

INFLUENCE OF SOME COMPOUNDS AS ANTITRANSPIRANT AGENTS ON GROWTH AND YIELD OF *PELARGONIUM GRAVEOLENS* PLANT

M.M. Moussa

Horticulture Dept., Fac. of Agric., Menoufia Univ., Shebin El-Kom, Egypt.

Received: Feb. 27 , 2019

Accepted: Mar. 17, 2019

ABSTRACT: An investigation concerning *Pelargonium graveolens* plant was carried out during two successive growing seasons of (2013 and 2014) at the Experimental Farm, Faculty of Agriculture, Menoufia University, Shebin El – Kom , Egypt. This study was designed to determine the efficiency of antitranspirant agents i.e., magnesium carbonate ($MgCO_3$) and sodium salicylate (S.S) at (10, 20 and 30 ppm) which used as chemical antitranspirant and active dry yeast (ADY) at (5, 10 and 15 g/l) which used as natural antitranspirant on growth, yield and active constituents of geranium plant (*Pelargonium graveolens*) grown on a clayey soil.

Results reported that, all antitranspirant agents at different concentrations had a significant effects on growth and yield characters such as plant height (cm), number of main branches/plant, fresh weight of herb (g/plant) and fresh weight of leaves (g/plant and ton/fed) in the 1st and 2nd cuts during two seasons. Their maximum values in this concern were found in plants sprayed with active dry yeast (ADY) at 10 g/l in two cuts during both seasons. Also, the application of sodium salicylate at (20 and 30 ppm) produced the highest oil content (%) for the 1st and 2nd cuts, respectively during both seasons. Moreover, geraniol, linalool, geranyl tiglate and cis-rose oxide were found to be the major compounds in the essential oil of *Pelargonium graveolens* which reached its maxima by spraying (ADY) at 10 mg/l ,(ADY) at 15 mg/l, (S.S) at 20 ppm and (S.S) at 30 ppm, respectively during second cut in the first season.

Key words: *Pelargonium graveolens*, Growth and yield characters, Antitranspirants, Chemical compositions

INTRODUCTION

Pelargonium graveolens (geranium plant) belongs to family Geraniaceae native to South Africa and widely cultivated in different countries i.e., China, Russia, Algeria, Morocco, Madagascar and Egypt (Shawl *et al.*, 2006 and Verma *et al.*, 2011). *Pelargonium graveolens* oil is one of the most important volatile oil which produced in Egypt for exportation and local market. The essential oil in the geranium herb can be obtained by steam distillation of the leaves. The main constituents of the essential oil are citronellol, geraniol, linalool, iso-menthone, citronellyl formate and geraniol formate (Miller, 2002 and

Peterson *et al.*, 2005). Geranium oil has many uses in fragrance industries (Singh *et al.*, 2008), cosmetic industries (Shawl *et al.*, 2006) and food and pharmaceutical industries (Rao, 2002). It is also considered one of the best skincare oil because it is good in cleaning oily complexions and opening skin pores (Peterson *et al.*, 2005). Furthermore (Peterson *et al.*, 2005) reported that, geranium oil is more useful for eczema and athlete foot problems. Also, the leaves of *Pelargonium graveolens* are used as a form of herbal tea to de-stress, ease tension, fight anxiety and to cure tonsillitis.

One of the main sensitive environmental factors affecting geranium plant growth and development is water status. The plants used 5% from water absorption to growth and nearly 95% were lost to transpiration (Prakash and Ramachandran, 2000). Thus, it is perfect to keep pace with transpiration and water uptake by roots. Reduction transpiration by using antitranspirant could save huge quantities of water and also minimize plant stress due to water deficits. The application of antitranspirants may decrease transpiration in three different ways: i) reflecting materials, which reduces the heat load on leaves, ii) thin film forming materials, which hinder the escape of water vapor from the leaves and stomata, iii) closing materials, which increase stomata resistance. Pinto and Torres-Pereira (2006) found that, the reflective coating foliar application of antitranspirant on *Quercus suber* plants reduced leaf temperature and water loss. The study of Del Amor *et al.* (2010) mentioned that, antitranspirant did not affect photosynthesis rate, meanwhile, leaf temperatures, stomatal conductance and transpiration rate of sweet pepper plants were decreased. Jifon and Syvertsen (2003) investigated that, the application of antitranspirant increases reflectance and decrease midday leaf temperature.

