Zagazig J. Agric. Res., Vol. 35 No .(1) 2008 33-46

ANTIOXIDANTS APPLICATION IN RELATION TO GARLIC GROWTH, BULBS YIELD AND DISEASE INCIDENCE

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Accepted 25/12/2007

ABSTRACT: Two field experiments were carried out at Nubaria region to evaluate the response of two garlic clones (clone 138 and T_7 selected clone) to foliar spray with some organic acids ; i.e., salisylic, citric and ascorbic at different concentrations under sandy soil condition using drip irrigation system.

The clone 138 exhibited significant increase in plant height and the fifth leaf length comparing to T_7 selected clone. The later genotype was more resistant to purple blotch disease, and achieved the higher values of all studied yield parameters, exept number of cloves / bulb.

All studied antioxidant concentrations augmented all of the measured growth traits. Salicylic acid at 200 ppm overcomed the other treatments in plant height, pseudo – stem length in the first season and number of leaves dried early in the season. All applied antioxidant reduced the damaged percentage of garlic plants caused by purple blotch disease, as the least damaged percentage was noticed due to salicylic acid at 50 ppm. Moreover, all tested antioxidant concentrations, generally, increased all studied yield parameters. Citric acid at 400 ppm exerted general significant increases in the average bulb diameter and height, average clove and bulb weights in both seasons, and bulbs yield ton / feddan in the second season.

Key words: Antioxidants , garlic, growth, yield, diseases incidence.

INTRODUCTION

Garlic (*Allium sativum* L.) is an important vegetable crop in Egypt used as a spice and medicinal herb.

Using antioxidant substances to improve plant growth and yield in addition to diseases resistance became an interest objective.

Salicylic acid, as antioxidant, was found to exert positive effect on plant growth and to overcome the harmful effect of some environmental stresses on plant growth (El-Khayat, 2001) .

Antioxidant citric acid was reported to stimulate nutrients absorption and hastenes growth activators synthesis (Abd El-Naem, 2005).

Vitamin C functions as antioxidant, an enzyme factor and as growth regulating factor. It participates in a variety of processes, including photosynthesis, photoprotection, cell wall growth and cell expansion, resistance to environmental stresses and synthesis of ethylene, gibberellins, anthocynins and hydroxyproline (Nicholas and Wheeler, 2000).

Furthermore, antioxidants were reported to increase plant resistance to diseases incidence (Julie *et al.*, 2001).

The present study was undertaken to evaluate the effect of some antioxidants; i.e., salicylic, citric and ascorbic acids on growth, bulbs yield and plant resistance to purple blotches and rust diseases of two garlic genotypes.

MATERIALS AND METHODS

The experiments were performed at Al-Nubaria area during 2004/2005 and 2005/2006 seasons to study the response of two garlic genotypes; i.e., T_7 selected and clone 138 to three antioxidants; i.e., salicylic, citric and ascorbic acids at the concentrations of 50, 100 and 200 ppm for salicylic, and 100, 200 and 400 ppm for the later two ones.

The soil of the site area was sandy in texture, and a drip irrigation system was followed. The studied treatments were randomly arranged in a split plot complete design as garlic genotypes occupied the main plots and antioxidant concentrations were distributed in the sub plots.

The experimental unit area was 24 m^2 which contained four rows with 5 m in length and 120 cm in width. Cloves were sown in four lines on the row surface 10 cm apart on October 1 and 2, during 2004 / 2005 and 2005 / 2006 seasons, respectively.

The antioxidants were foliage sprayed at the respective concentrations, five times at 10 days intervals beginning 10 January, 14 weeks after planting.

The normal agricultural practices were carried out as commonly followed.

Random samples, ten plants each, were undertaken randomly from each experimental unit at the intensive growth period; i.e., March 15 (22weeks from planting) as the following growth parameters were determined : plant height, pseudo-stem length, number of dry and green leaves (leaves that still green longer time in the season) and the fifth upper leaf length and width, as the fifth leaf is the most physiologically active leaf.

The purple blotch and rust diseases as affected by genotype and applied antioxidants were measured as the damaged plant percentage and number of blotches for the first disease (at 22 weeks from planting) and the damaged plants percentage for the second one (at 26 weeks from planting).

Bulbs harvesting was conducted on April 15 (28 weeks from planting) as the following yield parameters were determined: average bulb diameter and height, number of cloves / bulb, average clove and bulb weights (g) and bulbs yield (ton/fed.).

