Zagazig J. Agric. Res., Vol. 44 No. (5) 2017 1589-1600

Horticultural Science

http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

EFFECT OF N+K FERTILIZATION AND FOLIAR SPRAY WITH SOME ANTIOXIDANTS ON DRY WEIGHT, YIELD AND STORABILITY OF GARLIC PLANTS

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Received: 19/06/2017 ; Accepted: 19/07/2017

ABSTRACT: The present work was carried out in Vegetable Private Farm at Al-Blashon, Belbies District, Sharkia Governorate, Egypt during two successive winter seasons of 2014/2015 and 2015/2016, to evaluate the effect of N and K_2O rates, ascorbic acid (Vitam. C) and salicylic acid (SA) on dry weight, yield and storability of garlic (cv Balady) under clay soil conditions using surface irrigation system. The obtained results could be summarized as follows: The interaction between N+K at 80 kg N + 75 kg K_2O/fad., and foliar spray of Vitam. C at 100 mg/l gave the highest value for each of dry weight of leaves and bulb as well as total dry weight/plant, yield of grades 1, 2, 3 and 4, exportable yield, marketable yield, total yield/fad., average bulb weight and reduced weight loss percentage of bulbs during storage period in both seasons.

Key words: Garlic, N+K_2O fertilization, Vitam. C, SA, yield and storability.

INTRODUCTION

Garlic (*Allium sativum* L.), is a second vital cultivated *Allium* species after onion worldwide. It is a widespread popular crop with various functions to people. It is widely consumed as a spice form, flavoring and seasoning dishes, pickles and sauces. Popularity of this crop has been increased owing to a lot of health benefits attributed to garlic consumption (Rosen and Tong, 2001). Also, dehydrated cloves and extracts are speedy replacing fresh bulbs for industrial and home usage in the production of medicines, insecticides, plant nourishments and explosives (Kilgori *et al*., 2007).

Availability of nitrogen is of prime importance for growing plants as it is major and indispensable constituent of protein and nucleic acid molecules. It is an integral part of chlorophyll molecules, which are responsible for photosynthesis. An adequate supply of nitrogen is associated with vigorous vegetative growth and more efficient use of available inputs finally leading to higher productivity (Farooqui *et al*., 2009).

Potassium plays a vital role in enhancing starch formation, which consequently resulted in increasing weight and bulb diameter. As well, the increased dry matter accumulation in the bulb may be attributed to more syntheses and translocation of photosynthesis from the leaf to the bulb and also due to the availability of more nutrients from the soil. Similarly higher rate of photosynthesis due to higher dose of potassium enhanced to vegetative growth and accumulated more food, which perhaps encouraged the rate of splitting of bulbs and increased yield (Dilruba *et al.,* 2006).

Bardisi (2004) found that foliar spray of garlic with Vitam. C at 100or 200 ppm and SA at 50 ppm gave the highest yield of grade 1 and 2, total yield, exportable and marketable yield .Also, Vitam. C at 200 ppm and SA at 100 or 200 ppm recorded minimum values of emaciation, sprouting and total weight loss (%) in bulbs during storage period.

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Efficiency of nitrogen increases significantly in the process of adequate amount of potassium in garlic. Maximum and significantly higher bulb of garlic was obtained with the combined application of 150 kg of nitrogen and 150 kg K_2O/ha. (Yadav *et al.,* 2007). The highest fertilizer level of 200+100+120 kg/ha of N + P_2O_5 + K_2O increased single bulb weight and garlic yield followed by N+P_2O_5+K_2O at 200 + 0 + 120 kg/ha (Ijaz *et al*. 2007).

Ascorbic acid (Vitam. C) has a wide range of important functions as antioxidant defense, photoprotection, regulation of photosynthesis, affects nutritional cycle's activity in higher plants, electron transport system, as a cofactor for a large number of key enzymes in plants, also developmental senescence, programmed cell death and responses to pathogens (Blokhina *et al*., 2003).

Salicylic acid (SA) naturally occurs in plants in very low amounts and participates in the regulation of physiological processes in plant such as stomatal closure, photosynthesis, transpiration, nutrient uptake, chlorophyll and protein synthesis, inhibition of ethylene biosynthesis, resistance to pathogens plant disease and increased longevity of storage period (Hayat and Ahmad, 2007).

