162.8	29.8	3.4	170.9
1/2 RD × M × 15T	33.1	4.2	162.8	30.1	4	170.8
1/2 RD × M × 20T	33.9	4.2	164	32.2	5.2	171.6
3/4 RD × Azt × 10T	36.5	5.2	176.6	36.8	5.1	173.5
3/4 RD × Azt × 15T	36.8	5.4	178.5	37	5.6	180.7
3/4 RD × Azt × 20T	36.6	5	177.1	35.1	5	167.8
3/4 RD × Azo ×10T	32	4.4	171.1	34.6	5.2	170.9
3/4 RD × Azo ×15T	32.7	4.4	171.5	33.9	3.9	173.2
3/4 RD × Azo ×20T	33.5	4.3	172.8	33	4.1	178.3
3/4 RD × M ×10T	33.7	4.8	168	32	4.3	167.4
3/4 RD × M ×15T	35	4.2	170.5	34.4	4.4	179
3/4 RD × M ×20T	34.8	4.8	170.8	34.4	4.9	179
L.S.D at $_{0.05}$	1.5	0.6	2.3	2.9	0.6	4.2

*RD: Recommended dose of N kg / fed. = (150 kg / fed.)

**Azt: Azotobacter **Azo: Azospirillum ***M: mixture ****T: Ton/fed.

Table 5. Effect of interaction among mineral nitrogen, biofertilizers and compost rates on specific gravity and tubers dry matter% of potato in 2004/2005 and 2005/2006 seasons

Seasons / Characters / Treatments RD* x Bio** x Compost***	2004/2005		2005/2006	
	Specific gravity (g/cm^3)	Tubers dry matter (%)	Specific gravity (g/cm^3)	Tubers dry matter (%)
1/4 RD × Azt × 10T	1.008	28.1	1.02	24.4
1/4 RD × Azt × 15T	1.013	25.8	1.012	23.4
1/4 RD × Azt × 20T	1.015	25.6	1.058	21.8
1/4 RD × Azo × 10T	1.011	26.2	1.037	23.3
1/4 RD × Azo × 15T	1.017	27.7	1.08	23.9
1/4 RD × Azo × 20T	1.014	27.9	1.045	21.5
1/4 RD × M × 10T	1.012	29	1.014	25.5
1/4 RD × M × 15T	1.009	27.5	1.072	24.1
1/4 RD × M × 20T	1.013	28	1.039	22.9
1/2 RD × Azt × 10T	1.014	25	1.016	22.6
1/2 RD × Azt × 15T	1.008	22.4	1.088	21.9
1/2 RD × Azt × 20T	1.015	21.9	1.034	21.6
1/2 RD × Azo × 10T	1.015	23.5	1.013	20.7
1/2 RD × Azo × 15T	1.008	23.7	1.083	22.1
1/2 RD × Azo × 20T	1.035	23.7	1.026	21.2
1/2 RD × M × 10T	1.014	24.7	1.01	21.3
1/2 RD × M × 15T	1.012	22	1.08	23.8
1/2 RD × M × 20T	1.012	24.1	1.032	22.6
3/4 RD × Azt × 10T	1.009	22.3	1.009	21
3/4 RD × Azt × 15T	1.009	23.3	1.011	19
3/4 RD × Azt × 20T	1.023	20.6	1.016	18.8
3/4 RD × Azo ×10T	1.007	23.7	1.011	21
3/4 RD × Azo ×15T	1.01	23.9	1.011	19.4
3/4 RD × Azo ×20T	1.011	21.9	1.014	18.8
3/4 RD × M ×10T	1.01	22.5	1.014	19
3/4 RD × M ×15T	1.01	21.3	1.014	18.9
3/4 RD × M ×20T	1.011	23.7	1.016	20
L.S.D at $_{0.05}$	NS	1.5	NS	2.2

*RD: Recommended dose of N kg / fed. = (150 kg / fed.)

