Effect of Nitrogen and Some Antioxidants on Tuberose Production

Naglaa M. Gomaa[1] Mahmoud K. Hussein[2]; Ola A. El-Shennawy[2] and Mostafa M. Mostafa[1]
[1]Antoniadis Garden Research Branches, Horticultural Research Institute, A.R.C., Alexandria, Egypt.
[2]Dept. of Floriculture, Ornamental Horticulture and Landscape Gardening, Faculty of Agriculture, Alexandria University.

Received on: 16 /10/2010 *Accepted: 4 /1/2011*

ABSTRACT

This investigation was carried out during 2007 and 2008 on *Polianthes tuberosa* cv. Double grown in plastic pots of 30 cm diameter at Antoniades Research Branch, Horticulture Institute, Ministry of Agriculture, Alexandria, Egypt. The study was a trial to investigate the effect of different levels of nitrogen (zero, 0.9 and 1.8 g/plant), sprays of different concentrations of two antioxidants materials (ascorbic acid at zero, 125 and 250 ppm and diphenylamine at zero, 100 and 200 ppm were used four times) and their combinations (27 treatments) on the vegetative growth, flowering, corms production and some chemical analysis of tuberose (*Polianthes tuberosa* L.) cv. "Double" plants. Results revealed that using nitrogen alone at 0.9-1.8 g/plant/season gave the maximum values of number of leaves / plant and corms diameter. Also, adding nitrogen at 1.8 g/plant combined with ascorbic acid at 125-250 ppm gave the maximum values of dry weight of leaves/plant and of the essential oil percentage in the flowers. Besides, using nitrogen (1.8 g/plant) combined with diphenylamine at 100-200 ppm led to obtain the maximum values of leaves area/plant and cormels number/plant. On the other hand, adding ascorbic acid at 250 ppm combined with diphenylamine at 100 ppm gave the tallest and earliest flowering plants and the maximum number of flowers per spike. Furthermore, using the three factors together (0.9-1.8 g nitrogen, 125-250 ppm ascorbic acid and 100-200 ppm diphenylamine) gave the maximum values of rachis length, dry weight of flowers/spike, flowering period, corms dry weight, leaves total chlorophyll, and percentage of carbohydrate and nitrogen of the new corms. It can be generally, recommended to treat the tuberose plants with nitrogen at 1.8 g/plant/season and spraying their foliage four times at vegetative growth period with ascorbic acid at 250 ppm and diphenylamine at 100-200 ppm to give good improvements of the vegetative growth, flowering characteristics, corms production and essential oil percentage of tuberose.

Key Words: Nitrogen, antioxidants, Polianthes tuberosa.

INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) is economically considered as one of the most important florist crop in the floriculture industry for local and Arabian markets. It is also a landscape plant in the home garden, specimens for exhibition, and is used as lovely white colour cut flowers for their fragrance and long vase life. Besides, the natural flower oil of tuberose remains as one of the most expensive of the perfumer's raw materials.

Nitrogen is an essential element for plant growth as a constituent of all proteins such as amino acids, many enzymes and energy transfer materials such as chlorophyll, adenosine diphosphate and adenosine triphosphate. Growing plant must have nitrogen to form new cells, and the rate of growth then becomes very nearly proportional to the rate at which nitrogen is supplied. Photosynthesis can produce soluble sugars from CO_2 and H_2O, but the process can not go on to the production of proteins without the presence of nitrogen. Thus, a severe shortage of nitrogen will halt the growth process and reproduction (Bidwell, 1974).

Supplying the plants with adequate quantities of nitrogen at the right time tends to increase cell number and size with an overall increase in vegetative growth production (Thompsond and Troeh, 1975).

Yadav *et al.* (2005 a) reported that increasing the nitrogen level from 10 to 30 g/m^2 led to significant increase all the growth parameters of tuberose cv. Double. Application of 20 g N/m^2 was optimum for the different growth parameters. Rathore and Singh (2009) indicated that, the maximum vegetative growth and spike production of tuberose was observed in treatment received nitrogen at 320 kg/ha (32 g /m^2).

Antioxidants are substances which can prevent or slow the oxidative damage of the cell. When cells use oxygen, they naturally produce free radicals (by-products) which can cause damage. Antioxidants act as "free radical scavengers" and hence prevent and repair damage done by these free radicals. Well known antioxidants include a number of enzymes and other substances such as ascorbic acid (vitamin C), diphenylamine, vitamin E and beta-carotene etc. that are capable of counteracting the damaging effects of oxidation. Recently husbandry inputs involve the use of antioxidants which may play a role in the regulation of plant development, flowering and chilling or disease resistance had been studied (Sing *et al*., 2004).

Ascorbic acid is known as a growth regulating factor that influences many biological processes. Price (1966) reported that ascorbic acid increased nucleic acid content especially RNA. It also influenced the synthesis of enzymes, nucleic acids, protein and as a biological antioxidant. In addition, it acts as coenzyme in metabolic changes (Fadl *et al.*, 1977).

Shalata and Neumann (2006) reported that stress increased the accumulation of lipid peroxidation products produced by interactions with damaging active oxygen species in roots, stems and leaves. Additional ascorbic acid partially inhibited this response.

Abd El-Aziz *et al.* (2009) found that, the maximum plant height, number of leaves, fresh and dry weight of leaves of gladiolus were obtained by using ascorbic acid at 100 ppm, while using ascorbic acid at 200 ppm gave the maximum number and fresh weight of cormels, spike length, number of florets and fresh and dry weight of florets.

Diphenylamine $[(C_6H_5)_2\ NH]$ is an aromatic antioxidant amine, a plant growth regulator and a fungicide. Beside, it has been used in a test for nitrates and for scald control on apples (Carrasco *et al*. 2005).

Abou Dahab and Abd El-Aziz (2006) reported that, the foliar spraying of diphenylamine at 50 or 100 ppm significantly increased plant growth of *Philodendron erubescens* plants. (in terms of plant height, number of leaves/plant, stem diameter, root length, leaf area, as well as fresh and dry weights of the different plant parts).

The objective of this investigation was to study the effect of different levels of nitrogen and two antioxidants (ascorbic acid and diphenylamine) and their combinations on the vegetative growth, flowering, corms and cormels production and some chemical analysis of *Polianthes tuberosa‹ L.* cv. "Double".

MATERIALS AND METHODS

The present study was carried-out during the two successive seasons of 2007 and 2008 at Antoniades Research Branch, Horticulture Research Institute, A.R.C. Alexandria, Egypt.

Tuberose (*Polianthes tuberosa‹ L.*) cv. "Double" corms were planted in plastic pots of 30 cm diameter at a depth of 8 cm from the medium surface, on May 15, in the first season (2007) and on May 22, in the second one (2008). The averages diameter, volume and fresh weight of the chosen corms were 3.25 cm, 43.48 ml and 38.13 g respectively. The pots were filled with a mixture of sand and organic manure at the ratio of 3:1 by volume respectively (Dahiya *et al.,* 2001). The analysis of the used medium are presented in Table (A).

