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EFFECT OF DIFFERENT RATES OF NITROGEN AND POTASSIUM FERTILIZATION 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 2009 and 2010 at the experimental farm, El-Kassasein Research Station, Ismailia Governorate, to investigate the effect of different rates of nitrogen and potassium fertilization (100%, 75% and 50% of the recommended dose) and foliar application with urea and citrate potassium at rates of 0.05 and 1 % and their interactions on plant 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. Fertilization with 100% of nitrogen and potassium from the recommended dose recorded maximum values of plant height, number of shoots / plant both fresh and dry weight/plants, yield and its components, and chemical constituents of tubers in both seasons.

Spraying Jerusalem artichoke plants with urea and citrate potassium at a rate of 1% significantly increased plant growth, yield and its components as well as chemical constituents of tubers. In general, the best interaction treatment among different rates of nitrogen and potassium fertilization and foliar application with urea and citrate potassium was fertilization with 100% of the recommended dose and foliar application with urea and citrate potassium at a rate of 1% as compared with other treatments.

Keywords: Jerusalem artichoke, soil application, urea, citrate potassium, foliar application.

INTRODUCTION

Jerusalem artichoke(*Helianthus tuberosus* L.) is a non-traditional tuberous crop, which is recently introduced to Egypt for its high nutritional and medicinal values. The plant can grow in almost all soils with the exception of clay soil.

In France, it has been considered as a source of fructose sugar and fuel alcohol production. It is most favored as a food in Europe and. tubers are rich in nutrients and polysaccharides especially inulin; which possibly utilized as a fructose sweetener (Chubey and Dorrell, 1974). Moreover the above – ground parts of the plant can be used for biogas production and in animal nutrition (Gunnarson *et al.* 1985; Malmberg and Theander, 1986; Seiler,1988).

Growth conditions; e.g., soil and fertilization, play an important role in yield production. The effect of nutrition has been investigated mainly by application of the main nutrients (NPK), N being the main factor. Ashour *et al*. (1997) found that application of N fertilization at rates led to increase in plant

height, fresh and dry weight of potato foliage / plant. Application of N the form of $(NH_4)_2$ SO4 increased fresh weight of foliage and recorded greater number of branches, number of main stems, and tuber yield of Jerusalem artichoke more than that NH_4 NO_3 (El-Sharkawy 2003). Typic ustorthents showed little effect of nitrogen (urea) on potato yield (Brar, 2006). Yassen *et al*.(2010). showed that addition of nitrogen as foliar spray (1% urea) gave significant increase in 100 grain weight, nitrogen concentration and uptake in both grain and straw and protein yield as compared with the control. Results also revealed that spraying wheat plants with 1% urea showed marked increment in micronutrients concentration and uptake.

Potassium is one of the important macro-elements that play major physiological and biochemical roles in plants growth (Beringer *et al* ., 1990). Soja *et al*. (1990) reported that without potassium and phosphorus fertilization, the yield of Jerusalem artichoke tubers was decreased by 8-23%. Potassium application has been shown to improve plant growth and tuber yield. Increasing the concentration of K foliar application from 0 to 1% K_2O significantly increased tuber yield, and the highest value of tuber yield was at 1% K_2O (El-Sawy *et al*., 2000). Vegetative growth, yield and quality of local and fuseau Jerusalem artchoke cultivars were inproved under Egyption soil conditions after K_2O fertigation (Mansour *et al*., 2001).The application of 96 kg K_2O / fed. Increased tuber yield, dry matter, tuber inulin and total carbohydrate, (Tawfik *et al*., 2003).

Another study showed that, the application of 144 potassium units produced the highest values of all characters with the exception of plant height, protein and nitrogen contents, whereas 48 units gave the highest values of the previous mentioned characters (Abd El – Rehim *et al*., 2005). On Jerusalem artichoke.

