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RESPONSE OF GROWTH, PRODUCTIVITY AND STORABILITY OF GARLIC (*Allium sativum* L.) TO FOLIAR SPRAY WITH MAGNESIUM AND YEAST EXTRACT

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ABSTRACT

Foliar application of mineral nutrients considers a method of supplying nutrients to higher plants more rapidly than methods involving root application, which makes the nutrients more efficient. It is a quick and efficient method of supplying micro elements in particular. It can, also be used to satisfy acute needs of macro nutrients. This study was conducted on garlic cv. Sids-40, in the privet farm at Kafr Meet Faris village, near El-Mansoura, Dakahlia Governorate, during 2008/2009 and 2009/2010 seasons to study the effect of foliar application with certain magnesium concentrations (0.0%, 0.2%, 0.4% and 0.6% as Mg-citrate) either single and/or in combination with foliar application of some yeast extract concentrations (0.0, 25 ml/L, 50 ml/L and 100 ml/L) on plant growth, yield and its components, as well as chemical constituents and storability of bulbs during the storage period.

The obtained results could be summarized as follows:

In general, results showed that the plants sprayed with Mg-concentrations were better than those of the unsprayed ones. Increasing the foliar applied magnesium concentration from 0.2% to 0.6% Mg significantly increased plant height, number of leaves/plant, plant dry weight and bulbing ratio as well as total yield and bulb weight and diameter. Moreover, foliar application of magnesium at 0.6% Mg significantly increased concentrations of N, P and K in cloves. In addition, TSS% and volatile oils were increased. This concentration had the most interesting observation in the enhancing of storability. On the other hand, foliar application of yeast extract at 50 ml/L gave rise to significant increases in plant height, number of leaves/plant; plant dry weight, bulbing ratio, total yield, bulb weight and diameter and clove weight as well as chemical constituents in cloves and decreasing bulb weight loss percentage during the storage period compared with the other treatments. The combined treatments of Mg-concentrations and yeast extract were generally more effective on the most studied parameters than single ones. The best results were obtained by foliar application of 0.6% Mg with foliar application of yeast extract at 50 ml/L. This treatment achieved increases in yield at the end of the storage period reached to 18.20% and 18.80% in the first and second seasons, respectively compared with the untreated ones. Therefore, this treatment could be recommended for raising garlic yield and improving bulb quality during the storage period under similar conditions to this work.

INTRODUCTION

Garlic (*Allium sativum* L.) is one of the most important bulb vegetable crops. It plays dietary and medicinal roles in human being for countries. It has been cultivated since ancient times, used as a spice and flavoring. Become of its potential benefits in preventive and curative medicine, has been used in many culture. (Rivlin, 2001). Even today, the medical use of garlic is widespread and growing (Amagase, 2006). In Egypt, it has been generally cultivated for both local consumption and export. Therefore, increasing garlic

yield and improving bulb quality are essential aims for both growers and consumers. Magnesium nutrition is one of major factors that affect growth, yield and quality of garlic. Its ions (Mg^{2+}) have a specific role in the activation of enzymes involved in respiration, photosynthesis and the synthesis of DNA and RNA. Magnesium is also a part of the ring structure of the chlorophyll molecule. Studies indicate that 15 to 30% of the total magnesium in plants is associated with the chlorophyll molecule, the deficiency of magnesium will seriously affect of plant growth and development, being related directly to photosynthesis (Marschner, 1995).

The efficiency of fertilizers used in Egypt is low, either as a result of high pH of soil or high concentration of soil calcium carbonate. This problem could be solved by addition amounts of macro-elements fertilizers to the soil or through foliar application of them (Alexander, 1986). The positive effect of foliar application of macronutrients on growth, yield and chemical constituents of different plants may be attributed to the fact that these elements which can be readily absorbed by the leaves as a result of foliar spraying application and not lost through fixation, decomposition or leaching under unfavorable soils conditions (Doeing, 1986). Several attempts were done on the application of micronutrients spray to correct deficiency symptoms and enhance the vegetative growth of garlic which in turn reflects on increasing yield and its quality for facing local consumption and exportation (Eid *et al.*, 1991, Ibrahim *et al.*, 1991, Abdel-Fattah *et al.*, 2002, El-Morsy *et al.*, 2004 and El-Morsy, 2005). It can be, also used to satisfy acute needs of macro nutrients (Franke, 1986).