There are 27 treatments which are all the possible combinations of three levels of nitrogen (zero, 0.9 and 1.8 g N/plant), ascorbic acid (zero, 125 and 250 ppm) and diphenylamine (zero, 100 and 200 ppm). Diphenylamine $[(C_6H_5)_2\ NH]$ was brought from a commercial laboratory for chemicals in Alexandria as a powder product with a purity of 98 %. Ascorbic acid and diphenylamine are used as antioxidant materials. Ammonium nitrate (33.5 % N) was used as a source of nitrogen fertilizer. The amount of nitrogen were divided into four equal doses, where the first one was added to the pot soil one week after planting, the other doses were applied as a top-dressing at 30, 60 and 90 days from planting time.

The concentrations of the two other materials (antioxidants) were sprayed early in the morning four times (at 30, 45, 60 and 75 days from the sprouting) on the plant foliage until the run-off point using "Sticks" at a rate of one ml/l in all sprays as a surfactant substance.

Monocalcium superphosphate (15.5% P_2O_5) at 4.31 g P_2O_5/plant and potassium sulphate (50% K_2O) at 2.2 g K_2O/plant were mixed with the used medium for all plants just before planting, to cover the plant requirements for phosphorus and potassium (Singh *et. al.,* 2004). Besides, Mg and Fe fertilizers were sprayed four times at three weekly intervals at 150 and 75 ppm respectively as reported by Taha (2005).

The experiment layout was designed to provide a factorial experiment in complete randomized blocks containing three replicates, each replicate contained 27 different treatments. Four plants were used as a plot for each treatment in each replicate. The means of the individual factors and their interactions were compared by L.S.D. test at 5% level of probability (Snedecor and Cochran, 1974).

Table A: Mechanical analysis and some chemical properties of the used growth medium.

Mechanical analysis					Chemical properties			
Clay (%)	Silt (%)	Sand (%)	Texture	pH	EC (ds/m)	Total N (%)	Avail. P (ppm)	Exch. K (mg/1000g soil)
4.1	2.4	93.5	Sandy soil	7.6	1.62	0.01	6.01	1.40

The following data were recorded: plant height, leaves number, leaf area and dry weight, time taken to showing color, number of florets per spike, flowering duration, florets dry weight, rachis length, spike dry weight, florets essential oil percentage (after Guenther, 1961), corm diameter, corms and cormels number, total chlorophyll (after Rami and Porath, 1980) and carbohydrate (after Dubios *et al.*, 1956) and nitrogen contents (after Chapmann and Pratt, 1961) of the new corms.

RESULTS AND DISCUSSION

1. Vegetative growth

Plant height:

The analysis of variance showed that, only the F- values of nitrogen, diphenylamine and the interactions between ascorbic acid and diphenylamine were significant in both seasons, while the F- values for the other factors/ treatments were not significant. Generally, data on means of plant height of the two seasons in Table (1) clear that, using nitrogen or diphenylamine each alone or ascorbic acid combined with diphenylamine led to significant increase in the plant height of tuberose plants compared with the other treatments. These results may be probably due to the role of the used materials (nitrogen, ascorbic acid and diphenylamine) at specific concentrations by the formation of new cells, increasing the rate of cell division, and acceleration of many biological processes in plants, consequently the plant height could be increased. Besides, the tallest plants (87.49 cm = mean of the two seasons) was found by using ascorbic acid at 250ppm combined with diphenylamine at 100ppm, compared with using nitrogen or diphenylamine alone. These results may be due to the synergistic effects of the two antioxidants at proper concentrations on plant growth as a result of their involvement in the main metabolic processes especially carbohydrate metabolism, improved biosynthesize activity and DNA replication which led to enhance the cell division and/or enlargement, consequently the plant height could be increased, as reported by Noctor and Foyer (1998).

Table 1: Means of the plant height (cm) of *Polianthes tuberosa* L. cv. "Double" as influenced by the addition of the different levels of nitrogen, diphenylamine and the combinations between ascorbic acid and diphenylamine during the two seasons of 2007 and 2008.

Treatments				2007	2008	Means
Main effect of nitrogen						
0.0 (control)				83.73	85.02	84.38
0.9 g/plant				84.04	85.78	84.91
1.8 g/plant				85.77	87.45	86.61
L.S.D $_{0.05}$				1.74	1.95	
Main effect of diphenylamine						
0 (control)				82.37	83.08	82.73
100 ppm				85.63	87.63	86.63
200 ppm				85.55	87.55	86.55
L.S.D $_{0.05}$				1.74	1.95	
Effect of interaction between ascorbic acid (Asc.) and diphenylamine (DPA)						
Asc.(ppm)	0	DPA (ppm)	0	79.11	77.75	78.43
			100	85.89	88.63	87.26
			200	85.73	88.19	86.96
	125		0	85.42	87.57	86.50
			100	84.88	85.41	85.15
			200	85.42	86.31	85.87
	250		0	82.57	83.91	83.24
			100	86.13	88.85	87.49
			200	85.52	88.15	86.84
L.S.D $_{0.05}$				3.02	3.39	

L.S.D $_{0.05}$ = Least Significant Differences at 0.05 probability.

Number of leaves per plant:

The analysis of variance showed that, only the F- values of nitrogen were significant in both seasons, while the F values for the other factors/ treatments were not significant. Generally, using the highest rate of nitrogen (1.8 g/plant) alone gave the largest number of leaves per plant comparing with the other treatments. But, there were no significant differences in the number of leaves per plant between the two nitrogen levels namely 0.9 and/or 1.8 g/plant during the two seasons (Table 2). These results may be probably due to the importance of adding nitrogen at a suitable level on plant growth. Nitrogen is an essential component in chlorophyll molecule and is therefore necessary for photosynthesis, proteins and carbohydrates formation and meristematic activity which increase the initiation of leaves primordial, consequently the leaves number per plant would be more as reported by Parthiban *et al.* (1992).

Leaf area per plant:

Data presented in Table (3) clear that, the maximum expansion of *Polianthes tuberosa* leaves was obtained by adding nitrogen at the highest rate (1.8g/plant) combined with diphenylamine at 100 ppm, followed by the highest rate of nitrogen combined with ascorbic acid at 250 ppm compared with the other treatments during the two seasons. These results may be due to that supplying the plants with adequate quantities of N and diphenylamine led to increase leaves expansion and size or both as a result the leaves area could be increased (Thompsond and Troeh, 1975). Besides, Luwe (1996) reported that the antioxidants have the ability to prevent the environmental stress damage on plant growth and to increase the leaves area by increasing cell elongation and expansion.

