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Effect of compost on growth and chemical composition of *Matthiola incana* (L.)R.Br. under different water intervals

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ABSTRACT

Pots experiment was carried out in National Research Centre during two successive seasons 2009/2010 and 2010 /2011 to investigate the effect of different rates of Nile compost (0,100 and 200g /pot) under different water intervals (5,7 and 9 days intervals) on growth and chemical constituents of *Matthiola incana* plant. Results showed that, increasing water supply gradually increased significantly plant height, number of leaves/plant, fresh and dry weights of leaves, stems, flowers and number of flowers/plant. The same behavior was noticed concerning N,P and K percentages in leaves stems and roots. While root length and fresh and dry weights of roots increased as water level decreased. Chlorophylls carotenoids, proline and Na were also increased as water levels decreased. Data also observed that the growth of the aforementioned parameters, chlorophyll a,b ,caroteniods ,nitrogen, phosphorus and potassium content tended to increase by increasing the concentration of compost up to 200g/pot as compared with other treatments. On the other hand, sodium and proline content in leaves, stems and roots tended to decrease by increasing the concentration of compost up to 200 g/pot Compost application can be used to reduce the effect of water stress. This application may be recommended for overcoming the hazardous effect on growth and chemical constituents of *Matthiola incana* plant under water stress.

Key words: *Matthiola incana* -water regime-compost fertilizer.

Introduction

Matthiola incana (L.) R.Br. is a flowering plant in the Family Brassicacea ,Perrenial (or sometimes annual) herb, native to Miditerrean Sea and Canary Islands from Spain to Turkey and South to Egypt. It is also goes by the common name wall-gilly flowers. Woody at base 25-75 cm. height, branched mostly from the base ,branched or stellate hairs mixed with sessile glands ,leaves ablaneceolate usually entire, baselrosulate 13-16 cm.long, apex usually rounded, upper leaves smaller but similar, racemes 15-30 flowers, up to 30 cm. long in fruit, flower 2-4 cm. across, mauve or violet. *Matthiola incana* is cut flower plant. The double flowering varieties are used for decoration, for its beauty flowers and pleasant aroma of it. A fragrant bed of stocks in the garden makes spring and early summer delightful. The seeds are rich in oil up to 65% of oil consists of omega -3-fatty acids from vegetable oils could provide health benefits without any concomitant intake of cholesterol (Hunter 1990).

Drought is the one of the most common environmental factors which limits plant growth and agricultural development. In Egypt, there is tendency for cultivation of more newly reclaimed desert areas in the front of population increment problems. Rasearch on the response of plant drought is therefore necessary for improving plant growth and tree production in this region. Metwally *et al* 2002 found that plant height of roselle and number of leaves decreased with prolonging the water intervals, Shehata (1992) working on *Cupressus sempervirens* and *Eucalyputs camaldulensis* supplied seedlings with three soil moisture content (40, 60 and 80% of field capacity), they observed that plant height, stem diameter, fresh and dry weights of leaves, stems and roots were increased by increasing soil moisure, but root length was decreased. Sayed (2001) on *Khaya sengalenis* and Soad (2005) on *Simmondsia chinensis*, irrigated seedlings with different soil moisture content, they found that chlorophyll a,b and carotenoids contents were increased as soil moisture content decreased. In addition to the total sugar, N, P and K concentration in the leaves were also stimulated gradually by decreasing water supply, while leaf content of nitrogen, phosphorus and potassium was increased by increasing water supply. In recent years, the safe agricultural is one of the main attitudes in the world (El-koony 2002).Also recently there has been an increasing awareness of the undesirable impact of mineral fertilizers on the environment, as well as the potentially dangerous effects of chemical residues, in plant tissues on the health of human and animal consumers. Organic manure (compost) addition could be reputed to increase the organic content in the soil, resulting in more release substances such as compost (commercial product, preparing from

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recycling the plant residues),Hegazy (1994).Composting of agricultural residues by supplying newly reclaimed areas with their requirements, of inorganic nutrients such as nitrogen and phosphorus and applying a proper moistening and turning resulted in the final product with high ability to improve soils and enhance plant growth reported by Lawpkin(1990).