MATERIALS AND METHODS

This experiment was carried out through two successive growing seasons of (2013 and 2014) at the Experimental Farm, Faculty of Agriculture, Menoufia University, Shebin El – Kom , Egypt (30.52°N and 30.99°E), to evaluate the efficiency of antitranspirant agents *i.e.*, magnesium carbonate ($MgCO_3$) and sodium salicylate (S.S) at (10, 20 and 30 ppm) which used as chemical

antitranspirant and active dry yeast (ADY) at (5, 10 and 15 g/l) which used as natural antitranspirant on growth, yield and active constituents of geranium plants (*Pelargonium graveolens*) grown on a clayey soil. Representative surface soil samples (0 – 30 cm) were collected from the used soil before performance of the experiment. Soil samples were air - dried, ground, mixed well, sieved through a 2 mm sieve. The samples then were analyzed for determination of some physical and chemical properties. Also, the contents of some available macro - and micronutrients were described according to the methods by Cottenie *et al.* (1982); Page *et al.* (1982) and Kim (1996). The obtained data were recorded in Table (1).

The experiment was arranged in a randomized complete blocks design with three replicates. The experimental plots were 30 units (10 treatments × 3 replicates) for each cut during two seasons. The area of each plot (unit) was 3.6 m² (1.8 m × 2 m) including four ridges and the distance between plants is 30 cm. All plants received mineral NPK as ammonium nitrate (33.5 % N) at 400 kg/fed/year, calcium superphosphate (15.5 % P₂O₅) at 300 kg/fed/year and potassium sulphate (48% K₂O) at 300 kg/fed/year, respectively. All P amount was added during preparation the soil to cultivation, while the mineral N and K were divided in two equal groups at 14 days after planting and 10 days after harvesting the 1st cut through the first and second seasons. Foliar application of antitranspirants were occurred after three weeks from planting and repeated monthly in the early morning till the end of the experiment. Spraying was done till all plants were completely covered with the antitranspirants.

Table (1) : Some physical and chemical properties of the used soil

Physical properties	Particles size distribution (%)				Textural grade	Bulk density (Mg / m ³)	Total porosity (%)	Water field capacity (%)				
	Coarse sand	Fine sand	Silt	Clay								
	6.62	14.22	28.50	50.66	Clayey	1.33	49.81	34.5				
Chemical properties	pH 1:2.5 soil : water susp.	EC (soil paste) dS m ⁻¹	Soluble cations (meq / l)				Soluble anions (meq / l)			OM (%)	CEC (cmol / kg)	Ca CO ₃ (%)
			Na ⁺	K ⁺	Ca ²⁺	Mg ²⁺	Cl ⁻	HCO ₃ ⁻	SO ₄ ²⁻			
	7.81	2.03	9.1	2.81	5.21	3.18	11.13	2.19	6.98	1.97	34.20	3.22
Available nutrients	Macronutrients (mg / kg)				Micronutrients (mg / kg)							
	N	P	K	Fe	Mn	Zn	B					
	45.00	7.21	354	10.42	4.11	3.23	1.16					

Uniform plants of *Pelargonium graveolens* (15 cm in height) were secured from Medicinal and Aromatic Plants Res. Dept., Hort. Res. Inst., Agricultural Research Centre, Ministry of Agriculture, Giza, Egypt and were transplanted on the first of March during two growing seasons, 2013 and 2014. All agricultural practices beginning from transplanting to harvesting were performed as recommended by Egyptian Ministry of Agriculture.

The plant samples were harvested (cutting) twice after 6 and 9 months from transplanting in each season and taken carefully from each replicate to estimate the following parameters:

1- Vegetative growth characters:

Plant height (cm), number of main branches/plant, fresh weight of herb (g/plant) and fresh weight of leaves (g/plant and ton/fed.). A portion of each herb sample was air – dried, oven – dried at 70 °C for 72 hrs. and dry weights were measured as (g/plant).

2- Chemical constituents

Photosynthetic pigments (chlorophyll a, b and carotenoids) were determined in fresh leaves (mg/g fresh weight) as the methods described by Witham *et al.* (1971).

Essential oil percentages were determined in the fresh leaves through the 1st and 2nd cuts in both seasons as described by British (1963).