Leaves dry weight:

Generally, data presented in Table (3) show that, the highest significant values of the dry weight of the leaves per plant was obtained by using the highest level of nitrogen (1.8g/plant) combined with ascorbic acid at 250ppm during the two seasons which increase the leaves dry weight by 90.2% and 85.9%, compared with the control treatment in the first and the second season, respectively. These results may be due to the role of each used factor on activation the vegetative growth. Nitrogen lead to increase the photosynthesis efficiency and thus the biosynthesizes of proteins and carbohydrates could by increased, leading to increase the leaves number and size thus the accumulation of dry matter in the leaves could be increased. Beside, ascorbic acid acts as co-enzyme in the enzymatic reactions by which carbohydrates, fats and proteins are metabolized and involved in photosynthesis as reported by Helsper *et al.*, (1982). Consequently, using the two factors combined at the suitable concentrations gave the highest accumulation of the dry matter of the leaves, compared with the other factors/treatments (Belorkar *et al.*, 1993).

Table 2: Means of the number of leaves per plant of *Polianthes tuberosa*‹ *L.* cv. "Double" as influenced by the addition of the different levels of nitrogen during the two seasons of 2007 and 2008.

Nitrogen levels	2007	2008	Means
0.0 (control)	65.00	69.33	67.17
0.9 g/plant	80.72	88.14	84.43
1.8 g/plant	82.56	89.51	86.04
$L.S.D_{0.05}$	4.78	5.25	

$L.S.D_{0.05}$ = Least Significant Differences at 0.05 probability

II- Flowering characteristics

Flowering time:

The analysis of variance showed that, only the F- values of ascorbic acid, diphenylamine and the interactions between them were significant in both seasons, while the F- values for the other factors/ treatments were not significant. Generally, data of means of flowering time of the two seasons in Table (4) clear that, using any level of the experimental antioxidants (ascorbic acid and/or diphenylamine) alone led to a significant reduction in the time (days) needed for flowering, compared with the control treatment. Besides, all the combinations between the ascorbic acid and diphenylamine significantly reduced the time needed for flowering, compared with the control treatment. Furthermore, the application of ascorbic acid at 250 ppm combined with diphenylamine at 100 ppm gave the minimum time needed for flowering of tuberose, compared with the other treatments in the two seasons. These results may be due to that presence of any of the used antioxidant can serve as a source of energy and enhance synthesis of auxins, organic materials (Bonner, 1942) or enzymes (Patil and Lall, 1973) and other materials which are essential for increasing the vegetative growth rate and accumulation of flowering materials, consequently the flowering could be hasten.

Number of florets per spike:

The analysis of variance showed that, only the F- values of nitrogen, diphenylamine and the interactions between nitrogen and ascorbic acid and ascorbic acid and diphenylamine were significant in both seasons, while the F values for the other factors/treatments were not significant. Data in Table (5) indicate that, using nitrogen at 1.8 g/plant or diphenylamine alone at a rate of 200 ppm gave the highest significant increase in the number of florets per spike during the two seasons. These results may be due to the effect of adding N-fertilizer or spraying the diphenylamine at the suitable doses on improving the vegetative growth and accumulation of the row materials which needed for the formation of good spikes which had many florets. Furthermore, using any of combination between ascorbic acid and nitrogen or ascorbic acid and diphenylamine resulted in a significant increase in the number of florets, compared with the control treatment, during the two seasons (Table 5). These results may be due to the effect of the used factors at a specific concentration on improving the vegetative growth of tuberose plants, consequently the production and accumulation of the biosynthesizes would be increased and thus more florets could be initiated and developed on the spike.

Table 3: Means of the leaf area per plant (cm^2) and leaves dry weight per plant (g) of *Polianthes tuberosa‹ L.* cv. "Double" as influenced by the combinations between the different levels of nitrogen, ascorbic acid and diphenylamine during the two seasons of 2007 and 2008.

Nitrogen g/plant	Ascorbic acid (ppm)	Diphenylamine (ppm)	Leaf area /plant		Leaves dry weight	
			2007	2008	2007	2008
0	0	0	1134.13	1310.16	11.14	12.26
		100	2058.17	2118.17	14.39	15.63
		200	2162.03	2645.12	13.32	14.44
	125	0	2811.10	3485.67	14.84	17.61
		100	2270.64	2321.75	12.81	13.30
		200	3082.43	3009.91	13.76	15.43
	250	0	2128.72	2530.97	14.40	15.35
		100	2220.44	2225.26	13.46	14.82
		200	2503.57	2821.40	12.38	12.62
0.9	0	0	2270.44	2471.80	14.75	15.72
		100	3338.00	3877.54	18.33	19.28
		200	3470.02	3853.72	18.54	20.77
	125	0	2905.74	2845.83	18.39	20.53
		100	3066.16	3115.90	19.05	19.58
		200	2689.31	3231.17	18.78	20.42
	250	0	3266.21	3284.16	19.17	20.12
		100	3274.64	3730.68	18.37	21.16
		200	2397.11	3183.82	19.84	22.14
1.8	0	0	1632.35	1700.49	13.91	14.01
		100	3720.15	4210.77	20.94	22.34
		200	3029.23	3482.47	17.20	19.71
	125	0	2982.54	3420.59	20.56	22.74
		100	3120.92	3661.90	17.67	19.49
		200	3278.31	3526.77	16.14	17.27
	250	0	3509.58	3924.04	21.19	22.79
		100	3008.44	3422.18	17.56	19.35
		200	2857.30	3286.06	19.36	22.00
L.S.D 0.05 for N =			207.74	162.48	0.91	0.69
L.S.D 0.05 for A =			207.74	162.48	0.91	0.69
L.S.D 0.05 for D =			207.74	162.48	NS	NS
L.S.D 0.05 for NxA =			359.81	281.43	NS	NS
L.S.D 0.05 for NxD =			359.81	281.43	1.58	NS
L.S.D 0.05 for AxD =			359.81	281.43	1.58	1.19
L.S.D 0.05 for NxAxD =			623.21	487.45	2.74	2.07

L.S.D $_{0.05}$ = Least Significant Differences at 0.05 probability.

Table 4: Means of the flowering time (days) of *Polianthes tuberosa* ‹ *L.* cv. "Double" as influenced by the addition of the different levels of ascorbic acid, diphenylamine and their combinations during the two seasons of 2007 and 2008.