Foliar spray of 1% K_2 SO_4 with soil application caused significant increases in tuber yield and dry shoot weight of plants with no specific trend, while tuber yield was significantly increased by increasing K rate up to 48 Kg K_2O/fed., leaf N, P and K contents were significantly increased by foliar spray of 1% K_2O (Gomaa – Nadia, 2007) on potato. K foliar application at 2% K_2O on potato crop cv. Draga significantly increased dry shoot yield, fresh tuber yield, N, P an K % in shoots and tubers as compared to control. (El-Sirafy *et al*., 2008).

MATERIALS AND METHODS

The present investigation was conducted at the experimental farm ,El kassasein horticultural research station, Ismailia governorate, during two successive seasons of 2009 and 2010, to study the effects of different rates of nitrogen and potassium fertilization on growth, yield and quality of Jerusalem artichoke plants (*Helianthus tuberosus* L.) cv. fuseau 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 nine treatments, which were the combinations between three doses of soil nitrogen and potassium application and foliar application with three levels of nitrogen and potassium. The treatments were arranged in a split plot design with three replicates, soil application treatments were randomly assigned in the main plots, while foliar spray with urea and citrate potassium treatments were randomly distributed in the sub-plots as follows;-

Soil application

1. 100% of the recommended dose of mineral fertilizers (ammonium sulphate at 300kg and potassium sulphate at 150kg/fed.)
2. 75% mineral fertilizers (225kg ammonium sulphate and potassium sulphate at 112kg /fed.)
3. 50% mineral fertilizers (150kg ammonium sulphate and 75kg/ fed.) potassium sulphate)

Foliar application treatments

1. Control (spraying plants with tap water) .
2. Urea and citrate potassium (0.5%)
3. Urea and citrate potassium (1.0%)

Tuber seed of Jerusalem artichoke cultivar(Fuseau) were sown on April 19th in both seasons at 50 cm apart.

The experiment plot area was 12.6m^2. It contains 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 soil or spraying application.

Treatments of urea and citrate potassium foliar application were done for three times; i.e., 60,80 and 100 days from sowing. Each plot received 2l. solution for each level , the untreated plants were sprayed with tap water. The other agricultural practices were carried out as commonly followed in the district.

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) and percentage of tuber dry matter (calculated by drying 100 grams of fresh tubers in oven at 70^{o}C till a 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 collected 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 soil application rates of nitrogen and potassium

It is obvious from the data in Table 2 that plant height, shoots no. /plant, and both fresh and dry weights/plant were significantly decreased by decreasing nitrogen and potassium rates from 100% to 50% , the highest values of vegetative growth were recorded by 100% soil application of N and K followed by 75% , without significant differences between them. The favorable effect of N fertilization on plant growth may be due to the positive effects on activation of photosynthesis and metabolic processes of organic compounds in plants which in turn, encourage the plant vegetative growth (Gardener *et al*., 1985). These results are in harmony with those obtained by Ashour *et al*. (1997) on potato and El – Sharkawy (2003) on Jerusalem artichoke.

Effect of foliar application of urea and citrate potassium

Data presented in Table 2 show the effect of urea and citrate potassium on vegetative growth characters of Jerusalem artichoke plants as plant height / plant, shoots no. / plant, and fresh and dry weight / plant. It is clear that urea and citrate potassium foliar application had a promoted effect on all vegetative growth characters except shoots number in the second season as compared with the control. The superior treatments was foliar application at 1%. This is may be due to the stimulating effect of urea through improving the physiological performance of plants and multiple advantage of foliar application method such rapid and efficient response to plant needs.

Obtained results are in conformity with those of Soja *et al*. (1990),. Mansour *et al*. (2001). Tawfik *et al*. (2003). Abd El-Rehim *etal.* (2005) on

Jerusalem artichoke; Gomaa-Nadia (2007) and El- Sirafy *et al*. (2008) on potato.