The volatile oil obtained from the fresh leaves in the 2nd cut during the first season was analyzed by using GLC Model HP-5890 with flame ionization detector that was fitted with capillary column, coated with carbowax 20M. The operating conditions were injector temperature 190 °C, detector temperature 110 °C, linear temperature programmed at 5 °C min, to 175 °C min, nitrogen (carrier gas) flow 2 ml/min, hydrogen 30 ml/min, air 330 ml/min. The peaks were recorded and the areas were determined by using HP-integrator. Oil components

were identified by comparing the relation times of the authentic compound.

Plant samples were washed several times with a tap-water and then two times with distilled water, air-dried, oven-dried at 70 °C for 48 hour, ground separately to a fine powder in a stainless grinder and stored in plastic bags until analysis. Total carbohydrate (%) in the dried herb of geranium plants was determined by using the colorimetric method which described by Dubois *et al.* (1956). A half g portion of each dried plant sample was digested by 5 ml of concentrated mixture of H₂SO₄ + HClO₄ at (5: 0.5 ratio) according to Chapman and Pratt (1982). The content (%) of N, P and K were determined as described by Cottenie *et al.* (1982).

Statistical analysis

The obtained data of growth parameters were exposed to proper statistical analyses of variance (ANOVA) by using Minitab computer program and least significant difference (L.S.D.) were calculated at level of 5% (Barbara and Brain, 1994).

RESULTS AND DISCUSSION

Effect of foliar application of antitranspirant agents on :

Growth and yield characters

Antitranspirant treatments have been proposed as a method to minimize water loss and therefor improve the water status of plants. Data in Table (2) reported that, the effect of foliar spraying by active dry yeast (ADY), magnesium carbonate (MgCO₃) and sodium salicylate (S.S) at different concentrations increased growth and yield parameters of geranium plants expressed as plant height (cm), number of main branches/plant, fresh weight of herb (g/plant) and fresh weight of leaves (g/plant and ton/fed.) as follows: ADY >

S.S > MgCO₃ in the 1st and 2nd cuts through two seasons. The best results in these traits were obtained from using active dry yeast (ADY) at 10 g/l in two cuts during both seasons comparing with control.

The positive enhancement of these materials on growth and yield parameters could be explained through their effects on making powder (film) on the surface of leaf which can keep the plant from heat damage of reflected sunrays and also it can enhancing cell division and the biosynthesis (Nasraui, 1993). Also antitranspirant treatments reduce the transpiration rate by smaller stomata opening (Bittelli *et al.*, 2001). The obtained results are in line with Cantore *et al.* (2009) on tomato plants and Ibrahim and Selim (2010) on summer squash plants.

Essential oil production

It was clear from Table (3) that, the application of both natural (ADY) and chemical (MgCO₃ and S.S) antitranspirants significantly increased essential oil production which include oil content (%) and oil yield (cc/plant and l/fed) compared to untreated plant through the 1st and 2nd cuts during two seasons. Generally, the application of S.S at different concentrations were more effective on oil production followed by using MgCO₃ and then ADY in most cases during two cuts in both seasons. The highest increments in oil content (%) and oil yield (cc/plant and l/fed) were found by using S.S at 20 ppm and 30 ppm for the first and second cuts, respectively during two seasons.

Using antitranspirant improved the water use efficiency (Bose *et al.*, 2001) by reducing leaf transpiration rate via increasing leaf reflecting or inducing stomata closure (Tezara *et al.*, 1996) and that is led to an increase in

Influence of some compounds as antitranspirant agents on growth

photosynthesis (Fukutoka and Terai, 1996). As the volatile oil is secondary output of photosynthesis, so the application of antitranspirants enhance

volatile oil content. These results are similar to those obtained by Leithy *et al* (2015) on canola plants.

Table (2): Effect of foliar application of antitranspirants on growth and yield characters of geranium plants in two cuts during both seasons.