Treatments				2007	2008	Means
Main effect of ascorbic acid						
0.0 (control)				115.50	115.38	115.44
125 ppm				112.99	112.39	112.69
250 ppm				112.68	111.47	112.08
L.S.D $_{0.05}$				1.57	1.87	
Main effect of diphenylamine						
0 (control)				115.99	115.56	115.78
100 ppm				112.33	111.82	112.08
200 ppm				112.86	111.85	112.36
L.S.D $_{0.05}$				1.57	1.87	
Effect of interaction between ascorbic acid (Asc.) and diphenylamine (DPA)						
Asc.(ppm)	0	DPA (ppm)	0	122.31	123.54	122.93
			100	112.25	111.71	111.98
			200	111.94	110.88	111.41
	125		0	112.77	110.96	111.87
			100	113.27	113.25	113.26
			200	112.94	112.95	112.95
	250		0	112.87	112.18	112.53
			100	111.46	110.50	110.98
			200	113.71	111.73	112.72
L.S.D $_{0.05}$				2.72	3.24	

L.S.D $_{0.05}$ = Least Significant Differences at 0.05 probability

Flowering duration:

Generally, data of flowering duration of the two seasons in Table (6) clear that, using any level of nitrogen combined with any level of the used antioxidants led to increase the flowering duration, compared with the control treatment. Furthermore, the addition of ascorbic at 250 ppm and diphenylamine at 200 ppm in presence of the highest level of nitrogen (1.8 g/plant) gave the longest flowering duration on the plant which led to increase the flower duration with 9.69 and 11.26 days over the control treatment in the first and second seasons respectively. These results may be due to that using the antioxidants (ascorbic acid and diphenylamine) at suitable concentrations act as scavengers, helping to prevent cells and tissues damage and delay of the flowers senescence, furthermore, the role of nitrogen at a proper level in keeping the high water potential of flower cells, thus the florets could take a long period to reach the fading stage, as reported by Amarjeet *et al.*, (1996).

Florets dry weight per spike:

Generally data presented in Table (6) indicate that, adding of nitrogen at the highest level (1.8 g/plant) combined with ascorbic acid at 250 ppm and diphenylamine at 100 ppm gave the highest values of the florets dry weight per spike, comparing with the other treatments during the two seasons. The previous results may be related to the effect of nitrogen, ascorbic acid and diphenylamine at suitable levels on improving the vegetative growth characteristics, which led to increase the florets number and/or their size or both, consequently, the florets dry weight per spike could be increased. Similar trend of results was found by Waaly *et al.*, (2002) on *Antholyza aethiopica.*

Rachis length:

Data of the two experimental seasons in Table (6) show that, the longest rachis length by the flowering spike was obtained from treating the tuberose plant with 1.8g N combined with ascorbic acid at 250 ppm and diphenylamine at 100 ppm which led to increase the length of the rachis per flowering spike with 18.12 and 18.03 cm over the control treatment in the first and second season respectively. These results may be due to the synergistic effects of using ascorbic acid and diphenylamine at specific levels in the presence of a suitable concentration of nitrogen on enhancing the photosynthesis process, leading to increase the activity of the apical meristem and stimulate cell division and elongation of the spike, consequently the length of the rachis per spike could be increased as reported by Singh and Uma (1996).

Table 5: Means of the number of florets per spike of *Polianthes tuberosa* L. cv. "Double" as influenced by the addition of the different levels of nitrogen, diphenylamine and the combinations between nitrogen and ascorbic acid and/or ascorbic acid and diphenylamine during the two seasons of 2007 and 2008.

Treatments				2007	2008	Means
Main effect of nitrogen						
0.0 (control)				21.17	20.76	20.97
0.9 g/plant				22.16	22.54	22.35
1.8 g/plant				22.95	23.10	23.03
L.S.D $_{0.05}$				0.90	1.01	
Main effect of diphenylamine						
0 (control)				20.46	20.43	20.45
100 ppm				22.68	22.80	22.74
200 ppm				23.14	23.16	23.15
L.S.D $_{0.05}$				0.90	1.01	
Effect of interaction between nitrogen (N) and ascorbic acid (Asc.)						
N (g/plant)	0	Asc. (ppm)	0	19.69	18.94	19.32
			125	22.23	22.23	22.23
			250	21.59	21.09	21.34
	0.9		0	22.59	23.06	22.83
			125	22.00	22.29	22.15
			250	21.88	22.27	22.08
	1.8		0	22.77	23.05	22.91
			125	22.55	22.72	22.64
			250	23.53	23.54	23.54
L.S.D $_{0.05}$				1.56	1.74	
Effect of interaction between ascorbic acid (Asc.) and diphenylamine (DPA)						
Asc.(ppm)	0	DPA (ppm)	0	18.61	18.27	18.44
			100	22.33	22.54	22.44
			200	24.10	24.23	24.17
	125		0	22.42	22.87	22.65
			100	21.55	21.50	21.53
			200	22.81	22.87	22.84
	250		0	20.36	20.14	20.25
			100	24.15	24.38	24.27
			200	22.49	22.38	22.44
L.S.D $_{0.05}$				1.56	1.74	

L.S.D $_{0.05}$ = Least Significant Differences at 0.05 probability

Spike dry weight:

Data presented in Table (6) indicate that, using the highest levels of nitrogen (1.8g/plant) combined with diphenylamine at 200ppm gave the maximum dry weight of tuberose spike, compared with the other treatments during the two seasons. These results may be due to the biological and physiological roles of the nitrogen and diphenylamine on improving the rate of vegetative growth and their effects on the dry weight of spike as a result of their effects on increasing the spike length and/or spike diameter or both, consequently the spike dry weight could be increased.

Table 6: Means of the flowering duration (day), florets dry weight (g), rachis length per spike (cm) and spike dry weight (g) of *Polianthes tuberosa* L. cv. "Double" as influenced by the combinations between the different levels of nitrogen, ascorbic acid (Asc.) and diphenylamine (DPA) during the two seasons of 2007 and 2008.

