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Effect of Organo-Chemical Fertilizers Mixtures under the Condition of Irrigation Intervals with Magnetized Water on Yield and its Components of Jerusalem artichoke

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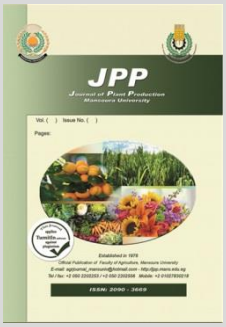

ABSTRACT

Two field experiments were conducted during the two growing seasons of 2017 and 2018 at the Experimental Farm, Sakha Horticulture Research Station, Horticulture Research Institute, Egypt, to study the effect of irrigation intervals, magnetized water, organic and inorganic fertilizers and their combined interactions on yield and its components of Jerusalem artichoke (*Helianthus tuberosus* L.) plants. The results can be summarized as follows: As for irrigation intervals treatments, the treatment were obtained from Jerusalem artichoke plants irrigated every 20 days treatment gave the highest tuber yield (tubers weight /plant and ton/fed), water use efficiency, total carbohydrates. On the other hand, plants irrigated every 25 days recorded the highest values of TSS and tuber inulin in both seasons. Jerusalem artichoke plants irrigated with magnetized water gave the highest yield and its components (number of tubers/plant, tubers weight as ton/fed), water use efficiency as well as the highest values of total carbohydrates, TSS, inulin and tuber vitamin C content compared to the lowest ones resulted in control non-magnetized water treatment in both seasons. Also, the highest yield and its components were recorded when the plants were fertilized by 50% organic + 50% mineral in both seasons. Generally, it could be recommended that the Jerusalem artichoke plants were irrigated with magnetized water every 15 or 20 days and fertilized by 50% organic (FYM compost)+ 50% mineral (NK) produced high tubers yield, improved tuber quality (carbohydrates %, inulin, vitamin C and TSS) and water use efficiency under the conditions of this study.

Keywords: Jerusalem artichoke, Magnetized water, Irrigation intervals, organic and Mineral fertilizers, yield and quality, water use efficiency.

INTRODUCTION

Jerusalem artichoke (*Helianthus tuberosus* L.) is a member of the composite family. Common names in English; Sunroot, Sunchoke, Earth apple and Topinambur. The total vegetation dies in the winter and giving rise to new growth during the spring every year to produce the tubers which used of many applications, i.e., human-diet, medical and industrial (Meijer and Mathijssen 1993).

Water scarcity is one of the limiting factors in crop production, the efficiency of crop production and water use is reduced (Chaves *et al*., 2002). Water in Egypt considered an important economic source because 80% of the water used to agriculture.

Increasing populations and fast economic development in the Nile Basin countries, pollution and environmental degradation are reducing the country's water availability.

Flood irrigation without charging farmers any water price encourages Egyptian farmers to over irrigate their farms. Therefore, calculating the water requirement of the research must be carried out. Several authors reviewed the search for Jerusalem artichoke irrigation scheduling, water deficit and its effect on potato yield (Abubaker *et al*., 2014, Abdel Nabi, 2017) and AL-Juboori *et al*., 2017). Potato yield and water use efficiency were decreased as water deficit increased (Kiziloglu *et al*., 2006). Decreasing the number of irrigations intervals of Jerusalem artichoke increased the total tuber yield and its components; number tuber /plant and total yield/fed (El-Sharkawy and El-Zohiri, 2007). Baba and Simon (2015) found that carrot yield affected by moisture and irrigation frequency. Water stress decreased yield per plant and total yield per fed (El-Zohiri and Abd El-Aal, 2014) and increasing the supplied irrigation increased the total tuber yield and its components of taro plants (Mabhaudhi *et al.*, 2013) and (Saqib *et al.*, 2017) on sweet potato. Fruit characters (El-Sharkawy and El-Zohiri, 2007), carbohydrates (Abou El-khair *et al*., 2011).

The magnetic technology has been investigated since the turn of 19th century; 1980s. The water treated by pass during a magnetic device has been called magnetized water that was successfully use in agriculture irrigation (Racuciu and Creanga, 2006). Magnetized water has many benefits; increasing the leaching of excess soluble salts, dissolving slightly soluble salts such phosphates, sulphates and carbonates and lowering soil alkalinity (Hilal and Hilal, 2000 a, b). Activation of phytohormone production such as gibberellic acid equivalents, indole-3-acetic acid and trans-

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zeatin as well as activation of the bio-enzyme systems that increase in cell activity, which leads to the growth improvement and increase the yield of crop (Abdul Qados and Hozayn, 2010). Many beneficial impacts of magnetizing irrigation water on yield and its components (number of tuber and tuber weight/ plant) of potato plants (Hozayn *et al.,* 2016 and Moussa and Hozayn, 2018). Increased water use efficiency of snow Pea plants (Maheshwari and Grewal, 2009) and sugar beet plants (Hozayn *et al.,* 2013). Showed a substantial reduction of total soluble sugar percentage of potato yielded plants when irrigated with magnetized water compared to ordinary water (Hozayn *et al.,* 2016), increased Vitamin C of husk tomato fruit content (Ahmed and Abd El-Kader, 2016).

Several scientists have researched the positive impacts of organic materials combined with inorganic fertilizer increased the productivity such yield, fruit characters and water use efficiency. The highest tuber yield of potato plants belonged with farmyard manure combined with mineral fertilization (Baniuniene and Zekaite, 2008, Abou El-khair *et al*., 2011) on Jerusalem artichoke (Awad and Ahmed, 2019) and on sweet potato (Adeyeye *et al.,* 2016). Organic-mineral fertilization recorded maximum values of potato tuber total carbohydrates (Abou El-khair *et al*., 2011) and highest content of total sugars (Mitova *et al.,* 2014). Therefore, the objective of this study was therefore to explore the effect of organ-chemical fertilizers, irrigation intervals with or without magnetized water and their interaction on yield, its component and water use efficiency of Jerusalem artichoke (*Helianthus tuberosus* L.) plants.

MATERIALS AND METHODS

The present study was carried out during the two growing seasons of 2017 and 2018 at Sakha Agricultural Research Station Farm, Kafr El-Sheikh Governorate, in North Middle Nile Delta, Egypt, to study the effect of the combinations of irrigation intervals and organic manure plus chemical fertilizers with or without magnetized water and their interactions on yield and its component and water use efficiency of Jerusalem artichoke (*Helianthus tuberosus* L.). Soil samples were collected from the experimental location before tuber planting at a depth of 0-45cm in the first season to determine some mechanical and chemical soil properties (Tables 1and 2). Determination of available soluble cation (nitrogen, phosphorus and potassium) were done according to Jackson (1967).