Several investigators indicated that spraying plants with magnesium enhanced plant growth, stimulated dry matter accumulation and increased yield and quality as well as chemical composition (Abd El-Rasoul and El-Azouni, 2002 on flax, Awad and El-Ghamry., 2007 on potato, Abo El-Hamd and Esmail, 2008 on sugar beet and Osman and El-Sawah, 2009 on tomato).

Yeast extract are the natural components (contains many compounds, i.e., cytokinins and proteins that enhance cell division and enlargement) which are safe and non-pollutant (Barnett *et al.*, 1990). Also, it contains the haloes-6-phosphate synthase (a key enzyme for trehalose biosynthesis) which not only affects plant development but also improves drought tolerance (Yeo et al., 2000). Several investigators indicated that soaking cloves or spraying garlic plants enhanced plant growth, stimulated dry matter accumulation, increased bulb yield and quality and enhanced bulb storability (Tartoura and El-Saei., 2006, Abd El-Mageed *et al.*, 2009). Similar conclusions had been shown on other crops, i.e. Tomato growth and yield were increased by the foliar spraying with yeast extract (Fathy *et al.*, 2000 and Eata, 2001), also, foliar application of yeast extract significantly increased plant growth and yield of pea (Tartoura, 2001 and El-Desuki and El-Gereadly, 2006).

Thus, this study was planned to determine the effects of foliar application concentrations of magnesium as Mg-citrate and some yeast extract concentrations, in addition to their interactions on garlic productivity and storability under the conditions of Dakahlia Governorate.

MATERIALS AND METHODS

Two field experiments were carried out in vegetable private Farm at Kafr Meet Faris, near El-Mansoura, Dakahlia Governorate, during two growing seasons of 2008/ 2009and 2009/2010, to study the effect of some magnesium foliar application concentrations (0.0, 0.2%, 0.4% and 0.6% Mg as magnesium citrate 14.5% Mg) either single and/or in combination with some foliar application of yeast extract concentrations (0.0, 25 ml/L, 50 ml/L and 100 ml/L) on garlic (Sids-40) growth, yield and its components, as well as chemical constituents in cloves and bulb storability.

The experiment included 16 treatments which were 4 concentrations of magnesium and 4 concentrations of yeast extract as follows :

a- **Mg-concentrations:** Control treatment (spray only with water).
1- 0.2% magnesium.
2- 0.4% magnesium.
3- 0.6% magnesium.

b- Yeast extract concentrations:
1- Control treatment (spray only with water).
2- 25 ml/L.
3- 50 ml/L.
4- 100 ml/L.

Yeast extract was prepared according to procedure of Fathy *et al.* (2000) and Eata (2001), its chemical analysis according to methods of A. O. A. C. (1990).

Magnesium and yeast extract concentrations were supplied as a foliar application at 60, 75 and 90 days after planting. The control treatment was sprayed with tap water.

Garlic cloves were planted in the second week of October in both seasons. The experimental design was split plot with three replicates, the four foliar magnesium concentrations occupied the main plots which were subdivided to 4 sub plots each contained one of the yeast extract concentrations. Nearly uniform garlic cloves were soaked in running water for 12 h prior to planting and hand-planted at 10 cm apart on two sides of each row. All the plants were fertilized with the recommended doses of N, P and K. The other cultural practices for garlic commercial production were used according to the instructions laid down by the Ministry of Agriculture, Egypt. The harvesting time was in the second week of April, for both seasons.

Data recorded:

Growth parameters:

A random sample of five plants was taken from each plot after 120 days from planting to estimate plant height, number of leaves/plant, plant dry weight and bulbing ratio (neck diameter/bulb diameter).

Yield and its components:

At harvest time, marketable plants of each plot were cured, 15 days after harvest weighted in kg and converted to record as total yield (ton/fed). A random sample (10 bulbs) was taken from each treatment to determine bulb weight and diameter, as well as the number of cloves/bulb and clove weight .

Chemical analysis:

Samples of the dried cloves were ground, wet digested as described by Hesse (1971) and their nitrogen (N), phosphorus (P) and potassium (K) contents were determined according to the methods described by Chapman and Pratt (1961), John (1970) and Brown and Lilleland (1946), respectively. Total soluble solids (TSS) and volatile oils (mg/kg bulbs fresh weight) were determined according to A.O.A.C. (1990) and Gunther (1961).