Nitrogen	Asc.	DPA	Flowering duration		Florets dry weight		Rachis length per spike		Spike dry weight	
g/plant	(ppm)	(ppm)	2007	2008	2007	2008	2007	2008	2007	2008
0	0	0	16.28	16.44	1.84	1.82	17.32	16.19	4.45	4.38
		100	19.96	18.69	2.44	2.46	30.39	31.28	6.38	6.42
		200	21.68	22.30	2.64	2.61	29.42	29.83	6.43	6.42
	125	0	21.88	21.50	2.42	2.47	28.81	27.50	6.26	6.25
		100	21.14	23.22	2.89	3.09	26.06	24.83	6.56	7.12
		200	23.72	24.26	2.78	2.90	25.86	27.83	6.73	6.94
	250	0	21.65	20.03	2.24	2.31	27.44	27.33	5.82	5.88
		100	23.75	25.81	2.75	2.74	30.86	30.33	6.24	6.30
		200	19.49	20.02	2.76	2.82	24.97	23.11	6.65	6.91
0.9	0	0	17.18	16.42	2.31	2.33	23.25	23.33	5.87	6.06
		100	20.82	20.61	2.98	3.03	31.08	30.83	7.12	7.01
		200	23.44	24.28	3.12	3.13	31.17	31.50	7.68	7.96
	125	0	20.26	18.85	2.76	2.71	30.47	30.17	7.53	7.72
		100	20.43	21.83	2.45	2.57	27.89	27.78	6.47	6.80
		200	22.01	23.40	3.10	3.14	27.89	29.28	7.54	7.68
	250	0	17.99	18.13	2.37	2.33	28.72	28.28	6.00	6.13
		100	21.95	23.29	2.81	2.83	33.47	32.06	7.14	7.36
		200	22.71	23.72	2.91	2.82	29.00	29.83	7.38	7.39
1.8	0	0	19.17	18.87	2.20	2.12	22.53	22.33	5.27	5.10
		100	20.67	20.19	2.81	2.72	32.25	31.39	6.66	6.86
		200	19.95	19.91	3.42	3.57	32.17	32.00	8.50	9.09
	125	0	21.54	20.10	2.78	2.84	27.58	27.78	6.82	7.23
		100	20.14	19.25	2.81	2.81	28.72	28.28	7.28	7.50
		200	22.19	23.28	2.81	2.85	30.78	30.50	6.65	6.87
	250	0	19.19	19.76	2.58	2.54	26.33	25.89	6.65	6.77
		100	24.11	26.61	3.42	3.59	35.44	34.22	7.64	7.91
		200	25.97	27.70	2.96	3.03	30.33	30.00	6.92	7.09
L.S.D 0.05 for N =			N.S	N.S	0.15	0.13	0.95	0.96	0.23	0.22
L.S.D 0.05 for A =			1.06	0.94	N.S	N.S	0.95	0.96	0.23	0.22
L.S.D 0.05 for D =			1.06	0.94	0.15	0.13	0.95	0.96	0.23	0.22
L.S.D 0.05 for NxA =			1.84	1.64	0.26	0.13	N.S	N.S	0.40	N.S
L.S.D 0.05 for NxD =			N.S	N.S	N.S	N.S	1.65	1.66	N.S	N.S
L.S.D 0.05 for AxD =			1.84	1.64	0.26	0.23	1.65	1.66	0.40	0.38
L.S.D 0.05 for NxAxD =			3.18	2.83	0.45	0.39	2.86	2.87	0.70	0.66

L.S.D $_{0.05}$ = Least Significant Differences at 0.05 probability.

III- Corm production

Corms diameter: The analysis of variance showed that only the F- values of the main effects of nitrogen, ascorbic acid and diphenylamine were significant in both seasons, while the F- values for the other treatments were not significant. Generally, data of the two experimental seasons in Table (7) show that, using each of nitrogen or ascorbic acid or diphenylamine alone had significant effect on corm diameter, compared with the control treatment. Besides, the maximum increase in the corm diameter was found by using nitrogen alone at 0.9 g/plant, compared with using ascorbic acid and/or diphenylamine each alone. These results may be due to the role of the used substances (nitrogen, ascorbic acid or diphenylamine) which had a positive effect on photosynthesis and respiration rates and leaf carbohydrate and this will reflect on the nutrients uptake and transport, consequently produced good plants with many leaves which can store large amount of food in the corm, thus the corm diameter could be increased. These results are in agreement with those found by Gonzalez *et al.*, (1994) on *Allium cepa*.

Table 7: Means of the new corms diameter of *Polianthes tuberosa‹ L.* cv. "Double" as influenced by the addition of the different levels of nitrogen, ascorbic acid and diphenylamine during the two seasons of 2007 and 2008.

Treatments	2007	2008	Means
Main effect of nitrogen			
0.0 (control)	2.84	2.85	2.85
0.9 g/plant	3.24	3.16	3.20
1.8 g/plant	3.15	3.07	3.11
L.S.D $_{0.05}$	0.13	0.17	
Main effect of ascorbic acid			
0 (control)	2.96	2.90	2.93
125 ppm	3.18	3.14	3.16
250 ppm	3.10	3.04	3.07
L.S.D $_{0.05}$	0.13	0.17	
Main effect of diphenylamine			
0 (control)	2.97	2.93	2.95
100 ppm	3.09	2.99	3.04
200 ppm	3.18	3.16	3.17
L.S.D $_{0.05}$	0.13	0.17	

L.S.D $_{0.05}$ = Least Significant Differences at 0.05 probability.

Corms dry weight:

Generally, data presented in Table (8) show that, using nitrogen at 1.8 g/plant combined with ascorbic acid at 250 ppm and diphenylamine at 200 ppm gave the maximum increase of corms and cormels dry weight, compared with the other treatments, during the two seasons. These results may be due to the role of the used materials at the suitable concentrations in the stimulation of the vegetative growth (Wally *et al.*, 2002) and increase the amounts of metabolites by plant, which in turn accelerate the back translocation and accumulation of organic matter in the new corms and finally reflexed on the corms dry weight (Aberg, 1961). Similar results were obtained by El-Sayed (1991) on potato, Bardisi (2004) on garlic and Carrasco *et al.*, (2005) on potato.

Number of the new cormels per plant:

The analysis of variance showed that only the F- values of nitrogen and the interaction between nitrogen and diphenylamine were significant in both seasons, while the F values for the other treatments were not significant. Data presented in Table (9) indicate that using the third level of nitrogen (1.8 g/plant) combined with 200 ppm of diphenylamine gave the maximum number of new cormels per plant, compared with the other treatments during the two successive seasons. These results may be attributed to that using nitrogen combined with diphenylamine at the suitable concentrations led to improve the formation of chlorophyll and carbohydrates in the tissue of tuberose leaves, hence plant growth was in turn could be improved, accordingly resulted in more back translocation and accumulation of carbohydrates and proteins in the new corms, which led to initiate more cormels per plant. Subsequently, the cormels number per plant could be increased These results are in agreement with those obtained by Aiello *et al.*, (1997) on iris, Jhon *et al.*, (1997) on gladioli, Singh and Singh (2005) and Yadav *et al.* (2005 b) on tuberose.

IV- Chemical analysis

Total chlorophyll content:

Using nitrogen at 0.9 g/plant combined with ascorbic acid at 250 ppm and diphenylamine at 100 gave the maximum increase of the chlorophyll content in the leaves, compared with the other treatments during the two seasons (Table 10). These results may be attributed to the direct role of nitrogen in the biosynthesis of the green pigment, hence using nitrogen at a proper rate activate the synthesis of chlorophyll. Beside, the used antioxidants have the ability on keeping the chlorophyll from degradation and delaying its senescence, consequently the total chlorophyll content in tuberose leaves could be increased. The previous results are in agreement with the findings of Shoala (2000) on *Lavendula multifida*, Hassanein (2003) on *Foeniculum vulgare* and Abou Dahab and Abd El-Aziz (2006) on *Philodendron erubescens* plant.

Table 8: Means of the dry weight of corms and cormels (g) of *Polianthes tuberosa* L. cv. "Double" as influenced by the combinations between the different levels of nitrogen, ascorbic acid (Asc.) and diphenylamine (DPA) during the two seasons of 2007 and 2008.

