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EFFECT OF DIFFERENT RATES OF FARMYARD MANURE AND PLANT SPACING ON GROWTH, YIELD AND QUALITY OF JERUSALEM ARTICHOKE PLANTS UNDER SANDY SOIL CONDITIONS

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ABSTRACT

Two field experiments were carried out during two successive summer seasons of 2008 and 2009 at the experimental farm, El-Kassasein Research Station, Ismailia Governorate, to investigate the effect of different rates of farmyard manure (10,20,30 and 40 m^3/fed), plant spacings (20,30,40 and 50 cm) and their interactions on vegetative growth, fresh and dry weight, yield and its components and chemical constituents of Jerusalem artichoke plants (*Helianthus tuberosus* L.) cv. fuseau under sandy soil conditions.

Farmyard manure at a rate of 40m^3/fed. recorded maximum values of plant height, number of shoots /plant, fresh and dry weight/ plant, and increased number of tubers per plant, average tuber weight and yield / plant as well as chemical constituents of tubers as compared with 10m^3/faddan.

Planting Jerusalem artichoke plant at 50 cm reflected the highest values of vegetative growth parameters, yield and yield components as well as chemical constituents of tubers.

The best interaction treatment between different rates of farmyard manure and plant spacing was fertilization with 40m^3 farmyard manure in combination with the highest plant spacing (50cm) as compared with other treatments.

Keywords: Jerusalem artichoke, farmyard manure, plant spacing, growth, yield, chemical constituents.

INTRODUCTION

Jerusalem artichoke is an agricultural crop with a great potential for high sugar yields per hectare 9-13/ha (Klaushofer, 1986). The main storage carbohydrate is fructan that contributes about 70-80% of the tuber dry matter (Chubey and Dorreli, 1974). The above-ground parts of the plant can be used for biogas production or in animal nutrition (Seiler, 1988). The main interest in Jerusalem artichoke is due to biotechnological utilization of the tubers. Fermentation of the tubers may yield ethanol or other bulk chemicals (Guiraud *et al.*, 1981;Fages *et al.*, 1986; Rosa *et al.* (1987).

Before the widespread use of chemical fertilizers, animal manures were used as a primary source of nutrients in crop production. In addition to supply nutrients to the soil, manure also improves soil health by increasing soil organic matter and promoting beneficial organisms. Organic manure could improved soil content of organic matter, encouraged the plant to have a good root development by improving aeration of soil, many species of living organisms, which release phytohormons that may stimulate the plant growth and absorption of nutrients (Reynders and Vlassak, 1982).

Organic fertilizaers such as FYM had a considerable effect on increasing yield and dry matter of potato tubers (Sharma and Arora, 1990). Also, Arisha and Bardisi (1999) found that plant height, NPK content in folige and tuber, number and weight of potato tubers /plant and total tubers yield/fed., as well as the tuber dry matter content were significantly increased with increasing FYM up to $30m^3$/fed.

Tuber yield and inulin content of Jerusalem artichoke increased as FYM level elevated from 10, 20, $40m^3$FYm/Fed., while fertilization with $40m^3$ FYM/fed., increased inulin concentration, carbohydrate, total sugar, total protein and NPK content (El-Sharkawy, 2003).

Fertilization Jerusalem artichoke plants with chicken manure at $12m^3$/fed. exhibited the highest vegetative growth characters, total tuber yield, average tuber weight and protein content of tubers (Ragab *et al.*, 2008). Increasing FYM levels up to $30m^3$/fed led to the highest significant NPK content of tubers, however, using 20 or $30m^3$ FYM/fed led to the highest P content of tubers (Abd El-kader, 2002)on potato.

Using farmyard manure at $20m^3$/fed combined with compost manure at $60m^3$/fed was the most effective treatment on increasing the vegetative growth parameters, total corms yield and its quality as well as chemical constituents of dasheen corms (NPK, stareh and protein percentages), (El-Sharkawy, 2007). Also, El-Sharkawy *et al.* (2003) on taro indicated that the total produced yield and its components as well as starch , NPK and protein content of corms were significantly increased with increasing farmyard manure application up to $80m^3$/fed.

