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The Effect of Growth Bed Containing Organic Substrates and Irrigation Period on the Growth of *Araucaria excelsa* L.

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Abstract

Araucaria excelsa L. of Araucariaceae family is a beautiful conifer which has a high economic importance in the flower industry. A factorial experiment based on randomized completely block design with two factors: 1. Irrigation intervals in 2, 4 and 6 days (I_1, I_2 and I_3) and 2. The growth bed in pots 3 L included M_1 (100 % v/v cocopeat), M_2 (100% municipal waste compost), M_3 (100 % vermicompost), M_4 (25 % cocopeat + 25 % perlite + 25 % soil + 25 % municipal waste compost), M_5 (25 % cocopeat + 25 % vermicompost + 25 % soil + 25 % perlite) and M_6 (25 % vermicompost +25 % municipal waste compost + 25 % perlite + 25 % soil) was conducted with 18 treatments in three replications. Traits that were measured in this experiment included height of the crown, number of lateral shoot, branches distance, number of branches, length of lateral shoot, fresh weight of root and shoot, total fresh weight, dry weight of root and shoot, total dry weight. The results showed that the growth indices increased in 100 % vermicompost. The treatment I_1M_3 was the best treatment in the growth of plant. The 100 % vermicompost bed had a better response to 6 days irrigation than in the other beds, but it was observed a considerable difference in the growth indices between 6 days and 2 days periods of irrigation.

Keywords: Cocopeat, Municipal waste compost, Perlite, Vermicompost.

INTRODUCTION

The possibility production flowers and ornamental plants have been provided in Iran, with regards to diversity of climate, cheap labor, the amount of enough light, and proximity to consumption markets. Despite such natural susceptibilities, Iran has the low share in the production and world trade (Chizari *et al.,* 2006).One of the main factors for the growth of ornamental plants, especially potted plants, is suitable substrates. The agricultural and industrial wastes in the country can be appropriatesubstrates in production ornamental plants (Padasht Dehkaei, 2004; Padasht Dehkaei *et al.,* 2006; Khaleghiand Padasht Dehkaei, 2000).

Nowadays, different organic and mineral materials are used in soilless culture systems (Davidson *et al.*, 1998). Substrates should be had properties such as low density, porous, suitable pH, neutrality, at least 3 years of constant quality, free of heavy metals and low cost (Malopa *et al.,* 2001). Cocopeat is a combination of processed coconut crust, physically spongy material same peat, composed equal ratios of lignin and cellulose (Noguera *et al.,* 2000; Savithri and Khan, 1993).Vermicomposts are the separated particles with the high ventilation, drainage and water holding capacity (Edwards and Burrows, 1988) and perlite is suitable for plant growth in combination with other media (Martinez and Abad, 1992; Shinohara *et al.,* 1999).

The use of municipal compostin many horticultural crops and grassland have positive been reported (Marcote *et al*., 2001; Mbarki, *et al.,* 2008; Ostos *et al.,* 2008; Almasiyan *et al*., 2006; Cala *et al.*, 2005; Eghbal *et al*., 2004; Somare *et al.*, 2003; Garcya -Gil *et al*., 2000). Hidlago *et al.* (2006) observed the increase in stem diameter and the number of flower buds of parsley due to the high cation exchange capacity of vermicompost. The highest yield of plant was reported in substrates containing cocopeat: perlite (Hall, 2009). Samiei *et al*. (2005) observed the highest growth of *Aglaonema* plant in cocopeat medium. Khomami (2010) stated that the greatest height and stem diameter of *Dieffenbachia* obtained in %50 vermicompost with sawdust.

Ornamental leaf plants has devoted an important part of flower industry e.g. conifer plants due to their resistant and beauty. *Araucaria excelsa* L. is an ornamental conifer that has the high importance taking consideration into beauty and economical. The export of *Araucaria* and other ornamental flower and plants to neighboring countries such as Iraq, Turkey, and Azerbaijan have many benefits (Zare, 2001).