Data were tested by analysis of variance. Duncan's multiple range test was used for comparisons among treatments means (Duncan, 1965).

RESULTS AND DISCUSSION

Plant growth, purple blotch and rust diseases incidence and bulbs yield in relation to grown genotype and antioxidants at such concentrations, along with their interaction, were presented as follows :

Plant Growth

Effect of garlic clones

Comparing to T_7 selected genotype, clone 138 exhibited significant increase in plant height and the fifth leaf length and the most physiologically active leaf. However, it showed insignificant superiority in the number of green leaves, leaves that still green longer time in the growing season (Table 1 a).

Besides, T_7 selected clone overcomed that of clone 138 in pseudo-stem length, number of dry and total leaves and the fifth leaf width, although significances were frequently noticed.

The varietal variations in growth parameters were quite expected since growth potentiality is mainly dependent on hereditical genes (Khalil *et al*,1988).El Shimi (1996),

Table 1a. Vegetative growth traits as affected by garlic clones after 22 weeks from planting during 2004 / 05 and 2005 / 06 seasons

Clones	Plant height (cm)		Pseudo – stem length (cm)		Number of leaves						Shape of the fifth leaf			
					dry		green		total		Length (cm)		Width (cm)	
	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06
Clone T7 selected	97.68 b	96.88 b	46.88 a	46.95 a	4.98 a	5.3 a	8.9 a	8.55 a	13.88 a	13.85 a	57.6 b	56.83 b	3.04 a	3 a
138 clone	108.88 a	108.4 a	45.18 b	44.65 b	3.78 b	4.05 b	9.43 a	8.95 a	13.2 b	13 a	63.2 a	63.3 a	2.46 b	2.36 b
F test	**	**	**	*	**	**	n.s	n.s	*	n.s	**	**	**	**

Values with the same alphabetical letters within each column did not significantly differ according to Dumcans multiple range test.

Table 1b. Vegetative growth traits as affected by different antioxidant substances in garlic after 22 weeks from planting during 2004 / 05 and 2005 / 06 seasons

Antioxidants (ppm)		Plant height (cm)		Pseudo – stem length (cm)		Number of leaves						The upper fifth leaf			
						dry		green		total		Length (cm)		Width (cm)	
		2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06
Salicylic acid	50	104.3ab	104.1 a	46.4b	45.9 a-c	5.1 a	4.8 ab	9.5 a	9.1a	14.6 a	13.9 a	64.0 a	63.9 a	2.84 a-c	2.88ab
	100	101.0b	102.0 a	45.0b	48.0 a	4.3 ab	4.5 ab	8.9 a	8.6 ab	13.2 b	13.1 a	57.3 b	63.1 a	2.83 a-c	2.98ab
	200	108.1a	107.0 a	49.4 a	46.3 a-c	4.8 ab	5.0 a	9.1 a	8.6 ab	13.9 ab	13.6 a	63.3 a	59.3 ab	2.86 ab	2.71a-d
Citric acid	100	103.3ab	103.3 a	45.0 b	44.0 bc	4.4 ab	4.3 ab	9.1 a	8.9 ab	13.5 ab	13.1 a	60.3ab	58.6 ab	2.85 a-c	2.60 cd
	200	102.9ab	102.8 a	46.3 b	46.1 a-c	4.4 ab	4.9 ab	8.9 a	8.8 ab	13.3 b	13.6 a	59.5 ab	58.6 ab	2.68 a-c	2.68b-d
	400	100.9b	099.0 a	46.9 b	47.5 ab	4.5ab	4.8 ab	9.0 a	9.1 a	13.5 ab	13.9 a	57.4 b	60.5 a	2.53 c	2.78 a-c
Ascorbic acid	100	105.5ab	102.3 a	46.0b	45.9 a-c	4.5 ab	4.8 ab	9.0 a	8.6 ab	13.5 ab	13.4 a	60.1ab	60.6 a	2.95 a	2.45dc
	200	103.3ab	102.6 a	46.5 b	45.3 a-c	4.3 ab	5.0 a	9.9 a	8.8 ab	14.2 ab	13.8 a	62.1ab	61.6 a	2.79 a-c	2.74 a-c
	400	103.8ab	105.9 a	44.6 b	46.3 a-c	3.8 b	3.9 b	9.1 a	8.9 ab	12.9 b	12.8 a	62.5ab	58.5 ab	2.54 bc	2.63 b-d
Control (Tap water)		99.9 b	101.9 a	44.3 b	42.9c	3.9b	5.0 a	9.1 a	9.1 a	13 b	13.1 a	57.6 b	54.6 b	2.65ac	2.35 e
F test		*	N.S.	**	*	*	*	N.S.	*	*	N.S.	*	**	**	**

Values with the same alphabetical letters within each column did not significantly differ according to Dumcans multiple range test.

