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EFFECT OF IRRIGATION INTERVALS AND POTASSIUM FERTILIZATION ON JERUSALEM ARTICHOKE.

BY

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ABSTRACT

Two field experiments were carried out in the Experimental Farm of the Faculty of Agriculture, Moshtohor, Benha University during two successive summer seasons of 2006 and 2007, to study the effect of irrigation intervals (5, 10 and 15 days) and potassium fertilization (72, 96 and 120 kg K_2O /fed. on vegetative growth, yield and quality of Jerusalem artichoke. Obtained results indicated that increasing water supply, i.e., irrigation every 5 days by intervals increased all the studied growth parameters i.e., plant length, fresh weight of plant and number of main stems per plant. Whereas, the dry matter percentage were significantly affect by decreasing the amount of irrigation up to 4072 m^3/fed regime. Increasing the application of potassium levels from 72kg K_2O/fed. to the highest used one(120 kg K_2O/fed.) significantly increased all measured growth aspects i.e., plant fresh weight of plant foliage and number of main stems per plant as well as the dry matter percentage in plant foliage. The interaction between irrigation regime and potassium application rate had a significant effect on all measured growth aspects. In this respect the highest recorded values were obtained as a result of irrigation every 10 days by intervals and application of the highest used level (120 kg K_2O/fed.) of potassium fertilization. Increasing the number of irrigations during the growing season i.e., irrigation every 10 or 5 days by intervals increased the total tuber yield and its components (number and weight of tuber /plant, average tuber weight as well as total produced yield/fed.). The highest concentration in all assayed chemical constituents was increased in case of irrigation every 10 days by intervals. Increasing the rate of potassium application at the highest level (120 kg K_2O/fed.) significantly increased the concentration of total nitrogen, phosphorus and potassium as well as inulin in produced tubers. The highest values of N, P, K and inulin concentration in tuber in both seasons were recorded as a results combined with the application of 120 kg K_2O/feddan and irrigation every 10 days by intervals. Finally, it could be concluded that under this situation treatment of irrigation every 10 days by intervals and application of potassium at 120 kg K_2O /fed. was the best for maximizing the growth and produced yield of Jerusalem artichoke.

INTRODUCTION

Jerusalem artichoke (JA) (*Helieanthus tuberosus* L.) is a new crop in Egypt. It has been grown to produce the tubers that can be used for many purposes i.e., human-diet, medical and industrial applications (Fuchs, 1993 and Meijer and

Mathijssen 1993). Agricultural practices especially irrigation and fertilization rate the primary limiting factors for crop production under arid and semi-arid conditions .in this regard, Hussain *et al.*, (2004), reported that water deficit had a great effects nearly on all the plant growth processes. However, the stress response depends upon the intensity, rate and duration of exposure and the stage of crop growth Wajid *et al.* (2004). When considering a watering regime for a crop, it is wise to understand the sensitive growth stages for water stress and the water requirements of the crop in order to achieve maximum yield and maintaining adequate soil moisture conditions during moisture sensitive stages of growth, so irrigation water may be saved if soil water could be depleted to a greater extent during certain growth stages without affecting yield. Currently, foliar-applied nutrients have limited direct use for enhancement of stress resistance mechanisms in field crops. Nevertheless, the interactions between plant nutrient levels and stress repair mechanisms are now being studied. In this regard Losavio *et al.* (1997) found that the highest tuber dry matter yield of Jerusalem artichoke was 10.7 t/ha. with applying 256 mm of irrigation water. In addition, the medium irrigation superior in terms of sugars content. Furthermore, Neri *et al.* (2002) who studied the decreasing water condition starting from restoration of 100 % ETM to the only supplemental irrigation to evaluate the effect of very little irrigation on JA. who found that biomass and sugar yields were increased in the aerial parts compared to the non-irrigated treatment. On the other crop, Abo-Sedera *et al.* (2004) on taro suggested that water supply, i.e. irrigation every 1/2 week by intervals throughout the growing season increased all vegetative growth characteristics. On the other hand, increasing the irrigation intervals from 1/2 up to 2 weeks led to a significant decrease in the concentration of macro-nutrient of plant leaves and corms.