Storability:

After curing, random samples (10 kg of marketable yield from every plot) were taken, stored at the normal room conditions (Table 1) and the percentage of weight loss was recorded monthly during the storage period (five months).

Data obtained during the two seasons of the study were statistically analyzed according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Vegetative growth:

Data presented in Table (1) show the effect of magnesium citrate concentrations, yeast extract concentrations and their interactions on growth aspects of garlic plants.

Concerning the effect of Mg-concentrations, it is clear from such data in Table (1) that plant height, number of leaves and plant dry weight in both seasons were significantly increased with increasing magnesium (Mg) concentration up to 0.6% Mg, also foliar application at this concentration was enhanced bullbing ratio. These increases in growth parameters may be attributed to the effect of Mg on some physical functions such as carbohydrates synthesis and active many enzymes which in turn affect plant growth (Marschner, 1995). The obtained results concerted with those of (Abd El-Rasoul and El-Azouni, 2002 on flax, Awad and El-Ghamry., 2007 on potato, Abo El-Hamd and Esmail, 2008 on sugar beet and Osman and El-Sawah, 2009 on tomato).

Regarding, the effect of yeast extract concentrations, the same data in Table (1) reveal that foliar application of yeast extract concentrations had significant increases in all studied parameters of vegetative growth in both seasons. In this connection, plants sprayed with yeast extract at 50 ml/L were generally stocky and healthy in appearance than untreated plants. These results could be attributed to the great role of yeast in stimulate the cell division, elongation, enlargement, protein and nucleic acid synthesis and chlorophyll formation (Kraig and Haber., 1980, Spencer *et al.*, 1983). The obtained results are in harmony with those reported by Tartoura and El-Saei (2006) Abd El-Mageed *et al.* (2009). They mentioned that plant growth was enhanced with spraying yeast. Similarly, Abdel-Aziz (1997), mentioned that tomato growth parameters were responded to spray with yeast extract at 1 kg baker's yeast/200 L water.

Table (1): Vegetative growth characters of garlic plants as affected by foliar Mg concentrations, Yeast and their interactions during 2008/2009 (S1) and 2009/2010 (S2) seasons.

Characters / Treatments		Plant height (cm)		Number of leaves/plant		Plant dry weight (gm)		Bulbing ratio	
		S1	S2	S1	S2	S1	S2	S1	S2
Mg-concentrations									
Control		76.6	74.7	11.3	11.1	12.383	11.383	0.392	0.368
0.2% Mg		78.1	76.8	11.6	11.6	12.533	12.150	0.392	0.362
0.4% Mg		80.4	79.2	11.9	11.7	12.917	12.417	0.377	0.351
0.6% Mg		82.2	81.8	12.3	11.8	13.650	13.367	0.368	0.348
LSD at 5%		00.9	01.1	00.2	00.2	00.203	00.247	0.014	0.001
Yeast-concentrations									
Control		77.0	75.8	11.4	11.0	12.050	11.750	0.397	0.371
25 ml/L Y. extract		78.9	77.5	11.6	11.3	12.633	12.167	0.387	0.363
50 ml/L Y. extract		81.8	80.0	12.3	12.1	13.700	12.900	0.367	0.342
100 ml/L Y. extract		79.6	78.7	11.8	11.6	13.100	12.500	0.379	0.353
LSD at 5%		00.7	00.6	00.2	00.3	00.265	00.261	0.001	0.001
Interactions:									
Mg-Concent.	**Y.Concentrations**								
Control	Control	75.0	73.2	10.8	10.7	11.467	10.867	0.407	0.377
	25 ml/L	76.2	73.7	11.1	10.9	12.400	11.333	0.393	0.373
	50 ml/L	78.5	76.8	12.0	11.8	13.000	11.933	0.377	0.357
	100 ml/L	76.8	75.0	11.4	11.0	12.667	11.400	0.390	0.363
0.2% Mg	Control	75.8	73.8	11.2	11.0	11.667	11.733	0.403	0.377
	25 ml/L	77.2	76.3	11.4	11.4	12.267	12.000	0.397	0.367
	50 ml/L	80.7	79.2	12.1	12.1	13.333	12.600	0.380	0.347
	100 ml/L	78.8	77.8	11.6	11.7	12.867	12.267	0.390	0.357
0.4% Mg	Control	77.3	76.8	11.6	11.1	12.133	11.933	0.393	0.367
	25 ml/L	80.3	79.0	11.8	11.6	12.667	12.333	0.383	0.357
	50 ml/L	83.2	81.2	12.3	12.2	13.867	12.800	0.360	0.333
	100 ml/L	80.7	79.7	11.9	11.8	13.000	12.600	0.373	0.347
0.6% Mg	Control	79.8	79.3	11.9	11.3	12.933	12.467	0.383	0.363
	25 ml/L	81.8	80.8	12.2	11.4	13.200	13.000	0.373	0.357
	50 ml/L	85.0	83.0	12.8	12.4	14.600	14.267	0.353	0.330
	100 ml/L	82.0	82.3	12.3	11.9	13.867	13.733	0.363	0.343
L.S.D. at 5%		N.S	N.S	00.3	00.6	00.530	N.S	0.013	0.011