El-Dinary (1998) and Omran *et al.* (2002), all on sweet potato; El-Mahdy (2002) and El-Gamal and Selim (2005), working on garlic, obtained similar results.

Effect of antioxidants

The tested antioxidants, at all tested concentrations, stimulated all of the measured growth traits (Table 1 b). Salicylic acid at 200 ppm overcomed the other treatments in plant height, pseudo-stem length in the first season and number of dry leaves in the second one. Besides, the salicylic acid concentrations of 50 or 100 ppm showed superiority in pseudo-stem length in the second season, number of dry and green laves, the fifth leaf length in both seasons, and the fifth leaf width in the second one.

The enhancement effect of applied antioxidants on growth parameters may be explained as these substances encourage nutrients absorption and stimulate some growth activators synthesis. Midan (1986) with ascorbic acid, Nicholas and Wheeler (2000) with salicylic acid and Abd El-Naem (2005) with citric acid came to similar conclusion.

Furthermore, some of these antioxidants were reported by Midan (1986) to activate the synthesis of amino-acids, the key materials of tissue building in plants.

Further explanation could be done as antioxidants could enhance plant cell growth and development and stimulate cell vacuolization and elongation as well as root growth (Gabo *et al.* 1996), factors that could positively reflected on plant growth.

Results could also be interpreted as antioxidants exert positive effect and overcome the harmful effect of some environmental stresses on plant growth (El-Gamal, 2005) working on ascorbic and citric acids, thereby they could encourage plant growth.

Similar enhancement effect of citric and ascorbic acids on number of leaves, diameter of neck and bulb, total dry weight in garlic was reported by Bardisi (2004).

The interaction effect

The highest plant height being obtained in selected clone 138 receiving citric acid at either 200 ppm in the first season or 400 ppm in the second one (Table 2). The selected clone 138 attained also superior values in number of green leaves when citric acid was applied in 400 ppm at the second season, although significances were not noticed. Comparing to control, or the other tested treatments,

Table 2. Vegetative growth traits as affected by the interaction between garlic clones and different antioxidant substances after 22 weeks from planting during 2004/2005 and 2005/2006 seasons