Materials and Methods

A pot experiment was carried out during two successive seasons of (2009/2010 – 2010/2011) at the screen of National Research Centre, Dokki, Cairo, Egypt. Seed of *Matthiola incana* were secured from Department of Medicinal and Aromatic Plants, Agricultural Research Centre, Ministry of Agricultural, A.R.E. The seeds were sown in nursery of fourth week of September2009 and 2010 respectively, to study the response of *Matthiola incana* grown under three contrasting soil regimes (5,7 and 9 days intervals) and compost (Nile compost)fertilizer (0,100 and 200 g/pot)was mixed well with soil during preparation of the soil. The soil of the experimental site was sandy. the investigated soil characterized by 80.5% coarsa sand ,9.4% fine sand,4.5% silt and 5.6% clay, pH 7.8,EC 1.4 dsm-1,$CaCO_3$ 46%,K^+ 0.3.Na^+ 2.3,CO^{++} 1.0,Mg^{++} 0.6,HCO_3 2.3,Cl^- 1.8,SO_4 0.1 meql-1.The physical and chemical properties of the soil were determined according to Chapman and Pratt (1961).

Seeds of *Matthiola incana* were sown at fourth week of September in the two seasons. The soil samples were uniformly packed in pots 30 cm in diameter and 30cm height containing 1 0 Kg soil. Each pot received 3-5 seeds/pot. The seedling was thinned at 3 weeks from sowing time, one seedling / pot.

Nile compost Table (1) was mixed with the soil at three rates (0,100 and 200 g/pot) before cultivation. Each pot was fertilized twice with 1.5 gm nitrogen as ammonium nitrate (33.5 % N) and 1.0 gm potassium as potassium sulphate (48.5% k_2O).The fertilizers were applied at 30 and 60 after planting. Phosphorus as calcium superphosphate (15.5% P_2O_5) was mixed with soil before planting at 3.0 g/pot. Other agricultural processes were performed according to normal practice. After a month of planting date, the plants were irrigated with three levels of soil moisture content (5, 7 and 9 days intervals).The experiments included nine treatments which were the combinations of the three water regime levels and three rates of compost. A completely Randomized Design was used, each treatment was replicated six times; plant height (cm), number of leaves/plant, root length (cm).fresh and dry weights of leaves, stems and roots, number of flowers/plant, fresh and dry weights of flowers were recorded in the flowering stage (May 2010 and 2011). Chlorophyll (a,b) and carotenoids contents were determined according to Saric *et al* (1967) Total carbohydrates percentages were determined according to Dubois *et al* (1956).Total proline content in leaves, stems and roots was determined using fresh material according to Bates *et al* (1973).

Nitrogen, phosphorus, potassium and sodium elements were determined according to the method described by Cottenie *et al, (*1982). The obtained resulted were subjected to statistical analysis of variance according to the method described by Snedecor and Cochran,1980 and the combined analysis of the two seasons was calculated according to the method of Steel and Torrie, (1980).

Results and Discussion

Vegetative growth:

The results obtained in Tables (2,3 and 4) showed that plant height, number of leaves/plant, leaves and stem fresh and dry weights of *Matthiola incana* plant were significantly gradually increased as the level of water irrigation was slopping down-word. The highest values for all this characters were obtained due to high irrigation level (5 days intervals).The increments were(25.7, 23.0, 33.8, 26.6, 50.9 and 31.3%) compared with 9 days. This may be vital roles of water supply at adequate amounts for different physiological processes such as photosynthesis, respiration transpiration translocation, enzyme reaction and cell turgidity occurs simultaneously. Such reduction could be attributed to a decrease in the activity of meristemic tissues responsible for elongation of water intervals El-Monayeri *et al* (1983) whereas root length, fresh and dry weights of roots took an opposite trend as they were gradually increased with the irrigation levels were slopping upward. The lower water supply causes the root system to pentrate deeper and extending wider in the soil with higher root system researching for moisture in lower. These results were in agreement with those obtained by Sayed, (2001), Uday *et al*, (2001), Soad, (2005) and Soad *et al*, (2010).