As for the interaction effects, it is obvious from the same data in Table (1) that all treatments of Mg-concentrations were generally more effective in the presence than in the absence of yeast extract. In this regard, plants sprayed with magnesium at 0.6% Mg and sprayed with yeast extract at 50 ml/L gave the highest values of plant growth in both seasons compared with the other treatments. Similar results were reported by Eata (2001) on tomato and Shokr and Fathy (2009) on snap bean.

Yield and its components:

Data illustrated in Table (2) show the effect of magnesium concentrations, yeast extract concentrations and their interactions on yield and its components of garlic. Such data indicate that foliar application of Mg at the high concentration (0.6% Mg) was generally beneficial than the other treatments. Moreover, this treatment significantly increased total yield, bulb weight and diameter as well as clove weight than the all studied Mg-concentrations in both seasons. However, number of cloves/bulb was

significantly affected by Mg-concentrations in the second season only. The positive effect of Mg-concentrations in improving total yield and its components may be attributed to the important role of Mg in increasing the activity of plant metabolism, which reflected on bulb yield and enhance bulb quality. In addition, the beneficial effect of Mg as a foliar fertilizer on the yield and its components may be due to the fact that Mg plays an important role in formation of the organic compound such as carbohydrates, lipids and etc...which translocate to the reproductive organs and consequently increasing the yield and its components (Marschner, 1995). These results are in agreement with those of (Abd El-Rasoul and El-Azouni, 2002 on flax, Hao-Xiuming and Papadopoulos, 2003 on tomato, Awad and El-Ghamry., 2007 on potato, Abo El-Hamd and Esmail, 2008 on sugar beet and Osman and El-Sawah, 2009 on tomato), they found that total yield, dray mattermarketable yield were increased with increasing Mg concentration.

Table (2): Total yield and its components as affected by foliar Mg concentrations, Yeast and their interactions during 2008/2009 (S1) and 2009/2010 (S2) seasons.

