J. Product. & Dev., 14(2): 329 – 338 (2009)

EFFECT OF SALINITY AND COMPOST LEVELS ON GROWTH, CHEMICAL COMPOSITION AND OIL PRODUCTION OF ROSEMARY (*Rosemarinus of ficinalis* L.) PLANT

A.H. M. Kassem; H. R. A. Mehasen and F. R. Mousa
Department of Medicinal & Aromatic plants, A.R.C. ,Giza, Egypt.

ABSTRACT

The pot experiment was conducted during 2006/2007 and 2007/2008 seasons in Medicinal and Aromatic Plants Department at Dokky, Giza, Egypt, to investigate the effect of saline soil at the levels of (0, 1000, 3000 and 5000 ppm) and compost fertilization at the rates of 0, 0.5 and 1.0 kg/ pot (0, 5 and 10.0 ton/ fad.) on vegetative growth, chemical composition and oil yield production of rosemary plant.

The results showed that increasing salinity levels reduced all vegetative growth, chemical composition and oil production, but application of compost reduced the harmful effects of saline and improvement the growth by increasing compost level.

Key words: Salinity, compost levels, growth, chemical composition, oil production of rosemary, *Rosemarinus of ficinalis* L

INTRODUCTION

Rosemary, *Rosemarinus officinalis* L. is one of the important medicinal and aromatic plants. It used externally as parasitic, cicatrizing for muscular pain and rheumatism, dermatitis, dandruff and exzema. It promotes hair growth.

Internally, it is used for asthma, bronchitis headache, rental flatulence (Lawless 1992) and it used for its volatile oil which is useful as anti-inflammatory activities, muscle contraction, reducing carcinogens and tumors **(**Chen and Ho, 1992).

In Egypt, there are wide of saline areas, which cause harmful effects on plant growth and its production recently there is reasonable planning in Egypt to cultivate wide different water sources such as drainage water. In the last few decades, great interest has been pointed out to utilize the saline water for expansion in the new areas and for using during the period of water shortage.

The harmful effect of salinity on medicinal, aromatic plants were mentioned by Ahmed *et al.* (2001) on damisissa and Attia (2003) on guar.

Organic fertilization had drawn the attention of research workers and had become in the last few decades a positive alternative to chemical fertilizers. Organic fertilizers are reasonably safer to environment compared to chemical fertilizers.

The organic fertilization application were increased plant growth, oil production and chemical composition on medicinal and aromatic plant were reported by various investigators as Edris *et al.* (2003) on sweet marjoram, Salim (2006) on *Salvia officinalis* and El-Sanafawy (2007) on *Ocimum basilicum*.

MATERIALS AND METHODS

This study has been conducted in the Farm of Medicinal and Aromatic Plants Department at Dokky, Giza, Egypt during two successive seasons (2006/ 2007 and 2007/ 2008).

Terminal cuttings (15- 20 cm long) from *Rosmarinus officinalis* L. plants were used in this investigation. The cuttings were planted on 28th January in both seasons in 40 cm diameter plastic pots.

Pots were filled with dry Nile clay. The chemical composition of the soil before salinization is presented in Table 1, where extraction of the soil.

Table 1. Chemical analysis of the experimental soil before salinization

Season	T.S.S	pH	E.C	Anions mg/ 100 g soil				Cations mg/ 100 g soil				ppm	
			Mmoh/ cm	Co_3	Hco_3	Cl	So_4	Ca	Mg	Na^+	K^+	N^+	P^+
2006	0.128	7.7	0.38	-	0.68	0.68	0.81	0.96	0.36	0.59	0.18	27.3	11.53
2007	0.200	7.5	0.56	0.09	1.25	1.81	1.85	1.21	0.89	1.35	0.60	31.2	11.21

The salinity treatments were 0. 1000. 3000 and 5000 ppm as sodium chloride on dried soil.

Three levels of compost was added to pots (0.0, 1.0 and 1.5 kg/ pot) (0.0, 10.0 and 15.0 ton/ fad.).

The physical and chemical characteristics of compost were (moisture content 35.7% pH 7.8 total nitrogen 1.4%, organic substance 48.26%, organic carbon 17.18%, total phosphorus 0.471% and total potassium 0.802%).

A split plot design with three replicates was used. The main plot was the different levels of compost, while the sub-plots were the different levels of salinity.