Potassium is the most prominent inorganic plant solute and is the only mineral nutrient that is not a constituent of organic structures. Its function is mainly in osmoregulation, the maintenance of electrochemical equilibria in cells and its compartments and the regulation of enzyme activities (Hsiao and Lauchli, 1986). Potassium has a crucial role in the energy status of the plant, translocation and storage of assimilates and maintenance of tissue water relation. K plays a key role of crop quality (Imas and Bansal, 1999). It improves size of tubers and stimulates root growth. It is necessary for the translocation of sugars and formation of carbohydrates. K also provides resistance against pest and diseases Marschner 1995, and drought as well as frost stresses. Soja *et al.* (1990) on Jerusalem artichoke found that nutrient regimes without adding potassium and phosphorus but including N depressed the yield of tubers by 8-23 %. Potassium is also improving vegetative growth, tuber yield, and chemical composition of Jerusalem artichoke El-Sharkawy, 1998).

MATERIAL AND METHODS

The study was carried out at the experimental Farm of the Faculty of Agriculture, Moshtohor, Benha University during two successive summer seasons of 2006 and 2007, to investigate the effect of irrigation intervals (5, 10 and 15 days) and potassium fertilization (72, 96 and 120 kg K_2O /fed). on growth characters, tubers yield and its components as well as chemical composition of Jerusalem artichoke (*Helieanthus tuberosus* L.), cv. local under the El-Kalubia conditions. The soil of the experimental field was loam in texture with pH 7.5. The mechanical and chemical analysis of the soil was determined according to the methods described by Jakson (1973), and are shown in Table (1).

Table (1): The main physical and chemical properties of the experimental soil during 2006 and 2007 seasons.

Soil characteristics		2006	2007
		Values	Values
Clay %		40.02	41.00
Silt %		35.12	33.88
Fine sand %		15.5	14.92
Coarse sand %		7.18	7.54
Texture class		Clay-loam	
2- chemical analysis as meq/100 g. soil:			
pH (1:2.5 suspension)		7.6	7.5
Organic matter %		1.77	1.82
HCO_3^-		1.92	1.90
Cl^-		1.38	1.41
$SO4^{--}$		0.58	0.61
Ca^{++}		1.29	1.30
Mg^{++}		0.70	0.72
Na^+		1.68	1.66
Available	P	**20.00**	**20.80**
	N	**81.66**	**80.98**

Data presented in Table (2) show average monthly temperature, relative humidity percentage and quantity of rainfall at Kalubia Governorate in the region surrounding the experimental site during the two seasons of experimental work.

The experimental design was a split plot design with three replicates. Tubers (seed tubers) were planted at 60 cm a part within rows of 60 cm width and 4 m length on 21st and 22^{ed} of March in the two seasons of study, respectively. Jerusalem artichoke tubers were obtained from Hort. Res. Inst., potato res. Department, ministry of Agriculture, Dokki Giza. The area of the experimental plot was 12 m^2 and included 6 ridges where fife ridges were planted and the sixth one was left with out planting as a grad ridge between plots to prevent fertilizers and water movements from any plot to adjacent one. The experiment included 9 treatments, 3 irrigation intervals (5, 10 and 15 days) within 3 potassium levels (72, 96 and 120 kg K_2O/fed.). The water regime treatments were distributed in the main plots and potassium levels were located in the sub plots. The amounts of chemical fertilizer (potassium) were divided into two equal portions and added at 40 and 70 days after planting. In addition, nitrogen and phosphorus were added as the recommended dose. Tubers were irrigated directly after planting, then three weeks later, and at intervals of 10 days from each one. All the plots were equally irrigated. After one month from planting, the water regime began for the different irrigation treatments as indicated in Table (3).

Surface irrigation was used through weir to regulate the rate of water flow and to calculate the quantity of water applied for each plot.

Table (2): Average monthly temperature, relative humidity (%), and quantity of rainfall at Kalubia Governorate in the region surrounding the experimental site through the two seasons of the experimental work.

Seasons	2006				
Month	Temperature (C°)			Relative humidity (%)	Quantity of rainfall
	Min.	Max.	Mean		
April	10.00	23.20	16.56	61.00	0.00
May	15.00	31.40	23.26	54.50	0.00
June	20.00	33.70	26.79	59.00	0.00
July	20.12	33.61	26.86	62.00	0.00
August	18.90	32.40	25.60	65.00	0.00
September	18.10	31.40	25.60	62.00	0.00
2007					
April	13.40	29.70	21.50	57.00	0.00
May	17.40	32.46	24.93	55.33	0.00
June	19.53	34.53	27.003	57.66	0.00
July	20.73	35.36	28.04	58.66	0.00
August	20.58	35.56	28.06	57.62	0.00
September	20.43	35.76	28.09	56.58	0.00

Table (3): Irrigation treatments as irrigation intervals in days, number of irrigations and quantity of applied water (m^3/f ed.) during 2006 and 2007 seasons.

