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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		Plant height (cm)		Number of leaves/plant		Plant dry weight (gm)		Bulbing ratio	
Treatments		**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**
Mg-concentrations									
Control		76.6	74.7	١١,٣	١١,1	١٢,٣٨٣	١١,٣٨٣	٠,٣٩٢	٠,٣٦٨
0.2% Mg		78.1	76.8	١١,6	١١,6	١٢,٥٣٣	١٢,١٥٠	٠,٣٩٢	٠,٣٦٢
0.4% Mg		80.4	79.2	١١,٩	١١,7	١٢,٩١٧	١٢,٤١٧	٠,٣٧٧	٠,٣٥١
0.6% Mg		82.2	81.8	١٢,٣	١١,8	١٣,٦٥٠	١٣,٣٦٧	٠,٣٦٨	٠,٣٤٨
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	١١,4	١١,٠	١٢,٠٥٠	١١,٧٥٠	٠,٣٩٧	٠,٣٧١
25 ml/L Y. extract		78.9	77.5	١١,٦	١١,٣	١٢,٦٣٣	١٢,١٦٧	٠,٣٨٧	٠,٣٦٣
50 ml/L Y. extract		81.8	80.0	١٢,٣	١٢,١	١٣,٧٠٠	١٢,٩٠٠	٠,٣٦٧	٠,٣٤٢
100 ml/L Y. extract		79.6	78.7	١١,٨	١١,6	١٣,١٠٠	١٢,٥٠٠	٠,٣٧٩	٠,٣٥٣
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	١٠,٨	١٠,٧	١١,٤٦٧	١٠,٨٦٧	٠,٤٠٧	٠,٣٧٧
	25 ml/L	76.2	73.7	١١,١	١٠,٩	١٢,٤٠٠	١١,٣٣٣	٠,٣٩٣	٠,٣٧٣
	50 ml/L	78.5	76.8	١٢,٠	١١,8	١٣,٠٠٠	١١,٩٣٣	٠,٣٧٧	٠,٣٥٧
	100 ml/L	76.8	75.0	١١,٤	١١,٠	١٢,٦٦٧	١١,٤٠٠	٠,٣٩٠	٠,٣٦٣
0.2% Mg	Control	75.8	73.8	١١,٢	١١,٠	١١,٦٦٧	١١,٧٣٣	٠,٤٠٣	٠,٣٧٧
	25 ml/L	77.2	76.3	١١,٤	١١,٤	١٢,٢٦٧	١٢,٠٠٠	٠,٣٩٧	٠,٣٦٧
	50 ml/L	80.7	79.2	١٢,١	١٢,١	١٣,٣٣٣	١٢,٦٠٠	٠,٣٨٠	٠,٣٤٧
	100 ml/L	78.8	77.8	١١,6	١١,٧	١٢,٨٦٧	١٢,٢٦٧	٠,٣٩٠	٠,٣٥٧
0.4% Mg	Control	77.3	76.8	١١,6	١١,١	١٢,١٣٣	١١,٩٣٣	٠,٣٩٣	٠,٣٦٧
	25 ml/L	80.3	79.0	١١,٨	١١,٦	١٢,٦٦٧	١٢,٣٣٣	٠,٣٨٣	٠,٣٥٧
	50 ml/L	83.2	81.2	١٢,٣	١٢,٢	١٣,٨٦٧	١٢,٨٠٠	٠,٣٦٠	٠,٣٣٣