Table 1. Mechanical, chemical characteristics and soil water constants of soil farm.

Soil depth	Particle size distribution				K	IR	Soil moisture characteristics			Bulk Density
(cm)	Sand (%)	Silt (%)	Clay (%)	Soil texture	Cm/d	Cm/h	F.C (%)	WP(%)	AW(%)	(kg/m)
0-15	15.76	31.70	52.54	clayey	2.15	0.65	42.50	22.6	19.90	1.29
15-30	14.84	30.86	54.30				40.60	21.8	18.80	1.36
30-45	14.67	30.61	54.72				38.91	20.7	18.21	1.43
Mean	15.63	31.06	53.85				40.67	21.7 0	18.97	1.36

FC: Field capacity, WP: wilting point, AW: available water, IR: infiltration rate, K: hydraulic conductivity

Table 2. Some chemical characteristics for the farm soil at different depths.

Soil depth	pH	EC	SAR	Esp	Soluble cations(Meq/L)				Solubleanions(Meq/L)		
(cm)		(dS/m)			Na^{+}	Ca^{+2}	Mg^{+2}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{-}
0-15	8.42	4.03	7.81	11.09	22.5	5.85	10.75	0.35	4.7	12.0	22.75
15-30	8.45	4.22	13.37	17.37	31.0	3.45	7.30	0.10	3.15	9.6	29.1
30-45	8.60	4.29	14.06	18.09	30.0	3.80	5.30	0.15	1.55	7.2	30.50
Mean	8.49	4.18	11.75	15.52	27.83	4.37	7.78	0.20	3.13	9.6	27.45

The experiment included 30 treatments, representing the combinations of three irrigation intervals (15, 20 and 25 days), two magnetized water (non-magnetized and magnetized water) and four organic and mineral (NK) fertilizers (100% organic, 100% mineral, 25% organic + 75% mineral, 50% organic + 50% mineral and 75% organic + 25% mineral) treatments. Each experimental unit included three ridges; 7.0 m length and 0.7 m width resulted an area about 14.7 m^2. The design of the experiment was a strip-split plot with three replication the main plots were assigned for the three irrigation intervals. The sub-plots included two magnetized and non-magnetized water treatments, whereas the sub-sub plots were devoted for the four fertilizer sources treatments. Tuber seeds of Jerusalem artichoke cv. Baladi were purchased from Agricultural Research Center and planted on 15th and 20th May in 2017 and 2018 in both seasons, respectively. Tubers were planted in hills with about 45 cm apart on one side of the ridge (Tubers treated with Rizolx, wp 70% as fungicide before planting).

The chemical fertilizer as Calcium super phosphate (15.5% P_2O_5) was applied once during soil preparation. While, both ammonium nitrate (33.5% N) was added in two equal doses, the first one was added after 21days from tuber seed planting and the second one was after 60 days from the first dose and potassium sulphate (48% K_2O) was applied twice with nitrogen fertilizer as above mentioned. As for FYM compost; 0.8 % N was added once before planting according the different of treatments in both seasons. The quantity of organic and chemical (NK) fertilizers were shown in Table (3).

Table 3. The experimental treatments of organic and chemical (NK) fertilizers mean of the two seasons.

Fertilization	Amount of fertilizers (Kg/fed.)		
treatments	FYM (m^3/fed)	Ammonium nitrate	Potassium sulphate
100% mineral	-	210.3	206
100% organic (FYM compost)	20.2	-	-
75% organic + 25% chemical	15.1	52.6	51.4
50% organic + 50% chemical (NK)	10.1	105.1	103
25% organic +75% chemical	5.1	157.7	154.1

Irrigation treatments; before start irrigation treatment all plots under the study were watered after planting immediately and received equal amount of water. The amount of the irrigation water was calculated by the following equation (Michael, 1978).

$$Q = CA\sqrt{2gh}$$

Where:

Q= Discharge through orifice (L/ sec)
C= Coefficient of discharge (0.61)
A= Cross section area of the orifice, (m^2)
g= Acceleration due to gravity, cm/sec^2 (98/cm/sec^2).
h= Pressure head, causing discharge through the orifice (cm).

The quantity of irrigation water applied (m^3/fed) in the different irrigation treatments during each growing season were tabulated in Table (4).

Table 4. The quantity of irrigation water applied (m^3/fed) and numbers of irrigation (mean of two seasons)

Irrigation intervals	No. of irrigations	Irrigation water applied (m^3/fed /seasons)
15 days (control)	9	4159
20 days	7	4013
25 days	5	3861

All irrigation treatment (magnetized or non-magnetized water) were started after 40 days of full germination (25 and 30 June in 2017 and 2018 season, respectively).

Magnetized water; It was obtained by passing the water through a magnetic device 1000 gauss magnetron unit, 1inch diameter supplied by Delta water Company, Alexandria, Egypt

All cultural practice; pests and diseases control... etc., were done when it was necessary according to the recommendation of the commercial production of Jerusalem artichoke as outlined by Ministry of Agriculture and Land Reclamation (2007).

Data recorded:

1. Tubers yield and water use efficiency (WUE):

The tubers of each plot at harvest time 15th and 20th November in 2017 and 2018 seasons, respectively (After 180 days from planting) were harvested and the data for the following traits was done:

1. Number of tubers/ plant
2. Yield /plant
3. Yield /fed. It was recorded as total weight of harvested tubers/plot and converted into ton /fed.
4. Water use efficiency (WUE) was calculated according to Ali *et al.* (2007) as follow:

WUE = tubers yield (kg/fed.) / Water applied (m^3 /fed.)

2. Tubers characters:

1. Total carbohydrates (%), was determined according to the methods of Somogy (1952).
2. Inulin content (%), was determined in tubers according to the methods of Winton and Winton (1985).
3. Vitamin C content (Ascorbic acid) in tuber juice was determined in three samples per treatment, using 2, 6-dichlorophenol indophenol solutions as described in (A.O.A.C., 1995).
4. Total soluble solids (%), was measured in the juice of tubers by using hand Refractometer (A.O.A.C., 1995).

Statistical analysis:

Data were analyzed by MSTATC computer software program (Bricker, 1991). The obtained data were subjected to analysis of variance according Little and Hills (1975). Duncan's multiple range test; DMRT (Duncan, 1955) at 5% level was used to compare the means.