Irrigation regime	No. of irrigation	Quantity of water (m^3/fed.) received before treatments application during seasons of 2006 and 2007.		Quantity of water(m^3/fed.) received after treatments application		Mean
		2006	2007	2006	2007	
Irrigation every 5 days	24	950	1150	6350	6470	7460
Irrigation every 10 days	12	950	1150	4150	4280	5265
Irrigation every 15 days	8	950	1150	2935	3110	4072

The quantity of water applied for experimental plot was calculated by using the following equation mentioned by Khurmi (1990).

$$Q = \frac{C a1\ a2}{\sqrt{a1^2 - a2^2}} . \sqrt{2gh}$$

Q=quantity of water flowing through the venturiflume.
C= coefficient of discharge = 0.7.
a_1= area of flow in channel = $b_1 h_2$.

a_2=area of flow in throat = b_2h_2.
b1=width of channel.
b_2=width of throat.
h_1=depth of water in throat.
h=difference of depth of water.
h=h_1-h_2.
g=acceleration equal to 9.81 m/sec.

Data recorded:

1- Growth characteristics:

Vegetative growth aspects of girasol plants were measured at 120 days after planting. Representative sample of 3 plants from each experimental plot was taken for measuring the vegetative growth aspects as follows: Average plant length (cm); measured from the soil surface up to the top of the plant. Average number of main stems/plant; fresh weight of whole plant (kg).

2- Yield and its components:

At harvesting time (180 days after planting) all tubers of each experimental plot were harvested after removal of plant foliage above ground surface, then tubers were cleaned from the soil and the following data were recorded: Total tuber yield per plot was weighted and converted into (tons/fed.). Average number of tubers per plant. Weight of tubers /plant. Average tuber weight, (weight of tubers per plant / number of tubers per plant). Percentage of tuber dry matter, a reprehensive sample of 100 g from fresh weight of tubers were taken and dried in an electric oven to constant weight at 70 °C and the dry matter percentage was calculated .

3- Chemical constituents

In the digested dry matter of tubers nitrogen was determined according to the methods by Pregl (1945) using micro-kjeldahl apparatus. Meanwhile, phosphorus was estimated calorimetrically according to the method described by Murphy and Riley (1962) modified by John (1970). Furthermore, potassium was determined flam-photometrically as described by Brown and Lilleland (1946). Tuber concentration of inulin was determinate according to (Winton and Winton, 1958).

All obtained data were subjected to statistical analysis according to SAS Institute (1989) including L.S.D. values to show the significant character.

Water and potassium use efficiency: Water use efficiency (WUE) is defined as the relationship between units produced and volume of irrigation water applied (Sinclair *et al.*, 1984). Potassium use efficiency (KUE) by plants calculated as kg of the tubers yield produced by each unit of potassium nutrients used.

RESULTS AND DISCUSSION

1-Vegetative growth characteristics.

Data presented in Table (4) show the effect of irrigation intervals and potassium fertilizer levels as well as their interaction on vegetative growth parameter of girasols plants expressed as plant height, number of main stems/plant, plant fresh weight and dry matter percentage of plant foliage during the two seasons of growth.

Table (4): Effect of irrigation intervals, potassium levels and their interaction, on growth characteristics of Jerusalem artichoke during seasons of 2006 and 2007.