Clones	Antioxidants (ppm)		Plant height (cm)		Pseudo-stem length (cm)		Number of leaves: dry		Number of leaves: green		Number of leaves: total		Shape of the fifth leaf: Length (cm)		Shape of the fifth leaf: Width (cm)	
			2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06
T7 selected clone	Salicylic acid	50	97.3 a	96.8 d-f	45.8 b-d	45.8 a	5.0 a-c	5.8 a	10.0 a	9.3 a	15.0 a	15.0 a	59.5 b-e	59.3 c-f	3.20 ab	3.1 a
		100	94.8 a	102.0 b-e	46.3 b-d	50.0 a	4.8 a-c	5.0 a	8.5 a	8.0 a	12.8 a	13.0 a	55.5 de	61.5 a-e	3.10 ab	3.3 a
		200	104.3 a	96.8 d-f	51.8 a	47.8 a	5.0 a-c	5.3 a	8.8 a	8.5 a	13.8 a	13.8 a	63.3 a-d	56.5 c-f	3.20 ab	3.2 a
	Citric acid	100	96.8 a	94.0 ef	45.5 b-d	42.3 a	5.3 ab	4.5 a	8.3 a	9.0 a	13.6 a	13.5 a	54.8 de	57.5 c-f	3.10 a-c	3.1 a
		200	94.8 a	93.1 f	46.3 b-d	47.0 a	5.3 ab	5.5 a	9.0 a	8.5 a	14.30 a	14.0 a	56.3 de	52.8 F	3.10 a-c	2.9 a
		400	96.8 a	94.8 ef	47.3 b-d	49.3 a	5.0 a-c	5.3 a	8.5 a	9.0 a	13.50 a	14.3 a	56.0 de	53.0 F	3.10 a-c	3.1 a
	Ascorbic acid	100	101.3 a	99.5 c-f	48.0 bc	48.3 a	5.8 a	5.8 a	8.5 a	8.3 a	14.3 a	14.0 a	58.8 b-e	56.5 c-f	3.10 a-c	2.8 a
		200	100.8 a	102.0 b-e	48.8 ab	47.8 a	4.8 a-c	5.8 a	9.8 a	8.5 a	14.6 a	14.3 a	60.8 a-e	61.0 a-f	2.90 a-d	3.1 a
		400	97.8 a	97.0 d-f	45.8 b-d	47.3 a	4.0 a-d	4.5 a	9.0 a	8.8 a	13.- a	13.3 a	57.5 c-e	54.3 c-f	2.70 b-e	2.9 a
	Control (Tap water)		93.0 a	93.0 f	43.5 ab	44.3 a	5.0 c	5.8 a	8.8 a	7.8 a	13.8 a	13.5 a	53.8 e	53.5 ef	3.10 a-c	2.7 a
Clone 38	Salicylic acid	50	111.3 a	111.5 a	47.0 b-d	46.0 a	5.3 ab	3.8 a	9.0 a	9.0 a	14.3 a	12.8 a	68.5 a	68.5 A	2.50 d-f	2.6 a
		100	107.3 a	109.0 ab	43.8 d	46.0 a	3.8 b-d	4.0 a	9.0 a	9.3 a	13.1 a	13.3 a	59.0 b-e	64.8 a-c	2.50 d-f	2.7 a
		200	112.0 a	107.5 a-c	47.0 b-d	44.8 a	4.5 a-d	4.8 a	9.5 a	8.8 a	14.- a	13.5 a	63.3 a-d	62.0 a-d	2.50 d-f	2.3 a
	Citric acid	100	109.8 a	106.8 a-c	44.5 cd	45.8 a	3.5 b-d	4.0 a	10.0 a	8.8 a	13.50 a	12.8 a	65.8 a-c	59.8 b-f	2.60 c-f	2.2 a
		200	111.5 a	110.5 a	46.3 b-d	45.3 a	3.5 b-d	4.3 a	8.8 a	9.0 a	12.3 a	13.3 a	62.8 a-e	64.5 a-c	2.30 e-g	2.5 a
		400	105.0 a	112.0 a	46.5 b-d	45.8 a	4.0 a-d	4.3 a	9.5 a	9.3 a	13.5 a	13.5 a	58.8 b-e	68.0 a-c	2.00 g	2.5 a
	Ascorbic acid	100	109.8 a	107.0 a-c	44.0 cd	43.5 a	3.3 cd	3.8 a	9.5 a	9.0 a	12.3 a	12.8 a	61.5 a-e	64.8 ab	2.90 a-d	2.1 a
		200	105.8 a	104.5 a-d	44.3 a-d	42.8 a	3.8 b-d	4.3 a	10.0 a	9.0 a	13.8 a	13.3 a	63.5 a-d	62.3 a-c	2.70 b-e	2.4 a
		400	109.8 a	110.0 ab	43.5 ab	45.3 a	3.5 b-d	3.3 a	9.3 a	9.0 a	12.8 a	12.3 a	67.5 ab	82.8 a-d	2.40 e-g	2.4 a
	Control (Tap water)		106.8 a	105.3 a-c	45.0 b-d	41.5 a	2.8 d	4.3 a	9.5 a	8.5 a	12.3 a	12.8 a	61.5 a-e	55.8 d-f	2.30 fg	2.0 a
F test			N.S.	*	*	N.S.	*	N.S.	N.S.	N.S.	N.S.	N.S.	*	*	*	N.S.

Values with the same alphabetical letters within each column did not significantly differ according to Dumcans multiple range test.

genotype T_7 selected receiving salicylic acid at 200 ppm in the first season and 100 ppm at the second one showed superior pseudo-stem length, although significances were only noticed in the first season. However, clone 138 receiving salicylic acid at 50 ppm showed significant increase in the fifth leaf length in both seasons. The highest fifth leaf width being obtained in T_7 clone receiving salicylic acid at 200 ppm in the first season and 100 ppm in the second one.

Diseases Incidence

Effect of garlic clones

Clone 138 was more resistant to purple blotch disease as no damaged plants were noticed in comparing to T_7 selected clone (Tale 3 a). On the other hand, T_7 selected clone was more resistant to rust disease comparing to clone 138 as no damaged plants were noticed in the first clone. Results could be interpreted as plant cultivars differed in several growth properties as well as their chemical constituents, factors that may affect their resistance to disease incidence. Similar conclusion was previously drawn by Awad *et al.* (1985) and El-Khateeb *et al.* (1987).