Treatments	Plant height (cm)		Number of main branches/plant		Fresh weight of herb (g/plant)		Fresh weight of leaves (g/plant)		Fresh weight of leaves (ton/fed)	
	First season									
	1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut
Control	47.26	45.12	9.68	10.80	353.47	384.16	183.57	199.08	4.89	5.31
ADY 5 g/l	62.40	60.16	11.94	13.59	445.72	476.48	243.80	261.49	6.50	6.97
ADY 10 g/l	68.11	65.93	13.35	14.77	481.19	513.67	266.75	285.62	7.11	7.61
ADY 15 g/l	66.16	63.54	12.05	12.87	433.51	460.94	231.45	250.19	6.17	6.67
SS 10 ppm	56.28	57.69	11.62	11.83	407.84	431.53	226.19	240.51	6.03	6.41
SS 20 ppm	59.23	51.77	12.87	13.66	448.60	452.74	239.80	249.78	6.39	6.66
SS 30 ppm	55.87	55.23	10.45	13.70	396.17	443.40	215.63	242.49	5.75	6.46
MgCO ₃ 10 ppm	53.61	52.87	10.38	12.80	384.51	421.85	207.32	231.90	5.53	6.18
MgCO ₃ 20 ppm	51.50	49.51	11.22	12.04	372.66	403.16	203.12	221.92	5.42	5.92
MgCO ₃ 30 ppm	48.66	45.40	10.15	10.93	359.70	395.76	191.40	214.53	5.10	5.72
L.S.D. at 5%	3.24	3.08	1.16	1.57	38.65	43.65	19.69	21.36	0.77	0.91
Second season										
Control	49.83	44.15	11.36	11.92	375.12	396.25	200.55	213.17	5.35	5.68
ADY 5 g/l	60.72	61.86	12.17	14.15	463.40	494.38	251.88	270.25	6.72	7.20
ADY 10 g/l	64.33	66.90	15.49	16.30	495.17	521.74	275.19	291.85	7.34	7.78
ADY 15 g/l	61.84	59.11	14.67	14.28	446.81	478.63	242.70	258.36	6.47	6.89
SS 10 ppm	57.93	55.20	13.09	13.17	419.53	449.35	231.41	242.45	6.17	6.46
SS 20 ppm	60.58	55.42	13.72	14.68	434.61	465.42	240.93	250.01	6.42	6.67
SS 30 ppm	53.76	51.25	12.40	12.35	402.77	424.16	219.15	234.30	5.84	6.25
MgCO ₃ 10 ppm	54.19	49.94	12.19	13.70	393.80	418.37	216.60	222.16	5.77	5.92
MgCO ₃ 20 ppm	50.07	48.88	11.60	12.51	388.46	411.22	211.33	219.75	5.63	5.86
MgCO ₃ 30 ppm	50.36	45.75	11.73	11.88	381.53	395.60	200.68	215.60	5.35	5.75
L.S.D. at 5%	2.97	6.87	1.58	2.09	46.82	51.33	20.37	30.18	0.86	1.26

Table (3) : Effect of foliar application of antitranspirants on essential oil production of geranium plants in two cuts during both seasons.

Treatments	Oil %		Oil yield (cc / plant)		Oil yield (l / fed)	
	First season					
	1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut
Control	0.28	0.26	0.51	0.52	13.69	13.81
ADY 5 g/l	0.31	0.29	0.76	0.76	20.15	20.21
ADY 10 g/l	0.36	0.30	0.96	0.86	25.60	22.83
ADY 15 g/l	0.40	0.33	0.93	0.82	24.68	22.01
SS 10 ppm	0.42	0.39	0.95	0.94	25.32	25.00
SS 20 ppm	0.48	0.43	1.15	1.07	30.67	28.64
SS 30 ppm	0.44	0.45	0.95	1.09	25.30	29.07
MgCO ₃ 10 ppm	0.38	0.34	0.79	0.78	21.01	21.01
MgCO ₃ 20 ppm	0.41	0.37	0.83	0.82	22.22	21.90
MgCO ₃ 30 ppm	0.41	0.35	0.78	0.75	20.91	20.02
L.S.D. at 5%	0.09	0.11	0.21	0.28	4.38	3.67
Second season						
Control	0.30	0.29	0.60	0.62	16.05	16.47
ADY 5 g/l	0.35	0.32	0.88	0.86	23.52	23.04
ADY 10 g/l	0.35	0.38	0.96	1.11	25.69	29.56
ADY 15 g/l	0.39	0.36	0.95	0.93	25.23	24.80
SS 10 ppm	0.48	0.43	1.11	1.04	29.61	27.78
SS 20 ppm	0.52	0.44	1.25	1.10	33.38	29.35
SS 30 ppm	0.50	0.46	1.10	1.08	29.20	28.75
MgCO ₃ 10 ppm	0.40	0.36	0.87	0.80	23.08	21.31
MgCO ₃ 20 ppm	0.43	0.39	0.91	0.86	24.21	22.85
MgCO ₃ 30 ppm	0.46	0.40	0.92	0.86	24.61	23.00
L.S.D. at 5%	0.13	0.17	0.23	0.31	3.97	5.51

