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Effect of Adding Compost and Sand to the Calcareous Soil on the Growth and Flowering of Lantana Plant

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ABSTRACT

The present work was carried out during the year of 2012 at two different locations of Maamoura and Montaza Research Branch, Horticulture Institute, Ministry of Agriculture, Alexandria, Egypt on Lantana plant. This study was a trial to improve some characters of the calcareous soil with using two natural soil conditioners i. e. compost and sand. Each compost and sand were added alone to the calcareous soil at a ratio of zero, 25% and 50% or with using an equal mixture of the three materials together (33.3% calcareous soil + 33.3% compost + 33.3% sand) to produce six different growing media.

Lantana plants were grown in 25 cm diameter clay pots on 15 March 2012 and they left to grow vegetatively for 45 days, then the plants were arranged in an experiment of randomized complete block design and they stayed for seven months for evaluation.

Results revealed that using calcareous soil alone or mixed with sand at 25% or 50% gave the lowest values of most of the studied parameters of Lantana plant (vegetative growth, flower characteristics, and chemical analysis of plant leaves).

Besides, adding compost at 25% or 50% to the calcareous soil led to significant increase in almost all the studied parameters of Lantana plant, compared with using calcareous soil alone.

Furthermore, using an equal mixture of the three materials had no significant effects on the vegetative growth or the flowing characteristics of Lantana plant, while the content of Lantana leaves of chlorophyll, nitrogen, phosphorus, potassium, and zinc were significantly increased, compared with using calcareous soil alone.

From the previous results it can be recommended to add compost at 25% to the calcareous soil for obtaining a suitable growing medium for planting and growing Lantana plant with good quality.

INTRODUCTION

Creeping Lantana (*Lantana montevidensis*, Spreng Briq.) is a showy-flowered garden shrub that has grown as an ornamental plant and it is a major weed in coastal and sub-coastal areas. It is found in tropical and sub-tropical environments, and occasionally also in temperate and semi-arid regions. It is native to tropical South America.

Distinguishing features for *Lantana montevidensis* are a low-growing, long-lived, shrubby plant forming dense mats of vegetative over the ground, small tubular inflorescences are borne in compact clusters (1-4 cm across and 8-12 mm long) yellowish coloured.

Garden uses *Lantana montevidensis* for flowering, shrubby, low-maintenance groundcover in frost-free areas. This is a superior selection for hanging baskets, containers or growing in wall gardens.

A calcareous soil is the soil which containing more than 10% of calcium carbonate ($CaCO_3$). Presence of calcium carbonate in the soil led to appearance of many troubles such as loss of irrigation water quality, forming a solid layer on the soil surface (crust forming) which prevent seed germination, high pH value, low cation exchange capacity, poor in its element content …. etc. This kind of soil spread in arid zones where the amount of rain water is little and can not be able to dissolvie and transport of $CaCo_3$ to the lower layer of the soil. Besides, it has limeston, calcite and dolomite as parent materials which contain high amount of calcium carbonate in their structure (Balba, 1974).

Partially improvement the properties of the calcareous soil can be done by using some of soil conditioners such as sulfur or organic matters.

Compost is an organic matters that has been decomposed and recycled as fertilizer and soil amendment. Compost is a key in organic farming. The

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compost itself is used for the land in many ways, including as a soil conditioner.

Usually sand grains consist chiefly of quartz but they may be of any mineral composition. However, sand occurs naturally as a granular material made up of fine divided mineral and rock material.

El-Sayed (1991) planted some flowering and ornamental plants such as *Chrysanthemum* and *Dianthus* in clay and calcareous soils. He concluded that calcareous soil had a higher injury effect on flowering than the clay one.

Usman *et al*. (2004) suggested that the biochemical properties of the calcareous soil can be enhanced by both organic wastes or the addition of sewage sludge, but the high salinity and extractability of heavy metals, may limit the application of the last one.