	100 ml/L	80.7	79.7	١١,٩	١١,8	١٣,٠٠٠	١٢,٦٠٠	٠,٣٧٣	٠,٣٤٧
0.6% Mg	Control	79.8	79.3	١١,٩	١١,٣	١٢,٩٣٣	١٢,٤٦٧	٠,٣٨٣	٠,٣٦٣
	25 ml/L	81.8	80.8	١٢,٢	١١,٤	١٣,٢٠٠	١٣,٠٠٠	٠,٣٧٣	٠,٣٥٧
	50 ml/L	85.0	83.0	١٢,٨	١٢,٤	١٤,٦٠٠	١٤,٢٦٧	٠,٣٥٣	٠,٣٣٠
	100 ml/L	82.0	82.3	١٢,٣	١١,٩	١٣,٨٦٧	١٣,٧٣٣	٠,٣٦٣	٠,٣٤٣
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		Total yield (ton/fed)		Bulb Weight (gm)		Bulb diameter (cm)		No. of cloves /bulb		Clove weight (gm)	
Treatments		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Mg- concentrations											
Control		٥,٩٣٥	٥,٦٧٨	٥٢,٠٧٥	٤٩,٧٨٣	٤,٩	٤,٧	١٤,٤	١٤,٧	٣,١٨٢	٢,٩٦٢
0.2% Mg		٦,١١٧	٥,٧٠٣	٥٣,٦٦٧	٥٠,٠٣٣	٥,4	٥,٢	١٤,8	١٤,٨	٣,١٩٣	٣,٠٥٨
0.4% Mg		٦,٦٩٧	٥,٩٨٠	٥٨,٧٣٣	٥٢,٤٧٥	٥,5	٥,٣	١٤,1	١٤,٩	٣,٦٨٧	٣,٠٩٧
0.6% Mg		٧,٠٩٨	٦,٣٣٠	٦٢,٢٥٠	٥٥,٥١٧	6.0	٥,6	١٣,٩	١٤,٠	٣,٩٤٢	٣,٤٤٦
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		٦,٠٥١	٥,٥٩٧	٥٣,٠٧٥	٤٩,٠٧٥	٥,1	٤,٨	١٤,٩	١٥,٣	٣,١٠٠	٢,٧٧٩
25 ml/L Y. extract		٦,٢٥١	٥,٧٨٤	٥٤,٨٣٣	٥٠,٧٥٠	٥,4	٥,١	١٤,٥	١٥,1	٣,٣٤٣	٢,٩٥١
50 ml/L Y. extract		٦,٩٢٩	٦,٢٨٢	٦٠,٧٧٥	٥٥,١٠٠	٥,8	٥,٦	١٣,٥	١٣,6	٣,٩٥١	٣,٦٢٥
100 ml/L Y. extract		٦,٦١٨	٦,٠٢٨	٥٨,٠٤٢	٥٢,٨٨٣	٥,٥	٥,3	١٤,3	١٤,٤	٣,٦٠٩	٣,٢٠٧
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	٥,٥٧٠	٥,٣٥٨	٤٨,٨٦٧	٤٦,٩٦٧	٤,4	٤,٢	١٥,٣	١٥,٧	٢,٧٣٣	٢,٦٦٧
	25 ml/L	٥,٥٩٨	٥,٤٦٣	٤٩,١٣٣	٤٧,٩٠٠	٥,٠	٤,٨	١٤,٧	١٤,٧	٢,٩٤٠	٢,٨٠٠
	50 ml/L	٦,٣٩٧	٦,١٠٣	٥٦,١٠٠	٥٣,٥٣٣	٥,3	٥,٠	١٣,٣	١٣,٧	٣,٦٨٣	٣,٤٠٠
	100 ml/L	٦,١٧٧	٥,٧٨٧	٥٤,٢٠٠	٥٠,٧٣٣	٥,٠	٤,٩	١٤,٣	١٤,٧	٣,٣٧٠	٢,٩٨٠
0.2% Mg	Control	٥,٧٩٣	٥,٤٣٠	٥٠,٨٣٣	٤٧,٦٣٣	٥,٠	٤,9	١٥,٣	١٥,٧	٢,٨٥٧	٢,٦٤٧