RESULTS AND DISCUSSION

Effect of irrigation intervals:

The response of Jerusalem artichoke plants to irrigation intervals on tuber yield characters, the data as shown in Table (5) pointed out that number of tubers/plant was significantly influenced by irrigation intervals treatments, Plants irrigated every 15 days resulted in the greatest values in this respect followed by irrigation every 20 and 25 days, respectively in both seasons without significant differences between each of them in the second one. The highest yield as kg /plant recorded with irrigation intervals treatment every 20 days followed by 15 days compared with 25 days which had the lowest ones in both seasons.

Table 5. Effect of irrigation intervals (A), magnetized irrigation water (B) and fertilizer sources (C) on number of tubers, tubers weight per plant, tubers weight per fed and water use efficiency (WUE) of Jerusalem artichoke plant during 2017 and 2018 seasons.

Treatments	No. of tubers/ plant		Tubers weight(kg/ plant)		Tubers weight(ton/ fed)		WUE	
	2017	2018	2017	2018	2017	2018	2017	2018
A- Irrigation intervals (day)								
15	35.90 a	37.46 a	1.52 b	1.61 a	28.87 b	30.81 a	9.21 b	9.55 b
20	31.83 b	27.63 b	1.58 a	1.69 a	30.04 a	32.20 a	10.15a	10.53 a
25	28.36 c	27.63 b	1.15 c	1.30 b	22.08 c	24.81 b	7.83 c	8.46 c
F. test	**	**	**	**	**	**	**	**
B- Magnetized irrigation water								
Non magnetized	27.93 b	27.48	1.30 b	1.40 b	24.87 b	26.66 b	8.69	9.01
Magnetized	36.13 a	34.33	1.52 a	1.67 a	29.11 a	31.89 a	9.43	10.01
F. test	**	NS	*	*	*	*	NS	NS
C- Fertilizer sources								
100 % organic	26.11 c	24.06 e	1.14 d	1.26 d	21.77 d	24.01d	6.74 c	7.19 c
100% mineral	27.27 c	28.11 d	1.33 c	1.44 c	25.42 c	27.51 c	9.45 b	9.84 b
25% organic+75% mineral	32.33 b	31.88 b	1.60 b	1.73 b	30.53 b	33.09 b	10.78 a	11.28 a
50% organic+50% mineral	40.94 a	39.72 a	1.78 a	1.90 a	33.92 a	36.24 a	11.07 a	11.56 a
75% organic +25% mineral	33.50 b	30.78 c	1.22 d	1.34 d	23.35 d	25.52 d	7.27 c	7.71 c
F. test	**	**	**	**	**	**	**	**

****, * and N.S indicate significant differences at P<0.01, P<0.05 and not significant, respectively according to F. test. Values having same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's test.**

With respect to the effect of irrigation intervals on yield as ton /fed and WUE, results presented in Table (5) show that plants irrigated every 20 days gave the highest values of these aforementioned characters with highly significant differences, followed by that irrigated every 15 days and finally 25 days in both seasons. The results are the same for both seasons. These results are agree with those obtained by El-Sharkawy and El-Zohiri (2007), Abou El-khair *et al*. (2011). In the same line, Khalel (2015) on potato plants, the same results were harmony with Wang *et al.* (2006) on potato plants, Saleh *et al.* (2012) on artichoke, Jasim and Ibraheem (2018) on potato plants.

Effect of magnetized irrigation water:

The data obtained in Table (5) show the effect of irrigation water treatments (magnetized and non-magnetized water) on yield and its components of Jerusalem artichoke plants; tuber number per plant, tuber kg/plant and tuber as ton/fed were significant in both seasons, except number of tubers in the second one as the differences were not significant. As for water use efficiency, plants irrigated with magnetized water not significantly affected compared to the control (normal irrigation water) in the both season. The highest values of tuber number, yield as kg/plant and ton/fed and water use efficiency recorded with magnetized irrigation water treatment, on the other hand, the least values were obtained from control (non-magnetized water) treatment in both seasons. The noticeable increase in yield and its components produced by magnetized water have been reported by Moussa and Hozayn (2018) concluded that, irrigation potato plants with magnetized water caused an increment of potato tubers yield as compared to using ordinary water.

Effect of fertilizer sources:

With respect to effect of fertilizer sources (organic and mineral) on tubers characters, data tabulated in Table (5) showed that, the treatment of 50% organic + 50% mineral gave the highest number of tubers/plant, tubers kg/plant, tubers as ton/fed and water use efficiency followed by the treatment of 25 % organic + 75% mineral. The lowest values of the parameters realized for the plants fertilized with 100% organic, the other treatments gave an intermediate values in both seasons. The superiority of organic fertilization 50% + 50% of recommended mineral fertilizer dose on number of tubers/plant and tubers weight/plant, tuber weight as ton/fed and water use efficiency might be attributed to the favorable effect tubers yield and quality (Mirdad 2010), Abou El-khair *et al.* (2011), Elsharkawy (2013), El-Sayed *et al*. (2014), reported similar results on potato plants. Such findings are in harmony with those reported by Mitova *et al*. (2014) on tuber properties, Habimana *et al.* (2014) on marketable root yield of carrot and the lowest values were in the control treatment.

Effect of interactions:

Effect of interaction between irrigation intervals and magnetized irrigation water on number of tubers, tubers weight plant^{-1}, tubers weight per fed and water use efficiency (WUE) of Jerusalem artichoke plant during 2017 and 2018 seasons.

Data in Table (6a) demonstrated that the number of tubers/plant, tuber weight /plant and /fed) and water use efficiency were not significantly affected by the interaction between irrigation intervals and magnetized irrigation water treatments in both season. In addition, the plants irrigated by magnetized water every 15 days tended to have the highest tubers number/plant in both seasons, meanwhile, yield as kg/plant and ton/fed were obtained from plants irrigated by magnetized water every 20 days followed by every15 days in both seasons. The plants irrigated with magnetized water followed by those irrigated by non-magnetized water every 20 days tended to record the highest values in both seasons.

Table 6a. Effects of interactions between irrigation intervals and magnetized irrigation water on number of tubers, tubers weight plant^{-1}, tubers weight per fed and water use efficiency (WUE) of Jerusalem artichoke plant during 2017 and 2018 seasons.