Alburquerque *et al*. (2007) showed that compost application to low-fertility calcareous soil enhanced ryegrass plant growth in both first and third harvests.

Shinde *et al*. (2009) pointed out that adding 134 $t.ha^{-1}$ of compost to the calcareous soil increased soil water holding capacity, but it reduced water movement and had the least leaching potential for phosphorus.

The objective of this investigation was to study the effect of using different media which resulted from adding various ratios of compost and/or sand to the calcareous soil on the vegetative growth, flowering characteristics and some chemical analysis of *Lantana montevidensis* under the circumstances of Alexandria city.

MATERIALS AND METHODS

The present study was carried out in two locations at Maamoura and Montaza Research Branch, Horticulture Research, A. R. C. Alexandria during the year of 2012.

Lantana rooted cuttings were obtained from a commercial nursery for flowers and ornamental plants in Alexandria city. These rooted cutting were similar in their shape and size with an average length of 12 cm. The rooted cuttings were planted in 25 cm clay pots filled with the different growing media on 15 March, 2012. Each pot had only one plant.

The planted *Lantana* young plants were placed in a partial shade place for three weeks and watered as needed according to the climatic conditions. After that these plants were left for another 24 days to grow vegetatively by early removing all the formed flower buds, then they were arranged in the experiment and left for 7 months for evaluation.

Calcareous soil was brought from the Northern Western Coast 37.5 km far off Alexandria city, then it was mixed with different ratios (v/v) of two natural soil conditioners, i.e., compost and sand. The used ratios of the different growing media and their physical and chemical analysis are presented in Table (A).

The plants were fertilized with a chemical complete fertilizer of 19N: $19P_2O_5$: $19K_2O$ at a rate of one gram per liter of irrigation water. Fertilizer was applied twice weekly during May, October and November and three times weekly during June, July, August and September.

A layer of plastic sheet was placed on the soil surface under the clay pots to prevent the plant roots to insert into the soil.

Table A. The physical and chemical analysis of the used growing media.

Media No.*	Texture	pH	Ec dsm^{-1}	$CaCO_3$ %	Macronutrients (mg/kg)			Micronutrients (ppm)				Field capacity %
					N	P	K	Cu	Fe	Mn	Zn	
1	Sandy loam	7.99	8.51	85.4	161	10	100	0.12	2.76	1.08	3.42	15.77
2	Loamy sand	7.80	20.2	73.9	168	55	2400	0.23	5.39	3.75	3.75	26.65
3	Loamy sand	7.70	38.4	38.3	196	322	5800	0.73	8.64	12.36	7.11	43.42
4	Sandy loam	7.84	7.37	74.5	133	3	60	0.00	1.44	0.68	3.08	16.92
5	Sandy loam	7.78	5.66	51.5	140	6	80	0.00	0.72	0.58	3.11	16.85
6	Sandy loam	7.57	24.50	63.4	182	82	3400	0.20	5.75	5.04	4.68	30.16

* 1- Calcareous soil. 2- 75% calcareous soil + 25% compost.
3- 50% calcareous soil + 50% compost. 4- 75% calcareous soil + 25% sand.
5- 50% calcareous soil + 50% sand. 6- 33.3% calcareous soil +33.3% compost + 33.3% sand.

Table B. Monthly average of temperature degree and relative humidity at Maamoura and Montaza locations during the growing season of Lantana plant.

Month	Maamoura		Montaza	
	Temperature (°C)	Relative Humidity (%)	Temperature(°C)	Relative Humidity (%)
May	32.5	57	27.3	61
June	37.2	48	31.2	52
July	38.8	58	33.8	67
August	36.4	75	32.4	71
September	34.2	65	31.0	59
October	32.3	64	29.9	60
November	28.0	72	24.8	66

The experiment carried out in randomized complete block design (RCBD) in four replicates and four plants were used for each treatment (plot). The means of individual factors were compared by L.S.D. test at 5% level of probability (Snedecor and Cochran, 1974).