Foliar application of ascorbic acid at 150 ppm significantly increased total yield, average bulb weight and diameter and cloves weight of garlic cv. Sides -40 (El-Morsy *et al.,* 2010). Garlic plants treated with ascorbic acid at 0.2 g/l recorded the lowest values of weight loss percentage in bulbs during storage period (Shalaby and El-Ramady, 2014).

Foliar spray of antioxidants as ascorbic acid at 200 ppm or salicylic acid at 200 ppm increased yield and its components as well as tuber root characters of sweet potato. Sweet potato plants sprayed with ascorbic acid at 200 ppm exerted significantly increases over these sprayed with salicylic acid in total yield, marketable yield and tuber yield/plant (El-Seifi *et al*., 2014).

Therefore, the objective of this work was to evaluate the effect of N + K fertilization and foliar spray with some antioxidants such as Vitam. C and SA on dry weight, yield and its components, and storability of garlic cv. Balady under clay soil conditions using surface irrigation system

MATERIALS AND METHODS

The present work was carried out in Vegetable Private Farm at Al-Blashon, Belbies District, Sharkia Governorate, Egypt during two successive winter seasons of 2014/2015 and 2015/2016, to evaluate the effect of N and K_2O rates, ascorbic acid (Vitam. C) and salicylic acid (SA) on dry weight ,yield and storability of garlic cv Balady under clay soil conditions using surface irrigation system.

The soil physical and chemical analyses of the used experimental properties site is clay soil in texture for the two experimental seasons, had 1.48 and 1.56% organic matter, 7.89 and 7.99 pH, 1.46 and 1.40 mmhos/cm EC, 8.19 and 9.52 ppm available N, 0.032 and 0.029 available P (%) and 0.54 and 0.51 available K (%) in the 1st and 2nd seasons, respectively

This experiment included 10 treatments which were combination between two N+K_2O rates (60+50 and 80+75 kg/fad.) and 4 levels of Vitam. C and SA at 50 and 100 ppm of each as well as control (sprayed with tap water). These treatments were arranged in a split plot in a complete randomized block design with three replicates. N + K_2O rates were randomly arranged in the main plots and foliar spray with Vitam. C and SA levels were randomly distributed in the sub plots.

Plants were sprayed three times, at 45, 60 and 75 days after planting with Vitam. C and SA solutions. Each plot received 2 L solution of Vitam. C or SA using spreding agent in all treatments. The untreated plants (cheek) were sprayed with tap water and spreading agent. The sources of commercial fertilizers were ammonium sulphate {$(NH_4)_2SO_4$} is a by-product of many industrial processes and contain 20.5% nitrogen and 23% sulphur and potassium sulphate (K_2SO_4) contains 48.-52% K_2O and 17-18% sulphur (SO_4).

Rates and time application of nitrogen and potassium during growing season of garlic plants are presented in Schedule 1.

Schedule 1. Rates and application time of N and K_2O during growing season of garlic plants

Rates	Time of application (Days after planting)		
	30	60	90
	20%	40%	40%
60 kg N/fad.+ 50 kg K_2O/fad.	12+10	24+20	24+20
80 kg N/fad. + 75 kg K_2O/fad.	16+15	32+30	32+30

All plants were fertilized with nitrogen and potassium as soil application. All experimental units were received equal amounts of FYM at 20 m^3/fad., and calcium superphosphate (15.5% P_2O_5) at 60 kg P_2O_5/fad., during soil preparation.

The cloves of garlic *cv* Balady were sown on 1st October in the two seasons. Garlic cloves were selected for uniformity in shape and size and were sown on both sides of ridge at distance 10 cm apart.

The experimental unit area were 16.8 m^2. It contained four ridges with 7m length and 60 cm distance between each two ridges. One ridge were used to measure the morphological traits and the other three ridges was used for yield determinations.

Data Recorded

A sample of five plants from each experimental unit were randomly taken after 105 and 135 days after planting. The different plant parts; *i.e.,* leaves and bulbs were oven dried at 70°C till constant weight and the following data were recorded: Dry weight of bulbs (g), dry weight of leaves (g), total dry weight/plant (bulb +leaves) (g) and relative of total dry weight.

Yield and its components

At proper maturity stage of bulbs (215 days after planting), bulbs in every plot were harvested and graded into four categories according to the Ministry of Economic for garlic exportation (1963) as follow: grade 1: Bulbs with diameter above 5.5 cm, grade 2: Bulbs with diameter between 4.5- 5.5 cm, grade 3: Bulbs with diameter between 3.5- 4.4 cm, and grade 4: Bulbs with diameter less than 3.5 cm. Then, each grade was weighed separately at the same harvest day and the following data were calculated as ton/fad.: exportable yield (grade 1+grade 2), marketable yield (grade 1 + grade 2 + grade 3), and total yield (grade 1+ grade 2 + grade 3 + grade 4). Also, average bulb fresh weight (g) was recorded.

