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GROWTH, YEILD AND QUALITY OF JERUSALEM ARTICHOKE PLANTS UNDER SANDY SOIL CONDITIONS AS AFFECTED BY FOLIAR SPRAY WITH MAGNESIUM AND DIFFERENT RATES OF NITROGEN FERTILIZATION

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ABSTRACT

This work aimed to study the effect of interaction between four N rates (100%, 75%, 50% and 25% of recommended dose) and spraying with three rates of Mg (0, 1%, and 2%) on Jerusalem artichoke plants growth, tuber chemical analysis and tuber yield under sandy soil conditions. The results indicated that application of 100% or 75% of recommended N were the best treatments for increasing plant growth, most of tuber chemical analysis parameters, and tuber yield / plant as well as per feddan. Spraying with Mg increased all studied parameters compared to control treatment. On the other hand, the best interaction treatments for increasing plant growth, tuber chemical analysis and tuber yield were application of 100% N + spraying with 1% or 2% Mg and application of 75% N+ spraying with 1% Mg approximately.

Keywords: Jerusalem artichoke, N fertilization , magnesium foliar application.

INTRODUCTION

Jerusalem artichoke is a native plant of the North American plains cultivated for different purposes in many countries. Jerusalem artichoke accumulates high levels of fructans in their stems and tubers. Fructans and the fructose resulting from fructans hydrolysis can be used in human diet or in medical and industrial applications (Schittenhelm, 1999; Monti *et al.*, 2005). Jerusalem artichoke is considered one of the primary sources for inulin in higher plants (Saengthongpinit and Sajjaanantakul, 2005). Its protein has high food value not only due to the presence of almost all essential amino acids but also due to their good balance (Rakhimov *et al.*, 2003). Jerusalem artichoke is considered a suitable livestock feed (Seiler and Campbell, 2004). In the last decades Jerusalem artichoke has been considered as a biomass crop for ethanol because it commonly produces high levels of carbohydrates (Denoroy, 1996). The possibility of growing Jerusalem artichoke for energy has aroused the scientific interest in this crop (Rodrigues *et al.*, 2007). It is known as a potato for the poor (Pimsaen *et al.*, 2010).

Jerusalem artichoke now attracts the attention of investigators to improve its productivity by application different levels of nitrogen and magnesium especially under sandy soil conditions. Sandy soil had a poor composition and high water infiltration. Under application of high amounts of nitrogen fertilizers especially there were no regulation for application of nitrogen fertilizers and its availability to losses by leaching can affect the under ground water quality which cause a direct risk for human body (Abril and Roca, 2008). Nitrogen has a pronounced role in plant metabolism. Nitrogen is a constituent of proteins, enzymes, hormones, vitamins alkaloids, chlorophyll and photosynthesis (Reddy and Reddi, 2002). Nitrogen is considered as one of the major nutrients required by the plants for their growth, development and yield (Singh *et al.*, 2003). The enhancing effect due to the increase in nitrogen dose on plant growth may be attribute to that N plays major roles in the synthesis of structural proteins and other several macromolecules, in addition to vital contribution in several biochemical process in the plant related to growth (Marschner, 1995). Besides, nitrogen is an important constituent of protoplasm. Also, enzyme the biological catalytic agents, which speed up life processes, have N as their major constituents (Mengel and Kirkby, 1978). Magnesium plays a vital role in plant , since it is a central atom of the chlorophyll molecule and required in several enzymes involved in phosphate transfer (Marschner, 1995; Reddy and Reddi, 2002) and increased the chlorophyll content in leaves (Bardisi, 2004) leading to high assimilation rate and consequently increase in plant growth. Besides its function in the chlorophyll molecule, Mg is required in other physiological processes. One major role of Mg is as a factor in almost enzymes activating phosphorylation structure of ADP or ATP and enzymes molecule (Mengel and Kirkby, 1978).

So, the attempt of this work is to decrease the amount of nitrogen used under application of different levels of magnesium under sandy soil conditions.