Table 2 :Effect of soil and foliar application of nitrogen and potassium on vegetative growth characters of Jerusalem artichoke during 2009 and 2010 seasons

Treatments	Growth characters / plant							
	Season 2009				Season 2010			
	Plant height (cm)	Shoots no.	Fresh wt. (g)	Dry wt.(g)	Plant height (cm)	Shoots no.	Fresh wt.(g)	Dry wt.(g)
N and K rates*								
100 %	205.7	40.3	1500	593.74	229.6	45.2	1827	740.11
75%	199.3	35.0	1175	441.16	212.3	31.2	1272	517.67
50%	189.0	34.0	983	329.13	204.9	29.3	1069	443.11
L.S.D at 5% level	6.15	4.55	83	25.38	8.17	2.52	93	49.14
Urea and Citrate Potassium								
0	186.7	32.7	1092	405.42	205.8	32.6	1271	509.67
0.5%	198.3	36.3	1200	455.90	215.9	35.6	1421	576.33
1%	209.0	40.3	1367	502.71	225.1	37.7	1477	614.89
L.S.D at 5% level	4.27	2.74	86	25.06	4.54	N.S	113	62.77

*** ; the recommended dose (300 kg ammonium sulphate + 150 kg potassium sulphate)**

Effect of interaction between soil application rates and foliar application of nitrogen and potassium

Data in Table 3 indicate the effect of the interaction between different rates of soil application of nitrogen and potassium and foliar application of urea and citrate potassium on vegetative growth characters of jerusalem artichoke plants. It is clear that the interaction between different rates of soil application of nitrogen and potassium (100 %, 75 % and 50% of the recommended dose) and foliar application of urea and citrate potassium (0 % , 0.5 % and 1 %) did not reflect any significant effect on all tested characters except plant height in both seasons of study.

Yield and Its Components

Effect of soil application rates of nitrogen and potassium

Data in Table 4 clearly show the effect of soil application rates of nitrogen and potassium on yield and its components of Jerusalem artichoke ; i. e., number of tubers per plant, average tuber weight, yield / plant, total yield / fed., and dry matter. It is obvious from such data that fertilization of Jerusalem artichoke plants with mineral N and K at 100% of the recommended dose significantly increased yield and its components, whereas the lowest values were recorded from the plants which received mineral N and K at 50% of the recommended dose.

The favorable effect of mineral nitrogen fertilizer on total yield and its components could be explained through the great role of these fertilizers in enhancing plant growth rate, which exert direct effect on the yield and its components. These results are in harmony with those obtained by Ashour *et al*. (1997) and Brar (2006) on potato, and El-sharkawy (2003) on Jerusalem artichoke.

Table 3: Effect of interaction between soil and foliar application of nitrogen and potassium on vegetative growth characters of Jerusalem artichoke during 2009 and 2010 seasons

Treatments		Growth characters / plant							
		Season 2009				Season 2010			
N and K rates*	Urea and Citrate Potassium	Plant height (cm)	Shoots no.	Fresh wt.(g)	Dry wt.(g)	Plant height (cm)	Shoots no.	Fresh wt.(g)	Dry wt.(g)
100%	0	200	37	1350	543.81	227.33	42.33	1675	672.33
	0.5%	205	40	1475	597.52	229.33	45.33	1840	728.33
	1%	212	44	1675	639.88	232.00	48.0	1965	819.66
75%	0	190	31	1075	390.67	200.00	28.33	1137	445.66
	0.5%	198	35	1150	438.29	211.00	32.33	1330	544.66
	1%	210	39	1300	494.51	226.00	33.0	1350	562.66
50%	0	170	30	850	281.79	190.00	27.0	1000	411.00
	0.5%	192	34	975	331.88	207.33	29.0	1092	456.00
	1%	205	38	1125	373.73	217.33	32.0	1115	462.33
L.S.D at 5% level		7.40	N. S	N. S	N. S	7.87	N. S	N. S	N. S

*** ; the recommended dose (300 kg ammonium sulphate + 150 kg potassium sulphate)**

Table 4: Effect of soil and foliar application of nitrogen and potassium on yield and its components of Jerusalem artichoke during 2009 and 2010 seasons