Studying the plant spacing and arrangement under sandy soil conditions is very important. It was found that high plant spacing increased plant height, number of branches and leaves/plant, while low plant spacing decreased plant height, number of branches and leaves/plant of sweet potato (El-Denary *et al.*,1998; Somda and kays ,1990; Sasaki,1991; Patil *et al.*, 1992; Ayoub, 2005). The wider spacing (60x30cm) gave lower sweet potato tuber yields/ha. compared with closer spacing (45x30cm) (Patil *et al.*, 1992; (El-Denary, 1998). Therefore, this study aimed to investigate the effect of farmyard manure rates and suitable plant spacing as well as their combinations on vegetative growth, yield and its components and its quality of Jerusalem artichoke plants grown under sandy soil conditions.

MATERIALS AND METHODS

The present investigation was conducted at the experimental farm ,El kassasein horticultural research station, Ismailia governorate, during two successive seasons of 2008 and 2009, to study the effect of different rates of farmyard manure and plant spacings on growth, yield and quality of jerusalem artichoke plants (*Helianthus tuberosus* L.) under sandy soil conditions

.Physical and chemical properties of the experimental soil are presented in Table 1.

Table 1: Physical and chemical properties of the experimental soil

Physical properties			Chemical properties		
	2009	2010		2009	2010
Sand%	96.5	95.6	Organic matter (%)	0.03	0.08
Silt %	1.7	1.6	Available K ppm	52	64
Clay %	1.8	2.8	Available P ppm	5.5	6.2
F.C.%	6.5	6.8	Available N ppm	5.4	6.9
W.P.%	2.4	2.5	Calcium carbonate (%)	0.18	0.26
Available water	4.5	4.5	pH	8.1	8.1
Water holding capacity	13.8	14.5			

This experiment included 16 treatments, which were the combinations between four (FYM) fertilizer rates and four plant spacings. The treatments were arranged in a split-plot design with three replicates, (FYM) application treatments were randomly assigned in the main plots, while the plant spacings were assigned at random in the sub-plots as follows;

A. Organic manure (FYM) fertilizers

1. $10m^3$/fed.,
2. $20m^3$/fed.,
3. $30m^3$/fed., and
4. $40m^3$/fed.

B. Plant spacing

1. 20cm.
2. 30 cm.
3. 40 cm.
4. 50 cm.

Tuber seed of Jerusalem artichoke cultivar(Fuseau) were sown on April 19th in both seasons.

The experimental plot area was $12.6m^2$. It contained three dripper lines with 6m in long and 70cm distance between each two dripper lines. One line was used to measure the vegetative growth parameters and the other two lines were for yield determination .In addition, one row was left between each two experimental plots as a guard area to avoid the overlapping infiltration of FYM fertilizer.

All experimental plots received equal amonts of commercial fertilizers at the rates of 150 kg/fed calcium super phosphate, 100 kg/fed sulpher per feddan were added before planting, ammonium sulphate at 300 kg/fed and potassium suphate at 150kg /fed at three times;i.e., after 30,60 and 90 days from planting.

Data recorded

1. Vegetative Growth Characters

A random sample of three plants from each experimental plot was taken at flower initiation stage (after 120 days from planting) to calculate plant height (cm), lateral shoots number/ plant, and fresh and dry weight/plant (gm).

2. Yield and Its Components

At harvest time , 180 days after planting , the total tubers yield / (Kg) , number of tubers / plant , average tuber weight (gm) , total yield (ton / feddan) were collected and percentage of tuber dry matter (calculated by drying 100 grams of fresh tubers in oven at 70°C till constant weight).

3. Tuber Quality

1. N,P and K contents, total nitrogen, phosphorus and potassium were determined according to mthods described by Bremner and Mulvaney (1982) , Olsen and Sommers (1982) and Jackson (1970) , respectively .
2. Total carbohydrate (%); it was determined calorimetrically in fine grained dry tubers as following the methods described by Michel *et al.* (1956).
3. Inulin content was determined in tubers according to the method of Winton and Winton (1985).

Statistical analysis ;

The data of this experiment were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1980) and means separation were done according to L.S.D. at 5% level of significance.