All data obtained were statically analyzed to the methods of Sendecor and cochran (1981).

The plants were cut 10 cm above the soil surface twice, the first one was on August 8th and the second was on November 9th, in both seasons.

The following data were recorded in the first and second cuts in both seasons:

A- Vegetative growth/ plant:

1- plant height (cm)
2- Number of branches.
3- Plant fresh and dry weights (g)

B- Essential oil production:

1- Essential oil percentage using the method of the British Pharmacopoeia (1963).
2- Essential oil yield/ plant

C- **Chemical analysis:**

1- Chlorophyll a, b and carotenoids contents in the fresh leaves (mg/ g F.W) were determined in samples according to Saric *et al.* (1976).
2- N, P and K percent in dry leaves were determined in the herb using the methods described by A.O.A.C (1970).

RESULTS AND DISCUSSION

1- Effect of salinity and compost treatments on vegetative growth of rosemary:

1-1 . Plant height and number of branches:

The data in Table 2 showed that the plant height and number of branches/ plant of rosemary significantly increased by increasing compost level. The highest level of compost (1.5 kg/ pot) resulted in the highest length of plants and the maximum number of branches.

As for the effect of salinity, the results mentioned that the plant height and the number of branches/ plant were significantly increased due to the lower level of salinity (1000 ppm). Increasing the salinity level decreased the plant height and the level of 5000 ppm led to the shortest plants and decrease number of branches/ plant. Regarding the combination treatments between salinity and compost, the data point out that adding the various levels of compost resulted in a progressive effect in reducing the harmful effect of salinity.

Table 2. Effect of salinity (Sa) and compost (Co) treatments on plant height (cm), and number of branches of *Rosmarinus officinalis* L. plant at 2006/ 2007 and 2007/ 2008 seasons.

Compost (Kg/ pot.)	Salinity (ppm)									
	0	1000	3000	5000	Mean	0	1000	3000	5000	Mean
	2006/ 2007					2007/ 2008				
Plant height (cm)										
0	33.0	35.5	26.9	15.5	27.73	32.0	33.6	24.5	13.8	25.98
10	47.3	48.8	33.2	26.8	39.03	45.6	46.5	31.3	25.1	37.13
15	49.4	50.9	35.7	29.1	41.28	47.2	49.0	32.5	27.0	38.93
Mean	43.23	45.07	31.93	23.8		41.6	43.03	29.43	21.97	
L.S.D at 5% for	Co				1.02					1.01
	Sa				1.18					1.17
	Co × Sa				1.42					1.46
Number of branches										
0.0	8.7	7.7	5.7	4.7	6.70	12.3	12.0	10.7	10.0	11.25
1.0	12.3	9.3	7.7	6.3	8.90	15.3	14.0	12.3	11.0	13.15
1.5	13.7	14.3	9.3	7.3	11.15	18.7	19.0	14.7	12.3	16.18
Mean	11.57	10.43	7.57	6.10		15.43	15.0	12.57	11.10	
L.S.D at 5% for	Co				0.54					0.61
	Sa				0.62					0.70
	Co × Sa				0.41					0.52

The highest level of compost (1.5 kg/ pot.) with the lower level of salinity (1000 ppm) led to the tallest plants and the greatest number of branches. The highest concentration of salinity (5000 ppm) without any compost caused the shortest plants and least number of branches/ plant.

These results were in agreement with those obtained by Ahmed *et al.* (2001) on damisissa

1-2- Herb fresh and dry weights:

The results in Table 3 cleared that the there was significant increased in herb fresh and dry weights per plant due to the lower level of salinity (1000 ppm).

Concerning compost treatments, the data indicated that there was a significant increase in herb fresh and dry weights by increasing the compost level.

The interaction between salinity and compost treatment show a significant effect and the best result was by using (1000 ppm salinity) and (1.5kg/ pot.).These results were in agreement with those obtained by Attia (2003) on guar and Shaalan (2005) on *Borago officinalis.*

Table 3. Effect of salinity(Sa) and compost (Co) treatments on fresh, and dry weights (g)/ plant of *Rosmarinus officinalis* L.