Storability

Just after harvesting bulb yield of each plot was separately collected and translocated to curing for twenty days in aired shady place, then tops were removed to obtain uniform bulbs and four kilograms of uniform cured bulbs for each plot were putted in palm crates and then stored at room temperature.

Weight loss (%)

Bulbs of each treatment were weighed at 30 days intervals, and then the cumulative weight loss percentage was calculated.

Statistical Analysis

Statistical analysis was conducted for all collected data. The analysis of variance were calculated according to Snedecor and Cochran (1980), means separation were done according to LSD at 0.05 level.

RESULTS AND DISCUSSION

Dry Weight

Effect of N+K_2O rates

Fertilization garlic plants with N+K at different rates had significant effect on dry weight of leaves, and bulb as well as total dry weight/ plant at 105 and 135 days after planting (DAP) in both seasons, except dry weight of bulb at 105 DAP in both seasons and total dry weight/plant in the 2nd season (Table 1). Fertilization garlic plants grown in clay soil with N + K at 80 kg N+75 kg K_2O/fad., increased dry weight of leaves and bulb as well as total dry

Table 1. Effect of N+K_2O rates on dry weight of garlic plants at 105 and 135 days after planting during 2014/2015 and 2015/2016 seasons

Treatment	Dry weight of leaves (g)		Dry weight of bulb (g)		Total dry weight (leaves + bulb) g/plant		Relative increases in total dry weight	
	Days after planting							
	105	135	105	135	105	135	105	135
N+K_2O (kg/fad.)	2014/2015 season							
60 +50	8.49	12.91	2.37	10.16	10.88	23.08	100.00	100.00
80+75	9.81	15.28	2.35	12.68	12.20	27.97	112.13	121.18
LSD at 0.05 level	0.95	1.84	NS	1.35	0.77	0.82	---	--
	2015/2016 season							
60 +50	11.07	15.40	2.97	13.5	14.06	28.90	100.00	100.00
80+75	12.29	17.12	3.08	14.7	15.24	31.07	108.39	107.50
LSD at 0.05 level	0.87	1.23	NS	0.81	NS	1.75	---	---

weight/plant at 135 DAP in both seasons. The increases in total dry weight at 135 DAP were about 21.18 and 7.50% for N+K at 80 kg N+75 kg K_2O/fad., over N+K at 60 kg N+50 kg K_2O/fad., in the 1st and 2nd seasons, respectively.

These increases may be due to potassium role in physiological processes inside the plant, photosynthesis; increasing enzyme activity (K is required as Co-factor for different enzymes. It also helps to main electroneutrality in plant cells), improving synthesis of protein, carbohydrates and fats, translocation of sugars, enabling their ability to resist pests and diseases (Dkhil *et al*., 2011). Moreover, potassium control of ionic balance, regulation of plant stomata and water use, activation of plant enzymes to metabolize carbohydrates for the manufacture of amino acids and proteins, increases root growth (Marschner, 2013). These results are in harmony with those reported with Abd El-Al *et al*. (2005) and Mansour (2006) and Dudhat *et al*. (2010).

Effect of foliar spray with Vitam. C and SA

Spraying garlic plants with vitamin c (Vitam. C) and salecylic acid (SA) at 50 and 100 mg/l of each reflect significant effect on dry weight of leaves and bulb as well as total dry weight/ plant at 105 and 135 DAP in both seasons (Table 2). Spraying with Vitam. C and SA at 50 or 100 mg/l of each increased dry weight of leaves and bulb as well as total dry weight/plant compared to control (unsprayed). Spraying with Vitam. C at 100 mg/l significantly increased dry weight of leaves and bulb as well as total dry weight/plant in both seasons. The increases in total dry weight at 135 DAP were about 57.37 and 35.48% for Vitam. C at 100 mg/l over the control (unsprayed) in the 1st and 2nd seasons, respectively. Ascorbic acid (Vitam. C) has a wide range of important functions as antioxidant defense, photoprotection, regulation of photosynthesis, affects nutritional cycle's activity in higher plants, electron transport system, as a cofactor for a large number of key enzymes in plants, also developmental senescence, programmed cell death and responses to pathogens (Blokhina *et al*., 2003). These results agree with those reported by Amin *et al*. (2007), El-Morsy *et al.* (2010) and El-Seife *et al.* (2014).