RESULTS AND DISCUSSION

Vegetative Growth

Effect of farmyard manure rates

Data presented in Table 2 show that all studied vegetative growth parameters ; i.e., plant height, shoots number, fresh weight and dry weight/plant were significantly effected by application of farmyard manure rates, application of farmyard manure at a rate of $10m^3$/fed. reflected the lowest values in all measured growth aspects, while, application of farmyard manure at a rate of $40m^3$./fed. reflected the highest values of plant height, shoots numbers, fresh weight and dry weight per plant during both seasons of growth compared to the other tested treatments. Such increment in growth traits due to the addition of FYM at $40m^3$/fed. compared with other tested treatments may be attributed to the main role of organic fertilizer as soil amendment, source of slow release macro-nutrients, improved chemical and biological properties of soil, increasing water retention especially under sandy soil conditions and in turn, increased the availability and uptake of nutrients by plant which affect positively plant growth. These results are in harmony with those obtained by Reynders and Vlassak(1982), El-Sharkaway (2003) and Ragab *et al.* (2008) on Jerusalem artichoke and Sharma and Arora (1990) and Arisha and Bardisi (1999) on potato, and El-Sharkawy (2007) and El-Sharkawy *et al.* (2003) on taro.

Effect of plant spacing

It is evident from the results in Table 2 that the plant growth characters; i.e., plant height, shoots number, plant fresh and dry weight were significantly affected by plant population. It is of great interest to note that planting at 50cm gave the highest plant height, number of shoots/plant, plant fresh and dry weights. On the other hand, planting at the narrowest space; i.e., 20cm

gave the lowermost values of all studied plant growth characters. The other plant populations gave values in between.

In general, increasing plant population were unfavorable for plant growth since the narrowest plant spacing had a detrimental effect on number of shoots, plant height, fresh and dry weight per plant.

Obtained results are coincided with those reported by Somda and Kays (1990) Sasaki (1991), Patil *et al.* (1992), El-Denary (1998) and Ayoub (2005) on sweet potato.

Table 2 : Effect of farmyard manure rates and plant spacing on growth characters of Jerusalem artichoke during 2007 and 2008 seasons

Treatments	Growth characters / plant							
	Season 2007				Season 2008			
	Plant height (cm)	Shoots no.	Plant fresh wt.(kg)	Plant dry wt. (g)	Plant height (cm)	Shoots no.	Plant fresh wt.(kg)	Plant dry wt. (g)
F.Y.M (M^3/ Fed.)								
10	180	25.50	0.865	328.655	180	20.00	0.898	335.062
20	207	33.25	1.184	445.152	203	26.75	1.163	442.298
30	217	42.00	1.328	505.157	212	37.75	1.424	519.230
40	234	44.25	1.485	566.212	241	44.75	1.570	597.243
L.S.D at 5%	0.11	2.97	0.07	2.60	0.150	2.74	0.09	14.00
Plant spacing (cm)								
20	197	32.50	1.150	431.838	194	27.25	1.237	448.475
30	206	35.25	1.196	455.354	209	30.50	1.220	465.977
40	215	37.75	1.235	470.804	214	33.00	1.274	484.173
50	220	39.50	1.281	487.181	219	35.50	1.324	495.207
L.S.D at 5%	0.067	3.14	0.05	1.51	0.135	1.80	0.08	1.207

Effect of interaction between farmyard manure rates and plant spacing

Data presented in Table 3 illustrate that application of 40m^3 FYM/fed. in combination with the highest plant spacing (50cm) recorded the highest values of plant height, number of shoots/plant, plant fresh and dry weight in both seasons of study. On the other hand , the lowest plant spacing (20cm) with application of 10m^3FYM/fed. recorded the lowest values of plant height, number of shoots/plant and fresh and dry weight/plant in both seasons.

Table 3: Effect of interaction between farmyard manure rates and plant spacing on growth characters of Jerusalem artichoke during 2007 and 2008 seasons