The data in the same tables revealed that all growth parameters i.e plant height, number of leaves /plant root length, fresh and dry weight of leaves, stems and roots of *Matthiola incana* were significantly affected by Nile compost at 100 and 200 g/pot in sandy soil, the gradually increased by increasing Nile compost rate .Nile compost encouraged all plant growth parameters through the stimulation effect the meristimatic activity of tissues, where these organic manures are rich in N,P,K and other minerals which required for growth, Safia *et al,* (2001).

In addition to compost effect, this might be related to the improvement of physical conditions of soil provided energy for microorganisms activity and increase the availability and uptake of N, P and K, which was positively reflected on the growth (Wani*et al*,.1988 and Romera*et al*, 2000).

Table 1: Chemical properties of Nile compost

Nile compost	Macronutrients %			Micronutrients ppm.			pH	C/N	OM
	N	P	K	Fe	Mn	Zn	7.5	14.1	132.9
	1.35	0.52	0.85	310	61	35			

The effect of interaction between moisture levels and compost levels, the results obtained in (Tables, 2, 3 and 4) indicated that, the interaction between different involved factors (irrigation intervals and compost) were almost significant for growth parameters under study. The highest values due to (irrigation at 5days intervals x compost 200g/pot) for plant height ,number of leaves and stems/plant and (9 days intervals x compost at 200g/pot) for root length, fresh and dry weights of roots.

Table 2: Effect of compost on plant height (cm), number of leaves/plant and root length (cm) of *Matthiola incana* plant grown under irrigation intervals (average of two seasons 2009/2010 and2010/2011).

Treatments	Plant height (cm)				Leaves No. /plant				Root Length (cm)			
	Compost (g)				Compost (g)				Compost (g)			
Irrigation Intervals	0	100	200	mean	0	100	200	mean	0	100	200	mean
5days	48.88	52.3	55.8	52.3	75.3	87.6	92.0	85.0	17.31	14.31	13.01	14.88
7 days	47.00	48.0	51.2	48.9	71.6	83.0	85.9	80.2	19.22	16.21	14.71	16.71
9 days	35.60	42.6	46.2	41.6	50.7	75.9	80.7	69.1	25.63	18.31	17.76	20.57
Mean	44.00	47.6	51.2		65.9	82.2	86.3		20.72	16.28	15.16	
L.S.D at 5%												
Irrigation Intervals (A)	2.1				2.4				1.51			
Compost (B)	1.7				1.9				1.02			
Interaction (A) x (B)	2.5				2.9				1.9			

Table 3: Effect of compost on leaves, stems and roots fresh weight (g) of *Matthiola incana* plant grown under irrigation intervals (average of two seasons 2009/2010 and 2010/2011)

Treatments	Leaves				Stems				Roots			
	Compost (g)				Compost (g)				Compost (g)			
Irrigation Intervals	0	100	200	mean	0	100	200	mean	0	100	200	mean
5days	30.63	38.62	40.94	36.73	11.53	12.29	16.08	13.73	6.71	7.93	8.18	7.61
7 days	28.73	29.35	33.12	30.40	10.57	11.81	14.46	12.28	8.35	8.91	9.29	8.85
9 days	25.51	26.71	30.11	27.44	9.61	11.06	11.86	10.84	9.01	9.53	10.67	9.74
Mean	28.29	31.56	34.72		10.57	11.7	14.13		8.02	8.79	9.39	
L.S.D at 5%												
Irrigation Intervals (A)	2.33				1.03				0.70			
Compost (B)	1.81				0.70				0.50			
Interaction (A) x (B)	2.75				1.18				0.90			

Table 4: Effect of compost on leaves, stems and roots dry weight (g) of *Matthiola incana* plant grown under irrigation intervals (average of two seasons 2009/2010 and 2010/2011).