MATERIALS AND METHODS

The present investigation was conducted at the experimental farm ,El kassasein horticultural research station, Ismailia governorate, during two successive seasons of 2009 and 2010, to study the effects of foliar application of magnesium and different rates of mineral nitrogen 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 twelve treatments, which were the combinations between four doses of soil nitrogen application and foliar application with three levels of magnesium. 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 magnesium treatments were randomly distributed in the sub-plots as follows:

Soil application

1. 100% of the recommended dose of mineral nitrogen fertilizer (ammonium sulphate at 300kg/fed .)
2. 75% mineral nitrogen fertilizers (ammonium sulphate225kg /fed.)
3. 50% mineral nitrogen fertilizers (ammonium sulphate150kg / fed.)
4. 25% mineral nitrogen fertilizers (ammonium sulphate75kg / fed.)

Foliar application treatments

1. Control (spraying plants with tap water) .
2. Magnesium (1%)
3. Magnesium (2%)

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 magnesium foliar application were done for three times; i.e., 60,85 and 110 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

Vegetative Growth Characters

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

Yield and its Components

At harvest time , 180 days after planting , the total tubers yield /plant (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°C till a constant weight).

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 by following the method 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

Plant Growth

Effect of nitrogen

Data presented in Table 2 show that application of nitrogen had a significant effect on Jerusalem artichoke growth parameters expressed in plant height, number of branches / plant and fresh as well as dry weight of shoots.

Table 2: Effect of mineral nitrogen fertilization rates on plant growth of Jerusalem artichoke

Treatments	Plant height (cm)	No. branches/plant	F.W. shoots/plant (g)	D.W. shoots/plant (g)
N rates*		First season (2009)		
100%	201.0a	37.67a	1343.0a	541.1a
75%	196.0a	34.00a	1208.0a	486.8ab
50%	175.6b	29.33b	1058.0b	428.7b
25%	151.6c	24.67c	874.0c	354.9c
		Second season (2010)		
100%	199.7a	40.00a	1483.0a	598.0a
75%	197.0a	36.67ab	1403.0a	565.4a
50%	183.8b	33.00b	1217.0b	490.1b
25%	166.0c	24.00c	930.0c	437.0c

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.
***: The recommended dose (300 Kg/fed.)**

The data reveal that all the abovementioned plant growth parameters were increased with increasing nitrogen rates up to the full dose of nitrogen without significant differences with application of 75% of recommended dose.

The increment in plant growth due to the increase in nitrogen dose might be owe to the pronounced role of nitrogen in plant metabolism. Nitrogen is a constituent of proteins, enzymes, hormones, vitamins alkaloids, chlorophyll and photosynthesis (Reddy and Reddi, 2002). Nitrogen is considered as one of the major nutrients required by the plants for their growth, development and yield (Singh *et al.*, 2003). The enhancing effect due to the increase in nitrogen dose on plant growth may be attributed to that N plays major roles in the synthesis of structural proteins and other several macromolecules, in addition to vital contribution in several biochemical processes in the plant related to growth (Marschner, 1995). Besides, nitrogen is an important constituent of protoplasm. Also, enzyme the biological catalytic agents, which speed up life processes, have N as their major constituents (Mengel and Kirkby, 1978).

Effect of magnesium

Data in Table 3 show that spraying Jerusalem artichoke plant with Mg at rates of 1% and 2% increased plant growth characters; i.e. plant height, number of branches / plant and fresh and dry weights of shoots compared to control treatment. Application of Mg at a rate of 1% was the superior treatment.

The increment in plant growth due to application of Mg might be owe to its vital role in plant which it is a central atom of the chlorophyll molecule and required in several enzymes involved in phosphate transfer (Marschner, 1995; Reddy and Reddi, 2002) and increased the chlorophyll content in leaves (Bardisi, 2004) leading to high assimilation rate, and consequently increase in plant growth.

In this concern, Bari *et al.*(2001) found that application of Mg at a rate of 6.5 kg Mg/ha. as magnesium oxide had no significant difference with control treatment on potato plant height, number of main stems/hill, and fresh haulm weight/ hill. Application of Mg at rates of 5, 10 15, and 20 kg/ha. did not show any significant differences with control treatment on potato plant height and number of shoots/plant (Talukder *et al.*, 2009).