Treatments		Growth characters / plant							
		Season 2007				Season 2008			
F.Y.M (M^3/ Fed.)	Plant spacing (cm)	Plant height (cm)	Shoots no.	Plant fresh wt.(kg)	Plant dry wt.(g)	Plant height (cm)	Shoots no.	Plant fresh wt.(kg)	Plant dry wt.(g)
10	20	1.600	22	0.797	302.03	1.730	15	0.811	308.49
	30	1.750	25	0.821	312.30	1.790	19	0.855	332.84
	40	1.890	27	0.891	338.92	1.820	22	0.920	349.96
	50	1.980	28	0.950	361.37	1.890	24	1.005	348.95
20	20	2.010	29	1.105	399.41	1.950	23	1.110	422.23
	30	2.050	32	1.175	446.96	2.010	26	1.150	437.45
	40	2.100	35	1.205	458.37	2.050	28	1.182	449.24
	50	2.150	37	1.251	475.87	2.110	30	1.210	460.27
30	20	2.210	39	1.277	485.76	1.787	31	1.528	492.60
	30	2.150	41	1.300	494.51	2.180	33	1.335	507.82
	40	2.210	43	1.345	511.62	2.240	36	1.393	528.74
	50	2.227	45	1.390	528.74	2.290	39	1.440	547.76
40	20	2.200	40	1.420	540.15	2.320	40	1.500	570.58
	30	2.327	43	1.488	567.64	2.380	44	1.540	585.80
	40	2.400	46	1.500	574.30	2.450	46	1.600	608.75
	50	2.450	48	1.532	582.74	2.50	49	1.640	623.84
L.S.D at 5%		0.134	6.31	0.10	3.01	0.27	3.62	0.17	25.60

Yield and Its Components

Effect of farmyard manure rates

Data illustrated in Table 4 show the effect of farmyard manure rates on total produced tubers yield and its components expressed as number of tubers per plant, average tuber weight, yield/ plant and dry matter percentage during the two seasons of study. Such data reveal that application of FMY at rate of $40m^3$/fed. significantly increased all the aforementioned yield parameters of Jerusalem artichoke plants except tuber number / plant in first season. As compared with $10m^3$/feddan. Obtained results were true during both seasons of growth. The superiority of using the farmyard manure at a rate of $40m^3$/fed. may be due to that farmyard manure is higher in its macro-nutrient content and act as a soil amendment which increased water retention of sandy soil .Therefore , such conditions affect positively plant growth (Table 2) and consequently increased the produced yield. Obtained results are in agreement with those reported by El-Sharkawy (2003) and Ragab *et al.* (2008) on Jerusalem artichoke and Sharma and Arora (1990) and Arisha and Bardisi, (1999) on potato, and El-Sharkawy *et al.* (2003) and El-Sharkawy (2007) on taro.

Effect of plant spacing

It is evident from the results in Table 4 that the yield and its components ; i.e., number of tubers/plant, average tuber weight, yield/plant and total yield/fed. as well as dry matter percentage were significantly affected by plant population. It is of great interest to note that planting at

50cm gave the highest average tuber weight, yield/plant and dry matter percentage, whereas planting at 40cm gave the highest significant total yield. These results were true in both seasons. On the other side, planting at the narrowest space; i.e., 20cm gave the lowermost values of all studied yield and its components characters except number of tubers/plant in first season.

Obtained results are coincide with those reported by Patil *et al.* (1992), El-Denary (1998) and Ayoub (2005) on sweet potato.

Table 4: Effect of farmyard manure rates and plant spacing on yield and its components of Jerusalem artichoke during 2007 and 2008 seasons

Treatments	Yield and its components									
	Season 2007					Season 2008				
	Tuber No./ plant	Average tuber wt.(g)	Yield / plant (kg.)	Total yield (ton/ fed.)	Dry matter (%)	Tuber No./ plant	Average tuber wt.(g)	Yield / plant (kg.)	Total yield (ton/ fed.)	Dry matter (%)
F.Y.M (M^3/ Fed.)										
10	43.498	32.598	1.436	24.471	20.609	41.748	30.713	1.280	21.845	21.267
20	43.248	33.973	1.467	24.995	21.492	42.748	32.568	1.392	23.944	21.838
30	43.498	35.212	1.528	26.066	22.617	42.498	34.143	1.455	24.798	22.353
40	43.583	35.358	1.537	26.225	23.602	42.330	34.672	1.469	25.019	23.310
L.S.D at 5%	N S	1.372	0044	0.685	0.14	0.352	1.117	0.44	0.637	0.04
Plant spacing (cm)										
20	43.915	18.753	0.824	24.713	21.710	42.250	18.254	0.771	23.354	21.945
30	43.663	28.340	1.260	25.200	21.998	42.413	27.748	1.177	23.547	22.110
40	43.165	40.454	1.747	26.198	22.207	42.245	38.967	1.647	24.709	22.268
50	43.083	49.593	2.137	25.647	22.407	42.415	47.127	2.000	23.997	22.445
L.S.D at 5%	0.393	0.981	0.030	0.51	0.10	N S	0.759	0.029	0.473	0.12