Treatments	Yield and its components									
	Season 2009					Season 2010				
	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 (%)
N and K rates										
100%	41.78	47.27	1.997	23.848	22.82	46.33	46.89	2.200	26.404	23.15
75%	40.78	45.93	1.873	22.480	22.61	45.33	46.03	2.085	25.021	22.76
50%	40.33	40.06	1.617	20.067	20.99	42.44	40.35	1.707	20.812	21.30
L.S.D at 5% level	0.80	1.56	0.059	0.737	0.219	2.95	1.10	0.185	1.943	0.20
Urea and Citrate Potassium										
0	40.33	42.04	1.697	21.027	21.70	43.56	42.50	1.856	22.605	21.92
0.5%	40.89	45.13	1.847	22.160	22.03	44.44	44.86	2.006	24.077	22.27
1%	41.67	46.60	1.943	23.209	22.69	46.11	45.91	2.130	25.555	23.03
L.S.D at 5% level	0.92	1.08	0.032	0.417	0.23	N. S	0.97	0.065	0.689	0.07

*** ; the recommended dose (300 kg ammonium sulphate + 150 kg potassium sulphate)**

Effect of foliar application of urea and citrate potassium

Presented data in Table 4 indicate the effect of foliar application of urea and citrate potassium on yield and its components of Jerusalem artichoke. The results reveal that spraying Jerusalem artichoke plants with urea and citrate potassium at 1 % reflect significant effect on number of tubers per plant, average tuber weight, yield per plant, total yield per fed. and dry matter percentage. The positive effect of high rate of K on tuber characters and tuber yield might be attributed to the role of K in assimilation

and translocation of carbohydrates as well as their conversion into starch (Nelson,1970) .

Similar results were reported by Soja *et al*. (1990), Mansour *etal*. (2001), Tawfik *et al*. (2003) and Abd El-Rehim *et al*. (2005) on Jerusalem artickoke, and Gomaa-Nadia (2007) and El-Sirafy *etal.*(2008) on potato, as well as Yassen *et al*. (2010) on wheat plants.

Effect of interaction between soil application rates and foliar application of nitrogen and potassium

According to the effect of the interaction between soil application rates (100% , 75% and 50% of the recommended dose) and foliar application of urea and citrate potassium at rate of 1% , 0.5% and without on yield and yield components, it is obvious from data in Table 5 that the interaction between mineral N and K at 100% of the recommended dose and foliar application of urea and citrate potassium at 1% gave the highest values of yield and its components, while this treatment significantly increased average tuber weight and yield per plant in first season and average tuber weight and dry matter (%) in second season.

Table 5 :Effect of interaction between soil and foliar application of nitrogen and potassium on yield and its components of jerusalem artichoke during 2009 and 2010 seasons

Treatments		Yield and its components									
		Season 2009					Season 2010				
N and K rates*	Urea and Citrate Potassium	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 (%)
100%	0	41.00	46.33	1.900	22.800	22.30	45.00	45.97	2.071	24.856	22.60
	0.5%	41.66	47.75	1.990	23.880	22.52	45.66	46.88	2.174	26.096	22.95
	1%	42.66	49.22	2.100	24.867	23.63	48.39	47.80	2.355	28.260	23.90
75%	0	40.00	44.76	1.790	21.480	22.44	44.33	44.77	1.983	23.396	22.55
	0.5%	40.66	45.50	1.850	22.200	22.61	45.33	46.04	2.083	25.000	22.75
	1%	41.66	47.53	1.980	23.760	22.79	46.33	47.27	2.189	26.268	22.99
50%	0	40.00	35.01	1.400	18.800	20.35	41.33	36.75	1.513	19.164	20.60
	0.5%	40.33	42.14	1.700	20.400	20.97	42.33	41.64	1.761	21.136	21.10
	1%	40.66	43.03	1.750	21.000	21.65	43.66	42.65	1.844	22.136	22.20
L.S.D at 5% level		N. S	1.87	0.056	N. S	0.39	N. S	1.68	N. S	N. S	0.11