Season		2006			
Treatments		Plant length (cm)	No. of stems /plant	Plant fresh weight (kg)	Plant D.M (%)
Irrigation Intervals (day)	Potassium Levels kg (K_2O/fed.)				
5 days		302.78	9.55	5.433	11.33
10 days		285.00	11.55	4.838	11.44
15 days		271.67	6.94	3.941	15.04
L.S.D. at 0.05		**10.97**	**1.63**	**0.478**	**0.60**
	72	286.67	7.66	4.433	11.46
	96	279.44	8.77	4.461	12.43
	120	293.33	11.61	5.318	13.93
L.S.D. at 0.05		**10.52**	**1.61**	**0.385**	**0.43**
5 days	72	311.67	9.00	4.633	10.45
	96	283.33	10.33	5.666	11.23
	120	313.33	9.33	6.000	12.32
10 days	72	273.33	8.66	4.633	10.70
	96	288.33	9.00	4.700	11.07
	120	293.33	17.00	5.183	12.56
15 days	72	275.00	5.33	4.033	13.22
	96	266.67	7.00	3.016	14.97
	120	273.33	8.50	4.773	16.92
L.S.D. at 0.05		**18.22**	**2.79**	**0.668**	**0.75**
		2007			
5 days		292.33	10.03	5.526	11.87
10 days		289.00	10.60	4.865	12.06
15 days		277.00	8.74	4.560	16.71
L.S.D. at 0.05		**10.14**	**0.64**	**0.276**	**0.43**
	72	280.67	7.38	4.688	12.05
	96	281.00	8.34	4.813	13.58
	120	296.67	13.66	5.450	15.02
L.S.D. at 0.05		**14.67**	**0.89**	**0.322**	**0.60**
5 days	72	300.00	8.10	5.250	10.78
	96	282.00	9.88	5.180	11.84
	120	295.00	12.12	6.150	12.99
10 days	72	262.00	7.8	4.600	10.87
	96	290.00	8.25	4.680	11.73
	120	315.01	15.75	5.350	13.58
15 days	72	280.00	6.25	4.250	14.49
	96	271.00	6.88	4.580	17.16
	120	280.00	13.10	4.850	18.47
L.S.D. at 0.05		**25.40**	**1.53**	**0.558**	**1.04**

a- Effect of irrigation intervals.

Obtained data in Table (4) show clearly that all the studied growth parameters i.e., plant height, number of main stems per plant, fresh weight of plant as well as the dry matter percentage were significantly affected by the rested irrigation regime treatments during both seasons of growth. In this respect, increasing the irrigation intervals from 5 days by interval to 15 days consistently and continuously decreased all morphological parameters of plant. However, it increased the dry matter percentage of plant foliage. On the other hand, increasing the amount of irrigation water from 4072 m^3/fed up to 7460 m^3/fed. reflected the highest values of plant height, number of main stem/plant and the fresh weight of plant. On the contrary it decreased the dry matter percentage. Obtained results are similar during the two seasons of study. Such increment in plant morphological parameters due to the reduction of irrigation intervals may be due to the main role of irrigation water increasing the availability and diffusion as well as the uptake of macro and micro-nutrients by plant which affect greatly on plant growth. Also the reduction in plant growth due to the deficiency of irrigation water might be due to the lack of water absorption by plant which inturn affect on the role of photosynthetic assimilation insufficient water condition. Similar results were recorded by Cooper, 1980, Sharma *et al.*, 1984 and Magda *et al.* (2007) all working on girasol and Abo Sedera *et al.*, 2004a on taro.

b. Effect of potassium fertilization.

As for the effect of potassium fertilization, the same data in Table (4) indicate that increasing the application of potassium levels from 72 kg K_2O/fed. to the highest used one (120 kg K_2O/fed.) significantly increased all measured growth aspects i.e., plant fresh weight of plant foliage, number of main stems per plant, fresh weight of plant foliage as well as the dry matter percentage in plant foliage during the two growing seasons. Such increase in plant growth traits due to higher rates of potassium fertilizer my be attributed to the role of K as an essential element for plant growth which affect positively on photosynthetic assimilates and absorbed macro-elements which had a positive effect on plant growth. In this respect, Soja *et al.*, 1990, Mansour *et al.*, 2000, Tawfik *et al.*, 2003 and Magda *et al.*, 2007 recorded similar results on Jerusalem artichoke.

C-Effect the interaction.

Concerning the effect of the interaction, the same data in Table (4) indicate that the interaction between irrigation regime and potassium application rate had a significant effect on all measured growth aspects. In this respect the highest recorded values were obtained as a result of irrigation every 10 days by intervals and application of the highest used level (120 kg K_2O/fed.) of potassium fertilization.

2-Yield and its components.

a- Effect of irrigation intervals.

Data in Table (5) indicate that increasing the number of irrigations during the growing season i.e., irrigation every 10 or 5 days by intervals increased the total tuber yield and its components (number and weight of tuber /plant, average tuber weight as well as total produced yield/fed.) on the other hand, the dry matter percentage was decreased with increasing the amount of irrigation water used throughout the growing season. Similar trend was recorded during the two seasons of growth. In this regard, the increasing in total yield either per plant or feddan are connected with the increasing in number of tubers produced by plant and the increasing of average weight per tuber. Moreover, increasing the number of irrigation i.e., irrigation every ten days exhibited the highest number of tubers/plant as well as the total produced yield either for plant or feddan compared with other irrigation treatments (irrigation every 5 or 15 days by intervals). Obtained results are connected with those recorded in case of vegetative growth parameters (Table, 4). In this regard, Magda *et al.* (2007) reported that number of tubers/plant and total produced yield per feddan were increased with increasing soil water up to 70 % of field capacity compared with other tested irrigation treatments (40, 60 and 100% of field capacity.

b. Effect of fertilization.