Effect of interaction between farmyard maure rates and plant spacing

According to the effect of the interaction between farmyard manure rates (10, 20, 30 and 40m^3/fed.) and plant densities (20, 30, 40 and 50cm) on yield and yield components, it is obvious from data in Table 5 that application of 40m^3 FYM/Fed. in combination with the highest plant spacing(50cm) recorded the highest values of average tuber weight, yield/plant and dry matter percentage in both seasons of study, but the total yield/fed was maximum with 40m^3 FYM /fed +40cm plant spacing. On the other hand, the lowest plant spacing (20cm) with application of 10m^3FYM/fed. recorded the lowest values of average tuber weight, yield/plant and total yield/fed. as well as dry matter percentage in both seasons of study.

Table 5: Effect of interaction between farmyard manure rates and plant spacing on yield and its components of Jerusalem artichoke during 2007 and 2008 seasons

Treatments		Yield and its components									
		Season 2007					Season 2008				
F.Y.M (M^3/ Fed.)	Plant spacing (cm)	Tuber No./plant	Average tuber wt.(g)	Yield / plant (kg.)	Total yield (ton/ fed.)	Dry matter (%)	Tuber No./plant	Ave tuber wt.(g)	Yield / plant (kg.)	Total yield (ton/ fed.)	Dry matter (%)
10	20	44.00	18.02	0.793	23.790	20.23	42.00	16.92	0.711	21.330	21.11
	30	43.66	27.59	1.205	24.100	20.52	42.00	25.78	1.083	21.660	21.22
	40	43.33	28.77	1.680	25.200	20.77	41.66	35.83	1.493	22.395	21.33
	50	43.00	48.04	2.066	24.792	20.91	41.33	44.35	1.833	21.996	21.41
20	20	43.66	18.46	0.806	24.180	21.15	43.00	17.86	0.768	23.904	21.62
	30	43.33	28.61	1.240	24.800	21.35	42.66	27.35	1.167	23.326	21.81
	40	43.00	24.00	1.720	25.800	21.59	42.33	38.97	1.650	24.750	21.90
	50	43.00	48.83	2.100	25.200	21.88	43.00	46.11	1.983	23.796	22.02
30	20	44.33	19.22	0.846	25.380	22.22	42.00	19.04	0.800	24.000	22.18
	30	43.67	29.66	1.295	25.900	22.53	42.33	28.93	1.225	24.500	22.29
	40	43.33	41.21	1.786	26.790	22.75	42.66	40.15	1.713	25.695	22.37
	50	43.00	50.76	2.183	25.196	22.96	43.00	48.44	2.083	224.996	22.57
40	20	44.00	19.31	0.850	25.500	23.24	42.00	1919	0.806	24.180	22.87
	30	44.00	29.54	1.300	26.000	23.59	42.66	28.94	1.235	24.700	23.12
	40	43.00	41.86	1.800	27.000	23.71	42.33	40.94	1.733	25.995	23.47
	50	43.33	50.77	2.200	26.400	23.87	42.33	49.61	2.100	25.200	23.78
L.S.D at 5%		N S	N S	N S	N S	0.19	0.469	N S	0.058	N S	0.24

Chemical Constituents

Effect of farmyard manure rates

The results listed in Table 6 clearly show the effect of farmyard manure rates on chemical constituents of Jerusalem artichoke tubers; i.e., N, P, K and inulin as well as total carbohydrates. The N, P, K, inulin and carbohydrates in both seasons increased with increasing FYM rates. Jerusalem artichoke plants received FYM at a rate of 40m^3/fed. recorded the highest values of N, P, K, and inulin as well as total carbohydrate percentage as compared with 10m^3/fed. FYM obtained results are true during both seasons of growth. These results agreed with those reported by El-Sharkawy (2003) and Ragab *et al.* (2008) on Jerusalem artichoke and Sharma and Arora (1990) and Arisha and Bardisi (1999) on potato.