Table 3 : Effect of magnesium foliar spray rates on plant growth of Jerusalem artichoke

Treatments	Plant height (cm)	No. branches/plant	F.W. shoots/plant (g)	D.W. shoots/plant (g)
Mg rates(%)		First season (2009)		
0(control)	174.8b	29.25b	1054.0b	426.4b
1	187.0a	33.00a	1165.0a	468.9a
2	181.5ab	32.00a	1144.0a	463.3ab
		Second season (2010)		
0(control)	180.6b	30.75b	1218.0b	500.7b
1	191.3a	35.25a	1285.0a	536.0a
2	188.0a	34.25a	1273.0a	531.0a

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

Effect of interaction between mineral nitrogen fertilization and magnesium foliar spray

Data in Table 4 reveal the effect of interaction between mineral nitrogen and magnesium foliar spray on growth of Jerusalem artichoke plants. The data show that fertilizing Jerusalem artichoke plants with the full dose of N (100%) either alone or with spraying of Mg at 1% or 2% as well as application of N at 75% of recommended dose with spraying Mg at the both doses (1% and 2%Mg) were the best treatments wherein increased the most plant growth parameters as plant height and number of branches in the first season as well as increased fresh and dry weight of branches /plant in the two season. Regarding plant height in the second season, the data illustrate that plant height was significantly increased with application of 100% N+1% Mg and application of 75% N +1% Mg. Number of branches in the second season was significantly increased with application of 100% N +1% Mg.

It could be concluded that application of 100% N+ spraying with 1% or 2% Mg and application of 75% N +1% or 2% Mg were the best interaction treatments, respectively.

The vital role of nitrogen and Mg in plant metabolism and their progressive effects on photosynthesis process beyond the increase in plant growth expressed in vegetative growth and plant dry weight.

Table 4 : Effect of interaction between mineral nitrogen fertilization and magnesium foliar spray on plant growth of Jerusalem artichoke

Treatments		Plant height (cm)	No. ranches/ plant	F.W. shoots/ plant (g)	D.W. shoots/ plant (g)	Plant height (cm)	No. branches/ plant	F.W. shoots/ plant (g)	D.W. shoots/ plant (g)
N rates	Mg rates(%)	First season (2009)				Second season (2010)			
	0 (control)	198.0c	35.0ab	1300.0ab	523.7ab	195.0c	38.0cd	1450.0ab	584.9a
100%	1	205.0a	40.0a	1380.0a	555.8a	206.0a	42.0a	1510.0a	608.7a
	2	200.0ab	38.0a	1350.0a	543.8a	198.0b	40.0b	1490.0a	600.3a
	0(control)	189.0d	32.0b	1120.0d	451.3b	190.0d	34.0f	1370.0c	551.8b
75%	1	203.0ab	36.0ab	1285.0b	517.7ab	204.0a	39.0bc	1440.0ab	580.3a
	2	196.0c	34.0ab	1220.0c	491.3ab	197.0bc	37.0de	1400.0bc	563.9b
	0(control)	165.0f	28.0bc	950.0e	389.3c	177.3f	31.0g	1170.0e	471.3d
50%	1	187.0d	31.0b	1115.0d	449.3b	189.0d	36.0e	1250.0d	503.6c
	2	175.0e	29.0bc	1110.0d	447.3b	185.0e	32.0g	1230.0d	495.3c
	0(control)	147.0h	22.0c	847.0f	341.3d	160.0i	20.0j	880.0g	394.6f
25%	1	153.0g	25.0bc	878.0f	352.8d	166.0h	24.0i	940.0f	451.3e
	2	155.0g	27.0bc	897.0ef	370.7c	172.0g	28.0h	970.0f	483.3d

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

*: The recommended dose (300 Kg/fed.)

Chemical Analysis of Tubers

Effect of nitrogen

The data in Table 5 reveal that application of 100% of recommended dose was the best treatment for increasing tuber nitrogen content in both seasons. Concerning phosphorus content the same data reveal that application of 100% N was the best treatment in both seasons, but without significant difference with application of 75% of N recommended dose in the second season only. This position was reversed with K content wherein application of 75% of N recommended dose was the best treatment in both seasons, but without significant difference with application of 100% N in the second season only.

Carbohydrates and inulin contents were significantly decreased with decreasing nitrogen doses to the lowest dose (25% of recommended dose) in both seasons.

Sawicka (2002) found that inulin content was the highest in objects with application of N up to 50 kg N; dry matter, true protein, fiber and ash contents in *Helianthus tuberosus* tubers increased up to 100 kg N rate). The highest content of nitrogen, calcium and sodium in Jerusalem artichoke tubers was found at the plots fertilized with a dose of 50 kg N/ha. (Sawicka and Kalembsa, 2008).