With regard to the effect of potassium fertilization, the same data in Table (5) show that all the studied yield parameters were significantly increased as the rate of potassium application increased up to the highest used level (120 kg K_2O/fed.). Obtained results are true during the two seasons of growth. In this respect, the positive effect of high rate of potassium on total tuber yield and its components might be attributed to the role of potassium as a macro-element in assimilation and translocation of plant synthetic assimilated molecules from the organs of synthesis to the storage organs (tubers). Similar results were recorded by Soja *et al.*, 1990, Mansour *et al.* 2001, Tawfik *et al.*, 2003 and Magda *et al.*, 2007.

b- Effect of the interaction.

Regarding the effect of the interaction between irrigation treatments and potassium levels on total produced yield and its components, results at Table (5) reveal that the highest tuber yield for both plants and feddan and the number of produced tubers as well as average tuber weight were obtained due to the irrigation with 5265 m^3/fed. during the growing season (irrigation every 10 days intervals) and application of the highest level of potassium fertilization(120 kg K_2O/feddan. Similar trend was reported by Abo-Sedera *et al.*, (2004b) on taro.

3-Chemical constituents of tubers.

Data in Table (6) show the effect of irrigation regime, potassium fertilization and their interaction on N, P, K and inulin concentration in produced tubers during both season of growth.

a-Effect of irrigation intervals.

Such data in Table (6) show clearly that total nitrogen, phosphorus and potassium as well as inulin concentration in produced tuber were significantly increased with increasing the amount of irrigation water i.e., shortening the irrigation intervals during growing season. In addition, the highest concentration in all assayed chemical constituents was recorded in case of irrigation every 10 days by intervals. Such increments in the concentration of macro-elements due to the higher rate of irrigation water my be due to the increasing of nutrients solubility and their availability to absorption and uptake by plant and in turn increased their accumulation in produced tubers. Obtained results are in agreement with those reported by Magda *et al.* (2007) on girasol and Abo-Sedera *et al.* (2004a) on taro.

Table (5): Effect of irrigation intervals, potassium levels and their interaction, on yield and its components of Jerusalem artichoke during seasons of 2006 and 2007.

Season		2006				
Treatments		No. of tubers per plant	Average tuber fresh weight (g)	Tubers Dry weight (%)	Total yield per plant (kg)	Total yield per fed. (ton)
Irrigation Intervals (day)	Potassium Levels kg (K_2O/fed.)					
5 days		35.75	83.39	17.87	3.018	33.199
10 days		46.15	75.35	24.36	3.461	38.068
15 days		38.50	74.72	22.95	2.576	28.347
L.S.D. at 0.05		**2.99**	**8.18**	**0.29**	**0.167**	**1.83**
	72	39.24	76.71	20.79	2.893	31.829
	96	39.68	78.84	21.88	3.017	33.192
	120	41.46	78.89	22.51	3.144	34.592
L.S.D. at 0.05		**1.89**	**n.s**	**0.79**	**0.09**	**0.994**
5 days	72	34.32	83.52	16.95	2.866	31.533
	96	36.02	83.27	17.78	3.000	33.000
	120	36.92	86.37	18.88	3.187	35.063
10 days	72	45.14	75.53	22.94	3.393	37.333
	96	44.51	78.03	24.74	3.453	37.990
	120	48.79	72.48	25.41	3.534	38.881
15 days	72	38.26	71.08	22.49	2.420	26.621
	96	38.53	75.23	23.12	2.598	28.587
	120	38.69	77.83	23.24	2.712	29.833
L.S.D. at 0.05		**3.29**	**6.80**	**1.37**	**0.156**	**1.72**
		2007				
5 days		34.42	81.10	16.52	2.823	31.057
10 days		44.86	75.09	21.65	3.365	37.021
15 days		38.38	73.95	20.10	2.550	28.050
L.S.D. at 0.05		**1.96**	**6.46**	**0.34**	**0.221**	**2.43**
	72	37.39	76.96	17.99	2.725	29.981
	96	39.00	78.77	19.45	2.974	32.719
	120	41.27	77.32	20.83	3.038	33.428
L.S.D. at 0.05		**1.76**	**n.s**	**1.05**	**0.152**	**1.67**
5 days	72	33.00	83.01	15.81	2.736	30.103
	96	34.75	81.53	16.5	2.833	31.167
	120	35.50	81.77	17.25	2.900	31.900
10 days	72	42.77	72.28	19.66	3.090	33.990
	96	44.50	76.62	21.55	3.406	37.473
	120	47.30	76.12	23.75	3.600	39.600
15 days	72	36.40	75.59	18.5	2.350	25.851
	96	37.75	78.17	20.31	2.683	29.517
	120	41.00	74.08	21.5	2.616	28.783
L.S.D. at 0.05		**3.05**	**8.35**	**1.82**	**0.263**	**2.89**