Effect of plant spacing

It is evident from the results in Table 6 that the chemical constituents of Jerusalem artichoke tubers; i.e., N, P, K, inulin and total carbohydrate percentage were significantly affected by plant population. It is of great interest to note that planting at 50 cm gave the highest P, K and inulin as well as total carbohydrate percentage. On the other side, planting at the narrowest space ; i.e., 20cm gave the lowermost values of all studied chemical constituents characters except N% in both seasons of study.

Obtained results are coincided with those reported by Patil *et al.* (1992), El-Denary (1998) and Ayoub (2005) on sweet potato.

Table 6: Effect of farmyard manure rates and plant spacing on chemical constituents of Jerusalem artichoke during 2007 and 2008 seasons

Treatments	Chemical constituents (%)									
	Season 2007					Season 2008				
	N	P	K	Inulin	Carbo-hydrats	N	P	K	Inulin	Carbo-hydrats
F.Y.M (M^3/ Fed.)										
10	1.203	0.334	1.462	10.69	21.62	1.311	0.436	1.702	11.15	21.46
20	1.248	0.383	1.755	11.13	21.81	1.340	0.460	2.087	11.67	22.01
30	1.720	0.403	2.092	11.64	22.53	1.388	0.468	2.460	12.04	22.56
40	1.487	0.433	2.438	12.13	22.84	1.519	0.484	2.730	12.66	22.97
L.S.D at 5%	0.21	0.010	0.14	0.11	0.52	0.13	0.013	0.06	0.26	0.28
Plant spacing (cm)										
20	1.305	0.377	1.808	11.21	21.59	1.343	0.454	2.117	11.64	21.98
30	1.628	0.385	1.895	11.34	22.04	1.416	0.459	2.200	11.83	22.18
40	1.445	0.392	1.978	11.47	22.36	1.438	0.466	2.275	11.96	22.34
50	1.279	0.399	2.068	11.59	22.45	1.360	0.469	2.387	12.08	22.51
L.S.D at 5%	0.17	0.011	0.07	0.14	0.42	0.16	0.017	0.04	0.14	0.19

Effect of interaction between farmyard manure rates and plant spacing

According to the effect of interaction between farmyard manure rates and plant spacing on chemical constituents of Jerusalem artichoke tubers, it is obvious from data in Table 7 that, application of 40m^3 FYM/fed. in combination with the highest plant spacing (50cm) recorded the highest values of P, K and inulin as well as carbohydrate percentage in both seasons of study.

Table 7: Effect of interaction between farmyard manure rates and plant spacing on chemical constituents of Jerusalem artichoke during 2007 and 2008 seasons

Treatments		Chemical constituents (%)									
		Season 2007					Season 2008				
F.Y.M (M^3/ Fed.)	Plant spacing (cm)	N	P	K	Inulin	Carbo-hydrats	N	P	K	Inulin	Carboh-ydrats
10	20	1.180	0.315	1.34	10.55	21.40	1.300	0.422	1.59	10.94	21.22
	30	1.200	0.330	1.42	10.65	21.51	1.307	0.437	1.64	11.05	21.33
	40	1.210	0.342	1.50	10.72	21.72	1.317	0.440	1.72	11.22	21.55
	50	1.220	0.350	1.59	10.86	21.85	1.320	0.446	1.86	11.39	21.75
20	20	1.227	0.376	1.65	10.92	21.56	1.330	0.450	1.95	11.51	21.81
	30	1.240	0.380	1.72	11.07	21.43	1.340	0.459	2.05	11.65	21.95
	40	1.257	0.385	1.80	11.21	22.03	1.340	0.462	2.10	11.72	22.09
	50	1.267	0.390	1.85	11.33	22.23	1.350	0.468	2.25	11.78	22.22
30	20	1.503	0.393	1.92	11.42	22.29	1.357	0.465	2.33	11.61	22.33
	30	2.083	0.400	2.05	11.59	22.42	1.457	0.460	2.42	12.01	22.49
	40	1.993	0.405	2.15	11.71	22.73	1.367	0.472	2.50	12.20	22.65
	50	1.300	0.415	2.25	11.83	22.67	1.370	0.476	2.59	12.33	22.80
40	20	1.310	0.425	2.32	11.94	22.55	1.387	0.479	2.60	12.50	22.56
	30	1.987	0.430	2.39	12.05	22.79	1.560	0.482	2.69	12.62	22.97
	40	1.320	0.436	2.46	12.22	22.96	1.730	0.488	2.78	12.70	23.09
	50	1.330	0.442	2.58	12.33	23.05	1.400	0.485	2.85	12.83	23.29
L.S.D at 5%		0.35	0.022	0.15	0.28	0.83	0.30	0.035	0.08	0.29	0.36

On the other side, the interaction between the lowest plant spacing (20cm) and application of 10m^3 FYM/fed. recorded the lowest values of N, P, K and inulin as well as total carbohydrates percentage in both seasons.