Compost	Salinity (ppm)									
(Kg/ pot)	0	1000	3000	5000	Mean	0	1000	3000	5000	Mean
	2006/ 2007					2007/ 2008				
	Fresh weight									
0.0	97.94	121.68	93.93	58.40	92.99	114.00	139.62	109.96	76.60	110.05
1.0	125.70	137.64	102.97	75.11	110.36	146.57	160.64	122.72	97.32	131.81
1.5	143.14	148.92	125.62	85.27	125.74	166.56	167.13	142.65	108.19	146.13
Mean	122.26	136.08	107.51	72.93		142.38	155.80	125.11	94.04	
L.S.D at 5% for Co					5.56					5.81
Sa					4.15					4.56
Co × Sa					4.88					5.13
	Dry weight									
0.0	25.22	40.21	23.57	18.90	26.98	42.87	59.18	41.82	37.41	45.32
1.0	31.13	40.71	25.51	25.28	30.66	46.48	58.63	46.78	47.13	49.76
1.5	43.87	51.97	29.67	26.34	37.96	65.48	72.79	51.24	47.32	59.24
Mean	33.41	44.30	26.25	23.50		51.65	63.53	46.61	43.95	
L.S.D at 5% for Co					2.86					2.58
Sa					2.51					2.98
Co × Sa					3.80					4.21

2- Pigments content:

The data on chlorophyll a, b and carotenoids contents (mg/g. fresh weight of leaves) are presented in Table 4 had a parallel trend to the other growth parameters in response to salinity and compost levels.

The low level of salinity (1000 ppm) increased chlorophyll a, b and carotenoids whereas the higher levels of salinity reduced chl. a, b and carotenoids during the two seasons.

These results are in agreement with the findings obtained by Shehata (1999) on *Cupressus sempervirent*.

Chlorophylls were markedly improved in the leaves of rosemary plants grown in soil containing compost.

The highest level of compost 3 ton/ fad, combined with the lower level of salinity 1000 ppm led to the highest concentration of pigments. Hammam (1996) on *Pimpinella anisum* reported similar results.

3- Mineral status:

Data obtained on the effect of saline irrigation water on N, P and K percentage in herb of rosemary plants in Table 5 revealed that increasing water salinity levels led to decreased N, P and K content.

Table 4. Effect of salinity and compost treatments on Chlorophyll "a, b, and carotenoids " content (mg/g fresh weight) in leaves of *Rosmarinus officinalis* L. plant.

Compost (kg/ pot.)	Salinity (ppm)							
	0	1000	3000	5000	0	1000	3000	5000
	2006/ 2007				2007/ 2008			
	Chlorophyll "a"							
0.0	1.12	1.23	0.92	0.82	1.18	1.28	0.97	0.80
1.0	1.96	2.08	1.98	1.51	1.32	2.14	1.98	1.22
1.5	2.07	2.20	2.01	1.36	2.08	2.19	1.90	1.31
	Chlorophyll "b"							
0.0	0.28	0.52	0.23	0.14	0.29	0.60	0.26	0.15
1.0	0.52	0.61	0.33	0.18	0.43	0.62	0.34	0.17
1.5	0.69	0.69	0.41	0.22	0.67	0.71	0.40	0.25
	Carotenoids							
0.0	0.13	0.16	0.11	0.10	0.10	0.21	0.13	0.11
1.0	0.20	0.26	0.14	0.12	0.22	0.26	0.12	0.17
1.5	0.22	0.31	0.15	0.14	0.30	0.34	0.20	0.18

Table 5. Effect of salinity and compost treatments on total nitrogen, phosphors and potassium (%)/ in herb of *Rosmarinus officinalis* L. plant

Compost (kg/ pot.)	Salinity (ppm)							
	0	1000	3000	5000	0	1000	3000	5000
	2006/ 2007				2007/ 2008			
	Nitrogen							
0.0	1.72	1.71	1.32	1.12	1.96	1.92	1.41	1.22
1.0	2.10	2.11	1.45	1.20	2.00	2.05	1.52	1.30
1.5	2.43	2.75	1.50	1.26	2.06	2.75	1.67	1.40
	Phosphor							
0.0	0.33	0.35	0.22	0.18	0.32	0.30	0.19	0.15
1.0	0.38	0.39	0.26	0.20	0.35	0.38	0.21	0.19
1.5	0.43	0.48	0.28	0.21	0.39	0.40	0.25	0.20
	Potassium							
0.0	2.10	2.10	1.21	0.94	2.18	2.19	1.13	0.97
1.0	2.25	2.30	1.11	1.09	2.84	2.91	1.29	1.17
1.5	2.96	2.94	1.51	1.18	3.00	3.17	1.54	1.38

Addition of compost to soil media could alter and reverse the effects of saline water on minerals content in rosemary herb, during both seasons.