Table (6): Effect of irrigation intervals, potassium levels and their interaction, on inulin, nitrogen, phosphorus and potassium (mg / 100 g D.W) content of Jerusalem artichoke during seasons of 2006 and 2007.

Season		2006				2007			
Treatments									
Irrigation Intervals (day)	Potassium Levels kg (K_2O/fed.)	N (mg)	P (mg)	K (mg)	Inulin (%)	N (mg)	P (mg)	K (mg)	Inulin (%)
5 days		1293	283	3139	14.24	1261	288	3014	14.22
10 days		1511	432	3645	17.69	1563	448	3612	17.53
15 days		1172	260	3008	14.04	1174	268	3014	13.93
L.S.D. at 0.05		**47.20**	**20.08**	**116.86**	**1.67**	**58.04**	**23.39**	**125.83**	**1.48**
	72	1216	272	3038	14.84	1237	280	3005	14.71
	96	1318	313	3218	15.30	1313	325	3179	15.28
	120	1443	390	3536	15.84	1448	399	3533	15.70
L.S.D. at 0.05		**41.43**	**16.56**	**90.20**	**1.76**	**59.84**	**10.76**	**93.63**	**1.42**
5 days	72	1218	246	2908	13.83	1229	242	2835	13.85
	96	1295	292	3163	14.22	1258	299	3105	14.30
	120	1368	312	3346	14.67	1298	323	3333	14.52
10 days	72	1359	347	3434	17.07	1425	384	3425	16.97
	96	1510	383	3560	17.65	1499	400	3503	17.55
	120	1664	566	3941	18.36	1766	560	3910	18.08
15 days	72	1071	224	2773	13.62	1059	215	2756	13.31
	96	1150	265	2931	1403	1183	275	2930	13.99
	120	1296	291	3320	14.48	1280	314	3356	14.49
L.S.D. at 0.05		**71.76**	**28.68**	**156.23**	**4.52**	**47.57**	**18.63**	**162.18**	**4.92**

b-Effect of potassium fertilization.

The same data in Table (6) indicate that increasing the rate of potassium application from 72 up to 120 kg K_2O/fed. significantly increased the concentration of total nitrogen, phosphorus and potassium as well as inulin in produced tubers during the two season of growth. The recorded results are similar to those reported by Magda *et al.* (2007).

c-Effect of the interaction.

Results in Table (6) reveal that the interaction between irrigation treatments and K fertilization rate had a significant effect on N, P, K and inulin concentration during both seasons of study. The highest values of N, P, K and inulin concentration in tuber in both seasons were recorded as a results combined with the application of 120 kg K_2O/fed., while the lowest values were recorded in case of irrigation every 15 days by intervals and using 72 kg K_2O/fed.

4-water and potassium use efficiency (WUE).

a- Effect of irrigation intervals.

Concerning the water use efficiency expressed as m^3/kg produced yield as affected by applied water frequency data in Table (7 and fig. 1) show clearly that the amounts of water require to produce one kg of tubers was increased with decreasing water supply from 5 up to 15 days by intervals. In this respect, irrigation by 5265 m^3 gave the highest values.

With respect to the effect of potassium use efficiency (kg yield/kg K_2O) data in Table (7 and fig.2) indicate that the utilized potassium was decreased with increasing the number of irrigations frequently.

b-Effect of potassium.

Regarding the water use efficiency as affected by potassium fertilization levels the same data presented in Table (7) and fig. (1) show that the amounts of water required to produce one kg of tubers was decreased with increasing levels of potassium application rates up to 120 kg K_2O/fed.