Treatments	Leaves				Stems				Roots			
	Compost (g)				Compost (g)				Compost (g)			
Irrigation Intervals	0	100	200	mean	0	100	200	mean	0	100	200	mean
5days	6.3	8.03	8.96	7.76	3.04	3.39	4.63	3.69	2.39	2.86	2.99	2.74
7 days	5.52	5.78	6.85	6.05	2.67	3.16	4.08	3.3	3.11	3.36	3.59	3.35
9 days	4.57	4.87	6.02	5.14	2.37	2.88	3.19	2.81	3.44	3.76	4.27	3.82
Mean	5.46	6.21	7.28		2.69	3.14	3.97		2.98	3.32	3.61	
L.S.D at 5%												
Irrigation Intervals (A)	0.20				0.07				0.05			
Compost (B)	0.07				0.05				0.02			
Interaction (A) x (B)	0.08				0.09				0.31			

Flowering characters:

Data in Table (5) showed that flowering characteristics were evaluated which included flowers number/plant, fresh and dry weights of flower /plant, all flowering characters following the same trend as that of growth parameters. The increments on number, fresh and dry weight of flowers/plant by 65.3, 17.4 and 26.0% respectively, for5 days compared with 9 days. These results are agreement with Soad *et al*, (2010) on *Helichrysum bracteatum*, they found that the high level of irrigation led to the increment of flowering parameters and quality. Compost treatment increased significantly flowering parameters, Nile compost could play an important role in improving all growth parameters and the nutrient status of the plant and increased soil fertility, this due to the releasing N, P and K and some important micro-nutrient, this may reflect to improving flowering status, in addition that (5 days intervals x 200g/pot compost) increased flowers number / plant and fresh weight of flower /plant.

Chemical composition:

Photosynthetic pigments:

Data in (Table 6) showed that, the leaves content of three photosynthetic pigments (Chlorophyll a, b and carotenoids) were increased by the gradual decrease in irrigation levels, It can be stated that irrigation at the low moisture level (9 days intervals) was the most effective treatment for promoting the synthesis and accumulation of photosynthetic pigments. This results in line with Shehata (1992) and Soad (2005).The recoded data revealed the positive and active of the Nile compost on pigments content in leaves of *Matthiola incana* plant as compared with control plants and other treatments. Organic fertilizer play an important role in plant growth, as they are source of plant nutrients, moreover, they improve soil properties and promote water use efficiency by plants. This is quite expected to enhance photosynthesis. Regarding the interaction of the two factors under study. Nile compost application (200 g/pot) was more effective on pigments content under (9 days intervals) of water irrigation.

Table 5: Effect of compost on flowers number/plant, fresh and dry weight of flower (g) of *Matthiola incana* plant grown under irrigation intervals (average of two seasons 2009/2010 and 2010/2011

Treatments	Flowers No/plant				Flower fresh weight (g)				Flower dry weight(g)			
	Compost (g)				Compost (g)				Compost (g)			
Irrigation Intervals	0	100	200	mean	0	100	200	mean	0	100	200	mean
5days	43.31	57.11	65.61	55.34	4.54	5.59	6.11	5.41	0.71	0.97	1.09	0.92
7 days	37.53	41.31	46.73	41.86	4.43	5.34	5.42	5.06	0.68	0.88	0.91	0.82
9 days	30.31	33.11	37.01	33.48	3.96	4.72	5.15	4.61	0.59	0.76	0.83	0.73
Mean	37.05	43.84	42.78		4.31	5.22	5.56		0.66	0.87	0.94	
L.S.D at 5%												
Irrigation Intervals (A)	2.11				0.06				0.04			
Compost (B)	1.53				0.03				0.01			
Interaction (A) x (B)	2.3				0.08				0.06			

Table 6: Effect of compost on chlorophyll a, b and carotenoids (mg/g F.W.) of of*Matthiola incana* plant grown under irrigation intervals (average of two seasons 2009/2010 and 2010/2011).

Parameters	Chlorophyll (a)				Chlorophyll (b)				Carotenoids			
Treatments	Compost (g)				Compost (g)				Compost (g)			
Irrigation Intervals	0	100	200	mean	0	100	200	mean	0	100	200	mean
5days	1.451	1.556	1.731	1.579	0.361	0.433	0.567	0.454	1.053	1.096	1.153	1.101
7 days	1.676	1.735	1.867	1.759	0.575	0.685	0.835	0.698	1.176	1.253	1.355	1.261
9 days	1.943	2.125	2.453	2.174	0.753	0.891	0.957	0.867	1.296	1.375	1.569	1.413
Mean	1.69	1.806	2.017		0.563	0.67	0.786		1.175	1.241	1.359	