Effect of magnesium

Regarding the effect of spraying with magnesium, the data in Table 6 illustrate that spraying with 2% Mg increased N content in tubers in both seasons without significant difference with spraying Mg at 1% in the second season. The same trend was found with K content. Concerning phosphorus content, the data reveal that spraying plants with Mg at 1 or 2% increased P content in the first season compared to control treatment, while it was not significantly affected in the second season.

Carbohydrates and inulin contents were significantly increased with spraying with Mg at 1 or 2% in the second season, but they were not significantly affected in the first season.

Kene *et al.* (1990) found that magnesium increased NPK uptake in sunflower and promote uptake and translocation of phosphorus (Russell, 1975).

Table 5: Effect of mineral nitrogen fertilization rates on chemical analysis (%) of Jerusalem artichoke tubers

Treatments	N	P	K	Carbohydrates	Inulin
N rates *			First season (2009)		
100%	0.563a	0.367a	2.72b	17.19a	10.77a
75%	0.498b	0.358b	2.93a	16.83a	10.45ab
50%	0.475c	0.329c	2.75b	16.38ab	10.23ab
25%	0.401d	0.316d	2.45c	16.12b	9.39b
			Second season (2010)		
100%	0.586a	0.384a	2.69a	17.12a	11.18a
75%	0.540b	0.368a	2.59a	16.65ab	10.81ab
50%	0.487c	0.332b	2.43b	16.37ab	10.35ab
25%	0.423a	0.314c	1.92c	16.07b	10.13b

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

***: The recommended dose (300 Kg/fed.)**

Table 6: Effect of magnesium foliar spray rates on chemical analysis (%) of Jerusalem artichoke tubers

Treatments	N	P	K	Carbohydrates	Inulin
Mg rates(%)			**First season (2009)**		
0(control)	0.450c	0.326b	2.52c	16.48a	10.25a
1	0.491b	0.357a	2.76b	16.74a	10.21a
2	0.511a	0.351a	2.85a	16.69a	10.17a
			Second season (2010)		
0(control)	0.486b	0.340a	2.06b	16.38b	10.41b
1	0.524a	0.357a	2.63a	16.66a	10.74a
2	0.518a	0.352a	2.53a	16.61a	10.69a

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

Effect of interaction between mineral nitrogen fertilization and magnesium foliar spray

Data in Table 7 show the effect of interaction between nitrogen application and magnesium on N, P, K, carbohydrates, and inulin in Jerusalem artichoke tubers. The data reveal that N, carbohydrates, and inulin contents were significantly increased with application of nitrogen at full dose with spraying Mg at rates of 1% and 2%. Phosphorus content was increased with application of N at 50%, 75%, and 100% of N recommended dose with spraying Mg at 1%, and 2% in both seasons.

Table 7: Effect of interaction between mineral nitrogen fertilization and magnesium foliar spray rates on chemical analysis (%) of Jerusalem artichoke tubers

Treatments		N	P	K	Carbohy-drates	Inulin	N	P	K	Carbohy-drates	Inulin
N rates*	Mg rates(%)	**First season (2009)**					**Second season (2010)**				
	0(control)	0.520b	0.360a-d	2.89cd	17.01b	10.54b	0.560ab	0.373abc	2.35d	16.77ab	10.88b
100%	1	0.595a	0.395a	2.25hi	17.30a	10.95a	0.610a	0.398a	2.98a	17.39a	11.41a
	2	0.575ab	0.374ab	3.02abc	17.25a	10.81a	0.590a	0.382ab	2.76bc	17.20a	11.25a
	0(control)	0.460c	0.345a-d	2.62ef	16.55c	10.35cde	0.505bcd	0.362a-d	2.15e	16.51cd	10.55c
75%	1	0.519b	0.370ab	3.20a	17.02b	10.52bc	0.561ab	0.374abc	2.91ab	16.76bc	10.98b
	2	0.515b	0.361abc	2.99bc	16.92b	10.47bcd	0.555abc	0.369abc	2.72c	16.69bc	10.91b
	0(control)	0.430cd	0.304cd	2.40gh	16.22d	10.15f	0.470def	0.320bcd	2.01e	16.22cd	10.25ef
50%	1	0.450cd	0.343a-d	3.10ab	16.50c	10.30def	0.500cd	0.341a-d	2.68c	16.47cd	10.44cd
	2%	0.545ab	0.341a-d	2.75de	16.43c	10.25ef	0.492de	0.337a-d	2.62c	16.41cd	10.35de
	0(control)	0.390d	0.298d	2.20i	16.07d	9.97g	0.410g	0.305d	1.75f	16.07d	9.97g
25%	1	0.402cd	0.320bcd	2.50fg	16.12d	9.05h	0.425fg	0.317cd	1.98e	16.04d	10.15f
	2	0.412cd	0.330bcd	2.65ef	16.17d	9.15h	0.435efg	0.322bcd	2.05e	16.15cd	10.27def