Nitrogen	Asc.	DPA	Corms and cormels	dry weight
g/plant	(ppm)	(ppm)	2007	2008
0	0	0	30.47	30.82
		100	36.46	37.80
		200	42.11	45.10
	125	0	42.38	47.06
		100	44.85	48.69
		200	42.27	43.16
	250	0	38.06	41.42
		100	49.24	52.42
		200	37.66	37.42
0.9	0	0	45.86	47.35
		100	55.24	58.60
		200	49.61	52.15
	125	0	55.47	61.86
		100	51.28	52.21
		200	61.88	64.83
	250	0	56.76	58.27
		100	52.29	57.05
		200	49.20	51.39
1.8	0	0	44.92	46.92
		100	53.98	58.16
		200	56.67	59.79
	125	0	49.39	54.33
		100	49.44	51.33
		200	53.96	56.14
	250	0	47.57	48.94
		100	44.09	45.46
		200	68.20	70.00
L.S.D 0.05 for N =			2.71	2.67
L.S.D 0.05 for A =			2.71	2.67
L.S.D 0.05 for D =			2.71	2.67
L.S.D 0.05 for N x A =			4.69	N.S
L.S.D 0.05 for N x D =			4.69	4.63
L.S.D 0.05 for A x D =			N.S	N.S
L.S.D 0.05 for N x A x D =			8.13	8.01

L.S.D $_{0.05}$ = Least Significant Differences at 0.05 probability.

Total carbohydrates content:

The presented data in Table (10) indicate that, using nitrogen at 0.9 g/plant combined with ascorbic acid at 250 ppm and diphenylamine at 100 ppm gave the maximum significant increase in the percentage of the total carbohydrate content in produced corms compared with the other treatments, during the two experimental seasons. These results may be probably due to that adding the used materials at the suitable levels could be involved in the main metabolic processes especially with energy transfer coenzymes, carbohydrate metabolic and improved photosynthetic activity, consequently the amount of the stored carbohydrates in the new corms could be increased. These results are in agreement with those found by Gonzalez *et al.*, (1994) on *Allium cepa*..

Table 9: Means of the number of new cormels per plant of *Polianthes tuberosa* L. cv. "Double" as influenced by the addition of the different levels of nitrogen and the combinations between nitrogen and diphenylamine during the two seasons of 2007 and 2008.

Treatments				2007	2008	Means
Main effect of nitrogen						
0.0 (control)				29.83	30.07	29.95
0.9 g/plant				32.31	32.31	32.31
1.8 g/plant				36.89	37.78	37.34
L.S.D $_{0.05}$				2.64	2.85	
Effect of interaction between nitrogen (N) and diphenylamine (DPA)						
N (g/plant)	0	DPA (ppm)	0	29.92	31.31	30.62
			100	30.06	30.24	30.15
			200	29.53	28.65	29.09
	0.9		0	32.72	32.50	32.61
			100	32.53	32.76	32.65
			200	31.69	31.69	31.69
	1.8		0	34.28	35.72	35.00
			100	33.17	33.06	33.12
			200	43.22	44.56	43.89
L.S.D $_{0.05}$				4.56	4.93	

L.S.D $_{0.05}$ = Least Significant Differences at 0.05 probability.

Nitrogen content:

The maximum increase in the N content in the produced corms, during the two experimental seasons was obtained from using the combination between the highest level of the three experimental factors, compared with the other treatments (Table 10). These results may be due to adding the used materials together (nitrogen, ascorbic acid and diphenylamine) at specific concentrations led to increase N-content of the new corms through increasing their absorption, consequently formation of enzymes, nucleic acid and protein could be increased, as a result the nitrogen content of the new corms would be increased. Similar trend of results were foud by Hardeep *et al.*, (2004) on tuberose and Abd El-Aziz *et. al.*, (2009) on *Gladiolus* plants.

Essential oil percentage:

Data of the two seasons presented in Table (10) clear that, using nitrogen at 1.8 g/plant combined with ascorbic acid at 125 ppm gave the maximum value of essential oil in the flowers, compared with the other treatments. This result may be due to the effects of nitrogen and ascorbic acid on enhancing the enzymes system of biosynthesis of the essential oil, or due to the effect of the used materials at the proper concentrations on increasing the number or the size of the oil glands per cm^2 or both of them, as a result the oil percentage of the flowers could be incresed. These results are in agreement with those obtained by Al-Shareif (2006) on *Carum carvi* and Said-Al Ahl *et al.* (2009 a and b) on oregano.

Table 10: Means of the total chlorophyll content (a+b) of the leaves (mg/g fresh weight), carbohydrate and nitrogen content of new corms (%) and the essential oil percentage (%) of the flowers of *Polianthes tuberosa* L. cv. "Double" as influenced by the combinations between the different levels of nitrogen, ascorbic acid (Asc.) and diphenylamine (DPA) during the two seasons of 2007 and 2008.

Nitrogen g/plant	Asc. (ppm)	DPA (ppm)	Total chlorophyll content		Carbohydrate content		Nitrogen content		Essential oil percentage	
			2007	2008	2007	2008	2007	2008	2007	2008
0	0	0	46.46	49.19	10.97	12.10	1.65	2.03	0.223	0.244
		100	58.90	60.21	12.89	14.54	1.95	2.27	0.253	0.263
		200	74.65	82.36	12.04	13.95	1.83	2.16	0.238	0.255
	125	0	65.92	72.03	12.03	13.38	1.85	2.22	0.232	0.250
		100	65.51	67.99	12.92	15.07	1.93	2.30	0.241	0.273
		200	60.61	65.45	13.07	15.28	2.10	2.43	0.260	0.286
	250	0	62.55	67.90	12.80	14.14	1.90	2.24	0.251	0.265
		100	67.17	72.23	11.69	13.33	1.91	2.28	0.282	0.297
		200	63.18	62.83	13.34	15.35	2.00	2.43	0.273	0.284
0.9	0	0	57.33	61.98	11.74	13.17	1.87	2.27	0.231	0.255
		100	73.74	80.31	12.66	14.38	2.00	2.30	0.262	0.275
		200	58.57	59.66	13.28	15.25	1.96	2.33	0.282	0.289
	125	0	68.76	72.55	11.47	12.67	1.81	2.20	0.256	0.268
		100	67.22	68.22	13.29	15.41	2.04	2.35	0.264	0.271
		200	74.50	82.55	13.72	15.66	2.10	2.47	0.277	0.281
	250	0	64.01	71.53	12.87	14.65	1.99	2.33	0.249	0.261
		100	76.60	84.04	13.83	15.70	1.97	2.33	0.259	0.263
		200	70.57	74.74	13.00	15.10	2.00	2.33	0.270	0.274
1.8	0	0	63.67	69.13	12.01	13.75	1.92	2.33	0.266	0.290
		100	73.55	79.34	13.32	15.10	1.98	2.30	0.293	0.328
		200	67.95	68.81	12.65	14.15	2.03	2.33	0.287	0.319
	125	0	71.85	77.16	12.50	13.76	2.03	2.43	0.332	0.354
		100	70.56	72.58	13.00	15.07	2.00	2.33	0.279	0.304
		200	68.92	70.88	12.19	13.55	2.00	2.33	0.269	0.292
	250	0	68.03	75.38	13.32	15.08	2.00	2.29	0.282	0.296
		100	67.45	67.87	13.45	15.62	1.97	2.30	0.322	0.349
		200	71.70	78.50	13.00	14.50	2.13	2.50	0.290	0.312
L.S.D 0.05 for N =			3.22	3.17	0.30	0.17	0.04	0.04	-	-
L.S.D 0.05 for A =			3.22	3.17	0.30	0.17	0.04	0.04	-	-
L.S.D 0.05 for D =			3.22	3.17	0.30	0.17	0.04	0.04	-	-
L.S.D 0.05 for N x A =			N.S	N.S	0.53	0.30	NS	NS	-	-
L.S.D 0.05 for N x D =			N.S	N.S	0.53	0.30	0.07	0.06	-	-
L.S.D 0.05 for A x D =			5.58	5.49	0.53	0.30	NS	0.06	-	-
L.S.D 0.05 for N x A x D =			9.67	9.50	0.91	0.52	0.13	0.11	-	-