	25 ml/L	٥,٨٩٣	٥,٦٠٣	٥١,٧٠٠	٤٩,١٦٧	٥,٣	٥,١	١٥,٠	١٥,٧	٣,٠٣٧	٢,٧٤٣
	50 ml/L	٦,٥٦٨	٥,٩٤٨	٥٧,٦٣٣	٥٢,١٦٧	٥,٦	٥,٦	١٤,٠	١٣,٣	٣,٦٣٣	٣,٦٠٧
	100 ml/L	٦,٢١٥	٥,٨٣٢	٥٤,٥٠٠	٥١,١٦٧	٥,٤	٥,3	١٤,٧	١٤,٧	٣,٢٤٣	٣,٢٣٣
0.4% Mg	Control	٦,٢٤٠	٥,٦٥٠	٥٤,٧٣٣	٤٩,٥٣٣	٥,3	٥,٠	١٤,٧	١٥,٣	٣,٢٥٧	٢,٧٧٠
	25 ml/L	٦,٥٥٠	٥,٩٢٨	٥٧,٤٦٧	٥٢,٠٦٧	٥,٤	٥,2	١٤,٣	١٥,٧	٣,٥٢٧	٣,٠٨٧
	50 ml/L	٧,١٤٧	٦,٢٨٢	٦٢,٦٦٧	٥٥,١٠٠	٥,8	٥,٧	١٣,٣	١٤,٣	٤,١٧٧	٣,٤٤٧
	100 ml/L	٦,٨٥٢	٦,٠٦٢	٦٠,٠٦٧	٥٣,٢٠٠	٥,٥	٥,3	١٤,٠	١٤,٣	٣,٧٨٧	٣,٠٨٣
0.6% Mg	Control	٦,٦٠٠	٥,٩٤٨	٥٧,٨٦٧	٥٢,١٦٧	٥,٦	٥,٢	١٤,٣	١٤,٧	٣,٥٥٣	٣,٠٣٣
	25 ml/L	٦,٩٦٢	٦,١٤٠	٦١,٠٣٣	٥٣,٨٦٧	٥,٧	٥,٤	١٤,٠	١٤,٣	٣,٨٦٧	٣,١٧٣
	50 ml/L	٧,٦٠٥	٦,٧٩٧	٦٦,٧٠٠	٥٩,٦٠٠	٦,٥	٦,2	١٣,٣	١٣,٠	٤,٣١٠	٤,٠٤٧
	100 ml/L	٧,٢٢٧	٦,٤٣٣	٦٣,٤٠٠	٥٦,٤٣٣	٦,١	٥,٦	١٤,٠	١٤,٠	٤,٠٣٧	٣,٥٣٠
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		١,٣3	١,٣٥	٠,٣٧	٠,40	١,٣١	١,٣٣	٤,٢1	٤,٤٣	٠,٣٧٨	٠,٣٩٣
0.2% Mg		١,٤٠	١,٤4	٠,٣٨	٠,٤1	١,٣4	١,٣٥	٥,٠٣	٥,١٥	٠,٤٢٨	٠,٤٤٣
0.4% Mg		١,٤٦	١,٤٨	٠,٤4	٠,٤٦	١,٣٦	١,٣٨	٥,٤٠	٥,٧٠	٠,٤٤٨	٠,٤٦٧
0.6% Mg		١,٥٦	١,٥٩	٠,٤5	٠,٤8	١,٣٧	١,٤١	٥,٧3	٥,٩٨	٠,٤٦٤	٠,٥١٥
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		١,٣٦	١,٣٩	٠,٣٩	٠,٤١	١,٣١	١,٣٤	٤,٥٣	٤,٧6	٠,٣٨٧	٠,٤٠٩
25 ml/L Y. extract		١,٤1	١,٤4	٠,40	٠,٤3	١,٣٣	١,٣٥	٤,٧8	٥,٠1	٠,٤١٨	٠,٤٤٤
50 ml/L Y. extract		١,٥٢	١,٥٤	٠,٤٣	٠,٤7	١,٣٨	١,٤1	٥,٧٩	٥,٩٨	٠,٤٦٧	٠,٥٠٢
100 ml/L Y. extract		١,٤٦	١,٤9	٠,٤2	٠,٤٤	١,٣٥	١,٣٨	٥,٢٧	٥,٥2	٠,٤٤٦	٠,٤٦٣
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	١,٢٥	١,٢٧	٠,٣٥	٠,٣٧	١,٢٨	١,٣١	٣,٧٣	٣,٨٧	٠,٣٥٧	٠,٣٧٣