Concerning the effect of potassium use efficiency the same data show that the amount of potassium required to produce one kg of tubers was increased with increasing the used levels of potassium fertilization during both seasons of growth.

Table (7): Effect of irrigation intervals and potassium levels on water and potassium use efficiency of Jerusalem artichoke during seasons of 2006 and 2007.

Season		2006		2007	
Treatments					
Irrigation Intervals (day)	Potassium Levels kg (K_2O/fed.)	Water use efficiency (m^3/kg)	Potassium use efficiency (kg yield/kg K_2O)	Water use efficiency (m^3/kg)	Potassium use efficiency (kg yield/kg K_2O)
5 days		4.45	461	4.16	431
10 days		7.22	396	7.03	385
15 days		6.96	236	6.88	233
L.S.D. at 0.05		**0.23**	**26.12**	**0.58**	**23.71**
	72	5.95	349	5.61	329
	96	6.22	364	6.18	356
	120	6.46	380	6.28	365
L.S.D. at 0.05		**0.217**	**9.66**	**0.34**	**16.83**
5 days	72	4.22	437	4.03	418
	96	4.42	458	4.17	433
	120	4.70	487	4.28	443
10 days	72	7.09	389	6.45	354
	96	7.21	395	7.11	390
	120	7.38	405	7.52	412
15 days	72	6.53	222	6.35	215
	96	7.02	238	7.24	246
	120	7.32	248	7.06	240
L.S.D. at 0.05		**0.37**	**16.74**	**0.59**	**29.15**

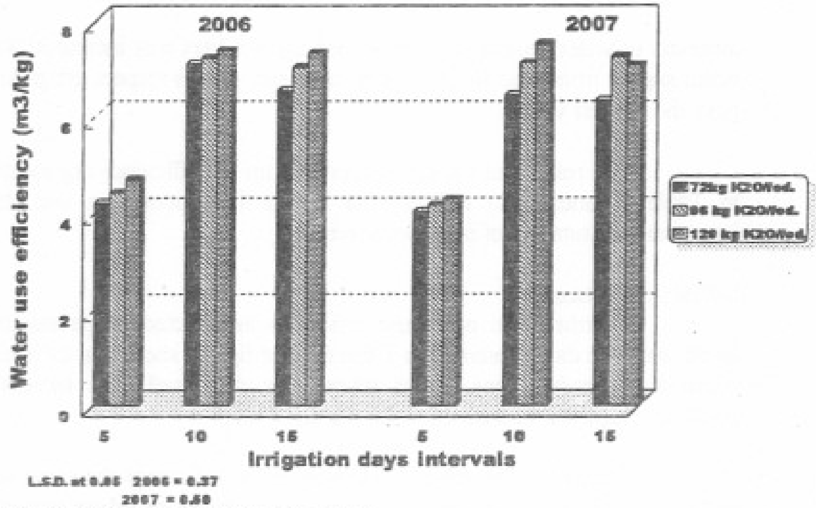

Fig.(1): Water use efficiency (m3/kg)

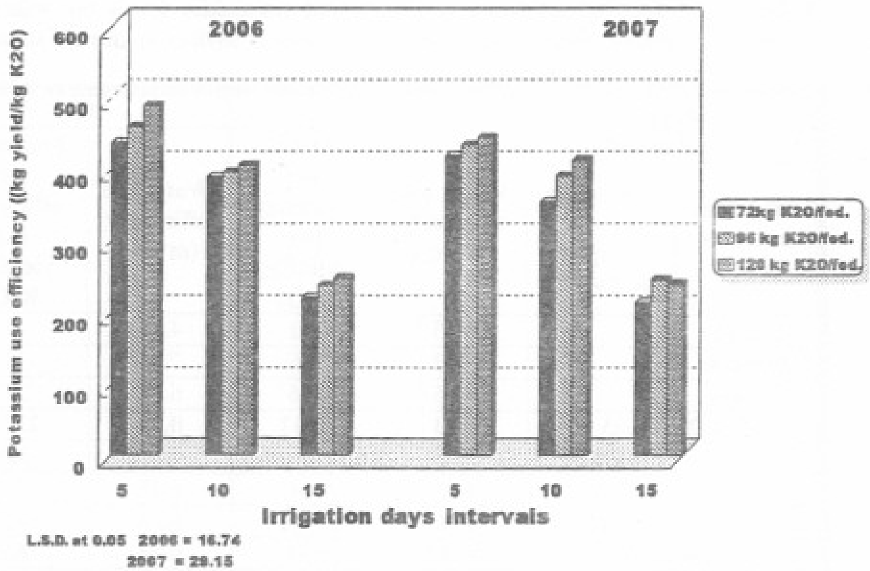

Fig.(2): Potassium use efficiency (kg yield/kg K2O)

Figs. (1 and 2): Effect of the interaction between irrigation intervals and potassium levels on water and potassium use efficiency of Jerusalem artichoke during seasons of 2006 and 2007.

c- Effect of the interaction.