Characters / Treatments		Total yield (ton/fed)		Bulb Weight (gm)		Bulb diameter (cm)		No. of cloves /bulb		Clove weight (gm)	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Mg- concentrations											
Control		5.935	5.678	52.075	49.783	4.9	4.7	14.4	14.7	3.182	2.962
0.2% Mg		6.117	5.703	53.667	50.033	5.4	5.2	14.8	14.8	3.193	3.058
0.4% Mg		6.697	5.980	58.733	52.475	5.5	5.3	14.1	14.9	3.687	3.097
0.6% Mg		7.098	6.330	62.250	55.517	6.0	5.6	13.9	14.0	3.942	3.446
LSD at 5%		0.252	0.135	02.192	01.193	0.2	0.2	N.S	00.6	0.304	0.160
Yeast-concentrations											
Control		6.051	5.597	53.075	49.075	5.1	4.8	14.9	15.3	3.100	2.779
25 ml/L Y. extract		6.251	5.784	54.833	50.750	5.4	5.1	14.5	15.1	3.343	2.951
50 ml/L Y. extract		6.929	6.282	60.775	55.100	5.8	5.6	13.5	13.6	3.951	3.625
100 ml/L Y. extract		6.618	6.028	58.042	52.883	5.5	5.3	14.3	14.4	3.609	3.207
LSD at 5%		0.081	0.076	00.720	00.662	0.1	0.1	00.5	00.6	0.147	0.132
Interactions:											
Mg-conc.	**Y. Concentrations**										
Control	Control	5.570	5.358	48.867	46.967	4.4	4.2	15.3	15.7	2.733	2.667
	25 ml/L	5.598	5.463	49.133	47.900	5.0	4.8	14.7	14.7	2.940	2.800
	50 ml/L	6.397	6.103	56.100	53.533	5.3	5.0	13.3	13.7	3.683	3.400
	100 ml/L	6.177	5.787	54.200	50.733	5.0	4.9	14.3	14.7	3.370	2.980
0.2% Mg	Control	5.793	5.430	50.833	47.633	5.0	4.9	15.3	15.7	2.857	2.647
	25 ml/L	5.893	5.603	51.700	49.167	5.3	5.1	15.0	15.7	3.037	2.743
	50 ml/L	6.568	5.948	57.633	52.167	5.6	5.6	14.0	13.3	3.633	3.607
	100 ml/L	6.215	5.832	54.500	51.167	5.4	5.3	14.7	14.7	3.243	3.233
0.4% Mg	Control	6.240	5.650	54.733	49.533	5.3	5.0	14.7	15.3	3.257	2.770
	25 ml/L	6.550	5.928	57.467	52.067	5.4	5.2	14.3	15.7	3.527	3.087
	50 ml/L	7.147	6.282	62.667	55.100	5.8	5.7	13.3	14.3	4.177	3.447
	100 ml/L	6.852	6.062	60.067	53.200	5.5	5.3	14.0	14.3	3.787	3.083
0.6% Mg	Control	6.600	5.948	57.867	52.167	5.6	5.2	14.3	14.7	3.553	3.033
	25 ml/L	6.962	6.140	61.033	53.867	5.7	5.4	14.0	14.3	3.867	3.173
	50 ml/L	7.605	6.797	66.700	59.600	6.5	6.2	13.3	13.0	4.310	4.047
	100 ml/L	7.227	6.433	63.400	56.433	6.1	5.6	14.0	14.0	4.037	3.530
L.S.D. at 5%		N.S	0.152	01.441	01.352	0.2	N.S	01.0	01.2	0.294	N.S

As for the effect of yeast extract concentrations, data in Table (2) indicate that total yield and its components were better with spraying the plants by yeast extract comparing with the untreated plants. Moreover, foliar application of yeast extract at 50 ml/L was more useful treatment to increasing total yield and improving its components than the other treatments. These increases might be ascribed to the fact that yeast contain sugar, proteins and amino acids, as well as several vitamins (Eata, 2001). The obtained results are in accordance with those of Tartoura and El-Saei (2006) Abd El-Mageed *et al.* (2009). Similar findings were established by El-Ghamriny *et al.* (1999) and Fathy *et al.* (2000) on tomato, Tartoura (2001) on Pea, El-Tohamy and El-Greadly (2007) on snap bean, Hanafy Ahmed, *et al.* (2007) on tomato.

Regarding the interaction effects, it is clear from data in Table (2) that the interactions between Mg-concentrations and yeast extract concentrations had a significant effect on total yield in the second season only while, bulb diameter and clove weight in the first season only, whereas, bulb weight and number of cloves/bulb were significantly affected in both seasons. In general, plants sprayed with 0.6% Mg concentration and 50 ml/L yeast extract produced the highest values. These results coincide with those of Shokr and Fathy (2009) on snap bean.

3- Chemical constituents:

Data in Table (3) show the effect of magnesium concentrations, yeast extract concentrations and their interactions on element concentrations of N, P and K in cloves as well as percentage of total soluble solids and volatile oils in cloves of garlic.

From such data, it is evident that the Mg-concentrations had a significant effect on chemical constituents in cloves of garlic. All tested chemical constituents i.e., N%, P% and K% as well as TSS% and volatile oils were increased with increasing Mg-concentrations from 0 up to 0.6% Mg in both seasons. These increases in P and K percentages were significant in the first season only. These results are in agreement with those of Osman and El-Sawah (2009) on tomato.

Concerning the effect of yeast extract concentrations, data in Table (3) show that all concentrations of elements in cloves and percentage of total soluble solids and volatile oils in cloves were significantly increased due to plants sprayed with yeast extract compared with the untreated plants. The highest values of chemical concentration were produced by plants sprayed with 50 ml/L yeast extract in both seasons. These results agreed with those reported by Fathy *et al.* (2000) and Abou-Aly (2005) on tomato and El-Tohamy *et al.* (2007) on eggplant.