L.S.D $_{0.05}$ = Least Significant Differences at 0.05 probability.

REFERENCES

Abd El-Aziz, N; Lobna Taha, and Soad Ibrahim. **2009**. Some studies on the effect of putrescine, ascorbic acid and thiamine on growth, flowering and some chemical constituents of *Gladiolus* plants at Nubaria. Ozean J. of Applied Sci., 2(2):169-179.

Aberg, B. **1961**. Vitamins as Growth Factors in Higher Plants. Encyclopedia of Plant Physiol. **XIV**: 418-448.

Abou Dahab, T. and Nahed, Abd El-Aziz, **2006**. Physiological effect of diphenylamine and tryptophan on the growth and chemical constituents of *Philodendron erubescens* plants. World J. of Agri. Sci. **2** (1):75-81.

Aiello, N.; A. Bezzi and F. Clemental. **1997.** Effect of organic mineral fertilizer application on the yield and quality of *Iris pallida* Lam. rhizomes. Trento, Italy. Sperimental per L' Asse-stamento forestale per L' Alpicotture, **9613**: 5-12.

Al-Shareif, A. **2006.** Response of caraway plants grown in sandy soil under drip irrigation system to some biofertilization and antioxidant treatments. M.Sc. Thesis. Fac. of Agric. Minia Univ.

Amarjeet, S.; N. Godara and K. Ashok. **1996.** Effect of NPK on flowering and flower quality of tuberose (*Polianthes tuberosa* L.) cv. Single. Haryana Agric.Univ. J. of Res. **26**(1):43-49.

Bardisi, A. **2004**. Influence of vitamin C and salicylic acid foliar application on garlic plants under sandy soil condition, I. Growth and plant chemical composition. Zagazig J. Agric. Res. **31** (4A):1335-1347.

Belorkar, P.; B. Patil; B. Dhumal; V. Golliwar and S. Dalal. **1993.** Effect of nitrogen levels and gibberellic acid on growth, flowering and yield of tuberose (*Polianthes tuberosa*). J. of Soils and Crops **3** (2): 106-108.

Bidwell, R. **1974.** Plant Physiology. Macmillan publishing company, New York, USA.

Bonner, J. **1942.** Transport of thiamin in the tomato plant. Amer. J. Botan., 29:136.

Carrasco, R.; F. Asensi and T. Del Valle. **2005.** Effect of tropospheric ozone on potato plants protected by the antioxidant diphenylamine (DPA). Water, Air, and Soil Pollution, **161:** 299–312.

Chapmann, H. and F. Pratt. **1961**. Methods of Analysis of Soil, Plant and Water. Dept. of Soil and Plant Nutrition, Univ. of California, Riverside, U.S.A.

Dahiya, S; S. Mohansundram; S. Sukhbir and D. Dahia. **2001**. Effect of nitrogen And phosphorus on growth and dry matter yield of tuberose (*Polianthes tuberosa* L.). J. of Hort. Sci. **30** (3/4): 198-200.

Dubios, M; K. Gilles; J. Hamlton; P. Robers and F. Smith. **1956**. Colourimetric methods for determination of sugar and related substances. Analytical Chemisty, **28** (3): 350-356.

El-Sayed, H. **1991**. Growth and yield of potato as affected by CCC, GA and vitamin C. J. Agric. Sci. Mansoura Univ. **16** (3):648-652.

Fadl, M.; F. Reda; R. Abdel-Ali and A. El-Moursi. **1977**. Physiological studies on *Ammi visnaga* L. Egypt J. of Physiol. Sci. **5**:73-83.

Gonzalez, K.; A. Hidalgo; A. Calcr; R. Palos and P. Navas. **1994.** Nutrient uptake changes in ascorbate free radical stimulated onion roots. Plant Physio., **104** (1):271-276.

Guenther, E. **1961**. Oil of Tuberose "The Essential Oils". Vol. I, II and V. D. Van Westrand Company Inc. New York. pp. 343-398.

Hardeep, K.; V. Ahlawat; B. Yadav. and S. Sehrawat. **2004**. Response of nitrogen and zinc application on spike length, bulb production and nutrient content in tuberose (*Polianthes tuberosa* Linn) cv. Double. Haryana J. Hort. Sci. **33** (3/4):221-223.

Hassanein, R. **2003**. Effect of some amino acids, trace elements and irradiation on fennel (*Foeniculum vulgare* L.). Ph. D. Thesis, Fac. Agric. Cairo Univ.

Helsper, J.; L. Kagan; C. Hilby; J. Maynard and F. Loewas. **1982**. Ascorbic acid biosynthesis on *Ochromonas danica*. Plant Physiol. **69**: 465-468.

Jhon, A.; M. Siddique and T. Paul. **1997**. Nutritional studies in *Gladiolus*. II: Corm and cormel production. Advances in Plant Sci. **10**(1):187-191.

Luwe, M. **1996**. Antioxidant in the apoplast and symplast of beech (*Fagus sylvatica* L.) leaves: Seasonal variation and responses to changing ozone concentration in air-plant cell. Environ. **19**: 321-328.

Noctor, G. and C. Foyer. **1998**. Ascorbate and glutathione keeping active oxygen under control. Ann. Rev. Plant Physiol. Plant Mol. Biol. **49**: 249-279.

Parthiban, S.; M. Khader and S. Thamburaj. **1992**. Effect of N, P and K on growth and development of tuberose (*Polianthes tuberosa* L.). South India Horti. **40** (3):166-171.

Patil, N. and B. Lall. **1973**. Effect of presowing treatment with L-ascorbic acid and gibberelic acid on growth and physiological constituents of wheat. Boil. Abst. 57:34.

Price, E. **1966**. Ascorbic stimulation of RNA synthesis. Nature 212: 1481.