**Azt: Azotobacter **Azo: Azospirillum ***M: mixture ****T: Ton/fed.

Table 6. Effect of interaction among mineral nitrogen, biofertilizers and compost rates on yield and its component of potato during 2004/2005 and 2005/2006 seasons

Seasons	2004/2005			2005/2006		
Characters / Treatments (RD* x Bio** x Compost***)	Average tuber weight/plant (g)	Average weight of tuber (g)	Total yield (t/fed)	Average tuber weight/plant (g)	Average weight of tuber (g)	Total Yield (t/fed)
1/4 RD × Azt × 10T	605.5	57.4	10.6	590.5	51.6	9.8
1/4 RD × Azt × 15T	469.2	61.4	8.3	606.1	61	9.9
1/4 RD × Azt × 20T	508.2	57.8	8.9	499.4	52.3	8.9
1/4 RD × Azo × 10T	565.4	60.8	9.9	559.1	57.2	9.3
1/4 RD × Azo × 15T	531.7	69.5	9.4	421.1	58.6	7.5
1/4 RD × Azo × 20T	587.5	76.3	10.3	513.4	52.3	8.2
1/4 RD × M × 10T	493.3	62.2	8.7	391.8	52.9	6.6
1/4 RD × M × 15T	485.9	66.4	8.5	406.2	60.2	7
1/4 RD × M × 20T	606.9	66.7	10.7	439.4	53.1	7.2
1/2 RD × Azt × 10T	707.2	67.7	12.9	661	66.6	11.5
1/2 RD × Azt × 15T	602.1	87.5	10.6	648.6	71.6	9.8
1/2 RD × Azt × 20T	529.8	71.8	9.3	560.3	67.6	10.4
1/2 RD × Azo × 10T	658.4	65.4	11.6	625.1	63.5	9.9
1/2 RD × Azo × 15T	532.1	70.8	9.4	635.6	63.8	10.8
1/2 RD × Azo × 20T	575.5	76.7	10.2	610.7	70.9	9.8
1/2 RD × M × 10T	515.8	66.4	9.1	538.9	66.9	8.8
1/2 RD × M × 15T	479.9	56.6	8.5	450.3	65.5	7.8
1/2 RD × M × 20T	458.8	52.7	8.1	571.3	69.9	9.3
3/4 RD × Azt × 10T	453.6	72.4	8.2	557.6	47.9	9.3
3/4 RD × Azt × 15T	475.5	55.7	8.4	505.3	52.3	8.8
3/4 RD × Azt × 20T	488.8	53.3	8.6	410.3	48.4	7.1
3/4 RD × Azo ×10T	444.4	47.5	7.8	445.9	48.5	7.7
3/4 RD × Azo ×15T	438.6	54.2	7.7	490.4	50.9	7.9
3/4 RD × Azo ×20T	469.3	48.6	8.3	412.4	46.2	7
3/4 RD × M ×10T	461.6	42.7	8.2	378.9	46.4	6.6
3/4 RD × M ×15T	459.4	48.4	8.2	419.6	51.2	7.8
3/4 RD × M ×20T	453.3	40.7	7.9	432.6	44	7.4
L.S.D at $_{0.05}$	16	3.5	0.4	38.7	2.2	0.7

*RD: Recommended dose of N kg / fed. = (150 kg / fed.)**Azt: Azotobacter
**Azo: Azospirillum ***M: mixture ****T: Ton/fed.

Table 7. Effect of interaction among mineral nitrogen, biofertilizers and compost rates on N, P K, NO_3 and NO_2 concentrations of potato in 2004/2005 and 2005/2006 seasons