Effect of the interaction between N+K_2O rates and foliar spray with Vitam. C and SA

The interaction between N+K fertilization at different rates and spraying with Vitam. C and SA at different concentrations had significant effect on dry weight of leaves and bulb as well as total dry weight/plant at 105 and 135 DAP in

Table 2. Effect of foliar spray with some antioxidants on dry weight of garlic plants at 105 and 135 days after planting during 2014/2015 and 2015/2016 seasons

Treatment	Dry weight of leaves (g)		Dry weight of bulb (g)		Total dry weight (leaves + bulb) g/plant		Relative increases in total dry weight	
	Days after planting							
	105	135	105	135	105	135	105	135
					2014/2015 season			
Control (untreated)	7.52	10.43	2.02	10.05	9.58	20.48	100	100.00
Vitam. C. at 50 mg/l	10.00	15.86	2.54	11.93	12.58	27.80	131.31	135.74
Vitam. C. at 100 mg/l	11.17	17.91	2.80	14.31	14.01	32.23	146.24	157.37
SA at 50 mg/l	8.82	14.66	2.35	11.18	11.20	25.85	116.91	126.22
SA at 100 mg/l	8.22	11.61	2.10	9.65	10.35	21.26	108.03	103.80
LSD at 0.05 level	0.62	0.89	0.10	0.66	0.69	1.06	--	--
					2015/2016 season			
Control (untreated)	10.50	12.95	2.90	13.03	13.41	25.98	100.00	100.00
Vitam. C. at 50 mg/l	13.05	16.40	3.50	16.03	16.56	32.43	123.48	124.82
Vitam. C. at 100 mg/l	13.67	19.26	3.51	15.93	17.20	35.20	123.26	135.48
SA at 50 mg/l	10.80	16.61	2.75	13.51	13.56	30.13	101.11	115.97
SA at 100 mg/l	10.37	16.06	2.45	12.08	12.51	26.20	92.59	100.84
LSD at 0.05 level	0.81	1.02	0.53	2.45	0.91	3.51	--	-

both seasons (Tables 3 and 4). At 135 DAP, the interaction between N+K at 80 kg N+ 75 kg K_2O/fad., and Vitam. C at 100 mg/l significantly increased dry weight of leaves and bulb as well as total dry weight/ plant in both seasons. The increases in total dry weight at 135 DAP were about 96.36 and 54.55% for the interaction between N+K at 80 kg N+75 kg K_2O/fad., and Vitam. C at 100 mg/l over the interaction between N+K at 60 kg N+50 kg K_2O/fad., and unsprayed with Vitam. C and SA in the 1st and 2nd seasons, respectively.

Yield and its Components

Effect of N+K_2O rates

Results in Table 5 indicate that, N + K fertilization at different rates had significant effect on yield of grades 1, 2, 3 and 4, exportable yield, marketable yield and total yield/fad., as well as average bulb weight in both seasons. Fertilization with N+K at 80 kg N+75 kg K_2O/fad., significantly increased yield of grades 1, 2, 3 and 4, exportable yield, marketable yield and total yield/fad., as well as average bulb weight, except yield of grades 3 and 4 in the 1st season. These results agree with those reported by Ijaz *et al.* (2007) and Yadav *et al*. (2007).

Effect of foliar spray with Vitam. C and SA

The obtained results in Table 6 illustrate that spaying garlic plants with Vitam. C and SA at 50 and 100 mg/l of each had significant effect on yield of grades 1, 2, 3 and 4, exportable yield, marketable yield and total yield/fad., as well as average bulb weight in both seasons. Spraying with Vitam. C and SA at 50 or 100 mg/l of each increased yield and its components compared to control (unsprayed). Spraying with Vitam. C at 100 mg/l significantly increased yield of grades 1, 2, 3 and 4, exportable yield, marketable yield and total yield/fad., in both seasons. The increases in total yield/fad., were about 20.00 and 29.12% for Vitam. C at 100 mg/l over the control (unsprayed) in the 1st and 2nd seasons, respectively. These results agree with those reported by Bardisi (2004), El-Morsy *et al*. (2010) and El-Seifi *et al.* (2014).