Effect of antioxidants

Comparing to control, all applied antioxidant concentrations significantly reduced the damaged plants caused by purple blotch disease, as the minimal damaged plants were noticed due to salicylic acid application at 50 ppm (Table 3b). Besides, the highest number of blotches / plant being obtained due to salicylic and citric acids, both at (200 ppm). The least number of blotches was noticed in plants received salicylic acid at 50 ppm.

As for rust disease, the highest damaged plants were noticed to follow salicylic acid spraying at 100 ppm, whereas the least percentage of damaged plants being obtained due to citric acid and ascorbic acid, both at 100, 200 and 400 ppm.

Table 3a. Diseases incidence as affected by garlic clone (Average of two seasons)

Clones	Purple blotches disease (at 22 weeks from planting)		Rust disease (at 26 weeks from planting)
	Damage plants* (%)	Number of blotches / Plant	Damage plants (%)
T_7 Selected clone	69.38 a	2.46 a	0.00 b
Clone 138	0.00 b	0.00 b	19.13 a
F test	**	**	**

* (number of damage plant / total plants number)

Table 3b. Diseases incidence as affected by antioxidant substances in garlic (average of two seasons)

Antioxidants (ppm)		Purple blotches disease (at 22 weeks from planting)		Rust disease (at 26 weeks from planting)
		Damage plants* (%)	Number of blotches / Plant	Damage plants (%)
Salicylic acid	50	22.00 g	0.50 d	10.00 d
	100	31.48 e	1.00 c	30.00 a
	200	31.50 e	2.00 a	25.00 c
Citric acid	100	46.00 a	1.50 bc	5.00 e
	200	42.00 b	2.00a	0.50 f
	400	38.00 c	1.50 bc	0.50 f
Ascorbic acid	100	34.00 d	1.00 c	0.50 f
	200	26.00 f	1.00 c	0.50 f
	400	30.00 e	1.00 c	0.50 f
Control (Tap water)		48.00 a	1.50 bc	29.00 b
F test		**	**	**

* (number of damage plant / total plants number)
Values with the same alphabetical letters within each column did not significantly differ according to Dumcans multiple range test.

These results were confirmed by those of Julie *et al.* (2001) who reported that salicylic acid is a key component of local and systematic disease resistance in plants.

Another explanation could also be done, as antioxidants increased the synthesis of phenolic compounds (El-Gamal, 2005), factor that well known to increase plant resistance to diseases. Salicylic and ascorbic acids were reported by Abd El-Naem (2005) to increase phenolic compounds in treated plants.

In addition, phenolic compounds include lignin, which found in cell walls of various types of supporting and conducting tissues. It is deposited in the thickened secondary and primary walls (Taiz and Zeiger, 1998), consequently it could increase cell resistance to diseases incidence.

The interaction effect

Control plants and those of T_7 selected clone which received citric acid at 100 ppm showed the highest percentage of damaged plants as a result of purple blotches disease (Table 3 c). Clone 138 receiving all applied antioxidant concentrations attained the lowest percentage of damaged plants.

Table 3c. Diseases incidence as affected by the interaction between garlic clones and different antioxidant substances (averages of two seasons)

Clones	Antioxidants (ppm)		Purple blotches disease (22 weeks from planting)		Rust disease (at 26 weeks from planting)
			Damage plants (%)	Number of blotches / plant	Damage plants* (%)
T7 selected clone	Salicylic acid	50	44.0 g	1.0d	0.00 g
		100	63.0 e	2.0c	0.00g
		200	63.0 e	4.0a	0.00 g
	Citric acid	100	92.0a	3.0 bc	0.00g
		200	84.0 b	4.0 a	0.00g
		400	76.0 c	3.0b	0.00g
	Ascorbic acid	100	68.0d	2.0 c	0.00 g
		200	52.0 f	2.0 c	0.00 g
		400	60.0 e	2.0 c	0.00 g
	Control (Tap water)		96.0 a	3.0b	0.00 g
Clone 138	Salsilic A.	50	0.001h	0.0000e	20.0d
		100	0.001h	0.0001e	60.00a
		200	0.001 h	0.0001e	50.00c
	Citric A.	100	0.001h	0.0001e	10.00e
		200	0.001 h	0.0001e	1.00 fg
		400	0.001h	0.0001e	1.00fg
	V.C.	100	0.001h	0.0001e	1.00fg
		200	0.001 h	0.0001e	1.00 fg
		400	0.001h	0.0001e	1.00 f
	Control (Tap water)		0.001h	0.0001e	58.00 b
	F test		**	**	**

* (number of damage plant / total plants number)

Values with the same alphabetical letters within each column did not significantly differ according to Dumcans multiple range test.