	25 ml/L	١,٣٠	١,٣٣	٠,٣٤	٠,٣٨	١,٢٩	١,٣٢	٣,٩٠	٤,١٠	٠,٣٧٣	٠,٣٩٠
	50 ml/L	١,٣8	١,٤١	٠,٤١	٠,٤٣	١,٣٤	١,٣٦	٤,٩٠	٥,٢٠	٠,٤٠٧	٠,٤٢٠
	100 ml/L	١,٣٧	١,٣٩	٠,٣٨	٠,٤٠	١,٣٣	١,٣٤	٤,٣٠	٤,٥٧	٠,٣٧٧	٠,٣٩٠
0.2% Mg	Control	١,٣٣	١,٣٦	٠,٣٥	٠,٣٧	١,٢٩	١,٣٢	٤,٣٠	٤,٥٣	٠,٣٨٠	٠,٤٠٠
	25 ml/L	١,٣٦	١,٣٨	٠,٣٧	٠,٣٩	١,٣4	١,٣٤	٤,٦٣	٤,٨٠	٠,٤٢٠	٠,٤٣٧
	50 ml/L	١,٥١	١,٥٣	٠,٤١	٠,٤٤	١,٣٧	١,٣٩	٥,٨٧	٥,٨٣	٠,٤٦٠	٠,٤٨٠
	100 ml/L	١,٤١	١,٤٧	٠,40	٠,٤١	١,٣٤	١,٣٦	٥,٣٣	٥,٤٣	٠,٤٥٣	٠,٤٥٧
0.4% Mg	Control	١,٣٨	١,٤١	٠,٤٢	٠,٤٤	١,٣٤	١,٣٥	٤,٨٠	٥,١٣	٠,٣٩٣	٠,٤١٧
	25 ml/L	١,٤٢	١,٤٥	٠,٤٣	٠,٤٥	١,٣٥	١,٣٧	٥,١٠	٥,٤٣	٠,٤٣٠	٠,٤٥٧
	50 ml/L	١,٥٧	١,٥٨	٠,٤٥	٠,٤9	١,٣٩	١,٤١	٦,١٠	٦,٤٠	٠,٤٩٠	٠,٥٢٣
	100 ml/L	١,٤٧	١,٤٦	٠,٤٤	٠,٤٧	١,٣٦	١,40	٥,٦٠	٥,٨٣	٠,٤٧٧	٠,٤٧٣
0.6% Mg	Control	١,٤٩	١,٥٢	٠,٤٤	٠,٤٦	١,٣٤	١,٣٧	٥,٣٠	٥,٥٠	٠,٤٢٠	٠,٤٤٧
	25 ml/L	١,٥٥	١,٥٨	٠,٤٤	٠,٤٧	١,٣٥	١,٣٨	٥,٤٧	٥,٧٠	٠,٤٥٠	٠,٤٩٣
	50 ml/L	١,٦٢	١,٦٥	٠,٤٦	٠,٥٠	١,٤٣	١,٤٧	٦,٣٠	٦,٥٠	٠,٥١٠	٠,٥٨٧
	100 ml/L	١,٥9	١,٦١	٠,٤٥	٠,٤٨	١,٣٦	١,٤٢	٥,٨٣	٦,٢٣	٠,٤٧٧	٠,٥٣٣
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		٣٢,٧	٣٣,5	٣٧,٠	٣٧,8	٤١,4	٤٣,٠	٤٧,7	٤٧,٩	٤٩,٧	٥٠,5
0.2% Mg		٣٢,١	٣٢,7	٣٦,٧	٣٧,1	٤٠,٩	٤3.0	٤٦,٥	٤٦,٠	٤٨,٧	٤٩,٣
0.4% Mg		٢٧,٨	٢٨,٦	٣١,٥	٣٣,٣	٣٤,5	٣٨,2	٣٨,٥	٤٠,٦	٤١,٥	٤٣,٥
0.6% Mg		٢٦,3	٢٨,٠	٢٩,5	٣١,٠	٣١,7	٣٥,3	٣٤,6	٣٦,9	٣٧,٣	٣٩,٥
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		٣١,8	٣٢,٥	٣٥,4	٣٦,٦	٣٩,٦	٤٢,3	٤٤,5	٤٦,6	٤٧,٢	٤٩,3
25 ml/L Y. extract		٣٠,١	٣١,١	٣٤,٢	٣٥,5	٣٧,٧	٤٠,٧	٤٢,٦	٤٣,٧	٤٥,1	٤٦,٥
50 ml/L Y. extract		٢٧,٩	٢٩,1	٣٢,٠	٣٢,8	٣٤,٨	٣٧,3	٣٩,٢	٣٩,6	٤١,٦	٤٢,6