Due to the slow growth of *Araucaria* and the high sensitivity to environmental factors, on the other hand, the use of improper bed and unknown irrigation have caused to increase the cost of production and reduce the growth of the plant. Determine the most suitable bed for this plant is very important. *Araucaria* due to inappropriate root system need to bed good and high nutrition. The aim of this study to evaluate some organic substrates in the growth media under different period of irrigation on *Araucaria.*

MATERIALS AND METHODS

The experiment was carried out in a greenhouse in Chaboksar, Guilan province, Iran. Araucaria transplants was prepared of Iran Green Company, and immediately were transferred to the green house with regards to safety tips. The transplants with same height and cover were selected. In order to disinfection pathogens such as *Phytophtora,* all transplants were sprayed with fungicides copper oxychloride (1:1000). The experiment performed as factorial based on randomized complete block design with two factors. The first factor was irrigation including I_1 (two days), I_2 (four days), I_3 (six days), irrigation with distilled water amounted 300 mL for every pot. Second factor was the growth medium including M_1 (100 % v/v cocopeat), M_2 (100 % municipal waste compost), M_3 (100 % vermicompost), M_4 (25 % cocopeat + 25 % perlite + 25 % soil + 25 % municipal waste compost), M_5 (25 % cocopeat + 25 % vermicompost + 25 % soil + 25 % perlite) and M_6 (25 % vermicompost + 25 % municipal waste compost + 25 % perlite + 25 % soil). Therefore, 18 treatments in 3 replicates applied in this study in pots 3 L. The materials used in substrates were observed in Table1.The concentrations of nitrogen, phosphorus, potassium, iron, zinc and manganese,

Table 1. The substrates used in experiment.

Treatments	Growth medium
M_1	% 100 v/v cocopeat
M_2	% 100 municipal waste compost
M_3	% 100 vermicompost
M_4	% 25 cocopeat + % 25 perlite + % 25 soil + % 25 municipal waste compost
M_5	% 25 cocopeat + % 25 vermicompost + % 25 soil + % 25 perlite
M_6	% 25 vermicompost + %25 municipal waste compost + %25 perlite + %25 soil

Table 2. Some properties of substrates used in experiment.

Growth medium	N (%)	P (mg/kg)	K (mg/kg)	Fe (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	EC (dS/m)	pH
M_1	2.1	64	300	59.6	12.6	24.8	1.2	7.70
M_2	1.4	1696	350	1993.6	248.6	38.4	7.8	7.90
M_3	0.7	64	320	125.2	52.6	20.0	2.8	6.80
M_4	1.4	320	450	152.4	314.4	60.0	2.9	7.64
M_5	1.4	120	1250	842.8	36.6	62.8	1.2	7.25
M_6	2.8	340	570	446.4	49.76	59.0	3.4	8.01

pH and EC were measured in the bed (Table 2).

After harvesting plant, fresh weight of shoot and root were measured and then dry weight of root and shoot were measured when the samples were dried in a temperature of 75ºC for 48 hours. After drying the samples, dry weight of roots and shoots were measured separated by the digital scale. Total nitrogen by Kejeldal method, potassium by flamephotometry method (Ehyaee and Behbahani, 1993), phosphorus by spectrophotometry method (Emami, 1995) and micronutrients by atomic absorption method (Manteghi, 1986) were measured. Data were analyzed by software SPSS, and mean comparisons were performed by Least Significant Differences (LSD) at 5% level.

RESULTS AND DISCUSSION

Irrigation treatment effect on the growth indices

The results showed that two-days treatment of irrigation increased root and shoot fresh weight. According to the result, two & four-days treatment of irrigation increased root dry weight and number of branches in compared to the six days treatment (Table 3). These duration were useful due to less distances of irrigation and reducing drought stress.

The impact of substrates (growth media) on the yield

Table 3 shows that increase in height of the crown is observed in media"%100 vermicompost", "25 % cocopeat + 25 % vermicompost + 25 % soil + 25 % perlite", and the treatment "100 % municipal waste compost" had the lowest height. The greatest number of lateral branches allocated to 100 % vermicompost (13.70). Increasing the number of lateral braches is an important index in marketability. Second substrate that had a desired effect on lateral branches was the medium containing 25 % cocopeat + 25 % perlite + 25 % soil + 25 % municipal waste compost (Table 3).

According to the report of Basantia *et al.* (2011), vermicompost caused to the highest vegetative growth and increase in height and number of lateral branches of marigold. Avang *et al*. (2009) reported that proportional to the used cocopeat in medium, it increases the stem length at zinnia, amaranths, marigold and oleander. The result of Avang *et al*. (2010) showed that the cocopeat used in the ratio of % 100 and %70 with two other organic matter increased the diameter of canopy and number of leaves in amaranth.