As for rust disease, all antioxidant treatments caused no damaged plants in clone T_7 and generally reduced the percentage of damaged plants in clone 138 comparing to unsprayed plants.

Bulbs Yield and its Components

Yield components were considered herein as average bulb diameter and height, number of cloves / bulb, average clove and bulb weights (g) and bulbs yield (Ton / fed.)

Effect of garlic clones

Excepting for number of cloves per bulb, T_7 selected clone achieved the higher values of all studied yield parameters

comparing to clone 138 (Table 4 a). In spite of the superiority of clone 138 in most of the studied growth characters, it showed no superiority in the produced bulbs yield, indicating no active migration for the metabolites from the source (leaves) to the sink (bulbs). It is note worthy to mentioned herein that an adverse relation was noticed between number of cloves per bulb and average clove weight.

Yield potentiality is well-known to be mainly depended on hereditical factors (Omran *et al.*, 2002), thus the variatal variation in this concern is easily explained. Similar varietal variations in yield were noticed by El-Shimi (1996), El-Dinary (1998), working on sweet potato, and El-Mahdy (2002) and El-Gamal and Selim (2005) working on garlic.

The adverse relation between number of cloves / bulb and average clove weight could be explained as the metabolites formed by plant will partitionate to much more cloves, then it is expected to affect the individual clove weight.

Effect of antioxidants

In general, all tested antioxidant concentrations, generally, stimulated yield parameters comparing to control (Table 4 b). Citric acid at 400 ppm exerted general significant increases in the average bulb diameter and height, average clove and bulb weights in both seasons and bulbs yield as ton per feddan in the second season.

Number of cloves / bulb as well as average clove weight and bulbs yield (ton / feddan) showed insignificant response to applied antioxidants in the first season only, although citric acid at 400 ppm achieved superior values.

The priority of citric acid in increasing garlic bulbs yield was also noticed by Nicholas and Wheeler (2000) and Abd El-Naem (2005).

Results could be explained as antioxidants activate plant metabolism and enzymes activity and consequently dry matter accumulation, factors that may positively reflected on bulbs yield. Similar interpretation was previously done by Abd El-Naem (2005) using salicylic and ascorbic acids and Nicholas and Wheeler (2000) on citric acid .

Another interpretation could be done, as antioxidants improved plants growth, thereby they could increase bulbs yield.

It is worthy to mention that the interaction of cultivars and applied antioxidants showed no significant effects on the tested yield parameters. Thus, its related data were omitted.

Table 4a. Bulbs yield, along with its components, as affected by garlic clone during 2004 / 2005 and 2005 / 2006 seasons

Clone	Average bulb diameter (cm)		Average bulb height (cm)		Number of cloves / bulb		Average clove weight (g)		Average bulb weight (g)		Bulbs yield (Ton / fed.)	
	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06
Clone T7 selected	8.26 a	7.96 a	6.20 a	5.97 a	12.24 b	12.13 b	10.81 a	11.50 a	131.79a	141.29a	17.57 a	18.83 a
138 clone	7.88 a	7.21 b	5.10 b	4.86 b	35.07 a	35.01 a	3.35 b	3.20 b	117.41b	111.97b	14.45 b	13.78 b
F test	N.S.	*	**	**	**	**	**	**	**	**	**	**

Values with the same alphabetical letters within each column did not significantly differ according to Dumcans multiple range test.