Macronutrients (N, P and K) and total carbohydrate percentage

Data presented in Table (4) reported that, the concentrations of macronutrients content (%) for (N, P and K) as well as total carbohydrate content (%) were progressively affected by using different concentrations of antitranspirants, where the highest increment in N (%) was found by using S.S at rates of 10 and 20 ppm for the

second and first and cuts, respectively during two years. While the highest P (%) was obtained as a result of using ADY at 10 and 15 g/l for the second and first seasons, respectively during two cuts. Also the application of S.S at 20 ppm produced the maximum K content (%) except the first cut in the first season and the second cut in the second season which reached its maxima by using S.S at 30 and 10 ppm, respectively.

Table (4) : Effect of foliar application of antitranspirants on some macronutrients (N, P and K) and total carbohydrate content (%) of geranium plants in two cuts during both seasons.

Treatments	N%		P%		K %		Total carbohydrate %	
	First season							
	1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut
Control	1.87	2.11	0.31	0.27	1.40	1.68	13.47	12.85
ADY 5 g/l	2.45	2.73	0.47	0.39	1.49	1.70	16.53	15.39
ADY 10 g/l	2.61	2.95	0.52	0.48	1.85	1.96	17.89	17.80
ADY 15 g/l	3.14	2.84	0.63	0.56	1.93	2.07	18.29	17.14
SS 10 ppm	3.35	3.81	0.48	0.42	2.11	2.53	17.44	16.42
SS 20 ppm	4.03	3.42	0.39	0.47	2.47	2.87	16.59	16.98
SS 30 ppm	4.00	3.47	0.31	0.47	2.75	2.80	15.91	14.53
MgCO ₃ 10 ppm	2.69	2.14	0.35	0.41	1.80	2.14	14.25	14.32
MgCO ₃ 20 ppm	2.85	2.80	0.42	0.38	1.91	2.16	15.67	13.59
MgCO ₃ 30 ppm	2.49	2.51	0.33	0.35	1.84	1.79	13.89	13.11
L.S.D. at 5%	1.37	1.04	NS	NS	0.46	0.34	2.68	3.09
Second season								
Control	2.27	2.68	0.25	0.29	1.34	1.58	11.30	11.66
ADY 5 g/l	2.80	3.15	0.36	0.47	1.65	1.93	14.82	15.78
ADY 10 g/l	3.21	3.72	0.44	0.52	1.74	2.10	15.63	17.94
ADY 15 g/l	3.64	4.18	0.41	0.50	1.82	2.17	16.75	17.16
SS 10 ppm	4.17	4.91	0.40	0.43	1.85	2.45	13.95	14.08
SS 20 ppm	4.83	4.75	0.37	0.48	1.93	2.31	15.40	13.99
SS 30 ppm	4.58	4.79	0.30	0.42	1.80	1.96	14.28	13.21
MgCO ₃ 10 ppm	4.61	3.92	0.29	0.35	1.65	2.12	12.62	13.75
MgCO ₃ 20 ppm	4.18	4.16	0.36	0.30	1.40	2.20	13.55	12.49
MgCO ₃ 30 ppm	4.21	3.89	0.32	0.31	1.37	1.74	12.19	12.51
L.S.D. at 5%	2.01	1.29	NS	NS	0.35	0.41	3.19	3.87

Finally, the treatments of ADY at 10 and 15 g/l produced the maximum total carbohydrate (%) for the second and first cuts, respectively during two years. The proper balance of moisture in plant as a result of using antitranspirants create a favorable conditions for metabolic and enzymes activity, protein synthesis and photosynthesis and metabolites translocation (Javan *et al.*, 2013) which accelerate the rates of nutrients uptake. In this respect, Abd El-Aal *et al.* (2008) mentioned that, foliar addition of antitranspirants gained more enhancement in growth and fruit yield as well as chemical properties of eggplant compared with the control. Also it play important role for reduce heat stress injury and this reflect on mineral and nutrient absorption. These results are in agreement with Kamal (2013) on sweet pepper plants and El-Said (2015) on eggplants.