As for the interaction effect, it is obvious from data in Table (7) and fig. (1) that decreasing the amount of water supplied to the plant either through longest the irrigation intervals, i.e., (irrigation every 15 days) or decreasing the irrigation frequencies throughout the growing season and increasing potassium levels up to the highest rates one (120 kg K_2O/fed. resulted in the highest water use efficiency values. In this respect, El-Zohery (1999) and Abo-Sedera *et al.* (2004) on taro.

The same data presented in Table (7) and fig. (2) indicate that decreasing water supply and increasing potassium application up to the highest rates during both season reflected the highest values of potassium use efficiency.

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تأثير فترات الرى والتسميد البوتاسى على الطرطوفة

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أقيمت تجربتان حقليتان بالمزرعة التجريبية لكلية الزراعة بمشتهر جامعة بنها خلال موسمى صيف عام ٢٠٠٦ و ٢٠٠٧ لدراسة تأثير فترات الرى (٥ ، ١٠ و ١٥ يوما) والتسميد البوتاسى بمعدل (٧٢، ٩٦ و ١٢٠ كجم بو٢أ / فدان) على النمو الخضرى والمحصول والجودة فى نبات الطرطوفة وكانت النتائج المتحصل عليها تشير إلى:-

زيادة كمية ماء الرى مثل (الرى كل ٥ أيام) أدى إلى زيادة كل قياسات النمو الخضرى المدروسة مثل (طول النبات– الوزن الطازج للنبات – عدد الفروع الرئيسية للنبات) بينما نسبة المادة الجافة للنبات تأثرت معنويا بخفض كمية الماء وحتى الرى بـ ٤٠٧٢ م^3 /فدان. أدت زيادة التسميد البوتاسى من ٧٢ كجم بو٢أ / فدان وحتى أعلى مستوى مستخدم (١٢٠ كجم بو٢أ / فدان) إلى زيادة كل صفات النمو المدروسة معنوياً (الوزن الطازج للنبات – عدد الفروع الرئيسية للنبات – محتوى النبات من المادة الجافة). أدى التفاعل بين معاملات الرى والتسميد البوتاسى إلى الحصول على زيادة معنوية فى كل قياسات النمو الخضرى الظاهرية وكانت أعلى القيم المتحصل عليها نتيجة الرى كل ١٠ أيام كفترة بين الريات مع استخدام أعلى مستوى من البوتاسيوم (١٢٠ كجم بو٢أ / فدان). أدت زيادة عدد الريات خلال موسم النمو (الرى كل ١٠ أو ٥ أيام) إلى زيادة محصول الدرنات الكلى ومكوناته (عدد الدرنات للنبات – متوسط وزن الدرنة – المحصول الكلى للنبات – المحصول الكلى للفدان). المحتوى الكيماوى للنبات زاد زيادة معنوية فى حالة رى النباتات كل ١٠ أيام كفترة بين الريات. أدت زيادة مستوى التسميد البوتاسى حتى ١٢٠ كجم بو٢أ /فدان إلى زيادة تركيز كل من النتروجين والفوسفور والبوتاسيوم وكذلك الأنيولين فى الدرنات الناتجة. أدى التفاعل بين الرى (كل ١٠ أيام) والتسميد البوتاسى بمعدل (١٢٠ كجم بو٢أ / فدان) إلى الحصول على أعلى القيم لمحتوى الدرنات من عناصر كل من النتروجين والفوسفور والبوتاسيوم وكذلك الأنيولين.

ختاما يمكن القول بأنه تحت مثل هذه الظروف يمكن استخدام معاملة التسميد البوتاسى بمعدل ١٢٠ كجم بو٢أ للفدان مع الرى كل ١٠ أيام للحصول على أقصى نمو خضرى ومحصول عالي الجودة من نبات الطرطوفة.