Treatment		No of .tubers /plant		Tubers weight (kg/ plant)		Tubers weight (ton/fed)		WUE	
Irrigation intervals (day)	Magnetized irrigation water	2017	2018	2017	2018	2017	2018	2017	2018
15	Non magnetized	33.40	34.27	1.40	1.48	26.82	28.35	8.84	9.11
	Magnetized	38.40	40.67	1.62	1.74	30.92	33.27	9.58	9.99
20	Non magnetized	26.20	24.93	1.49	1.56	28.48	29.88	10.02	10.20
	Magnetized	37.47	30.33	1.65	1.81	31.60	34.52	10.26	10.86
25	Non magnetized	24.20	23.27	1.01	1.14	19.32	21.75	7.20	7.73
	Magnetized	32.53	32.00	1.30	1.46	24.82	27.87	8.46	9.19
F. test.		NS	NS	NS	NS	NS	NS	NS	NS

N.S indicate significant differences at not significant, respectively to F. test.

Values having same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's test.

Effect of interaction between irrigation intervals and fertilizer source on number of tubers, tubers weight plant^{-1}, tubers weight per fed and water use efficiency (WUE) of Jerusalem artichoke plant during 2017 and 2018 seasons.

Data in Table (6b) showed that the plants fertilized with 50% mineral + 50% organic followed by those fertilized with 25% organic + 75% mineral and watered every 15 and 20 days produced the highest number of tubers/plants, meanwhile the highest values of tubers weight as kg/plant, ton/fed and water use efficiency recorded with plants irrigated every 20 days treatment in both seasons. On the other hand, the plants irrigated every 25 days and fertilized with 100 % organic fertilizer tended to produce the lowest values compared with other treatments which gave an intermediate value in both seasons. Results showed that there were significant differences between the interaction treatments of irrigation intervals and fertilizer sources on the abovementioned tuber characters in both seasons.

Effect of interaction between magnetized irrigation water and fertilizer source on number of tubers, tubers weight plant^{-1}, tubers weight per fed and water use efficiency (WUE) of Jerusalem artichoke plant during 2017 and 2018 seasons.

Concerning the effect of the combined interaction between magnetized water and fertilizer sources, Data obtained during 2017 and 2018 seasons and presented in

Table (6c) evident that, there were not statistical differences within all treatments of tubers number, tubers weight/plant, tubers weight as ton/fed and water use efficiency in both seasons, except number of tubers in the second as the differences were highly significant. The highest number of tubers per plant, tubers weight per plant as kg/plant and ton per fed resulted by plants irrigated with magnetized irrigation water and fertilized with 50% mineral + 50% organic, followed by 25%organic + 75% mineral treatments compared to the lowest values obtained from plants which irrigated with the normal irrigation water and fertilized by 100% organic treatment in both seasons.

Table 6b. Effects of interactions between irrigation intervals and fertilizer sources on number of tubers, tubers weight plant^{-1}, tubers weight per fed and water use efficiency (WUE) of Jerusalem artichoke plant during 2017 and 2018 seasons.

Treatment		No of. tubers /plant		Tubers weight (kg/ plant)		Tubers weight (ton/fed)		WUE	
Irrigation intervals (day)	Fertilizer sources	2017	2018	2017	2018	2017	2018	2017	2018
15	100 % organic	31.33bc	30.16b-d	1.20 d-f	1.29 e-g	22.95 d-f	24.60 e-g	6.67 h	6.96 h
	100% mineral	31.83bc	35.66b	1.42 c	1.50 cd	27.17 c	28.67 cd	9.35 d	9.54 e
	25% organic+75% mineral	36.16a-c	37.33 b	1.76 b	1.87 b	33.65 b	35.72 b	11.26 bc	11.53 cd
	50% organic+50% mineral	46.83a	50.83a	1.90 ab	2.02 b	36.19 ab	38.57 b	11.48 bc	12.01 bc
	75% organic +25% mineral	33.33 bc	33.33 bc	1.28 c-e	1.39c-f	24.38 c-e	26.51 c-f	7.29 f-h	7.73 gh
20	100 % organic	28.66b-d	21.16 d	1.21d-f	1.33 d-g	23.05 d-f	25.36 d-g	7.08 gh	7.56 gh
	100% mineral	25.66cd	24.16 cd	1.45 c	1.54 c	27.68 c	29.33 c	10.64 c	10.80 d
	25% organic+75% mineral	31.16bc	28.00b-d	1.82 b	1.96 b	34.73 b	37.37 c-e	12.13 ab	12.65 ab
	50% organic+50% mineral	40.16ab	35.50 b	2.06 a	2.20 a	39.30 a	42.00 a	12.79 a	13.38 a
	75% organic +25% mineral	33.50bc	29.33 b-d	1.33 cd	1.41 c-e	25.46 cd	26.95 c-e	8.08 e-g	8.28 fg
25	100 % organic	18.33d	20.83 d	1.01 g	1.15 g	19.30 g	22.07 g	6.46 h	7.04 h
	100% mineral	24.33cd	24.50 cd	1.12e-g	1.28 e-g	21.40e-g	24.54 e-g	8.35 d-f	9.19 ef
	25% organic+75% mineral	29.66b-d	30.33 b-d	1.21 d-f	1.37 c-f	23.20d-f	26.19 c-f	8.96 de	9.65 e
	50% organic+50% mineral	35.83a-c	32.83 bc	1.37 cd	1.47 cd	26.26 cd	28.16 cd	8.94 de	9.27 ef
	75% organic +25% mineral	33.66bc	29.66 b-d	1.06 fg	1.21 fg	20.22 fg	23.11 fg	6.45 h	7.13 h
F. test		**	**	**	**	**	**	**	**

**** indicate significant differences at P<0.01 according to F. test. Values having same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's test.**

Table 6c. Effects of interactions between magnetized irrigation water and fertilizer sources on number of tubers, tubers weight plant^{-1}, tubers weight per fed and water use efficiency (WUE) of Jerusalem artichoke plant during 2017 and 2018 seasons.