Total carbohydrates percentage:

The results obtained in Table (7) indicate that effect of water regime levels affected total carbohydrate%, Table 7 indicate that total carbohydrate% affected by different irrigation treatments, followed the same trend obtained previously on photosynthetic pigments were gradually decreased by increasing the level of irrigation. The obtained results were in harmony with the finding obtained by Sayed (2001) and Soad (2005). Nil compost at the both used concentration caused an increase in total carbohydrate percentage at different plant organs of *Matthiola incana* plant as compared with untreated plant. This increased in total carbohydrate percentage may be indicating the effect of compost to final product with high ability to improve soils and enhance plant growth and carbohydrate content Lawpkin (1990).

Regarding the interaction effect, showed that the plants treated with compost at 200g gave the highest values of total carbohydrates percentage under 9 days intervals were more effective on carbohydrates percentage.

Characters	Leaves				Stems				Roots			
Treatments	Compost (g)				Compost (g)				Compost (g)			
Irrigation Intervals	0	100	200	mean	0	100	200	mean	0	100	200	mean
5days	21.36	24.34	28.67	24.79	19.11	21.35	24.45	21.64	22.61	23.96	27.74	24.77
7 days	25.71	29.12	32.74	29.19	21.61	23.44	27.56	24.2	25.74	26.02	28.45	26.66
9 days	29.31	35.63	36.96	33.97	25.67	26.11	29.63	27.14	28.31	30.63	32.63	30.52
Mean	25.46	29.7	32.79		22.13	23.63	27.21		25.55	26.86	29.54	

Table 7: Effect of compost on total carbohydrates % in leaves, stems and roots of *Matthiola incana* plant grown under irrigation intervals (average of two seasons 2009/2010 and 2010/2011).

Minerals percentage:

Effect of irrigation treatments and compost at different levels (0,100 and 200g/pot) were presented in Tables (8, 9 and 10) showed that a gradual reduction in the leaves

Stems and roots on the percentages of nitrogen, phosphorus and potassium were parallel to increase the irrigation level (9 days intervals).Increasing water regime (5 days intervals) decreased N,P and K % as compared with decreasing water regime (9 days intervals).This may be due to leaching of the minerals from the soil. Furthermore, sodium percentage increased by increasing water intervals (9 days) in plant, these results run parallel with those obtained by Farahat (1990) on *Schinus molle* L and *Myoprum acumination*, El-Tantawy *et al*, (1993) *on Eucalyptus camaldulensis* and Azza *et al* ,.(2010) on *Jatropha curcus* L. In relation to the effect of compost concentrations, the percentage of the previous minerals in leaves stems and roots gradually increased by increasing compost level. Compost application was increased previous minerals due to its effect on enhancing the plant metabolism.

Table 8: Effect of compost on nitrogen % in leaves, stems and roots of *Matthiola incana* plant grown under irrigation intervals (average of two seasons 2009/2010 and 2010/2011

Characters	Leaves				Stems				Roots			
Treatments	Compost (g)				Compost (g)				Compost (g)			
Irrigation Intervals	0	100	200	mean	0	100	200	mean	0	100	200	mean
5days	1.23	1.41	1.53	1.39	1.19	1.25	1.29	1.24	1.03	1.11	1.13	1.09
7 days	1.07	1.13	1.25	1.15	0.96	1.05	1.19	1.07	0.89	0.95	0.98	0.94
9 days	0.81	0.95	0.98	0.91	0.78	0.93	0.99	0.9	0.73	0.81	0.91	0.82
Mean	1.09	1.16	1.25		0.98	1.08	1.16		0.88	0.96	1.01	

Table 9: Effect of compost on phosphorus % in leaves, stems and roots of *Matthiola incana* plant grown under irrigation intervals (average of two seasons 2009/2010 and 2010/2011).