100 ml/L Y. extract		٢٩,1	٣٠,1	٣٣,٢	٣٤,4	٣٦,٣	٣٩,2	٤١,٠	٤١,٦	٤٣,٣	٤٤,5
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	٣٣,8	٣٤,٠	٣٧,٦	٣٨,٢	٤٢,٣	٤٤,٢	٤٩,٠	٥١,٢	٥٢,٢	٥٤,٠
	25 ml/L	٣٢,٧	٣٣,٧	٣٧,١	٣٨,٠	٤١,٩	٤٣,٩	٤٨,٧	٤٨,١	٥٠,٣	٥١,٠
	50 ml/L	٣٢,٠	٣٢,٩	٣٦,٤	٣٧,٢	٤٠,٤	٤١,6	٤٥,8	٤٥,٨	٤٧,٢	٤٨,١
	100 ml/L	٣٢,٥	٣٣,٣	٣٦,٩	٣٧,٧	٤٠,9	٤٢,٤	٤٧,٣	٤٦,٥	٤٩,١	٤٨,9
0.2% Mg	Control	٣٢,8	٣٣,5	٣٧,١	٣٧,8	٤٢,٣	٤٣,7	٤٨,٣	٤٨,١	٥٠,٣	٥١,١
	25 ml/L	٣٢,٣	٣٢,٩	٣٧,٠	٣٧,5	٤١,٤	٤٢,٩	٤٧,١	٤٦,6	٤٩,٣	٥٠,١
	50 ml/L	٣١,١	٣١,٩	٣٦,٠	٣٦,٢	٣٩,١	٤٢,١	٤٤,٧	٤٣,8	٤٧,٠	٤٧,٠
	100 ml/L	٣٢,٣	٣٢,٤	٣٦,٨	٣٦,٩	٤٠,٨	٤٣,١	٤٦,٠	٤٥,٩	٤٨,٠	٤٩,٠
0.4% Mg	Control	٣١,٩	٣٢,٢	٣٤,٣	٣٦,٢	٣٨,٤	٤٢,١	٤٢,٣	٤٥,٢	٤٥,٣	٤٨,٠
	25 ml/L	٢٨,١	٢٨,٨	٣٢,٢	٣٤,٣	٣٥,٤	٣٩,6	٣٩,١	٤١,٣	٤٢,٤	٤٤,٠
	50 ml/L	٢٥,٠	٢٦,١	٢٩,٠	٣٠,٠	٣١,٠	٣٤,٠	٣٥,٣	٣٧,٠	٣٨,٣	٤٠,٠
	100 ml/L	٢٦,٢	٢٧,٤	٣٠,6	٣٢,٨	٣٣,٠	٣٧,١	٣٧,٣	٣٩,٠	٤٠,٠	٤٢,٠
0.6% Mg	Control	٢٨,7	٣٠,٤	٣٢,٣	٣٤,٢	٣٥,٣	٣٩,١	٣٨,٢	٤١,8	٤١,٠	٤٣,٩
	25 ml/L	٢٧,٤	٢٩,٢	٣٠,5	٣٢,١	٣٢,١	٣٦,6	٣٥,6	٣٨,٧	٣٨,١	٤١,٠
	50 ml/L	٢٣,٧	٢٥,٤	٢٦,6	٢٧,7	٢٨,8	٣١,٣	٣١,٢	٣٢,٠	٣٤,٠	٣٥,٢
	100 ml/L	٢٥,٢	٢٧,١	٢٨,6	٣٠,١	٣٠,6	٣٤,٠	٣٣,٣	٣٥,٠	٣٦,١	٣٨,٠
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 الثوم للرش بالماغنسيوم ومستخلص 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 سدس-٤٠) فى مزرعة خضر خاصة بكفر ميت فارس بالقرب من المنصورة بمحافظة الدقهلية خلال موسمى الزراعة ٢٠٠٨/٢٠٠٩ و ٢٠٠٩ / ٢٠١٠ م لدراسة تأثير بعض تركيزات الرش الورقى بعنصر الماغنسيوم(٠,٠% ٠,٢%، ٠,٤% و ٠,٦% ماغنسيوم فى صورة سترات