Seasons	2004/2005					2005/2006				
Nutrients / Treatments RD* x Bio** x Compost***	N %	P %	K %	NO_3 ppm	NO_2 ppm	N %	P %	K %	NO_3 ppm	NO_2 ppm
1/4 RD × Azt × 10T	1.6	0.33	0.71	229.8	88.9	1.3	0.32	0.69	219.5	92.4
1/4 RD × Azt × 15T	1.7	0.31	0.72	221.5	86.9	1.5	0.3	0.65	215.8	89.7
1/4 RD × Azt × 20T	1.5	0.31	0.58	244.1	108.9	1.2	0.3	0.58	226.3	100.9
1/4 RD × Azo × 10T	1.3	0.27	0.73	250.1	82.3	1.5	0.26	0.73	225.6	86.4
1/4 RD × Azo × 15T	1.3	0.28	0.83	257.1	89.3	1.6	0.27	0.8	230.8	93.5
1/4 RD × Azo × 20T	1.6	0.26	0.69	281.8	106.3	1.4	0.25	0.71	235.7	111.3
1/4 RD × M × 10T	1.6	0.27	0.73	295.8	94.9	1.4	0.26	0.75	245.3	94.8
1/4 RD × M × 15T	1.5	0.25	0.81	300.8	102.9	1.6	0.24	0.78	250.1	105.1
1/4 RD × M × 20T	1.7	0.23	0.7	294.1	80.1	1.4	0.22	0.7	254.4	95.6
1/2 RD × Azt × 10T	1.9	0.32	0.78	246.1	82.6	2	0.33	0.75	220.7	87.7
1/2 RD × Azt × 15T	2.2	0.28	0.82	233.5	87.3	2.2	0.3	0.76	229.1	90.4
1/2 RD × Azt × 20T	2.2	0.34	0.77	272.1	101.9	2	0.31	0.71	231	107.7
1/2 RD × Azo × 10T	2.1	0.28	0.82	266.8	83.3	2.1	0.29	0.79	231.4	88.8
1/2 RD × Azo × 15T	2.2	0.27	0.85	275.1	94.3	2.4	0.28	0.86	239.4	97.2
1/2 RD × Azo × 20T	2.2	0.3	0.8	291.1	114.9	2.1	0.31	0.75	240.6	112.9
1/2 RD × M × 10T	2.1	0.23	0.84	289.8	88.9	2	0.24	0.8	257.2	89.5
1/2 RD × M × 15T	2.3	0.22	0.82	313.1	99.3	2.4	0.23	0.85	259.3	95.7
1/2 RD × M × 20T	2.5	0.19	0.8	316.1	114.6	2.5	0.2	0.7	264.3	112.9
3/4 RD × Azt × 10T	2.2	0.33	0.76	249.8	85.9	1.4	0.3	0.71	230	90.8
3/4 RD × Azt × 15T	2.4	0.3	0.7	265.5	94.3	1.6	0.27	0.69	234.9	94.7
3/4 RD × Azt × 20T	2.3	0.31	0.7	291.5	100.3	1.8	0.28	0.67	235.4	101.4
3/4 RD × Azo ×10T	2.1	0.27	0.8	287.1	82.9	1.8	0.29	0.76	238.1	87.6
3/4 RD × Azo ×15T	2.2	0.28	0.75	291.8	111.6	1.7	0.26	0.74	245.2	95.3
3/4 RD × Azo ×20T	2.5	0.27	0.71	298.1	91.9	1.4	0.25	0.73	249.8	111.2
3/4 RD × M ×10T	1.9	0.24	0.8	325.5	92.9	1.9	0.24	0.77	260.4	94.1
3/4 RD × M ×15T	2.2	0.21	0.75	334.1	102.6	1.7	0.2	0.75	270.5	100.5
3/4 RD × M ×20T	2	0.16	0.74	297.5	115.3	1.6	0.18	0.73	264.2	113.4
L.S.D at $_{0.05}$	0.4	NS	2.4	30.2	20.6	0.4	NS	3.6	6.4	17.4

*RD: Recommended dose of N kg / fed. = (150 kg / fed.)**Azt: Azotobacter **Azo: Azospirillum ***M: mixture ****T: Ton/fed.

Were obtained when applying half of the recommended dose of N/fed + *Azotobacter* + 10 tons/fed.

Nitrogen Percentage

The observed results in Table 7 indicate that when applying half of the recommended dose, mixture of *Azotobacter* plus *Azospirillum* and 20 t/fed compost gave the highest values (2.5%) in both seasons.