The highest concentration of compost (1.5 kg/ pot.) without the salinity or (1000 ppm) caused the highest N, P and K percent on the plant.

These results agreed with those obtained by Attia (2003) on guar plants.

4- ***Oil percentage and yield*****:**

Data in Table (6) revealed that oil percentage and yield of rosemary increased at the lower salinity levels. Increasing salinity levels significantly decreased both of oil percentage and oil yield/ plant (ml), the highest levels of salinity (5000 ppm) led to the greatest reduction.

Concerning the effect of compost on rosemary plant data in Table 6, pointed out compost significantly increased oil percentage and yield per plant (ml) in the both seasons. The present findings were in agreement with the finding of El-Sanafawy (2007) on *Ocimum basilicum* and *Origanum majorana*.

Table 6. Effect of salinity (Sa) and compost (Co) treatments on volatile oil percentage and yield of *Rosmarinus officinalis* L. plant

Compost (kg/ pot.)	Salinity (ppm)									
	0	1000	3000	5000	Mean	0	1000	3000	5000	Mean
	2006/ 2007					2007/ 2008				
	Oil (%)									
0.0	0.26	0.28	0.25	0.17	0.24	0.29	0.33	0.28	0.21	0.28
1.0	0.34	0.39	0.31	0.21	0.31	0.37	0.42	0.33	0.25	0.34
1.5	0.37	0.43	0.33	0.26	0.35	0.38	0.45	0.35	0.27	0.36
Mean	0.32	0.37	0.30	0.21		0.35	0.40	0.32	0.24	0.33
L.S.D at 5% for Co					0.009					0.016
Sa					0.011					N.S
Co × Sa					N. S.					N. S.
	Oil yield (ml)									
0.0	0.261	0.337	0.232	0.099	0.232	0.331	0.456	0.304	0.158	0.312
1.0	0.427	0.537	0.323	0.160	0.362	0.542	0.676	0.409	0.247	0.469
1.5	0.525	0.646	0.411	0.219	0.450	0.752	0.752	0.495	.296	0.546
Mean	0.404	0.507	0.322	0.159		0.628	0.628	0.403	0.234	
L.S.D at 5% for Co					0.112					0.128
Sa					N. S.					0.237
Co × Sa					N. S.					N. S.

The results indicated that the organic manures may reduced the harmful effects of saline with increasing compost level causing an increase in plant growth parameters of rosemary plant expressed as plant height, number of branches/ plant, fresh and dry weights as well as oil yield and chemical composition. As an explanation, organic fertilization undoubtedly supplied the growing plants with the required micro and macronutrient

elements. Naturally, these elements play important roles in the metabolic processes like photosynthesis, respiration and carbohydrate synthesis and enhance chlorophyll and carbohydrate content in these plants. Thus it was suggested that organic manures favors both the meristemic activity and extension of cells in the plant under study (Abou El-Seoud *et al.*1997, Kandeel *et al.* 2002).

Conclusively, Application of compost reduced the harmful effects of saline and improvement the growth by increasing compost level.

REFERENCES

Abou El-Fetouh, M.M. (2002): Growth and composition of marigold as affected by chemical and organic fertilization in the presence of copper and zinc. Ph.D. Thesis, Faculty of Agriculture, Cairo University, Egypt.

Abou El-Seoud, M.A.; M.F. Abd El-Sabour and E.A. Omar (1997): Productivity of roselle (*Hibiscus sabdariffa* L.) plant as affected by organic waste composts addition to sandy soil. *Bull. NRC*, Egypt, **22**(4): 495-505.

Ahmed, Shadia K.; A. F. Ali and M.R. Khater (2001): Effect of salinity treatments and active dry yeast on growth and active ingredients of *Ambrosis maritime* L. *Proceeding. Fifth Arabian Horticulture Conference*, Ismailia, Egypt, March 25-28:217-224.

A.O.A.C. (1970): *Official Methods of Analysis*. Association of Official Agricultural Chemists. 14 edition, Washington. D.C.