Substrate 100 % municipal waste compost was the most undesirable medium. It has the

Table 3. The impact of growth media and irrigation period on the growth indices of *Araucaria excelsa* L.

Treatments	Height of plant (cm)	Number of lateral shoot	Length of lateral branches (mm)	Number of branches	Branches distance (mm)	Root fresh weight (g)	Shoot fresh weight (g)	Total fresh weight (g)	Root dry weight (g)	Shoot dry weight (g)	Total dry weight (g)
I_1	10.1 a	12.6 a	44 a	2.5 a	19.9 a	0.52 a	1.8 a	2.36 a	0.17 a	0.6 a	0.76 a
I_2	10.0 a	11.7 a	44 a	2.3 a	17.4 a	0.41 b	1.4 b	1.87 b	0.17 a	0.5 a	0.65 a
I_3	9.4 a	10.0 b	39 a	2.2 a	15.4 a	0.31 b	1.3 b	1.61 b	0.12 b	0.4 a	0.57 a
M_1	9.4 b	12.0 a	48 a	2.2 b	16.1 a	0.47 b	1.9 b	1.6 c	0.14 c	0.33 c	0.48 c
M_2	6.9 c	5.7 b	29 c	1.1 c	3.9 b	0.16 d	0.7 d	0.9 d	0.11 d	0.28 d	0.39 d
M_3	11.6 a	13.7 a	49 a	2.7 a	24.8 a	0.61 a	2.4 a	3.0 a	0.22 a	0.79 a	1.01 a
M_4	9.3 b	13.2 a	47 a	3.0 a	19.8 a	0.48 b	1.9 b	2.4 b	0.18 b	0.62 b	0.80 b
M_5	11.2 a	12.0 a	39 b	2.7 a	24.1 a	0.41 c	1.1 c	2.3 b	0.14 c	0.61 b	0.76 b
M_6	9.1 b	12.0 a	40 b	2.3 b	16.6 a	0.39 c	1.1 c	1.5 c	0.16 b	0.38 c	0.53 c

In each column, means with the similar letters are not significantly different at 5% level of probability using LSD test.

M_1 100 % v/vcocopeat
M_2 100 % municipal waste compost
M_3 100 % vermicompost
M_4 25 % cocopeat + 25 % perlite + 25 % soil + 25 % municipal waste compost
M_5 25 % cocopeat + 25 % vermicompost + 25 % soil + 25 % perlite
M_6 25% vermicompost +25 % municipal waste compost + 25 % perlite + 25 % soil
I_1 2 days
I_2 4 days
I_3 6 days

high amount of some nutrient such as iron, phosphorus that can be toxic and also it makes negative effect due to the salinity. Topcuoglo (2005) investigated the use of municipal compost as an alternative of peat on the growth of poinsettia. Peat was replaced by 25 and 50 % v/v municipal waste compost and the height of plant and leaves number increased in 25 % municipal waste compost. The maximum length of branch was observed in substrates "100 % cocopeat", "100 % vermicompost" and "25 % cocopeat + 25 % perlite + 25 % soil + 25 % municipal waste compost".

Fascella and Zizzo (2005)planted five cultivars of roses on the beds perlite and perlite + cocopeat and reported that the maximum branches length was observed in all the cultivars on perlitee + cocopeat medium. The largest number of branches were observed on substrates "100% vermicompost" "25 % cocopeat + 25 % vermicompost+ 25 % soil + 25 % perlite" "25 % vermicompost + 25 % municipal waste compost + 25 % perlite + 25 % soil.

The branch number is one of the favorable factors in the ornamental araucaria. Plant growth and development is highly depends on soil fertility (Chanda *et al.*, 2011). Improved physical properties, chemical and biological by municipal waste compost (Bachman and Metzger, 2007) and vermicompost (Chanda *et al*., 2011) can be a reason to increase the growth of plant. In an experiment conducted by Padasht Dahkaei and Gholami (2009), the greatest stem height of *Dracaena* was reported in a medium containing tree bark, municipal waste and perlite. The maximum distance of branches, root fresh weight, total fresh weight, total dry weight, shoot dry weight, shoot fresh weight obtained in the substrate 100 % vermicompost (Table 3). Vermicompost intensifies activity of microorganisms in soil due to the soil aeration, consequently promotes soil fertility to increase effective product.