The degree of air temperature and relative humidity (%) at Maamoura and Montaza locations were recorded daily at noon (12 PM) during the growing season (7 months) and the monthly average of them are presented in Table (B).

The following data were recorded : plant hight (cm), plant diameter (cm), number of leaves per plant, leaf area (cm^2), leaves dry weight (g), plant dry weight (g), inflorescence diameter (cm), total number of inflorescences per plant, inflorescences fresh weight (g) per plant, inflorescences dry weight (g) per plant, total chlorophyll content (SPAD unit) and leaf content of nitrogen, phosphorus, potassium, copper, iron, manganese and zinc.

RESULTS AND DISCUSSION

Vegetative growth characteristics:

Generally, data of the two locations in Tables 1 and 2 indicated that using calcareous soil alone gave the lowest values of most of the vegetative growth characteristics of Lantana plant (plant height, diameter, leaves dry weight and plant dry weight), compared with using the other media.

These results may be attributed to the properties of the calcareous soil which had a high pH value (7.99) due to their high content of calcium carbonate (> 85%), low cation exchange capacity, low water content and low fertility at most of macro- and micro-elements. Thus, less water is available to plants. Nutrient uptake is also decreased as water availability decreased. All these factors led to inhibit the vegetative growth of the used plant.

These results were agreed with those obtained by many researchers such as Abo El-Fadl *et al*. (1989) on *Pelagronium graveolens*, El-Sayed (1991) on *Chrysanthemum* and *Dianthus* and Singh (1999) on wheat.

Besides, results of the two locations showed that adding compost at 25% or 50% to the calcareous soil gave the highest values of all the studied vegetative growth parameters of Lantana plant, compared with the other used media (Tables 1 and 2).

These results were probably due to the presence of compost at a specific ratio which led to improve some properties of the used calcareous soil such as soil structure, water penetration, moisture holding capacity, nutrient supply, increase number and activity of the benefit soil micro-organisms, decrease the percentage of calcium carbonate and soil pH value, … etc. Consequently, all the vegetative growth parameters of Lantana plant could be increased as compared with growing the plant in the other media. Similar results were found by El-Mahdy (2001), El-Sayed and El-Shal (2008) and Mazher *et al*. (2012) on other plants.

Furthermore, data of the two locations indicated that adding sand at 25% or 50% to the used calcareous soil or using an equal mixture of calcareous soil (33.3%), compost (33.3%) and sand (33.3%) together did not significant increase all the vegetative growth parameters of Lantana plant, compared with using calcareous soil alone (Tables 1 and 2).

These results were probably due to the presence of the sand at the used ratios (25% or 33.3% or 50%) which led to decrease the moisture – holding capacity of the calcareous soil, consequently the benefit of the cultivated plant from the adding compost could be decreased and this had a negative effect on the growth of the cultivated plant.

These results were agreed with those obtained by many researchers such as Abo El-Fadl *et al*. (1989) on *Pelargonium graveolens,* El-Sayed (1991) on *Chrysanthemum* and *Dianthus* and El-Mahdy (2001) on *Canna*.

Flower characteristics:

Generally, using calcareous soil alone gave the minimum values of most of the flower parameters of Lantana plant, compared with the other media (Table 3).

These results were probably due to that calcareous soil had unsuitable properties for growing the used plant (high pH value, high calcium carbonate, low fertility, low water content, low cation exchange capacity... etc.), consequently growing Lantana plant in calcareous soil alone led to produce weak plants. Similar result was obtained by EL-Sayed (1991) on *Chrysanthemun* and *Dianthus*.

Beside adding compost at 25% or 50% to the calcareous soil led to significant increases of all the studied flower parameters of Lantana plant, compared with using calcareous soil alone.