Treatment		No of. tubers /plant		Tubers weight (kg/ plant)		Tubers weight (ton/fed)		WUE	
Magnetized Irrigation water	Fertilizer sources	2017	2018	2017	2018	2017	2018	2017	2018
Non magnetized	100 % organic	22.444	23.11 d	1.06	1.17	20.25	22.28	6.55	6.94
	100% mineral	24.111	25.00 cd	1.21	1.30	23.21	24.82	9.04	9.27
	25% organic+75% mineral	24.444	26.00 cd	1.46	1.56	27.91	29.78	10.30	10.57
	50% organic+50% mineral	38.778	37.33 ab	1.64	1.71	31.26	32.70	10.50	10.83
	75% organic +25% mineral	29.889	26.00 cd	1.14	1.24	21.73	23.72	7.05	7.45
Magnetized	100 % organic	29.778	25.00 cd	1.22	1.35	23.28	25.73	6.92	7.44
	100% mineral	30.444	31.22 bc	1.45	1.58	27.61	30.20	9.85	10.41
	25% organic+75% mineral	40.222	37.77 ab	1.74	1.91	33.14	36.40	11.26	11.97
	50% organic+50% mineral	43.111	42.11 a	1.92	2.09	36.57	39.79	11.64	12.28
	75% organic +25% mineral	37.111	35.55 ab	1.31	1.43	24.97	27.32	7.50	7.97
F. test		NS	**	NS	NS	NS	NS	NS	NS

**** and NS indicate significant differences at P<0.01 and not significant, respectively according to F. test.**
Values having same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's test.

Effect of the combined interactions among irrigation intervals, magnetized irrigation water and fertilizer sources on number of tubers, tubers weight plant^{-1}, tubers weight per fed and water use efficiency (WUE) of Jerusalem artichoke plant during 2017 and 2018 seasons.

Results in Table (6d) indicated a significant variance due to interaction effect of various combinations on number of tubers/plant in the second season only. Tubers weight as kg/plant, ton/fed and water use efficiency not significantly affected by the combined interaction treatments in both seasons. The plants irrigated every15 days and fertilized with 50% mineral + 50% organic fertilizer by non-magnetized water in the first season and magnetized water in the second one produced the highest number of tubers/plant. In addition, yield as kg/plant, ton/fed and water use efficiency were increased under the combination treatments of plants irrigated every 20 days with magnetized water compared with other treatments in both seasons.

1.Tubers characters:

Effect of irrigation intervals:

Concerning the effect of irrigation intervals treatments (15, 20 and 25 days) on carbohydrates contents, TSS, inulin and vitamin C tuber content, the obtained results presented in Table (7) cleared that, irrigation intervals treatments were resulted in a highly significant increase in the above-mentioned characters in both seasons.

Table 6d. Effect of the combined interactions among irrigation intervals, magnetized irrigation water and fertilizer sources on number of tubers, tubers weight plant^{-1}, tubers weight per fed and water use efficiency (WUE) of Jerusalem artichoke plant during 2017 and 2018 seasons.

Treatment			No. of tubers /plant		Tubers weight (kg/plant)		Tubers weight (ton/fed)		WUE	
Irrigation intervals (day)	Magnetized irrigation water	Fertilizer sources	2017	2018	2017	2018	2017	2018	2017	2018
15	NMW	F1	30.000	31.00f-i	1.11	1.18	21.14	22.54	6.35	6.60
		F2	29.667	33.33d-h	1.32	1.37	25.14	26.22	8.97	9.06
		F3	29.000	30.66e-i	1.60	1.70	30.48	32.38	10.64	10.86
		F4	50.667	50.33ab	181	1.88	34.60	35.87	11.19	11.56
		F5	27.667	26.00h-m	1.19	1.30	22.73	24.76	7.03	7.48
	MW	F1	32.667	29.33f-k	1.30	1.40	24.76	26.66	6.99	7.33
		F2	34.000	38.00c-e	1.53	1.63	29.20	31.11	9.72	10.03
		F3	43.333	44.00bc	1.93	2.05	36.82	39.05	11.87	12.19
		F4	43.000	51.33a	1.98	2.16	37.78	41.27	11.77	12.46
		F5	39.000	40.66cd	1.36	1.48	26.03	28.25	7.56	7.98
20	NMW	F1	24.667	20.66l-n	1.15	1.27	21.96	24.31	7.03	7.54
		F2	22.000	21.66k-n	1.37	1.39	26.16	26.60	10.62	10.30
		F3	25.000	27.00h-m	1.72	1.77	32.89	33.78	11.95	11.97
		F4	34.667	33.33d-h	1.95	2.05	37.14	39.05	12.45	12.96
		F5	24.000	22.00j-n	1.27	1.34	24.25	25.65	8.07	8.24
	MW	F1	32.667	21.66k-n	1.26	1.38	24.12	26.41	7.13	7.58
		F2	29.333	26.66h-m	1.53	1.68	29.20	32.06	10.66	11.28
		F3	37.333	29.00g-k	1.92	2.15	36.57	40.95	12.30	13.33
		F4	45.667	37.66c-e	2.17	2.36	41.46	44.95	13.12	13.79
		F5	42.333	36.66c-g	1.40	1.48	26.66	28.25	8.09	8.32
25	NMW	F1	12.333	17.66n	0.92	1.05	17.65	20.00	6.27	6.68
		F2	20.667	20.00mn	0.96	1.13	18.35	21.65	7.54	8.45
		F3	19.333	20.33[-n	1.07	1.21	20.38	23.17	8.31	8.90
		F4	31.000	28.33h-l	1.15	1.21	22.03	23.17	7.86	7.96
		F5	37.000	30.00e-j	0.95	1.09	18.22	20.76	6.05	6.65
	MW	F1	24.000	24.00i-n	1.10	1.26	20.95	24.12	6.64	7.41
		F2	28.000	29.00g-k	1.28	1.44	24.44	27.43	9.17	9.93
		F3	40.000	40.33cd	1.36	1.53	26.03	29.20	9.60	10.39
		F4	40.667	37.33c-f	1.60	1.74	30.47	33.14	10.03	10.59
		F5	30.000	29.33f-k	1.16	1.33	22.22	25.46	6.86	7.62
F. test			NS	**	NS	NS	NS	NS	NS	NS

NMW= non-magnetizes water, MN= magnetized water, F1= 100% organic, F2=100 % mineral, F3= 25% org+75% min, F4= 50% org+50% min F5=75% org+25% min,. **, * and NS indicate significant differences at P<0.01, P<0.05 and not significant, respectively according to F. test. Values having same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's test.

Table 7. Effects of irrigation intervals (A), magnetized irrigation water (B) and fertilizer sources (C) of total carbohydrates, total soluble solids, inulin and Vitamin C of Jerusalem artichoke plant during 2017 and 2018 seasons.