Table 4b. Bulbs yield in garlic, along with its components, in garlic as affected by some antioxidants application during 2004 / 2005 and 2005 / 2006 seasons

Antioxidants (ppm)		Average bulb Diameter (cm)		Average bulb height (cm)		Number of cloves / bulb		Average clove weight (g)		Average bulb weight (g)		Bulbs yield (Ton / fed.)	
		2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06	2004/05	2005/06
Salicylic acid	50	8.00 ab	7.72 bcd	5.58 ab	5.50 bc	23.67 a	23.70 a	6.93 a	7.40 ab	123.38 ab	128.57 bcd	15.85 a	16.56 bc
	100	7.77 ab	7.50 cde	5.43 ab	5.35 cd	23.53 a	23.53 a	7.00 a	7.50 ab	120.12 ab	125.33 cde	14.45 a	16.15 cd
	200	8.13 ab	7.85 a-d	5.68 ab	5.62 abc	23.57 a	23.55 a	7.15 a	7.60 ab	125.53 ab	130.87 a-d	16.13 a	16.86 abc
Citric acid	100	8.00 ab	8.03 abc	5.57 ab	5.70 abc	23.68 a	23.62 a	6.78 a	7.55 ab	123.17 ab	133.65 abc	15.79 a	17.18 abc
	200	8.38 ab	8.45 ab	5.88 ab	6.05 ab	23.70 a	23.77 a	7.37 a	8.17 a	129.72 ab	141.40 ab	16.68 a	18.23 ab
	400	8.57 a	8.63 a	6.02 a	6.17 a	23.83 a	23.92 a	7.37 a	8.13 a	132.30 a	143.92 a	16.99 a	18.53 a
Ascorbic acid	100	7.93 ab	6.63 cd	5.62 ab	4.77 de	23.73 a	23.68 a	7.17 a	6.62 bc	123.00 ab	110.98 ef	15.85 a	14.33 de
	200	8.55 a	7.10 def	5.98 ab	5.08 cde	23.52 a	23.55 a	7.58 a	7.00 abc	131.82 ab	118.50 def	16.94 a	15.26 cde
	400	7.82 ab	6.48 f	5.45 ab	4.60 e	23.55 a	23.52 a	6.72 a	6.20 c	120.28 ab	108.18 f	15.41 a	13.83 e
Control (Tap water)		7.55 b	7.47 cde	5.30 b	5.33 cd	23.77 a	23.80 a	6.73 a	7.33 abc	116.72 b	124.92 cde	15.02 a	16.10 cd
F test		*	**	*	**	N.S	N.S	N.S	*	*	**	N.S	**

Values with the same alphabetical letters within each column did not significantly differ according to Dumcans multiple range test.

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المعاملة بمضادات الأكسدة وعلاقة ذلك بالنمو ومحصول الأبصال وحدوث الإصابة ببعض الأمراض في الثوم

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أجريت تجربتان حقليتان في منطقة النوبارية في ارض رملية، حيث اتبع نظام الري بالتنقيط وذلك لتقييم استجابة سلالتين من الثوم هما 138 Clone, T_7 selected للرش ببعض الأحماض العضوية التي تستخدم كمضادات للأكسدة وهي حمض الستريك والسالسيليك والاسكوربيك بتركيزات ٥٠ ، ١٠٠ ، ٢٠٠ جزء في المليون لحمض السالسيليك و ١٠٠ ، ٢٠٠ ، ٤٠٠ جزء في المليون للحمضين الأخيرين .

أظهرت السلالة 138 clone زيادة معنوية في ارتفاع النبات وطول الورقة الخامسة من اعلي وكانت السلالة T_7 selected أكثر مقاومة لمرض اللفحة الارجوانية، وحققت السلالة الأخيرة اعلي قيمة في جميع قياسات المحصول ماعدا عدد الفصوص / البصلة .

ادت جميع التركيزات المستخدمة من مضادات الأكسدة إلي زيادة جميع مؤشرات النمو وتفوق حمض السالسيليك بتركيز ٢٠٠ جزء / المليون علي جميع تركيزات مضادات الأكسدة المستخدمة في ارتفاع النبات، وطول الساق الكاذبة في الموسم الأول، وعدد الأوراق التي جفت مبكرا في الموسم الثاني ، وأظهرت مضادات الأكسدة نقصاً في نسبة النباتات المصابة باللفحة الأرجوانية وحقق حمض السالسيليك بتركيز ٥٠ جزء / مليون اقل نسبة من النباتات المصابة ، كما أدت جميع تركيزات مضادات الأكسدة المستخدمة ، بوجه عام، إلي زيادة جميع مؤشرات المحصول وادي حمض الستريك بتركيز ٤٠٠ جزء / مليون إلي زيادة معنوية في متوسط قطر وارتفاع البصلة، ومتوسط وزن الفص والبصلة في كلا الموسمين، ومحصول الأبصال بالطن للفدان في الموسم الثاني .