Table 3. Effect of the interaction between N+K_2O rates and foliar spray with some antioxidants on dry weight of garlic plants at 105 and 135 days after planting during 2014/2015 season

Treatment		Dry weight of leaves (g)		Dry weight of bulb (g)		Total dry weight (leaves +bulb) g/plant		Relative increases in total dry weight	
		2014/2015 season							
N+K_2O kg/fad.	Antioxidant	Days after planting							
		105	135	105	135	105	135	105	135
60 +50	Control (untreated)	6.80	8.00	1.90	9.60	8.73	17.60	100.00	100.00
	Vitam. C. at 50 mg/l	9.65	14.36	2.55	10.80	12.20	25.16	139.74	120.22
	Vitam. C. at 100 mg/l	11.05	17.36	2.75	12.53	13.83	29.90	158.41	169.88
	SA at 50 mg/l	8.20	14.33	2.50	9.73	10.73	24.06	122.90	136.7
	SA at 100 mg/l	6.75	10.50	2.15	8.16	8.93	18.66	102.29	106.02
80+75	Control (untreated)	8.25	12.86	2.15	10.50	10.43	23.36	119.47	132.72
	Vit C. at 50 mg/l	10.35	17.36	2.53	13.06	12.96	30.43	140.45	172.89
	Vit C. at 100 mg/l	11.30	18.46	2.85	16.10	14.20	34.56	162.65	196.36
	SA at 50 mg/l	9.45	15.00	2.20	12.63	11.66	27.63	133.56	156.98
	SA at 100 mg/l	9.70	12.73	2.05	11.13	11.76	23.86	134.70	135.56
LSD at 0.05 level		0.87	1.26	0.15	0.93	0.98	1.50	--	--

Table 4. Effect of the interaction between N+K_2O rates and foliar spray with some antioxidants on dry weight of garlic plants at 105 and 135 days after planting in 2015/2016 season

Treatment		Dry weight of leaves (g)		Dry weight of bulb (g)		Total dry weight (leaves+bulb) g/plant		Relative increases in total dry weight	
		2015/2016 season							
N+K_2O kg/fad.	Antioxidant	Days after planting							
		105	135	105	135	105	135	105	135
60 +50	Control (untreated)	9.20	11.30	2.65	12.40	11.86	23.70	100.00	100.00
	Vitam. C. at 50 mg/l	12.35	15.30	3.30	14.70	15.66	30.00	132.04	126.58
	Vitam. C. at 100 mg/l	12.90	18.76	3.45	15.00	16.36	33.76	137.94	142.45
	SA at 50 mg/l	11.00	16.73	2.80	12.96	13.80	29.70	116.36	125.32
	SA at 100 mg/l	9.90	14.90	2.65	12.46	12.60	27.36	106.24	115.44
80+75	Control (untreated)	11.80	14.60	3.15	13.66	14.96	28.26	126.14	119.24
	Vitam. C. at 50 mg/l	13.75	17.50	3.71	17.36	17.46	34.86	147.22	147.09
	Vitam. C. at 100 mg/l	14.45	19.76	3.58	16.86	18.03	36.63	152.02	154.56
	SA at 50 mg/l	10.60	16.50	2.70	14.06	13.33	30.56	112.39	128.95
	SA at 100 mg/l	10.85	17.23	2.26	11.704	12.43	25.03	104.81	105.61
LSD at 0.05 level		1.15	1.44	0.75	3.47	1.28	4.96	--	--

Table 5. Effect of N+K_2O rates on yield and its components during 2014/2015 and 2015/2016 seasons

Treatment	Yield and its components (ton/fad.)							Average bulb weight (g)
	Grade 1	Grade 2	Grade 3	Grade 4	Exportable	Marketable	Total	
N+K_2O (kg/fad.)	2014/2015 season							
60 +50	3.188	2.311	0.664	0.443	5.499	6.163	6.606	48.84
80+75	3.690	2.563	1.023	0.682	6.252	7.276	7.958	58.83
LSD at 0.05 level	0.261	0.159	0.038	0.024	0.422	0.417	0.417	2.98
	2015/2016 season							
60 +50	2.718	2.319	0.844	0.562	5.037	5.880	6.442	56.86
80+75	3.878	2.605	0.658	0.278	6.484	7.142	7.420	64.25
LSD at 0.05 level	0.161	0.100	0.044	0.030	0.257	0.293	0.319	2.28

Table 6. Effect of foliar spray with some antioxidants on yield and its components during 2014/2015 and 2015/2016 seasons