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

***: The recommended dose (300 Kg/fed.)**

Regarding K content, the data in Table 7 show that application of 75% N+ 1% Mg recorded the highest value in the first season without significant difference with application of 50% N+1% Mg. On the other hand, application of 100% N+ 1% Mg recorded the highest K content in the second season without significant difference with application of 75% N + 1%Mg.

Yield

Effect of nitrogen

It is obvious from Fig. 1 that dry matter was significantly increased with increasing N doses up to the highest level (100% N). The contents of dry matter are 21.45% and 20.71% for 25% N as well as 22.95% and 22.40% for 100%N in the first and second seasons, respectively.

Concerning number of tubers/plant, the data in Table 8 reveal that number of tubers /plant was significantly increased with increasing N levels up to 75% of recommended dose in the second season while, it was not significantly affected in the first season. Average tuber weight, yield/plant and yield / fed. were significantly increased with increasing N levels, wherein application of N at 75% and 100% N were the superior treatments in both seasons. The increment in yield / fed. owe to the increment in average tuber weight and yield /plant. Moreover, the increment in tuber yield might be attributed to the pronounced role of nitrogen in plant metabolism. Nitrogen is a constituent of proteins, enzymes, hormones, vitamins alkaloids, chlorophyll and photosynthesis (Reddy and Reddi, 2002) and increasing in vegetative growth as well as dry weight of plant which increased tubers production.

Losavio *et al.* (1997) found that tuber yield was not significantly affected by nitrogen fertilization. On the other hand, Rodrigues *et al.* (2007) found that nitrogen application at a rate of 100 kg/ha. increased dry matter yield, and tuber fresh weight of Jerusalem artichoke plants.

Effect of magnesium

It is obvious from Fig. 2 that spraying Jerusalem artichoke plants with Mg at a rate of 1% increased the content of dry matter in tubers in both seasons (22.40% and 21.74% for the first and second seasons, respectively) without significant difference with spraying Mg at a rate of 2% in the second season (21.66%).

Regarding number of tubers/plant, the data in Table 9 show that number of tubers/plant was not significantly affected in both seasons. Average tuber weight. yield/plant and yield / fed. were significantly increased with spraying Mg at 1 or 2% (Table 9).

The increment in yield due to application of Mg might be owe much to its vital role in plant which it is a central atom of the chlorophyll molecule and required in several enzymes involved in phosphate transfer (Marschner, 1995: Reddy and Reddi, 2002) and increased the chlorophyll content in leaves (Bardisi, 2004) leading to high assimilation rate and consequently increase in plant growth as well as tuber yield.

In this concern, Bari *et al.* (2001) found that application of Mg at a rate of 6.5 kg Mg/ha. as magnesium oxide did not show significant difference with control treatment on number of tubers/hill, dry matter of tubers, yield of tubers/hill, yield of tubers/plot and yield of tubers/ha. Talukder *et al.* (2009) found that application of Mg at rates of 5, 10, 15, and 20 kg/ha. did not reflect significant differences with control treatment on number of potato tubers/hill,, but tuber weight/hill and tuber yield /ha. were increased with increasing Mg rates up to 10 Kg/ha.,but tuber yield tended to decrease with increasing rate of magnesium.

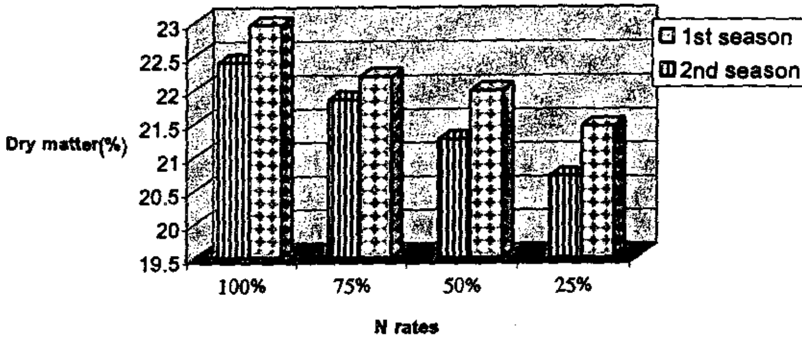

Fig. 1: Effect of mineral nitrogen fertilization rates on tuber dry matter content of Jerusalem artichok