Treatments	Total carbohydrates (%)		TSS (%)		Inulin (%)		Vitamin C mg/100g F.W	
	2017	2018	2017	2018	2017	2018	2017	2018
A- Irrigation intervals (day)								
15	33.30b	34.38b	14.34b	16.44b	10.39 c	10.91b	8.26 a	8.85 a
20	35.58a	36.20a	23.35a	24.01a	11.39b	11.86a	7.46 b	7.91 b
25	32.13b	33.07c	24.12a	24.84a	11.77a	11.89a	7.34 b	7.26 c
F. test	**	**	**	**	**	*	**	**
B- Magnetized irrigation water								
Non magnetized	28.78b	29.32b	20.14	21.15b	10.46	10.44b	7.62	7.90
Magnetized	38.55a	39.78a	21.06	22.37a	11.90	12.66a	7.76	8.11
F. test	*	**	NS	**	NS	*	NS	NS
C- Fertilizer sources								
100 % organic	32.25d	33.20d	20.7bc	21.92b	10.39d	10.68d	6.83b	7.47c
100% mineral	30.41e	31.32e	19.08d	20.29c	10.02e	10.45d	7.10b	6.71d
25% organic+75% mineral	34.88b	36.17b	20.87b	22.17b	11.83b	12.31b	8.49a	8.60b
50% organic+50% mineral	37.45a	37.71a	22.55a	23.57a	12.69a	13.05a	8.84a	9.75a
75% organic +25% mineral	33.34c	34.36c	19.8cd	20.88c	10.97c	11.29c	7.19b	7.49c
F. test	**	**	**	**	**	**	**	**

****, * and NS indicate significant differences at P<0.01, P<0.05 and not significant, respectively according to F. test. Values having same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's test.**

The highest values of total carbohydrates produced from plants irrigated every 20 days comparing with the other irrigation intervals. About the effect of irrigation intervals on TSS % and inulin contents results indicate that increasing irrigation intervals form 15 up to 25 days resulted in an increment of TSS and inulin in both seasons. On the other hand, tuber vitamin C content had an adverse trend; 15days intervals had the highest value followed by 20 and 25 days, respectively in both seasons. Ezzat *et al.* (2015) obtained similar positive effects on Jerusalem artichoke plants. Also, El-Sharkawy and El-Zohiri (2007) on Jerusalem artichoke, Kumar *et al.* (2009) and Abou El-khair *et al*. (2011) on potato plants.

Effect of magnetized irrigation water

The data obtained in Table (7) show that total carbohydrates significantly affected by treatments in both seasons, TSS and inulin in the second one. On the other hand, tuber vitamin C content not significantly affected in both seasons. The magnetized irrigation water treatment had the highest values of total carbohydrates, TSS, inulin and vitamin C tuber content of Jerusalem artichoke comparing with normal irrigation water treatment in both seasons. These previously mentioned results seemed to agree with those reported by. Hozayn *et al.* (2016) and Ahmed Abd El-Kader (2016) on potato.

Effect of fertilizer source:

With respect to the effect of fertilizer sources (organic and mineral) on tubers total carbohydrates, TSS, inulin and vitamin C tuber content, data tabulated in Table (7) show that, the treatment of 50% inorganic + 50% organic gave the highest values of tuber characters followed by the treatment of 25% organic + 75% mineral compared to the lowest values of these parameters which were realized for the plants were fertilized with 100% organic in both seasons. Other treatments gave an intermediate values, The differences among fertilizer sources treatments were highly significant affected in both seasons. Such findings are in harmony with those reported by Anwar *et al.* (2011) on Jerusalem artichoke, Mitova *et al.* (2014) and Ahmed *et al.* (2015) on potato plants.

Effect of interactions:

Effect of interaction between irrigation intervals and magnetized irrigation water on total carbohydrates, total soluble solids, inulin and Vitamin C of Jerusalem artichoke plant during 2017 and 2018 seasons.

Results presented in Table (8a) cleared that the interaction effect of various combinations between irrigation intervals and magnetized irrigation water treatment son tubers inulin content was highly significant in the second season only. While, there was non-significant variance due to the interaction effect of various combinations between irrigation intervals and magnetized irrigation water treatments on total carbohydrates, TSS and vitamin C tubers content in both seasons. Plants watered with magnetized water every 20 gave the highest records of total carbohydrates, tubers TSS and inulin in both seasons. On the other hand, plants irrigated with non-magnetized water every 25 and 15 days gave the highest values of vitamin C content in both seasons, respectively.

Effect of interaction between irrigation intervals and fertilizer source on total carbohydrates, total soluble solids, inulin and Vitamin C of Jerusalem artichoke plant during 2017 and 2018 seasons.

Results presented in Tables (8b) show that, the interaction between irrigation intervals and fertilizer sources had a non-significant effect on total carbohydrates, TSS and vitamin c contents of tubers in both seasons, indicated a significant variance due to interaction effect of various combinations as for tuber inulin in both seasons.

Table 8a. Effects of interactions between irrigation intervals and magnetized irrigation water of total carbohydrates, total soluble solids, inulin and Vitamin C of Jerusalem artichoke plant during 2017 and 2018 seasons.

Treatment		Total carbohydrates (%)		TSS (%)		Inulin (%)		Vitamin C mg/100g F.W	
Irrigation intervals (day)	Magnetized irrigation water	2017	2018	2017	2018	2017	2018	2017	2018
15	Non magnetized	28.06	28.38	13.89	15.60	10.18	10.39de	8.37	8.93
	Magnetized	38.78	39.72	14.79	17.28	10.59	11.43c	8.17	8.77
20	Non magnetized	30.47	30.54	22.35	23.04	9.75	10.04e	7.41	7.82
	Magnetized	40.68	41.86	24.36	24.97	10.03	13.67a	7.52	7.99
25	Non magnetized	27.82	29.04	24.19	24.81	11.46	10.90cd	7.09	6.95
	Magnetized	36.18	37.74	24.06	24.88	12.08	12.89b	7.59	7.58
F. test.		NS	NS	NS	NS	NS	**	NS	NS

**** and NS indicate significant differences at P<0.01 and not significant, respectively according to F. test. Values having same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's test.**

Table 8 b. Effects of interactions between irrigation intervals and fertilizer sources of total carbohydrates, total soluble solids, inulin and Vitamin C of Jerusalem artichoke plant during 2017 and 2018 seasons.