Phosphorus Percentage

Response of the phosphorus content in potato tubers to N rates, biofertilizer and compost rates is illustrate in Table 7, had no significant in both seasons.

Potassium Percentage

Data in Table 7 indicate that applying half of the recommended dose, *Azospirillum* and 15 t/fed compost, gave the highest values (0.85 and 0.86%) in both seasons.

Nitrate Content in Potato Tubers

Data in Table 7 indicate that when applying three fourth of the recommended dose, mixture of *Azotobacter* plus *Azospirillum* and 15 t/fed compost, gave the highest values (334.1 and 270.5 ppm) and the lowest values (221.5 and 215.8 ppm) were obtained when applying one fourth of the recommended dose nitrogen; *Azotobacter* and 15 t/fed. compost in both seasons.

Nitrite Content in Potato Tubers

Data in Table 7 Show that when applying three fourth of the recommended dose, mixture of *Azotobacter* plus *Azospirillum* and 20 t/fed compost, gave the highest values (115.3 and 113.4), in both seasons, but the lowest values (82.3 and 86.4) were obtained when applying 1/4 recommended dose of Nitrogen, Azospirillum and 10 t/fed. compost in both seasons.

DISCUSSION

Applying biofertilizers to the soil and reducing mineral nitrogen fertilizers in the present study increased the vegetative growth parameters. This effect may be due to that applying the biofertilizers led to increase microorganisms in root one and convert which organic matter in the soil from organic form of nutrients such as N to mineral N. This increment in the uptake of nutrients from soil by roots of plant promotes plant growth characteristics (Lampkin, 1990).

Similar results were reported by Abou- Hussein *et al.* (2002a) and Abdel-Ati (1998). Applying compost, mineral N and biofertilizer to potato plants increased the vegetative growth. This effect might be due to that applying compost to the soil improves soil fertility and increase cation exchange capacity of soils, thus increase availability of certain nutrients such as Ca, Mg and P (Brady, 1974). Similar results were obtained by (Abou-Hussein, 2002c).In general, the obtained results suggested fertilizing potato plants of cv." Diamont" with three fourth of N recommended dose, 15 tons of compost and applying *Azotobacter* to enhance the vegetative growth at similar conditions to that of the present study. When potato plants received nitrogen fertilizer, biofertiluzer and organic fertilizer rates the percentage of N and K increased. This effect could be resulted from the increase of these elements in the soil. Similar results were reported by Abou- Hussein *et al.* (2002a) and Abdel-Ati (1998).

Nitrate and nitrite contents were increased in tubers tissue due to the application of high rates of nitrogen fertilizer, biofertilizer and compost, but the value was still within the acceptable range for human health. Prins (1983) found that the highest nitrate content (> 1-2% by weight) in forage can be toxic to livestock. Moreover, the most interesting results were that added half of the recommended dose of nitrogen fertilizer, *Azotobacter* and (10 t/fed) compost recorded the highest potato tuber yield and achieved low values of NO_3 and NO_2 in tuber tissues and did not differ significantly with the lowest NO_3 and NO_2 values in both seasons. This effect may be due to that adding nitrogen fertilizer, biofertilizer and compost increased N nutrient in the soil and the uptake was then increased by plants, which in turn increased NO3 and NO2 concentration. Similar results were found by Abou-Hussein *et al.* (2002b) and Abdel-Ati (1998).

Applying biofertilizers to potato crop with nitrogen fertilizer and compost increased average tuber weight, which led to increase total yield. This effect may be due to that microorganisms were increased in the soil, which converts the ability of mobilizing the unavailable form of nutrients elements to available forms (Ishac, 1989). So that the synthesis of organic matter as well as cell division increased this led to increase vegetative growth. This increase in vegetative growth may increase photosynthesis rates leading to an increase of assimilation rates, so that tuber weight and tuber size increased, which consequently increased the total yield. Similar results were reported by Ghosh and Das (1998);

Abdel-Ati (1998) and Abou-Hussein *et al.* (2002c). On the other hand, results show that applying half of the recommended dose of nitrogen fertilizer, *Azotobacter* and (10 t/fed) compost had a beneficial effect on total tuber yield and weight of tubers/plant. So, the later treatment could be recommended for enhancing tuber yield, reduced nitrate and nitrite contents, reduce environment pollution and potato production costs.