Conclusion

From the previous results of this investigation, it could be concluded that the superior treatment for enhancing growth, yield and yield components as well as chemical constituents of tubers as compared with other treatments was fertilization of Jerusalem artichoke plants that grown under sandy soil conditions with 40 m^3 FYM / fed. And planted at 50 cm.

REFERENCES

Abd El-Kader, A. (2002). Effect of some organic and mineral fertilizers on some potato cultivars (*Solanum tuberosum* L.). M. Sc. Thesis, Fac. Agrec., Mansoura Univ., Egypt.

Arisha, H. M. and A. Bardisi (1999). Effect of mineral and organic fertilizer on growth, yield and tuber quality of potato under sandy soil conditions. Zagazig J. Agric. Res. 20(2): 391-405.

Ayoub, I.I. (2005). Effect of fertilization and plant population on growth ,yield and storability of sweet potato grown under sandy soil conditions. Ph. D. Thesis, Fac. Agric. Zagazig Univ., Egypt.

Bremner, J. M. and C.S. Mulvaney (1982). Total nitrogen In: Page, A. L., R.H.Miller and D. R. Keeney(Eds.). Methods of Soil Analysis. Part 2. Amer. Soc. Agron. Madison, W.I.USA.pp. 595-624.

Chubey, B.B. and D.G. Dorreli (1974). Jerusalem artichoke, opotential fructose crop for the prairies. Can. Inst. Food Sci. Technol. J. 7: 98-100.

El-Denary, M.E.M. (1998). The performance of sweet potato (*Ipomoea batata* (L.) Lam.) plants in response to some cultural treatments. M.Sc. Thesis, Fac. Agric., Minufiya Univ., Egypt.

El-Sharkawy, Z.A. (2003). Response of growth and yield of Jerusalem artichoke to different nitrogen sources and organic manure (FYM). J. Agric. Sci., Mansoura Univ., 28 (3): 2033-2051.

El-Sharkawy, Z.A. (2007). Response of Dasheen to different organic fertilizer sources and rates under newly reclaimed sandy soil conditions. Ann. Agric. Sci., Moshtohor, Vol. 45(4): 1651-1661.

El-Sharkawy, Z.A., A.A. Salem and A.S. Omran (2003). Influence of organic manure (FYM), two bio – fertilizers and potassein foliar spray of taro (*Colocassia esculenta* L. Schoot). J. Agric. Sci., Mansoura Univ. 28(3): 1993-2006.

Fages, J. D., Mulrd, J.J. Rouuet and J.L. Wilelm (1986). 2, 3-Buranediol production from Jerusalem artichoke, *Helianthus tuberosus*. by Bacillus polymyxa ATCC 12321, Optimization of Kia profile. Appl. Microbiol. Biotechnol., 25: 197-202.

Guiraud, J.P., J. Daurelles and P.Galzy (1981). Alcohol production from Jerusalem artichoke using yeasts with inulinase activity. Biotechnol. Bio engineering, 23: 1461-1465.

Jackson, M.L. (1970). Soil Chemical Analysis. Prentice Hall, Engle wood ceiffs, N.J.

Klaushofer, H. (1986). Zur Biotechnologie fructosanhaltiger pflanzen. Starch, 38: 91-94.

Michel, K., J.K. Gilles, P. A. Hamilton and F. Smith (1956) . Colorimetric method for determination of sugars and related substances. Analysis Chemistry 28 (3): 350.

Olsen, S.R. and L.E Sommers (1982). Phosphorus . In. Page A.L.R. H. Miller, and D.R.Keeney (Eds.). Methods of Soil Analysis, part2, Amer. Soc. Agron. Madison, W.I. USA. pp. 403 – 430.