*** ; the recommended dose (300 kg ammonium sulphate + 150 kg potassium sulphate)**

Chemical Constituents

Effect of soil application rates of nitrogen and potassium

The results listed in table 6 clearly show the effect of soil application rates of nitrogen and potassium on chemical constituents of Jerusalem artichoke tubers; i.e., N,P,K, Inulin and carbohydrates percentage. The N,P,K, Inulin and carbohydrates concentrations at both seasons increased

with increasing nitrogen and potassium rates from 50 up to 100% of the recommended dose. These results agreed with those reported by Ashour *et al*. (1997) on potato and El-Sharkawy (2003) on Jerusalem artichoke.

Table 6 : Eeffect of soil and potassium application nitrogen and potassium on chemical constituents of Jerusalem artichoke during 2009 and 2010 seasons

Treatments	Chemical constituents (%)									
	Season 2009					Season 2010				
	N	P	K	Inulin	Carbohydrates	N	P	K	Inulin	Carbohydrates
N and K rates*										
100%	0.593	0.380	3.13	11.18	17.19	0.618	0.367	2.64	10.88	17.03
75%	0.524	0.367	2.87	10.68	16.75	0.567	0.356	2.19	10.03	16.58
50%	0.451	0.367	2.77	10.31	16.36	0.508	0.343	1.97	9.72	16.18
L.S.D at 5% level	0.014	0.019	0.059	0.04	0.37	0.013	0.019	0.31	0.19	0.19
Urea and Citrate Potassium										
0	0.480	0.366	2.72	10.27	16.51	0.533	0.340	2.08	9.93	16.40
0.5%	0.516	0.372	2.95	10.81	16.75	0.568	0.353	2.27	10.23	16.58
1%	0.573	0.376	3.11	11.08	17.04	0.592	0.373	2.44	10.47	16.81
L.S.D at 5% level	0.015	0.018	0.065	0.07	0.34	0.015	0.021	0.09	0.14	0.09

*** ; the recommended dose (300 kg ammonium sulphate + 150 kg potassium sulphate)**

Effect of foliar application of urea and citrate potassium

Presented data in Table 6 indicate the effect of foliar application of urea and citrate potassium on chemical constituents of Jerusalem artichoke tubers. The results reveal that spraying Jerusalem artichoke plants with urea and citrate potassium at 1% significantly increased N, P, K, Inulin and total carbohydrates as compared with 0.5% or control. It was recognized that supplementary foliar fertilization during crop growth improved the mineral status of plants and increased the crop yield Kolota and Osinska, (2006). These results contradicted with those reported by Mansour *et al*. (2001) and Tawfik *et al*. (2003) on Jersualem artichoke and El- Sirafy *et.al*. (2008) on potato.

Effect of interaction between soil application rates and foliar application of nitrogen and potassium

According to the effect of interaction between soil application rates (100% , 75% , and 50% of the recommended dose) and foliar application of urea and citrate potassium (0% , 0.5% and 1%) on chemical constituents of Jerusalem artichoke tubers expressed as nitrogen, phosphorus, potassium, inulin and total carbohydrates (%) , it is obvious from such data in Table 7 that the interaction between l00 % of the recommended dose and foliar application of urea and citrate potassium at 1% significantly increased N%, P%, K% and Inulin (%) in first season and N% in second one, while the lowest values were recorded by the interaction between 50% of the recommended dose and foliar application of urea and citrate potassium at zero%.