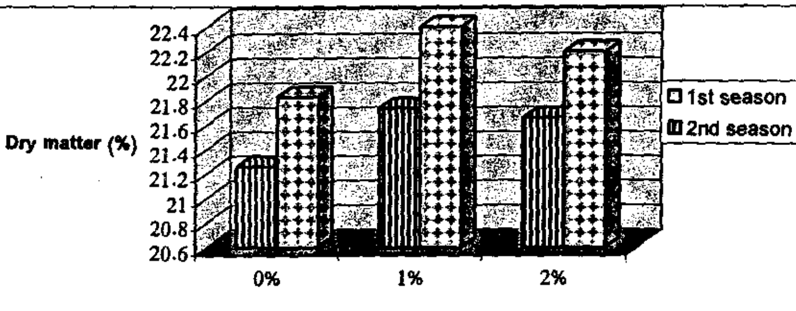

Fig.2: Effect of magnesium foliar application rates on tuber dry matter content of Jerusalem artichok

Table 8: Effect of mineral nitrogen fertilization rates on yield of Jerusalem artichoke

Treatments	No. tubers/plant	Avg. tuber weight (g)	Yield/plant (g)	Yield/fed. (ton)
N rates*		First season (2009)		
100%	46.00a	40.37a	1857.0a	22.27a
75%	45.33a	38.32a	1737.0a	20.84a
50%	46.67a	32.52b	1516.6b	18.20b
25%	46.78a	28.70c	1343.0c	16.12c
(2010)		Second season		
100%	42.67b	45.52a	1942.0a	23.31a
75%	43.33ab	42.65a	1848.0a	22.17a
50%	45.00a	36.39b	1637.0b	19.64b
25%	45.00a	32.68b	1470.6c	17.64b

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

***: The recommended dose (300 Kg/fed.)**

Table 9: Effect of magnesium foliar spray rates on yield of Jerusalem artichoke

Treatments	No. tubers/plant	Avg. tuber weight(g)	Yield/plant (g)	Yield/fed. (ton)
Mg rates(%)		First season (2009)		
0(control)	45.58a	32.52b	1482.5b	17.79b
1	46.25a	36.25a	1676.5a	20.11a
2	46.75a	36.27a	1695.6a	20.34a
		Second season (2010)		
0(control)	43.25a	37.02b	1633.0b	19.59b
1	44.25a	40.97a	1805.0a	21.66a
2	44.50a	39.94ab	1772.0a	21.27a

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.

Effect of interaction between mineral nitrogen fertilization and magnesium foliar spray

It is obvious from Fig. 3 that application of 100% N + sparing with 1% Mg was the superior treatment which recorded the highest record of dry matter content in tubers (23.55% and 22.75% in the first and second seasons, respectively).

Data in Table 10 reveal that number of tubers /plant was not significantly affected in the 1st season, but it was increased with increasing N dose up to75% of the recommended N+ spraying Mg at a rate of 2% wherein fertilizing with 100% N + 1% or 2% Mg were the best treatments in the second season. Application of high doses of N (100% and 75%) + spraying with Mg at 1% were approximately the best treatments for increasing average tuber weight, yield / plant and total yield / fed. in both seasons.

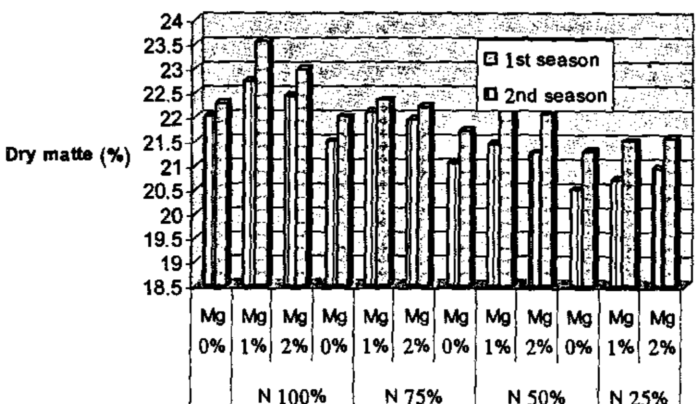

Fig. 3: Effefct of interaction between mineral nitrogen fertilization and magnesium foliar spray on tuber dry matter content of Jerusalem artichok

Table 10 : Effect of interaction between mineral nitrogen fertilization and magnesium foliar spray on yield of Jerusalem artichoke.