As for the interaction effects, it is evident from data in Table (3) that the interactions between Mg-concentrations and yeast extract concentrations had a significant effects on all concentrations of studied chemical constituents in cloves in both seasons. Plants sprayed with 0.6% Mg and 50 ml/L yeast extract achieved the highest concentrations of N, P and K, as well as TSS% and volatile oils.

Table (3): Chemical constituents in garlic bulbs as affected by foliar Mg concentrations, Yeast and their interactions during 2008/2009 (S1) and 2009/2010 (S2) seasons.

Characters		Macronutrients						TSS%		Volatile oils (Mg/100g f.w)	
		N %		P %		K %					
Treatments		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Mg-concentrations											
Control		1.33	1.35	0.37	0.40	1.31	1.33	4.21	4.43	0.378	0.393
0.2% Mg		1.40	1.44	0.38	0.41	1.34	1.35	5.03	5.15	0.428	0.443
0.4% Mg		1.46	1.48	0.44	0.46	1.36	1.38	5.40	5.70	0.448	0.467
0.6% Mg		1.56	1.59	0.45	0.48	1.37	1.41	5.73	5.98	0.464	0.515
LSD at 5%		0.01	0.01	0.01	N.S	0.01	N.S	0.06	0.10	0.004	0.008
Yeast-concentrations											
Control		1.36	1.39	0.39	0.41	1.31	1.34	4.53	4.76	0.387	0.409
25 ml/L Y. extract		1.41	1.44	0.40	0.43	1.33	1.35	4.78	5.01	0.418	0.444
50 ml/L Y. extract		1.52	1.54	0.43	0.47	1.38	1.41	5.79	5.98	0.467	0.502
100 ml/L Y. extract		1.46	1.49	0.42	0.44	1.35	1.38	5.27	5.52	0.446	0.463
LSD at 5%		0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.07	0.010	0.006
Interactions: Mg-Conc. Yeast-concentrations											
Control	Control	1.25	1.27	0.35	0.37	1.28	1.31	3.73	3.87	0.357	0.373
	25 ml/L	1.30	1.33	0.34	0.38	1.29	1.32	3.90	4.10	0.373	0.390
	50 ml/L	1.38	1.41	0.41	0.43	1.34	1.36	4.90	5.20	0.407	0.420
	100 ml/L	1.37	1.39	0.38	0.40	1.33	1.34	4.30	4.57	0.377	0.390
0.2% Mg	Control	1.33	1.36	0.35	0.37	1.29	1.32	4.30	4.53	0.380	0.400
	25 ml/L	1.36	1.38	0.37	0.39	1.34	1.34	4.63	4.80	0.420	0.437
	50 ml/L	1.51	1.53	0.41	0.44	1.37	1.39	5.87	5.83	0.460	0.480
	100 ml/L	1.41	1.47	0.40	0.41	1.34	1.36	5.33	5.43	0.453	0.457
0.4% Mg	Control	1.38	1.41	0.42	0.44	1.34	1.35	4.80	5.13	0.393	0.417
	25 ml/L	1.42	1.45	0.43	0.45	1.35	1.37	5.10	5.43	0.430	0.457
	50 ml/L	1.57	1.58	0.45	0.49	1.39	1.41	6.10	6.40	0.490	0.523
	100 ml/L	1.47	1.46	0.44	0.47	1.36	1.40	5.60	5.83	0.477	0.473
0.6% Mg	Control	1.49	1.52	0.44	0.46	1.34	1.37	5.30	5.50	0.420	0.447
	25 ml/L	1.55	1.58	0.44	0.47	1.35	1.38	5.47	5.70	0.450	0.493
	50 ml/L	1.62	1.65	0.46	0.50	1.43	1.47	6.30	6.50	0.510	0.587
	100 ml/L	1.59	1.61	0.45	0.48	1.36	1.42	5.83	6.23	0.477	0.533
L.S.D. at 5%		0.01	0.01	0.01	0.01	0.01	0.01	0.10	0.15	0.013	0.011

4- Storability:

Data in Table (4) show the effect of magnesium concentrations, yeast extract concentrations and their interactions on monthly weight loss percentage of garlic bulbs during the storage period. Such data indicate that foliar application of Mg at the high concentration (0.6% Mg) was generally beneficial than the other treatments. The weight loss percentages during and at the end of storage period were decreased with increasing the foliar application concentration up to 6% Mg-citrate in both seasons. These results may be due to increase dry matter in plants (Table 1), TSS % and chemical constituents in cloves (Table 3).