These results may be related to the presence of compost at a suitable ratio which led to improve the soil characters and provide the plants with water and minerals, consequently the vegetative growth parameters of the used plants would be increased, thus their flower quality would be improved.

Many researchers obtained similar results such as EL-Sayed (1991), Manoly (1996), EL-Menaie *et al.* (2008) and Mazher *et al.* (2012) on other plants.

Furthermore, adding sand at 25% or 50% to the calcareous soil did not gave any significant effect on most of the flower parameters of the used plant, compared with using calcareous soil alone.

These results were probably due to that mixing sand with calcareous soil could not be improved the physical or the chemical properties of the calcareous soil, because sand is a poor medium in its nutrient elements content, and it does not keep enough water.

Also, results of the two locations illustrated that adding compost at 33.3% and sand at.33.3% to 33.3% calcareous soil gave significant effects on most of the flower parameters of Lnatana plant, compared with using calcareous soil alone (Table 3).

These results were probably due to the presence of compost at a specific ratio which benefit the calcareous soil principally by improving soil structure, water penetration, moisture holding capacity, supply moderate nutrient and humus. Consequently all the flower parameters of the plant used could be increased, compared with the growing plants in the calcareous soil alone.

Chemical analysis:

Chlorophyll content:

Generally, using calcareous soil alone gave the lowest values of the chlorophyll content in the leaves of Lantana plant, compared with the other media (Table 4).

These results were probably due to the high pH value of the used calcareous soil which led to decrease the availability and the absorbed amount of the important elements for chlorophyll formation in the plants such as nitrogen, magnesium and others leading to decrease in the biosynthesis of chlorophyll in the plant leaves.

Similar results were obtained by Badr *et al.* (1979) on other ornamental plants.

Besides, data of the two locations indicated that generally adding compost at 25% or 50% to the calcareous soil gave the highest significant values of chlorophyll content in the leaves of Lantana plant, compared with using calcareous soil alone (Table 4).

These results may be attributed to the increase in the solubility and availability of some elements affecting chlorophyll formation such as nitrogen, magnesium and other elements resulted from adding compost at a suitable ratio which led to decrease the values of soil pH from 7.99 to 7.80 and 7.70 , respectively (Table A) and soil calcium carbonate content from 85.40 % to 73.9 % and 38.31%, respectively consequently the chlorophyll biosynthesis in the leaves of lantana plant could be increased.

These results are in good agreement with those obtained by EL-Naggar *et al*. (2004), Abd EL-Hady (2006), Abdel-Fattah *et al*. (2008), Yang e*t al*. (2010), Agamy *et al*. (2012) on other plants.

Furthermore, data of the two locations showed that adding sand at 25% or 50% to the calcareous soil or using an equal mixture from calcareous soil, compost and sand had no significant effect on the values of chlorophyll content in the leaves of the used plant, compared with using calcareous soil alone, with two exceptions which they were significant (Table 4).

These results were probably due to that increasing the ratio of sand in calcareous soil led to increase the amount of soil water loosing by drainage, as a result the absorbed amount of the essential elements for chlorophyll formation would be decreased, consequently the chlorophyll value in the plant leaf would be decreased.

Similar results were obtained by Badr *et al*. (1979) on other ornamental plants.

Mineral elements content:

Generally, data of the two locations indicated that using calcareous soil alone gave the lowest significant values of N, P, K, Fe and Zn in the leaves of Lantana plant, compared with the other media (Tables 4 and 5).

These results were probably due to the unsuitability properties of the calcareous soil for growing many plants as a result of its high pH, high calcium carbonate, low cation exchanges capacity, ... etc, consequently the availability of most of the nutrition elements would be decreased, thus the grown plants in this medium will contain the minimum value of the mineral elements.

Besides, data of the two locations showed that adding compost at 25% or 50% gave the highest significant increases in the values of N, P, K, Cu, Fe, Mn and Zn in the leaves of Lantana plant, compared with the other media.