Treatments		No. tubers/plant	Avg. tuber weight (g)	Yield/plant (g)	Yield/fed. (ton)	No. tubers/plant	Avg. tuber weight(g)	Yield/plant (g)	Yield/fed. (ton)
N rates*	Mg rates(%)	First season (2009)				Second season (2010)			
	0(control)	46.00a	39.00ab	1750.0c	21.17b	42.00c	44.00ab	1870.0bc	22.44b
100%	1	46.00a	40.00a	1920.0a	23.04a	43.00bc	46.00a	2007.0a	24.09a
	2	46.00a	39.00ab	1896.0ab	22.96a	43.00bc	45.00a	1950.0ab	23.93a
	0(control)	45.00a	34.00bc	1530.0e	18.36d	43.00bc	40.00cd	1720.0cd	20.64c
75%	1	45.00a	39.00ab	1883.0ab	22.63a	43.00bc	43.00abc	1933.0ab	23.55a
	2	46.00a	35.00abc	1866.0b	21.46b	44.00abc	41.00bcd	1890.0b	23.50a
	0(control)	46.00a	30.00cd	1400.0g	16.80e	45.00ab	35.00e	1510.0fg	19.32d
50%	1	47.00a	34.00bc	1600.0d	19.20c	45.00ab	38.00de	1750.0c	21.00c
	2	47.00a	32.00cd	1550.0e	18.60cd	45.00ab	36.00e	1650.0de	19.83d
	0(control)	45.33a	27.00d	1250.0i	15.00g	43.00bc	31.00f	1430.0g	17.76e
25%	1	47.00a	28.00d	1330.0h	15.96f	46.00a	35.00e	1530.0f	18.36e
	2	48.00a	30.00cd	1450.0f	17.40e	46.00a	36.00e	1600.0ef	19.20d

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to Duncan's multiple range test.
*: The recommended dose (300 Kg/fed.)

Recommendation:

It could be recommended from the pervious results that increasing nitrogen dose up to 75% of recommended dose (225 kg ammonium sulphate /fed.) with spraying of Mg at a rate of 1% produced the same yield obtained by 100 % of N recommended dose.

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تأثير التسميد النيتروجيني بمعدلات مختلفة مع الرش بالماغنسيوم علـــى النمـــو والمحصول والجودة فى نباتات الطرطوفة تحت ظروف الأراضى الرملية

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أجريت تجربتان حقليتان خلال الموسم الـصيفي لعـامي ٢٠٠٩ و ٢٠١٠ فـي مزرعـة التجارب البحثية بمحطة بحوث البساتين بالقصاصين ، محافظة الاسماعيلية ، لدراسة تأثير التفاعل بين أربعة معدلات من النيتروجين المعـدني (١٠٠% ، ٧٥ % ، ٥٠% ، ٢٥% مـن المعـدل الموصى به) والرش بثلاث معدلات من الماغنسيوم (صفر ، ١% ، ٢%) على نمـو نباتـات الطرطوفة والمحتوى الكيماوى للدرنات والمحصول تحت ظروف الأراضى الرمليـة ، وتتـضح النتائج بالتسميد بـــ ١٠٠% ، ٧٥% نيتروجين وكانت احسن المعاملات حيث أعطت اعلى القيم بالنسبة لنمو النباتات ، وقياسات المحتوى الكيماوى للدرنات ، ومحصول النبات ، ومحصول الفدان ، كما أعطي الرش بالماغنسيوم زيادة فى جميع القياسات مقارنة بمعاملة الكنترول ، ومـن جهـة أخري فكانت أحسن معاملات التفاعل التى أعطت زيادة فى نمو النبـات والمحتـوى الكيمـاوى للدرنات ومحصول الدرنات هي التسميد بــــ ١٠٠% نيتـروجين + ١% أو ٢% ماغنـسيوم والتسميد بـــ ٧٥% سماد نيتروجينى + ١% ماغنسيوم على الترتيب .

قام بتحكيم البحث

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