Patil, Y.B., A.A. Patil, B.N. Madalageri, and V.S. Patil. (1992). Effect of levels of N, K. and inter-row spacing on growth and yield of sweet potato. J. Root Crops 18(1): 58-61 (C.F. Field Crop Abstr. 47 (10): 854).

Ragab, M.E., Nadia M. Hamed, and zohora A. El-Sharkawy, (2008). Response of Jerusalem Artichoke (*Helianthus tuberosus* L.) Plants to some Bio and organic fertilization treatments in the new reclaimed lands. Firest International Conference of Agric. Sci. Consohdated of Role the Research in Sustainability Agricultural Development plants, 13-15 October 2008, Faculty Agric., Aleppo Univ., Syria.

Reynders, L. and K. Vlassak. (1982). Use of Azospirllum brasilense as bio-fertilizer in intensive wheat cropping. Plant and Soil, 66: 217-223.

Rosa, M.F., I.S.A. Correla and J.M. Novais (1987). Production of ethanol at high Temperatures in the fermentation of Jerusalem artichoke juice and asimple medium by klyveromyces marxianus. Biotechnol. Letters, 9: 441-444.

Sasaki, O. (1991). Development of the shoot system in relation to tuber formation in sweet potato. 2.Effects of planting density on successive development of tops and tubers. Bulletin of the Fac. Agric. Kagoshima Univ. 41: 1-6.9 (C.F. field Crop Abstr., 45: 7292, 1992).

Seiler, G. J. (1988). Nitrogen and mineral content of selected wild and cultivated geno types of Jerusalem artichoke. Agron. J. 80: 681-687.

Sharma, V.C. and B.R. Arora (1990). P and K uptake pattern in potato as affected by applied nitrogen. Madras Agric. J., 77(3-4): 125-130.

Snedecor, G. W. and W. G. Cochran (1980) . Statistical Methods. 7th ed. . Iowa State Univ., Press, Amer., Iowa, U.S.A.

Somda, Z.C. and Kays (1990). Sweet potato canopy morphology: 2. leaf distribution. J. Amer. Soc. Hort. Sci. 115 (1): 39-45.

Winton, A. L. and K.B. Winton (1985). The analysis of foods. John wiley and sons. Inc. London. 85 7.P.

تأثير معدلات مختلفة من التسميد العضوي ومسافات الزراعة على النمو والمحصول والجودة في نباتات الطرطوفة تحت ظروف الأراضى الرملية.

رفعت صلاح الدين محمد أنور، محمد محمد عبد اللطيف رمضان و إبراهيم عبد الله سليم العسيلي
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أجريت تجربتان حقليتان خلال الموسم الصيفي لعامي ٢٠٠٨ و ٢٠٠٩ في مزرعة التجارب البحثية بمحطة بحوث البساتين بالقصاصين ، محافظة الاسماعيلية ، وذلك لدراسة تأثيرإضافة معدلات مختلفة من التسميد العضوي (١٠ ،٢٠ ،٣٠ ،٤٠ متراً مكعباً للفدان)ومسافات الزراعة(٢٠ ،٣٠ ، ٤٠ ،٥٠ سنتيمتر) والتفاعل بينها على النمو، والوزن الطازج، والوزن الجاف، والمحصول ومكوناته، والمحتوي الكيماوي لنباتات الطرطوفة صنف فيوزا تحت ظروف الأراضي الرملية.

سجلت معاملة تسميد نباتات الطرطوفة بمعدل ٤٠ متراً مكعباً للفدان من التسميد العضوي أعلى القيم بالنسبة لارتفاع النبات، وعدد الافرع، والوزن الطازج والوزن الجاف للنبات ، والمحصول ومكوناته، والمحتوي الكيماوي للدرنات بالمقارنة مع ١٠ متر مكعب للفدان.

زراعة نباتات الطرطوفة على مسافة ٥٠ سنتيمتر أعطت أعلى القيم بالنسبة لقياسات النمو الخضري، والمحصول ومكوناتة ، والمحتوي الكيماوى للدرنات .

كانت افضل معاملات التفاعل بين المعدلات المختلفة من التسميد العضوي ومسافات الزراعة هي التسميد بمعدل ٤٠ متر مكعب سماد بلدى بالتداخل مع أعلى مسافة زراعة ٥٠ سنتميتر بالمقارنة مع باقى المعاملات الأخري.

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