Table 7: Effect of interaction between soil and foliar application of nitrogen and potassium on chemical constituents of Jerusalem artichoke during 2009and 2010 seasons

Treatments		Chemical constituents (%)									
		Season 2009					Season 2010				
N and K rates*	Urea and Citrate Potassium	N	P	K	Inulin	Carbohydrates	N	P	K	Inulin	Carbohydrates
100%	0	0.543	0.371	2.95	10.99	16.95	0.590	0.356	2.40	10.50	16.80
	0.5%	0.595	0.380	3.05	11.05	17.06	0.625	0.366	2.63	10.90	17.03
	1%	0.642	0.388	3.40	11.49	17.56	0.640	0.380	2.88	11.20	17.26
75%	0	0.482	0.362	2.70	10.27	16.56	0.520	0.342	2.01	9.80	16.41
	0.5%	0.502	0.369	2.91	10.82	16.80	0.570	0.354	2.20	10.00	16.55
	1%	0.588	0.370	3.01	10.95	10.90	0.610	0.372	2.35	10.30	16.78
50%	0	0.415	0.365	2.51	9.56	16.01	0.490	0.322	1.83	9.50	15.99
	0.5%	0.450	0.367	2.88	10.57	16.40	0.510	0.340	1.99	9.75	16.15
	1%	0.489	0.369	2.92	10.80	16.66	0.525	0.367	2.10	9.90	16.39
L.S.D at 5% level		0.025	0.031	0.113	0.11	N. S	0.025	N. S	N. S	N. S	N. S

*** ; the recommended dose (300 kg ammonium sulphate + 150 kg potassium sulphate)**

Conclusion

From the previous results of this investigation, it could be concluded that fertilization of Jerusalem artichoke plants with 100% of the recommended dose of nitrogen and potassium and adding urea and citrate potassium as foliar application at a rate of 1% was the superior treatment for enhancing growth, yield and its components and chemical constituents of tubers as compared with other treatments under sandy soil conditions.

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تـأثير إضـافة معـدلات مختلفـة مـن التسـميد النيتروجينـي والبوتاسـي علـي النمـو والمحصول والجودة في نباتات الطرطوفة تحت ظروف الأراضى الرملية.

رفعـــت صـــلاح الـــدين محمـــد أنـــور ، الســـيد محمـــد محمـــد عـــوض و إبراهيم عبد الله سليم العسيلي

قسم بحوث البطاطس ومحاصيل الخضر خضرية التكاثر – معهدبحوث البساتين

أجريـت تجربتـان حقليتـان خـلال الموسـم الصـيفي لعـامي ٢٠٠٩ و ٢٠١٠ فـي مزرعـة التجارب البحثيـة بمحطـة بحـوث البسـاتين بالقصاصـين ، محافظـة الاسماعيلية ، وذلك لدراسـة تـأثير معدلات مختلفة من التسميد النيتروجيني والبوتاسي (١٠٠% ، ٧٥% ، ٥٠% من المعدل الموصـى بـه) والرش باليوريا وسترات البوتاسيوم بمعدل صـفر ، ٠,٥ ، ١ % والتفاعل بينهم ، علـي النمو والوزن الطازج والوزن الجاف والمحصول ومكوناته والمحتوي الكيماوي لنباتات الطرطوفة صنف فيوزا تحت ظروف الأراضي الرملية.

سجلت معاملة تسميد نباتات الطرطوفة بمعدل ١٠٠% من التسميد النيتروجينـى والبوتاسـى الموصـى به أعلي القيم بالنسبة لارتفاع النبات، وعدد الأفرع، والوزن الطـازج والجـاف للنبـات، والمحصـول ومكوناته، والمحتوي الكيماوي للدرنات في كلا الموسمين .

أدي رش نباتات الطرطوفة باليوريا وسترات البوتاسيوم بمعدل ١% إلي زيادة معنوية فى النمو الخضرى ، والمحصول ومكوناته، وكذلك المحتوى الكيماوي للدرنات ، كما أظهرت النتائج أن أفضل معاملات التفاعل بين المعدلات المختلفة من التسميد النيتروجيني والبوتاسي مع الرش الـورقى باليوريا وسترات البوتاسيوم كان معدل ١٠٠ % من المعدل الموصي به مع الرش الورقـى باليـوريا وسـترات البـوتاسيوم بمعـدل ١ % بالمقارنـة بباقي المعاملات.

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