Photosynthetic pigments

It is obvious from Table (5) that, photosynthetic pigments such as chlorophyll a, b as well as carotenoids (mg/g of fresh leaves) were higher by using any concentrate of antitranspirant agents. The application of S.S at 30 ppm produced the highest contents of chlorophyll a in two cuts during two seasons except the first cut through the first season which reached its maxima by using S.S at 20 ppm. Also, using S.S at 20 ppm produced the highest content of chlorophyll b in two cuts during both seasons except the first cut in the first season and the second cut in the second season which reached its maxima by using S.S at 10 ppm and 30 ppm, respectively. Finally, the best

enhancement in carotenoids were done by adding MgCO₃ at 10 ppm except the second cut in the first season and the first cut during second season which reached its maximum values by using MgCO₃ at 20 ppm and S.S at 30 ppm, respectively. Antitranspirants may be relieve the effect of water stress on photosynthetic pigments by improving endogenous levels of cytokinins, which encourage the synthesis of chlorophyll (Samir, 1988). Also our results appeared more enhancement in both nitrogen and potassium contents in geranium plants as shown in (Table 4), which may be have a vital part in rising cell number and size per unit area, number of chloroplasts per cell and increased synthesis of chlorophyll (Possingham, 1980). Similar results were confirmed by Ezzat *et al.* (2009) they stated that, foliar application of antitranspirant significantly increased photosynthetic pigments, *i.e.*, chlorophyll a, b and carotenoids in the leaves of potato plants.

Essential oil composition

Data in Table (6) reported that, there were 8 components were identified for the essential oil of *Pelargonium graveolens*. The highest concentrations of geranyl butyrate, geranyl tiglate and cis-rose oxide were found by using S.S at 10, 20 and 30 ppm, respectively.

While the application of MgCO₃ at 20 ppm produced the highest concentrations of citronellol, citronellyl formate and isomenthone. Also, the best improvement in geraniol and linalool were found by the application of ADY at 10 and 15 g/l in the second cut during the first season.

Influence of some compounds as antitranspirant agents on growth

Table (5) : Effect of foliar application of antitranspirants on photosynthetic pigments of geranium plants in two cuts during both seasons.

Treatments	Chlorophyll A		Chlorophyll B		Carotenoids	
	First season					
	1 st cut	2 nd cut	1 st cut	2 nd cut	1 st cut	2 nd cut
Control	2.21	1.97	1.06	0.85	1.69	1.18
ADY 5 g/l	2.37	2.18	1.10	0.97	1.73	1.20
ADY 10 g/l	2.68	2.45	1.18	1.15	1.84	1.46
ADY 15 g/l	3.17	2.56	1.62	1.29	1.79	1.65
SS 10 ppm	3.95	2.81	1.97	1.60	1.95	2.03
SS 20 ppm	4.36	3.14	1.80	1.86	2.19	2.15
SS 30 ppm	3.89	3.25	1.53	1.78	1.70	1.98
MgCO ₃ 10 ppm	3.18	2.65	1.43	1.20	2.32	1.81
MgCO ₃ 20 ppm	3.51	2.50	1.67	1.26	2.15	2.25
MgCO ₃ 30 ppm	3.40	2.37	1.29	1.14	1.86	1.68
L.S.D. at 5%	1.05	0.89	0.48	0.61	NS	0.42
Second season						
Control	2.71	2.58	1.16	1.23	1.46	1.58
ADY 5 g/l	3.12	2.94	1.35	1.75	1.58	1.79
ADY 10 g/l	3.52	3.05	1.48	1.83	1.66	1.90
ADY 15 g/l	3.24	3.18	1.49	1.57	1.71	2.11
SS 10 ppm	3.77	3.86	1.53	1.67	1.59	2.14
SS 20 ppm	3.91	4.15	2.12	1.96	2.16	2.23
SS 30 ppm	4.23	4.20	2.08	2.31	2.48	2.05
MgCO ₃ 10 ppm	3.18	2.89	1.68	1.37	1.89	2.30
MgCO ₃ 20 ppm	3.50	3.40	1.75	1.41	1.65	2.18
MgCO ₃ 30 ppm	3.67	3.35	1.45	1.52	1.82	2.13
L.S.D. at 5%	1.23	1.12	0.76	1.01	0.74	0.50

Table (6): Effect of foliar application of antitranspirants on essential oil composition of geranium plants during second cut in the first season.