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دراسة مقارنة لثلاثة أنواع مختلفة من الأسمدة علي محصول وجودة البطاطس المنزرعة فى تربة طميه رملية

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أجريت هذه الدراسة في موسمي ٢٠٠٤/٢٠٠٥ و ٢٠٠٥/٢٠٠٦ في مزرعة كلية الزراعة – جامعة جنوب الوادى بمحافظة قنا فى تربة طميه رملية وكان الصنف المستخدم في هذه الدراسة هو صنف البطاطس "دايمونت" وذلك لمعرفة أفضل معاملات التسميد تأثيراً على المحصول والجودة وذلك بالتسميد بنترات الأمونيوم (ربع الجرعة الموصي بها ، نصف الجرعة الموصي بها ، ثلاثة أرباع الجرعة الموصي بها) مع السماد العضوي (كمبوست بمعدل ١٠ ، ١٥ ، ٢٠ طن/فدان) والسماد الحيوي حيث استخدم لقاحي (الأزوتوباكتر ، الأزوسبيريللم وخليط من اللقاحين) ومقارنتهم معاً.

أظهرت نتائج هذه الدراسة أن استخدام ثلاثة أرباع الكمية الموصي بها من السماد الآزوتى مع استخدام لقاح الأزوتوباكتر كسماد حيوي بالإضافة إلي ١٥ طن/ فدان سماد عضوي "كمبوست" أدى إلي زيادة صفات النمو الخضري لنباتات البطاطس معبراً عنها بإرتفاع النبات وعدد السيقان الهوائية لكل نبات والوزن الجاف للسيقان الهوائية لكل نبات.

بينما أدي استخدام ربع كمية السماد الازوتي الموصي بها مع ١٠ طن /فدان سماد عضوي "كمبوست" مع خليط من الأسمدة الحيوية (الأزوتوباكتر و الأزوسبيريللم) لزيادة النسبة المئوية للمادة الجافة لدرنات البطاطس. دلت هذه الدراسة على أنه لم تكن هناك أي تأثير معنوي للمعاملات موضع الدراسة على صفة الكثافة النوعية في كلا الموسمين.

أظهرت نتائج هذه الدراسة أن نسبة النتروجين والبوتاسيوم فى النبات إزدادت مع استخدام نصف كمية السماد الآزوتي الموصي به مع خليط من اللقاحين مع ٢٠ و١٥ طن/ فدان سماد عضوي "كمبوست" علي الترتيب. كما أن النتائج أوضحت أنه لم يكن هناك تأثير معنوي للمعاملات علي نسبة الفوسفور في النبات، كما وجد أن نسبة النترات في الدرنات تكون في اقل مستوياتها عند استخدام ربع الجرعة الموصي بها من السماد الآزوتي مع خليط من الأزوتوباكتر و١٥ طن/فدان سماد عضوي. كما وجد أن نسبة النيتريت تصل إلي اقل مستوياتها فى درنات البطاطس مع ربع الكمية الموصي بها من السماد الآزوتي مع خليط من الازوسبريلليم و١٠ طن/فدان سماد عضوي. علاوة على ذلك وجد أن استخدام نصف الكمية الموصي بها من السماد الآزوتي مع لقاح الأزوتوباكتر و١٠ طن كمبوست/فدان أعطى زيادة معنوية فى متوسط وزن الدرنات للنبات وكذلك المحصول الكلي (طن/فدان) وفى نفس الوقت أعطت نفس المعاملة قيم منخفضة لمحتوى الدرنات من النترات والنيتريت خلال موسمي الدراسة.