Table (4): Weight loss percentage of garlic as affected by foliar Mg concentrations, yeast and their interactions during 2008/2009 (S1) and 2009/2010 (S2) seasons.

Characters		Weight loss (%) during the storage period									
		30 days		60 days		90 days		120 days		150 days	
Treatments		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Mg-concentrations											
Control		32.7	33.5	37.0	37.8	41.4	43.0	47.7	47.9	49.7	50.5
0.2% Mg		32.1	32.7	36.7	37.1	40.9	43.0	46.5	46.0	48.7	49.3
0.4% Mg		27.8	28.6	31.5	33.3	34.5	38.2	38.5	40.6	41.5	43.5
0.6% Mg		26.3	28.0	29.5	31.0	31.7	35.3	34.6	36.9	37.3	39.5
LSD at 5%		01.1	01.1	01.4	0.6	01.2	01.0	01.5	01.5	00.5	00.2
Yeast- concentrations											
Control		31.8	32.5	35.4	36.6	39.6	42.3	44.5	46.6	47.2	49.3
25 ml/L Y. extract		30.1	31.1	34.2	35.5	37.7	40.7	42.6	43.7	45.1	46.5
50 ml/L Y. extract		27.9	29.1	32.0	32.8	34.8	37.3	39.2	39.6	41.6	42.6
100 ml/L Y. extract		29.1	30.1	33.2	34.4	36.3	39.2	41.0	41.6	43.3	44.5
LSD at 5%		00.4	00.6	00.4	00.6	00.4	00.6	00.3	00.6	00.5	00.2
Interactions: Mg-concent.	**Yeast-Concent.**										
Control	Control	33.8	34.0	37.6	38.2	42.3	44.2	49.0	51.2	52.2	54.0
	25 ml/L	32.7	33.7	37.1	38.0	41.9	43.9	48.7	48.1	50.3	51.0
	50 ml/L	32.0	32.9	36.4	37.2	40.4	41.6	45.8	45.8	47.2	48.1
	100 ml/L	32.5	33.3	36.9	37.7	40.9	42.4	47.3	46.5	49.1	48.9
0.2% Mg	Control	32.8	33.5	37.1	37.8	42.3	43.7	48.3	48.1	50.3	51.1
	25 ml/L	32.3	32.9	37.0	37.5	41.4	42.9	47.1	46.6	49.3	50.1
	50 ml/L	31.1	31.9	36.0	36.2	39.1	42.1	44.7	43.8	47.0	47.0
	100 ml/L	32.3	32.4	36.8	36.9	40.8	43.1	46.0	45.9	48.0	49.0
0.4% Mg	Control	31.9	32.2	34.3	36.2	38.4	42.1	42.3	45.2	45.3	48.0
	25 ml/L	28.1	28.8	32.2	34.3	35.4	39.6	39.1	41.3	42.4	44.0
	50 ml/L	25.0	26.1	29.0	30.0	31.0	34.0	35.3	37.0	38.3	40.0
	100 ml/L	26.2	27.4	30.6	32.8	33.0	37.1	37.3	39.0	40.0	42.0
0.6% Mg	Control	28.7	30.4	32.3	34.2	35.3	39.1	38.2	41.8	41.0	43.9
	25 ml/L	27.4	29.2	30.5	32.1	32.1	36.6	35.6	38.7	38.1	41.0
	50 ml/L	23.7	25.4	26.6	27.7	28.8	31.3	31.2	32.0	34.0	35.2
	100 ml/L	25.2	27.1	28.6	30.1	30.6	34.0	33.3	35.0	36.1	38.0
L.S.D. at 5%		00.8	01.2	00.7	01.3	00.8	01.2	00.6	01.2	01.1	00.4

Regarding the effect of yeast extract concentrations, the same data in Table (4) indicate that bulb storability of plants sprayed with yeast extract was better than that of the untreated plants. Moreover, foliar application of yeast extract at 50 ml/L was more beneficial than the application once. These results are in harmony with those of Tartoura and El-Saei (2006) and Abd El-Mageed *et al.* (2009) they found that weight loss percent of bulbs was significantly reduced during the storage period with plants sprayed by yeast extract.