Treatment	Yield and its components (ton/fad.)							Average bulb weight (g)
	Grade 1	Grade 2	Grade 3	Grade 4	Exportable	Marketable	Total	
	2014/2015 season							
Control (untreated)	3.161	2.182	0.772	0.515	5.34	6.11	6.63	51.28
Vitam. C. at 50 mg/l	3.433	2.436	0.819	0.546	5.87	6.69	7.23	55.53
Vitam. C. at 100 mg/l	3.787	2.687	0.892	0.595	6.47	7.37	7.96	57.28
SA at 50 mg/l	3.452	2.411	0.888	0.592	5.86	6.75	7.34	52.45
SA at 100 mg/l	3.361	2.470	0.849	0.566	5.83	6.68	7.25	52.64
LSD at 0.05 level	0.141	0.076	0.061	0.041	0.169	0.138	0.138	0.93
	2015/2016 season							
Control (untreated)	3.041	2.040	0.663	0.442	5.08	5.74	6.18	53.12
Vitam. C. at 50 mg/l	3.338	2.496	0.829	0.452	5.83	6.66	7.11	61.14
Vitam. C. at 100 mg/l	3.549	3.113	0.890	0.426	6.66	7.55	7.98	66.60
SA at 50 mg/l	3.263	2.287	0.769	0.446	5.55	6.32	6.76	61.11
SA at 100 mg/l	3.302	2.376	0.605	0.337	5.68	6.28	6.62	60.84
LSD at 0.05 level	0.102	0.159	0.048	0.032	0.190	0.201	0.214	1.53

Effect of the interaction between N+K_2O rates and foliar spray with Vitam. C and SA

The interaction between N+K fertilization at different rates and spraying with Vitam. C and SA at 50 and 100 mg/l of each had significant effect on yield of grades 1, 2, 3 and 4, exportable yield, marketable yield and total yield/ fad., as well as average bulb weight in both seasons (Tables 7 and 8). The interaction between N+K at 80 kg N+ 75 kg K_2O/fad., and Vitam. C at 100 mg/l significantly increased yield of grades 1, 2, 3 and 4, exportable yield, marketable yield and total yield/fad., as well as average bulb weight in both seasons. The increases in total yield/fad., were about 38.74 and 52.18% for the interaction between N+K at 80 kg N+75 kg K_2O/fad., and Vitam. C at 100 mg/l over the interaction between N+K at 60 kg N+50 kg K_2O/fad., and unsprayed with Vitam. C and SA in the 1st and 2nd seasons, respectively.

Storability

Effect of N+K_2O rates

Results in Table 9 indicate that, weight loss percentage of bulbs during storage period increased with increasing storage period up to 180 days and fertilizing garlic plants with N+ K at 80 kg N+75 kg K_2O/fad., reduced weight loss percentage compared to N+ K at 60 kg N+50 kg K_2O/fad., in both seasons. These results agree with Ibrahim (2004) who showed that application of lowest N + K_2O fertilizer rate (60 kg N + 75 kg K_2O/fad.) significantly decreased weight loss, sprouting and decay percentage in onion bulbs.

Effect of foliar spray with Vitam. C and SA

Results in Table 10 show that spaying garlic plants with Vitam. C and SA at 50 and 100 mg/l of each reduced weight loss percentage of bulbs during storage period compared to control (unsprayed). Weight loss percentage of bulbs increased with increasing storage period up to 180 days. Salicylic acid (SA) naturally occurs in plants in very low amounts and participates in the regulation of physiological processes in plant such as stomatal closure, photosynthesis, transpiration, nutrient uptake, chlorophyll and protein synthesis, inhibition of ethylene biosynthesis, resistance to pathogens plant disease and increased longevity of storage period (Hayat and Ahmad, 2007). These results agree with those reported by Bardisi (2004), Abou El- Khair and Khalil (2014) and Shalaby and El-Ramady (2014). They found that spraying garlic plants with Vitam. C and SA recorded the minimum values of weight loss percentage of bulb during storage period compared to control.

Effect of the interaction between N+K_2O rates and foliar spray with Vitam. C and SA

The obtained results in Tables 11 and 12 illustrate that the interaction between 80 kg N+75 kg K_2O/fad., and spraying with Vitam. C and SA at 50 and 100 mg/l of each reduced weight loss percentage of bulbs during storage period.