Treatment		Total carbohydrates (%)		TSS (%)		Inulin (%)		Vitamin C mg/100g F.W	
Irrigation intervals (day)	Fertilizer sources	2017	2018	2017	2018	2017	2018	2017	2018
15	100 % organic	30.84	31.813	15.100	16.850	9.79hi	10.09e	7.900	8.583
	100% mineral	29.33	29.995	13.400	14.533	9.35i	10.01e	6.817	6.917
	25% organic+75% mineral	32.82	34.328	13.383	16.783	10.88d-f	11.38cd	9.350	9.750
	50% organic+50% mineral	37.66	38.140	16.600	18.333	11.45cd	11.96bc	9.783	10.917
	75% organic +25% mineral	32.36	33.830	13.217	15.700	10.45f-h	11.07c-e	7.483	8.083
20	100 % organic	34.43	35.175	23.400	24.217	10.50e-g	11.04c-e	6.083	7.133
	100% mineral	31.28	32.130	20.717	22.250	9.88g-i	10.36de	7.383	6.250
	25% organic+75% mineral	37.45	38.305	24.283	24.733	12.00bc	12.84ab	8.367	8.200
	50% organic+50% mineral	39.42	39.628	25.267	25.600	13.29a	13.61a	8.550	10.033
	75% organic +25% mineral	35.30	35.777	23.117	23.233	11.27d	11.45cd	6.950	7.933
25	100 % organic	31.47	32.610	23.650	24.683	10.86d-f	10.92c-e	6.500	6.717
	100% mineral	30.63	31.843	23.133	24.083	10.82d-f	10.96ab	7.100	6.983
	25% organic+75% mineral	34.37	35.867	24.950	25.000	12.62b	12.69ab	7.767	7.850
	50% organic+50% mineral	35.26	35.360	25.800	26.767	13.32a	13.55a	8.200	8.317
	75% organic +25% mineral	32.375	33.472	23.083	23.700	11.21de	11.32cd	7.150	6.467
F. test		NS	NS	NS	NS	**	**	NS	NS

**** and NS indicate significant differences at P<0.01 and not significant, respectively according to F. test.**
Values having same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's test.

The combination treatment every 20 days with 50% mineral + 50% organic tabulated the highest records of total carbohydrates, inulin every 25 and 20 days without significant differences between each of them. Meanwhile those irrigated every 25 days and fertilized with 50% mineral + 50% organic gave the highest values of TSS compared with 15 days treatment which tended to score the vitamin C tuber content with the same of fertilized treatment.

With respect to the effect of interaction between irrigation intervals and fertilizer sources on total carbohydrates, TSS and vitamin C tubers contents, results presented in Table (8b) indicate that, the differences were non-significant affected by the combined interaction treatments in both seasons, except inulin tuber content as the differences were highly significant in both seasons. The plants fertilized with 50% mineral + 50% organic ether every 25 or 20 days recorded the highest values in both seasons.

Effects of interactions between magnetized irrigation water and fertilizer sources on total carbohydrates, total soluble solids, inulin and Vitamin C of Jerusalem artichoke plant during 2017 and 2018 seasons

Data in Table (8c) evident that, there were statistical differences within all treatments of tuber TSS in both seasons and inulin in the first season. The combination treatments of magnetized irrigation water and 50% mineral + 50% organic followed by normal irrigation water with 50% mineral + 50% organic treatments gave the highest values of tuber TSS and inulin in both seasons compared with the combination treatment of normal irrigation water and 100% mineral which recorded the lowest values in both seasons.

Effect of the combined interactions among irrigation intervals, magnetized irrigation water and fertilizer sources on total carbohydrates, total soluble solids, inulin and vitamin C of Jerusalem artichoke plant during 2017 and 2018 seasons.

Data in Tables (8 d) show that, the interaction effect among all treatments of irrigation intervals, magnetized irrigation water and fertilizer sources were non- significant differences of total carbohydrates, vitamin C and inulin tuber content in both seasons and TSS in the first season only.

Table 8c. Effects of interactions between magnetized irrigation water and fertilizer sources of total carbohydrates, total soluble solids, inulin and Vitamin C of Jerusalem artichoke plant during 2017 and 2018 seasons.

Treatment		Total carbohydrates (%)		TSS (%)		Inulin (%)		Vitamin C mg/100g F.W	
Magnetized irrigation water	Fertilizer sources	2017	2018	2017	2018	2017	2018	2017	2018
Non magnetized	100 % organic	28.060	28.898	21.26ab	22.38 b	9.68e	9.47	6.944	7.289
	100% mineral	26.671	27.396	18.23c	19.66 c	9.60e	9.51	6.800	6.544
	25% organic+75% mineral	28.997	29.971	20.21bc	21.56bc	11.30c	11.38	8.400	8.878
	50% organic+50% mineral	31.868	31.524	21.31ab	22.36 b	11.75bc	11.83	8.567	9.133
	75% organic +25% mineral	28.346	28.829	19.70 bc	19.76 c	9.97de	10.00	7.411	7.678
Magnetized	100 % organic	36.434	37.501	20.16 bc	21.44bc	11.08c	11.89	6.711	7.667
	100% mineral	34.162	35.250	19.93 bc	20.91bc	10.43d	11.38	7.400	6.889
	25% organic+75% mineral	40.771	42.362	21.53 ab	22.77 ab	12.36b	13.22	8.589	8.322
	50% organic+50% mineral	43.036	43.894	23.80 a	24.76 a	13.62a	14.26	9.122	10.378
	75% organic +25% mineral	38.348	39.890	19.91 bc	21.98 bc	11.98b	12.57	6.978	7.311
F. test		NS	NS	**	**	**	NS	NS	NS

**** and NS indicate significant differences at P<0.01 and not significant, respectively according to F. test.**

Values having same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's test.

Table 8 d. Effect of the combined interactions among irrigation intervals, magnetized irrigation water and fertilizer sources on total carbohydrates, total soluble solids, inulin and vitamin C of Jerusalem artichoke plant during 2017 and 2018 seasons.