Concerning the interaction between foliar spray of magnesium and yeast extract concentrations, data in Table (4) show that the positive interactions often observed on storability of bulbs. The lowest total weight loss percentages during and at the end of the storage period were obtained from foliar spray with 0.6% Mg and 50 ml/L yeast extract in both seasons. From the obtained results of this study, it could be concluded that, spraying garlic plants with combination between 0.6% Mg and 50 ml/L yeast extract

was the superior treatment to enhancing the garlic plant growth, yield and its components, as well as bulb quality and storability. This treatment achieved increases in yield at the end of the storage period reached to 18.20% and 18.80% in the first and second seasons, respectively compared with the untreated ones. Therefore, this treatment could be recommended under similar conditions to this work.

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استجابة نمو وإنتاجية وقابلية تخزين الثـوم للـرش بالماغنـسيوم ومـستخلص الخميرة.

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تعتبر إضافة العناصر المغذية للنباتات بالرش الورقى أكثر سرعة وكفاءة لسد احتياج النبات من العناصر الصغرى عنها بالإضافة الأرضية، ويمكن أيضاً الاستفادة من هذه الطريقة لسد احتياجات النبات من بعض العناصر الكبرى.

ولهذا الغرض، نُفذت تجربتان حقليتان على محصول الثوم (صنف سـدس-40) فـى مزرعة خضر خاصة بكفر ميت فارس بالقرب من المنصورة بمحافظة الدقهلية خلال موسـمى الزراعة 2009/2008 و 2009 / 2010 م لدراسة تأثير بعض تركيزات الرش الورقى بعنـصر الماغنسيوم(0.0% 0.2%، 0.4% و 0.6% ماغنسيوم فى صورة سترات الماغنسيوم) كلٌ منهـا منفرداً أو مع الرش بمستويات مختلفة من مستخلص الخميرة (25 مل/لتر، 50 مـل/لتـر و100 مل/لتر بالإضافة لمعاملة الكنترول) على نمو النباتات ومحصول الأبصال ومكوناته بالإضافة إلى المحتويات الكيماوية فى الفصوص والقدرة التخزينية للأبصال خلال فترة التخزين (5 شهور). وقد وزعت المعاملات فى قطع منشقة مرة واحدة فى ثلاثة مكررات، ويمكن تلخيص النتائج المتحصل عليها فيما يلى :-

بصفة عامة أوضحت النتائج أن الرش بالماغنسيوم عند تركيز 0.6% إلى حدوث زيادات ملموسة فى ارتفاع النبات، عدد الأوراق و الوزن الجاف لعرش النبات كما تحسّنت نسبة التبصيل وكذلك ازداد المحصول الكلى ومتوسط وزن وقطر البصلة وبجانب ذلك زادت معنوياً تركيـزات المواد الصلبة الكلية والزيوت الطيارة وكـذلك زادت نـسبة عناصـر النيتـروجين والفوسـفور والبوتاسيوم فى فصوص الثوم، وقد أدت أيضاً إلى حدوث انخفاض معنوى فى نسبة نقـص وزن الأبصال خلال فترة التخزين فى كلا موسمى الدراسة.

ومن ناحية أخرى أدى رش النباتات بمستخلص الخميرة بتركيز 50 مل/لتر إلى حـدوث زيادات معنوية فى معظم صفات النمو الخضرى للنباتات وكذلك المحصول الكلى ومكوناته، كمـا أدى إلى زيادة تركيزات المواد الصلبة الكلية والزيوت الطيـارة والنيتـروجين والفوسـفور فـى الفصوص مقارنة مع معاملة الكنترول، وبجانب ذلك أدى إلى انخفاض نسبة نقص وزن الأبـصال عند نهاية فترة التخزين معنوياً.

التفاعلات بين تركيزات الرش بالماغنسيوم و تركيزات الـرش بمـستخلص الخميـرة لوحظت فى حالات كثيرة ، ولقد كانت أفضل النتائج باستخدام الرش الـورقى بالماغنـسيوم عـن تركيز 0.6% مع الرش بمستخلص الخميرة عند تركيز 50 مل/لتر، كما أدت هذه المعاملة إلـى زيادة فى المحصول فى نهاية فترة التخزين تُقدر بـ 18.20 % و 18.80% فى الموسـم الأول والموسم الثانى على التوالى مقارنة بمعاملة الكنترول.

وبناءً على ماتقدم، يمكن التوصية باستخدام هذه المعاملة لرفع إنتاجية الثوم وتحسين جودة الأبصال وقابليتها للتخزين تحت الظروف المشابهة لظروف هذا البحث.

قام بتحكيم البحث

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