الماغنسيوم) كلٌ منها منفرداً أو مع الرش بمستويات مختلفة من مستخلص الخميرة (٢٥ مل/لتر، ٥٠ مل/لتر و١٠٠ مل/لتر بالإضافة لمعاملة الكنترول) على نمو النباتات ومحصول الأبصال ومكوناته بالإضافة إلى المحتويات الكيماوية فى الفصوص والقدرة التخزينية للأبصال خلال فترة التخزين (٥ شهور). وقد وزعت المعاملات فى قطع منشقة مرة واحدة فى ثلاثة مكررات، ويمكن تلخيص النتائج المتحصل عليها فيما يلى :-

بصف عامة أوضحت النتائج أن الرش بالماغنسيوم عند تركيز ٠,٦% 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 تركيزات المواد الصلبة الكلية والزيوت الطيارة وكذلك زادت نسبة عناصر النيتروجين والفوسفور والبوتاسيوم فى فصوص الثوم، وقد أدت أيضاً إلى حدوث انخفاض معنوى فى نسبة نقص وزن الأبصال خلال فترة التخزين فى كلا موسمى الدراسة.

ومن ناحية أخرى أدى رش النباتات بمستخلص الخميرة بتركيز ٥٠ مل/لتر إلى حدوث زيادات معنوية فى معظم صفات النمو الخضرى للنباتات وكذلك المحصول الكلى ومكوناته، كما أدى إلى زيادة تركيزات المواد الصلبة الكلية والزيوت الطيارة والنيتروجين والفوسفور فى الفصوص مقارنة مع معاملة الكنترول، وبجانب ذلك أدى إلى انخفاض نسبة نقص وزن الأبصال عند نهاية فترة التخزين معنوياً.

التفاعلات بين تركيزات الرش بالماغنسيوم و تركيزات الرش بمستخلص الخميرة لوحظت فى حالات كثيرة ، ولقد كانت أفضل النتائج باستخدام الرش الورقى بالماغنسيوم عن تركيز ٠,٦% مع الرش بمستخلص الخميرة عند تركيز ٥٠ مل/لتر، كما أدت هذه المعاملة إلى زيادة فى المحصول فى نهاية فترة التخزين تُقدر بـ ١٨,٢٠ % و ١٨,٨٠% فى الموسم 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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