Characters	Leaves				Stems				Roots			
Treatments	Compost (g)				Compost (g)				Compost (g)			
Irrigation Intervals	0	100	200	mean	0	100	200	mean	0	100	200	mean
5 days	0.76	0.8	0.87	0.81	0.65	0.72	0.78	0.72	0.54	0.56	0.58	0.58
7 days	0.7	0.8	0.82	0.76	0.64	0.67	0.71	0.67	0.5	0.52	0.56	0.53
9 days	0.65	0.72	0.74	0.7	0.53	0.57	0.66	0.59	0.41	0.43	0.52	0.45
Mean	0.7	0.8	0.81		0.61	0.65	0.72		0.48	0.5	0.55	

Table 10: Effect of compost on potassium % in leaves, stems and roots of *Matthiola incana*plant grown under irrigation intervals (average of two seasons 2009/2010 and 2010/2011).

Characters	Leaves				Stems				Roots			
Treatments	Compost (g)				Compost (g)				Compost (g)			
Irrigation Intervals	0	100	200	mean	0	100	200	mean	0	100	200	mean
5 days	1.27	1.46	1.51	1.41	1.22	1.25	1.37	1.28	1.12	1.31	1.37	1.27
7 days	1.16	1.25	1.36	1.26	1.02	1.13	1.26	1.14	0.98	1.2	1.25	1.14
9 days	1.05	1.09	1.19	1.11	0.92	1.07	1.14	1.04	0.93	1.16	1.19	1.09
Mean	1.16	1.27	1.35		1.05	1.15	1.26		1.01	1.22	1.27	

The interactive of compost to plants under water regime that increased N.P and K content in different plant organs of *Matthiola incana*, the highest values occurred at (5 days intervals x 200g/pot compost). Nile compost x 7 days of water intervals was decreased sodium percentage in leaves, stems and roots.

Table 11: Effect of compost on sodium % in leaves, stems and roots of *Matthiola incana* plant grown under irrigation intervals (average of two seasons 2009/2010 and 2010/2011).

Characters	Leaves				Stems				Roots			
Treatments	Compost (g)				Compost (g)				Compost (g)			
Irrigation Intervals	0	100	200	mean	0	100	200	mean	0	100	200	mean
5days	1.76	1.67	1.56	1.66	1.46	1.37	1.33	1.39	1.41	1.31	1.25	1.32
7 days	1.93	1.85	1.76	1.85	1.67	1.63	1.54	1.61	1.45	1.39	1.28	1.37
9 days	2.12	1.88	1.8	1.93	1.75	1.7	1.59	1.68	1.51	1.46	1.36	1.44
Mean	1.94	1.8	1.71		1.63	1.57	1.49		1.46	1.39	1.3	

Proline content:

From the given data in (Table 12), that proline content in leaves, stems and roots, when decreasing soil moisture level significantly increased proline content this may be due to the proline metabolism which is a typical mechanism of biochemical adaptation subjected to stress condition. Proline is considered as a cell stabilizer for osmotic potential and some enzymes synthesis. Greenway and Munns (1980), who mentioned that praline concentration increased under stress to make plants more adapted to this unsuitable condition, in addition that proline alleviate the harmful effect of stress condition on growth of biochemical constituents. Regarding the interaction of the two factors under study, Nile compost (5 days intervals)gradual decrease in irrigation levels were decreasing proline content in leaves, stems and roots of *Matthiola incana* plant Table (12), thus could be due to the influence effect of compost on decreasing the effect created by drought condition, Marschner (1995).

From the above-mentioned results, it can be concluded that compost application had decreased the hazard effect of water stress, in addition had a favorable effect on growth and flowering of *Matthiola incana* plant.

Table 12: Effect of compost on proline content (μ mg^{-1} F.W.) in leaves, stems and roots of *Matthiola incana* plant grown under irrigation intervals (average of two seasons 2009/2010 and 2010/2011).

Characters	Leaves				Stems				Roots			
Treatments	Compost (g)				Compost (g)				Compost (g)			
Irrigation Intervals	0	100	200	mean	0	100	200	mean	0	100	200	mean
5 days	7.3	6.6	5.9	6.6	3.9	3.4	2.9	3.4	4.2	3.6	3	3.6
7 days	8.1	7.3	6.7	7.3	4.7	4.4	4	4.4	4.5	4	3.6	4
9 days	9.2	8.5	7.6	8.4	5.6	5.2	4.7	5.2	5.3	5	4.7	5
Mean	8.2	7.5	6.7		4.7	4.3	3.9		4.7	4.2	3.8	

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