Oil constituents Treatments	Citronellol	Geraniol	Linalool	Citronellyl formate	Isomenthone	Geranyl Butyrate	Geranyl Tiglate	Cis-rose oxide
Control	0.64	5.14	4.54	8.35	7.15	11.90	24.08	34.14
ADY 5 g/l	0.58	5.35	4.73	7.42	8.03	11.19	20.62	36.90
ADY 10 g/l	0.91	5.91	4.34	7.84	7.29	12.52	21.85	36.66
ADY 15 g/l	1.11	5.60	4.89	7.19	8.42	12.47	19.30	37.89
SS 10 ppm	1.25	4.89	4.03	7.30	7.89	15.69	23.55	33.73
SS 20 ppm	0.63	3.75	3.20	6.52	8.11	14.78	25.19	36.60
SS 30 ppm	0.26	2.99	2.66	7.79	8.25	12.50	24.77	39.19
MgCO ₃ 10 ppm	1.08	4.05	3.93	8.31	8.65	13.83	22.46	32.88
MgCO ₃ 20 ppm	1.32	4.40	2.80	8.60	9.13	10.92	23.28	34.71
MgCO ₃ 30 ppm	0.91	5.12	3.45	7.55	8.39	11.67	22.15	36.40

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تأثير بعض المركبات كمواد مضادة للنتح علي نمو ومحصول نبات العتر

محمد محمد موسي

قسم البساتين - كلية الزراعة - جامعة المنوفية - شبين الكوم- مصر

الملخص العربي

أجريت تجربة علي نبات العتر خلال موسمي نمو متتاليين (٢٠١٣ و ٢٠١٤ م) بالمزرعة البحثية بكلية الزراعة - جامعة المنوفية - شبين الكوم - مصر . وإن هذه الدراسة صممت لتقدير كفاءة المواد المضادة للنتح مثل كربونات المغنيسيوم و ساليسيلات الصوديوم بتركيزات (١٠ و ٢٠ و ٣٠ جزء في المليون) وقد تم إستخدامهما كمواد كيميائية مضادة للنتح وأيضاً تم إستخدام الخميرة بتركيزات (٥ و ١٠ و ١٥ جرام / لتر) كمواد طبيعية مضادة للنتح علي النمو والمحصول و المكونات الفعالة لنبات العتر النامي في الأرض الطينية .

وقد أوضحت النتائج أن جميع المواد المضادة للنتح بتركيزاتها المختلفة كانت لها تأثيرات معنوية علي النمو والمحصول مثل طول النبات (سم) ، عدد الفروع الرئيسية / نبات ، الوزن الطازج للعشب (جم/نبات) وأيضاً الوزن الطازج للأوراق (جم / نبات ، طن / فدان) وذلك خلال الحشة الأولى و الثانية أثناء موسمي النمو. كما كانت أعلي هذه المقاييس وضوحاً في النباتات المعاملة بالخميرة بمعدل رش ١٠ جرام / لتر وذلك خلال الحشة الأولى والثانية أثناء موسمي النمو. أيضاً أدي إستخدام ساليسيلات الصوديوم بمعدل (٢٠ و ٣٠ جزء في المليون) إلي الحصول علي أعلي محتوى من الزيت الطيار للنبات وذلك خلال الحشة الاولى والثانية علي التوالي اثناء موسمي الزراعة. واتضح أيضاً أن المكونات الأساسية في زيت العتر(جيرانيول و لينالول و حيرانيال تجليت و سث- روز اوكسيد) كانت أكثر تواجداً و أعلي نسبة في النباتات المعاملة بالخميرة بمعدل ١٠ جرام / لتر ثم النباتات المعاملة بالخميرة بمعدل ١٥ جرام / لتر ثم النباتات المعاملة بساليسيلات الصوديوم بمعدل ٢٠ جزء في المليون ثم النباتات المعاملة بساليسيلات الصوديوم بمعدل ٣٠ جزء في المليون علي التوالي وذلك خلال الحشة الثانية أثناء موسم النمو الأول .

أسماء السادة المحكمين

أ.د/ علي عبدالحميد معوض كلية الزراعة- الرقايق

أ.د/ مجدى رابح محمد رابح كلية الزراعة- جامعة المنوفية