Table 7. Effect of the interaction between N+K_2O rates and foliar spray with some antioxidants on yield and its components during 2014/2015 season

Treatment		Yield and its components (ton/fad.)							Average bulb weight (g)
N+K_2O kg/fad.	Antioxidant	Grade 1	Grade 2	Grade 3	Grade 4	Exportable	Marketable	Total	
60 +50	Control (untreated)	2.941	2.078	0.684	0.456	5.019	5.703	6.159	45.04
	Vitam. C. at 50 mg/l	3.087	2.212	0.705	0.47	5.299	6.004	6.474	45.21
	Vitam. C. at 100 mg/l	3.609	2.671	0.657	0.438	6.28	6.937	7.375	47.43
	SA at 50 mg/l	3.259	2.247	0.704	0.469	5.506	6.21	6.679	46.16
	SA at 100 mg/l	3.042	2.347	0.572	0.381	5.389	5.961	6.342	49.35
80+75	Control (untreated)	3.38	2.286	0.86	0.574	5.666	6.526	7.1	57.51
	Vitam. C. at 50 mg/l	3.779	2.659	0.933	0.622	6.438	7.371	7.993	58.85
	Vitam. C. at 100 mg/l	3.965	2.702	1.127	0.751	6.667	7.794	8.545	60.13
	SA at 50 mg/l	3.645	2.574	1.071	0.714	6.219	7.29	8.004	58.74
	SA at 100 mg/l	3.679	2.592	1.126	0.751	6.271	7.397	8.148	58.92
LSD at 0.05 level		0.200	0.108	0.087	0.058	0.239	0.195	0.185	1.32

Table 8. Effect of the interaction between N+K_2O rates and foliar spray with some antioxidants on yield and its components during 2015/2016 season

Treatment		Yield and its components (ton/fad.)							Average bulb weight (g)
N+K_2O kg/fad.	Antioxidant	Grade 1	Grade 2	Grade 3	Grade 4	Exportable	Marketable	Total	
60 +50	Control (untreated)	2.515	1.999	0.795	0.53	4.514	5.309	5.839	51.71
	Vitam. C. at 50 mg/l	2.817	2.111	0.989	0.659	4.928	5.917	6.576	56.98
	Vitam. C. at 100 mg/l	2.605	2.89	0.943	0.628	5.495	6.438	7.066	64.68
	SA at 50 mg/l	2.821	2.219	0.891	0.594	5.04	5.931	6.525	56.62
	SA at 100 mg/l	2.832	2.374	0.6	0.4	5.206	5.806	6.206	54.33
80+75	Control (untreated)	3.566	2.08	0.53	0.353	5.646	6.176	6.529	54.52
	Vitam. C. at 50 mg/l	3.859	2.88	0.668	0.245	6.739	7.407	7.652	65.3
	Vitam. C. at 100 mg/l	4.492	3.335	0.836	0.223	7.827	8.663	8.886	68.51
	SA at 50 mg/l	3.704	2.354	0.647	0.298	6.058	6.705	7.003	65.6
	SA at 100 mg/l	3.771	2.377	0.61	0.273	6.148	6.758	7.031	67.34
LSD at 0.05 level		0.144	0.225	0.069	0.045	0.268	0.284	0.303	1.02

Table 9. Effect of N +K_2O rates on weight loss percentage of garlic bulb during 2014/2015 and 2015/2016 seasons

Treatmen	Days from storage					
	30	60	90	120	150	180
N+K_2O (kg/fad.)			2014/2015 season			
60 +50	5.78	7.49	9.12	13.81	15.37	17.83
80+75	3.01	5.37	6.79	9.84	11.91	13.78
LSD at 0.05 level	0.58	1.08	1.17	1.10	1.24	0.83
			2015/2016 season			
60 +50	2.2307 a	4.96	7.83	10.94	14.33	17.44
80+75	2.0727	3.84	7.06	9.39	11.85	13.80
LSD at 0.05 level	0.10	0.49	NS	NS	1.99	2.65

Table 10. Effect of foliar spray with some antioxidants on weight loss percentage of garlic bulb during 2014/2015 and 2015/2016 seasons

Treatment	Days from storage					
	30	60	90	120	150	180
			2014/2015 season			
Control (untreated)	6.00	7.63	9.34	13.96	15.76	17.89
Vitam. C. at 50 mg/l	3.81	5.51	7.39	11.19	13.92	16.65
Vitam. C. at 100 mg/l	3.68	5.14	7.05	10.90	11.78	14.16
SA at 50 mg/l	3.98	6.83	8.11	11.34	13.31	14.86
SA at 100 mg/l	4.50	7.05	7.91	11.74	13.46	15.48
LSD at 0.05 level	0.45	0.84	0.91	0.86	0.96	0.64
			2015/2016 season			
Control (untreated)	2.60	5.45	9.52	12.97	16.67	19.33
Vitam. C. at 50 mg/l	2.22	4.30	7.28	9.94	13.46	15.88
Vitam. C. at 100 mg/l	2.01	4.23	6.74	9.03	11.69	14.52
SA at 50 mg/l	1.78	3.69	6.07	8.62	10.75	13.29
SA at 100 mg/l	2.13	4.34	7.62	10.25	12.87	15.07
LSD at 0.05 level	0.62	1.27	2.10	2.49	3.14	3.44