These results were probably due to the presence of compost at a suitable ratio which led to decrease the pH value of the medium besides it contains a high value of N, P, K, Cu, Fe, Mn and Zn, consequently the grown plants had absorbed a high amount of these elements, thus the contents of these elements in their leaves could be increased.

These results are in agreement with those obtained by many researchers such as EL-Maadawy *et al*. (2006), EL-Sayed and EL-Shal (2008), Hassanein and EL-Sayed (2009), EL-Kholy *et al*. (2010), Barakat *et al*. (2012), Mazher *et al*. (2012) on other plants.

Furthermore, data of the two locations indicated that adding sand at 25% or 50% to the calcareous soil or using an equal mixture of the three materials (calcareous soil + compost + sand) together, gave significant increases in the contents of N, P, K and Zn in the leaves of Lantana plant, compared with using calcareous soil alone (Tables 4 and 5).

These results were probably due to the presence of sand and/or compost each at a specific ratio which led to decrease each of soil pH and percentage of calcium carbonate of the calcareous soil (Table A) thus improving the availability of the nutrition elements, consequently the grown plants had absorbed a high amount of elements and the contents of these elements in their levels would be increased.

These results are in agreement with those obtained by Adeleye *et al*. (2010) on other plants.

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الملخص العربي

تأثير إضافة الكمبوست والرمل إلى التربة الجيرية على نمو وإزهار نبات اللانتانا

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أجرى هذا البحث خلال عام ٢٠١٢ فى موقعين مختلفين(المعمورة والمنتزة) فى فرع بحوث نباتات الزينة– معهد بحوث البساتين- مركز البحوث الزراعية- وزارة الزراعة بالإسكندرية على نبات اللانتانا بهدف تحسين بعض خواص التربة الجيرية باستخدام اثنين من المحسنات الطبيعية للتربة هما الكمبوست والرمل. هذا وقد تم إضافة كل من الكمبوست والرمل على انفراد وبنسبة صفر، ٢٥%، ٥٠% للتربة الجيرية مع استخدام خليط متساوى من الكمبوست(٣٣,٣%)، الرمل(٣٣,٣%) والتربة الجيرية (٣٣,٣%) للحصول على ست بيئات زراعية مختلفة. وقد زرعت نباتات اللانتانا فى ١٥ مارس ٢٠١٢(فى الموقعين) فى أصص فخار قطرها ٢٥ سم محتوية على بيئات النمو المختلفة وتركت النباتات لتنمو خضرياً لمدة ٤٥ يوم ثم بعد ذلك وضعت فى تجربة على هيئة مكررات عشوائية كاملة واستمرت التجربة لمدة سبعة أشهر لتقييم النباتات.

وقد أظهرت النتائج المتحصل عليها أن استخدام التربة الجيرية منفردة كبيئة زراعية أو مخلوطة بالرمل بنسبة ٢٥% أو٥٠% أعطى أقل قيم لمعظم الصفات المدروسة لنبات اللانتانا (نمو خضرى، نمو زهرى، تحليل كيماوى لأوراق النبات). فى حين أن إضافة الكمبوست بنسبة ٢٥% أو٥٠% للتربة الجيرية أدى إلى زيادة معنوية فى معظم الصفات المدروسة للنبات بالمقارنة بالتربة الجيرية منفردة.

أما إضافة الثلاث مواد معاً بنسب متساوية فلم يؤثر معنوياً على معظم صفات النمو الخضرى والزهرى للنبات، فى حين أدى ذلك إلى زيادة معنوية فى محتوى أوراق اللانتانا من الكلوروفيل والنيتروجين والفوسفور والبوتاسيوم والزنك بالمقارنة بالتربة الجيرية المنفردة.

مما سبق يمكن التوصية بإضافة ٢٥% كمبوست إلى التربة الجيرية للحصول على بيئة زراعية مناسبة لزراعة وتنمية نباتات اللانتانا بجودة جيدة.