Treatment			Total carbohydrates (%)		TSS (%)		Inulin (%)		Vitamin C mg/100g F.W	
Irrigation intervals (day)	Magnetized irrigation water	Fertilizer sources	2017	2018	2017	2018	2017	2018	2017	2018
15	NMW	F1	27.370	28.300	14.867	16.53jk	9.77	9.92	8.467	8.667
		F2	25.343	25.470	13.233	14.66kl	9.07	8.97	6.167	6.333
		F3	28.250	29.257	12.767	16.43jk	10.77	11.08	9.600	10.333
		F4	30.997	30.267	15.733	17.46ij	11.14	11.29	10.233	10.667
		F5	28.387	28.617	12.867	12.90l	10.16	10.66	7.367	8.667
	MW	F1	34.313	35.327	15.333	17.16ij	9.81	10.26	7.333	8.500
		F2	33.323	34.520	13.567	14.40kl	9.64	11.05	7.467	7.500
		F3	37.403	39.400	14.000	17.13ij	10.99	11.68	9.100	9.167
		F4	44.063	44.950	17.467	19.20hi	11.76	12.64	9.333	11.167
		F5	36.340	39.043	13.567	18.50ij	10.74	11.49	7.600	7.500
20	NMW	F1	29.340	29.947	23.500	24.30b-f	8.79	8.99	5.933	6.933
		F2	28.173	29.000	19.067	21.10gh	8.93	9.08	7.033	5.833
		F3	31.323	31.263	23.467	23.86b-f	10.64	11.12	9.233	9.000
		F4	33.333	32.977	23.133	23.63c-f	11.14	11.69	7.633	8.900
		F5	30.197	29.533	22.600	22.30fg	9.25	9.30	7.233	8.467
	MW	F1	39.520	40.403	23.300	24.13b-f	12.22	13.08	6.233	7.333
		F2	34.400	35.260	22.367	23.40d-g	10.83	11.65	7.733	6.667
		F3	43.577	45.347	25.100	25.60a-d	13.36	14.53	7.500	7.400
		F4	45.513	46.280	27.400	27.56a	15.43	15.53	9.467	11.167
		F5	40.407	42.020	23.633	24.16b-f	13.28	13.61	6.667	7.400
25	NMW	F1	27.470	28.447	25.433	26.33ab	10.49	9.50	6.433	6.267
		F2	26.497	27.717	22.400	23.23d-g	10.81	10.48	7.200	7.467
		F3	27.417	29.393	24.400	24.40b-f	12.51	11.95	6.367	7.300
		F4	31.273	31.330	25.067	26.00a-c	12.97	12.50	7.833	7.833
		F5	26.453	28.337	23.633	24.10b-f	10.49	10.03	7.633	5.900
	MW	F1	35.470	36.773	21.867	23.03e-g	11.23	12.34	6.567	7.167
		F2	34.763	35.970	23.867	24.93b-e	10.83	11.45	7.000	6.500
		F3	41.333	42.340	25.500	25.60a-d	12.73	13.43	9.167	8.400
		F4	39.530	40.453	26.533	27.53a	13.68	14.61	8.567	8.800
		F5	38.297	38.607	22.533	23.30d-g	11.92	12.60	6.667	7.033
F. test			NS	NS	NS	**	NS	NS	NS	NS

NMW= non-magnetizes water, MN= magnetized water, F1= 100% organic, F2=100 % mineral, F3= 25% org+5% min, F4= 50% org+50% min F5=75% org+25% min. **, * and NS indicate significant differences at P<0.01, P<0.05 and not significant, respectively according to F. test. Values having same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's test.

The highest values of TSS tuber contents were obtained by the interaction treatments of magnetized irrigation water every 20 and 25 days and 50% organic + 50% mineral fertilizer compared with the lowest values were obtained by normal irrigation water every 15 days and 25% mineral + 75% organic.

Meanwhile, tuber inulin content tended to record the highest values with plants irrigated by magnetized irrigation water every 25 and 20 days and fertilized with 50% organic + 50% mineral while the lowest values obtained from plants irrigated with non-magnetic water every 15 days and fertilized by 100 % mineral fertilizer in both seasons

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تأثير خلطات التسميد العضوى و المعدنى تحت ظروف فترات رى مختلفة بالماء المعالج مغنطيسيا على المحصول ومكوناتة لنبات الطرطوفة

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أجريت تجربتان حقليتان خلال موسمى 2017 و2018 م بالمزرعة البحثية- محطة بحوث البساتين بسخا بشمال وسط الدلتا– معهد بحوث البساتين- مركز البحوث الزراعية- مصر. لدراسة تأثير الرى بالماء المعالج مغناطيسيا وفترات الرى ومصادر التسميد العضوى والمعدنى(NK) والتفاعل بينهم على المحصول ومكوناته وجودة الدرنات وكفاءة استخدام المياه لنباتات الطرطوفة. يمكن تلخيص النتائج كما يلي: اعطت فترات الرى كل 20 يوم اعلى محصول (وزن الدرنات/نبات وطن/فدان) وكفاءة استخدام المياه ومحتوى الدرنات من الكربوهيدرات، في حين سجلت فترات الرى كل 25 يوم اعلى القيم لمحتوى الدرنات من المواد الصلبة الذائبة الكلية وسكر الانيولين في كلا الموسمين أعطت نباتات الطرطوفة التى تم ريها بالماء المعالج مغناطيسيا أعلى القيم لمحصول الدرنات (عدد الدرنات/نبات، وزن الدرنات بالكجم/نبات اوطن/فدان)، كفاءة استخدام المياه ومحتوى الدرنات من الكربوهيدرات الكلية والمواد الصلبة الكلية وسكر الانيولين ومحتوى الدرنات من فيتامين سى مقارنة بمعاملة الرى بالماء الغير معالج مغناطيسيا والذى اعطى اقل القيم في كلا الموسمين. سجلت النباتات التي تم تسميدها بمعاملة 50% عضوى + 50% معدنى (NK) أعلى محصول للدرنات (عدد الدرنات/نبات، وزن الدرنات كجم/نبات ووزن الدرنات بالطن/فدان) وكفاءة استخدام المياه، وكذلك محتوى الدرنات من الكربوهيدرات الكلية، المواد الصلبة الكلية وسكر الانيولين ومحتوى الدرنات من فيتامين سى في كلا الموسمين. طبقا للنتائج السابقة يمكن التوصية برى نباتات الطرطوفة بالماء المعالج مغناطيسيا كل 15 او 20 يوم وتسميدها بـ 50% كمبوست السماد عضوى (10.08 م^3/فدان) + 50% سماد معدنى (105.1 كجم نترات امونيوم + 103 كجم سلفات بوتاسيوم /فدان) للحصول على أعلى محصول للدرنات وتحسين صفات الجودة (محتوى الدرنات من الكربوهيدرات، فيتامين سى، المواد الصلبة الكلية الذائبة وسكر الانيولين) وكفاءة استخدام المياه تحت ظروف تلك الدراسة.