Rami, M. and D. Porath. **1980**. Chlorophyll determination in intact tissues using N, N-dimethyl formamid. Plan Physiol. **65**: 478-479.

Rathore, A. and J. Singh. **2009**. Optimization of nitrogen application and irrigation for improved growth and spike production of tuberose (*Polianthes tuberosa* Lin.) Indian J. soil conservation **37**(1).

Said-Al Ahl, H.; Hasnaa, Ayad and S. Hendawy. **2009a**. Effect of potassium humate and nitrogen fertilizer on herb and essential oil of oregano under different irrigation intervals. J. Applied Sci. **2**(3):319-323.

Said-Al Ahl, H., E. Omer and N. Naguib. **2009b** Effect of water stress and nitrogen fertilizer on herb and essential oil of oregano. Intern. J. Agrophysics **23**(3):269-275.

Shalata, A. and P. Neumann. **2006**. Exogenous ascorbic acid (vitamin C) increases resistance to salt stress and reduces lipid peroxidation. J. Exp. Botany, **52**:2207-2211.

Shoala, T. **2000**. Physiological studies on lavender (*Lavendula multifida*) Ph. D. Thesis, Fac. Agric. Cairo Univ.

Singh, K. and P. Uma. **1996**. Response of graded levels of nitrogen on growth and flowering in 'Shringar' tuberose (*Polianthes tuberosa*). Indian J. Agric. Sci. **66** (11): 655-657.

Singh, S.; K. Dhiraj and V. Singh. **2004**. Effect of NPK combinations on growth and flowering of tuberose (*Polianthes tuberosa* L.) cv. Double. Plant Archives 4(2): 515-517.

Singh, S. and R. Singh. **2005**. Response of different level of nitrogen and plant density on the performance of tuberose (*Polianthes tuberosa* L.). Plant Archives **5**(1): 285-288.

Snedecor, G. and W. Cochran. **1974**. Statistical Methods. Sixth Edition. Lowa State University Press. Ames. Lowa, USA.

Taha, Asmaa. **2005**. Effect of concentration and application methods of ascorbic acid, Thiamine and tryptophane on the growth of tuberose plants. M. Sc. Thesis, Fac.of Agric. Alex. Univ. Egypt.

Thompsond, L. and F. Troeh. **1975**. Soil and Soil Fertility. TATA Mc Grawl Hill Pub. Co. Ltd. New Delhi.

Waaly, Hend; M. Safaa; E. Attoa and F. Abeer. **2002**. Response of *Antholyza aethiopica* to foliar spray with some amino acid and mineral nutrition with sulphur. Annals Agric. Sci. (Cairo) **47**(3):929-944.

Yadav, B,; A. Gupta and S. Sukhbir. **2005a**. Studies on the effect of nitrogen, plant spacing and biofertilizers on growth parameters in tuberose cv. Double. Haryana J. Hort. Sci. **34**(1/2): 78-80.

Yadav, B.; A. Gupta; S. Sukhbir and S. Sehrawat. **2005b**. Impact of nitrogen, plant spacing and biofertilizers on bulb production and root characters in tuberose cv. Double. Haryana J. Hort. Sci. **34**(1/2): 81-83.

الملخص العربي

تأثير النتروجين وبعض المواد المضادة للأكسدة على إنتاج نباتات التبروز

نجلاء مصطفى جمعة[1]، محمود خطاب حسين[2]، علا عبد العزيز الشناوى[2]، مصطفى محمد مصطفى[1]
[1]فرع بحوث الحدائق النباتية ونباتات الزينة بأنطونيادس – معهد بحوث البساتين – مركز البحوث الزراعية
[2]كلية الزراعة – جامعة الإسكندرية – قسم الزهور ونباتات الزينة وتنسيق الحدائق

أجري هذا البحث فى فرع بحوث نباتات الزينة بأنطونيادس ـــ معهد بحوث البساتين بالإسكندرية عامى ٢٠٠٧ –٢٠٠٨على الصنف "المجوز" للتبروز المنزرع فى أصص بلاستيكية قطرها ٣٠ سم بهدف دراسة تأثيرثلاثة مستويات مختلفة من النتروجين (صفر، ٠,٩، ١,٨ جرام/نبات) وثلاثة تركيزات من إثنين من مضادات الأكسدة هما حامض الأسكوربيك (صفر، ١٢٥، ٢٥٠ جزء فى المليون) والداى فنيل أمين (صفر، ١٠٠، ٢٠٠ جزء فى المليون) وجميع التوافيق الممكنة بينهم (٢٧ معاملة) على بعض صفات النمو الخضرى والزهرى وإنتاج الكورمات وبعض التحاليل الكيماوية.

أظهرت النتائج المتحصل عليها أن إضافة النتروجين منفرداً بمعدل يتراوح من ٠,٩ حتى ١,٨جم /نبات/موسم أدى إلى الحصول على أعلى قيم لكل من عدد الأوراق/نبات وأقطار الكورمات الجديدة، فى حين أن إضافته بمعدل ١,٨جم مع رش النباتات بحامض الأسكوربيك بتركيز من ١٢٥–٢٥٠ جزء فى المليون قد أدى إلى الحصول على أكبر وزن جاف ٢ (١,٨جم) مع رش النباتات بالداى فنيل أمين بتركيز ١٠٠–٢٠٠جزء فى المليون فقد أعطى أكبر مساحة ورقية/نبات وعدد أزهار/نورة وعدد كريمات/نبات. أما أطول النباتات وأبكرها تزهيراً فقد وجد عند رش النباتات بكل من حامض الأسكوربيك (٢٥٠ جزء فى المليون) والداى فنيل أمين (١٠٠جزء فى المليون)، بالأضافة إلى ذلك فإن إضافة الثلاثة مواد مجتمعة (نتروجين بمعدل ٠,٩– ١,٨ جم ، حامض الأسكوربيك بتركيز ١٢٥–٢٥٠ جزء فى المليون، داى فنيل أمين بتركيز ١٠٠ ـــ ٢٠٠ جزء فى المليون) قد أعطى أعلى قيم لكل من طول حامل النورة، فترة التزهير، أكبر وزن جاف للأزهار، الوزن الجاف للكورمات، تركيز الكلوروفيل الكلى فى الأوراق، النسبة المئوية للكربوهيدرات والنتروجين فى الكورمات الجديدة.

مما سبق يتضح أنه يمكن معاملة نباتات التبروز الصنف "المجوز" بمعدل ١,٨جم نتروجين/نبات/موسم مع رش النباتات أربع مرات أثناء نموها الخضرى بحامض الأسكوربيك بتركيز٢٥٠ جزء فى المليون والداى فنيل أمين بتركيز ١٠٠–٢٠٠جزء فى المليون للحصول على أعلى معدلات النمو الخضرى والزهرى وإنتاج الكورمات ونسبة الزيت الطيار.