Attia, D.M. (2003): Physiological studies on guar plants in sandy soil. M.Sc. Thesis, Fac. Agric., Suez Canal University.

British Pharmacopoeia (1963): *Determination of Volatile in Drugs*. The Pharmaceutical press, London.

Chen Q.Y.H and C.T.Ho. (1992): Effect of rosemary extracts and major constituents on lipid oxidation and soybean lipoxygenase activity. *Journal Amer. oil Chemist Soc*., **60**:999.

Edris, A.E.; A. Shalaby and H.M. Fadel (2003): Effect of organic agriculture practices on the volatile aroma components of some essential oil plants growing in Egypt. II: Sweet marjoram (*Origanum majorana* L.) essential oil. *Flavor and fragrances* Journal, **18** (4): 345-351 (*Hort. Abs*., **73:** 10361).

El-Sanafawy, S.E.A. (2007): Effect of some fertilization treatments on *Ocimum basilicum* and *Origanum majoranum.* Ph.D. Thesis, Faculty of Agriculture, Kafr El-Sheikh, Tanta University, Egypt.

El-Shafey, S.; A. Awad, A. Meawad and M. El-Shaer (1991): II-Leaf pigments and chemical constituents of sweet basil plants, *Zagazig Journal of Agriculture Research*, **18** (6): 2234-2247.

Kandeel, A.M. and Abou-Taleb, N.S. (2002): Effect of some organic manures on the growth, volatile oil yield and chemical composition of *Ocimum basilicum* L. plant. *Zagazig Journal of Agriculture Research*, **29**(3): 1839-1857.

Lawless, Julia (1992): *The Encyclopedia of Essential Oils*. Element Books Ltd. Longmead, Shaflesbury, Dorest Britain 226.

Salim, E.M.A., (2006): Effect of chemical, organic fertilizers and spraying with active dry yeast on growth, oil production and plant constituents of sage (*Salvia officinalis*,L.) plant. M.Sc. Thesis, Faculty of Agriculture, Cairo University, Egypt

Saric, M., R. Kastrori, R. Couria, T. Cupina and I. Gerie (1976): Chlorophyll determination. Univ. Unoven Sadu Parktikum is Fiziologize Bilijaka, Beogard, Hauncan, Anjiga, 215.

Snedecor, G.W. and W.G. Cochran (1981). *Statistical Methods*. 7th Ed., Iowa State Univ. Press, Ames. Iowa, USA, 305.

Shaalan, M.N. (2005): Effect of compost and different sources of biofertilizers on borage (*Borago officinalis* L.) plants. *Egyptian Journal of Agriculture Sci.,*

Shehata, M. (1999): Effect of ground water depth and irrigation with saline water on sugar beat II-Chemical constituents. *Egyptian Journal of Agriculture Research*, **77** (4): 1675-1686.

تأثير الملوحة وبعض معدلات الكمبوست على النمو والمكونات الكيميائية وإنتاج الزيت في نبات حصالبان

عبير حمدى قاسم- حسام الدين رمضان محسن- فاتن رمزى موسى
قسم بحوث النباتات الطبية و العطرية - مركز البحوث الزراعية- الجيزة- ج.م.ع.

تم اجراء تجربة حقلية لمدة موسمين متتاليين ٢٠٠٦/٢٠٠٧& ٢٠٠٧/ ٢٠٠٨ فى قسم بحوث النباتات الطبية والعطرية بالدقى، (زرعت النباتات فى أصص بلاستيك) لمعرفة تأثير مستويات مختلفة من ملوحة التربة (٠، ١٠٠٠، ٣٠٠٠ و٥٠ جزء/ مليون) والتسميد بالكمبوست بمعدلات ٠، ٠.٥، ١كجم/ أصيص (٠، ٥، ١٠طن/ فدان) على النمو الخضري والتركيب الكيماوى وانتاجية الزيت في نبات حصالبان. وقد أظهرت النتائج ان زيادة معدلات الملوحة قد أدت إلى انخفاض معدلات النمو الخضري والتركيب الكيماوي وإنتاج الزيت ولكن معاملات التسميد بالكمبوست قد خفضت التأثيرات الضارة للملوحة وأدت زيادة مستويات التسميد إلى تحسين النمو.