Table 11. Effect of the interaction between N+K_2O rates and foliar spray with some antioxidants on weight loss percentage of bulb garlic during 2014/2015 season

Treatment		Days from storage					
N+K_2O kg/fad.	Antioxidant	30	60	90	120	150	180
60 +50	Control (untreated)	6.91	8.77	10.62	16.17	18.020	20.00
	Vitam. C. at 50 mg/l	4.79	6.39	8.78	12.78	15.18	18.70
	Vitam. C. at 100 mg/l	5.18	6.18	7.37	11.95	12.55	14.34
	SA at 50 mg/l	5.83	7.94	9.24	13.94	15.72	17.50
	SA at 100 mg/l	6.19	8.17	9.62	14.23	15.42	18.65
80+75	Control (untreated)	5.09	6.49	8.07	11.75	13.50	15.79
	Vitam. C. at 50 mg/l	2.83	4.63	6.00	9.61	12.66	14.61
	Vitam. C. at 100 mg/l	2.18	4.11	6.73	9.86	11.02	13.99
	SA at 50 mg/l	2.13	5.72	6.99	8.74	10.90	12.23
	SA at 100 mg/l	2.82	5.94	6.20	9.25	11.50	12.32
LSD at 0.05 level		0.20	1.19	1.29	1.22	1.36	0.91

Table 12. Effect of the interaction between N+K_2O rates and foliar spray with some antioxidants on weight loss percentage of garlic bulb during 2015/2016 season

Treatment		Days from storage					
N+K_2O kg/fad.	Antioxidant	30	60	90	120	150	180
60 +50	Control (untreated)	2.98	6.76	10.55	14.45	18.96	21.88
	Vitam. C. at 50 mg/l	2.32	5.11	8.18	11.08	15.65	18.68
	Vitam. C. at 100 mg/l	1.88	4.62	6.81	9.74	12.92	16.89
	SA at 50 mg/l	1.99	4.26	6.35	9.60	11.92	15.33
	SA at 100 mg/l	1.97	4.07	7.29	9.82	12.20	14.43
80+75	Control (untreated)	2.23	4.14	8.49	11.49	14.39	16.78
	Vitam. C. at 50 mg/l	2.11	3.49	6.37	8.80	11.28	13.09
	Vitam. C. at 100 mg/l	2.13	3.84	6.68	8.32	10.46	12.15
	SA at 50 mg/l	1.58	3.12	5.79	7.64	9.57	11.26
	SA at 100 mg/l	2.30	4.61	7.96	10.69	13.54	15.72
LSD at 0.05 level		0.14	1.80	2.97	3.52	4.44	4.86

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تأثير التسميد النيتروجينى والبوتاسى والرش الورقي ببعض مضادات الأكسدة على الوزن الجاف والمحصول والقدرة التخزينية لنباتات الثوم

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أجرى هذا البحث فى مزرعة خضر خاصة بالبلاشون- بلبيس - محافظة الشرقية خلال شتاء موسمى ٢٠١٤/٢٠١٥ و٢٠١٥/٢٠١٦ بهدف دراسة تأثير التسميد النيتروجينى والبوتاسى والرش الورقي بحمض الساليسيلك وفيتامين ج على الوزن الجاف والمحصول والقدرة التخزينية لنباتات الثوم تحت ظروف الأرض الطينية والرش السطحى، أعطى التفاعل بين النيتروجين + البوتاسيوم بمعدل ٨٠ كجم نيتروجين + ٧٥ كجم بو٢أ والرش الورقي بفيتامين ج بتركيز ١٠٠ ملجم/لتر أعلى القيم من الوزن الجاف للأوراق والأبصال والوزن الجاف الكلى للنبات وكذلك محصول الدرجة الأولى والثانية والمحصول القابل للتسويق والمحصول القابل للتصدير والمحصول الكلى للفدان وكذلك سجل اقل فقد فى الوزن للأبصال أثناء التخزين.

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