Interaction irrigation and different substrates on the growth indices

Based on Table 4, thesubs trates containing 100 % vermicompost,"25 % cocopeat + 25 % perlite + 25 % soil + 25 % municipal waste compost", with two-days irrigation were the best treatment with regards to root fresh weight, shoot fresh weight and total fresh weight. Sezen *et al.*(2010) reported that the highest yield obtained in a medium containing volcanic slag and peat (1:1) with irrigation once and twice in every day. The results showed increase in root dry weight, shoot dry weight, total dry weight, in the substrate "100%vermicompost" with two days irrigation (Table 4). The number branches, length of lateral branches increased in the growth medium of 100 % vermi-

Table 4.The interaction impact of growth media and irrigation period on the growth indices of *Araucaria excelsa* L.

Treatment	Shoot fresh weight (g)	Root fresh weight (g)	Total fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)	Total dry weight (g)	Length of lateral branches (mm)	The number of branches	Branches distance (mm)
I_1M_1	0.80 d	0.43 c	1.20 c	0.20 c	0.10 d	0.33 d	48 a	2.00 b	17.60 a
I_1M_2	1.30 c	0.26 d	1.53 c	0.40 c	0.13 c	0.53 c	35 c	1.30 c	5.60 c
I_1M_3	3.50 a	0.83 a	4.33 a	1.20 a	0.33 a	1.53 a	48 a	2.30 a	31.00 a
I_1M_4	2.40 a	0.66 a	3.06 a	0.80 b	0.23 b	1.00 b	38 b	3.00 a	19.00 a
I_1M_5	1.90 b	0.43 c	2.30 a	0.50 b	0.10 d	0.63 b	35 c	2.30 a	20.00 a
I_1M_6	1.20 c	0.53 b	1.76 c	0.40 c	0.16 c	0.53 c	50 a	2.60 a	20.00 a
I_2M_1	1.40 c	0.46 c	1.83 b	0.40 c	0.10 d	0.53 c	46 a	2.30 a	14.00 b
I_2M_2	0.40 e	0.10 e	0.53 d	0.20 c	0.10 d	0.33 d	27 d	1.00 c	3.00 c
I_2M_3	1.80 b	0.43 c	2.26 b	0.50 b	0.31 c	0.66 b	44 b	2.60 a	22.10 a
I_2M_4	1.60 b	0.40 c	2.03 b	0.60 b	0.16 c	0.80 b	47 a	2.60 a	17.60 a
I_2M_5	1.80 b	0.40 c	2.20 b	0.60 b	0.13 c	0.73 b	40 b	2.60 a	24.50 a
I_2M_6	0.70 d	0.10 e	0.08 d	0.30 c	0.10 d	0.36 d	31 c	2.00 b	14.00 b
I_3M_1	1.20 c	0.50 b	1.70 c	0.30 c	0.23 b	0.56 c	52 a	2.30 a	16.80 a
I_3M_2	0.40 e	0.10 e	0.80 d	0.20 c	0.10 d	0.30 d	27 d	1.00 c	3.00 c
I_3M_3	1.90 b	0.56 b	2.43 b	0.60 b	0.20 b	0.83 b	54 a	3.00 a	21.40 a
I_3M_4	1.60 b	0.36 c	2.00 b	0.50 b	0.13 c	0.60 b	48 a	3.3 b	21.80 a
I_3M_5	1.90 b	0.40 c	2.36 b	0.70 b	0.20 b	0.90 b	43 b	3.00 a	25.60 a
I_3M_6	1.40 c	0.53 b	1.93 b	0.50 b	0.20 b	0.70 b	42 b	2.30 a	15.70 b

In each column, means with the similar letters are not significantly different at 5% level of probability using LSD test.

M_1 100 % v/vcocopeat
M_2 100 % municipal waste compost
M_3 100 % vermicompost
M_4 25 % cocopeat + 25 % perlite + 25 % soil + 25 % municipal waste compost
M_5 25 % cocopeat + 25 % vermicompost + 25 % soil + 25 % perlite
M_6 25% vermicompost +25 % municipal waste compost + 25 % perlite + 25 % soil
I_1 2 days
I_2 4 days
I_3 6 days

compost and "25 % cocopeat + 25 % perlite + 25 % soil + 25 % municipal waste compost", with a six days irrigation.

According to the report of Suhane *et al.* (2008), vermicompost could reduce the water requirement of plant to about 30 to 40 %. Wilson *et al.* (2002) concluded that the compost regardless of irrigation system increased the quality of salvia flowers. The use vermicompost in the amount higher than 30 % reduced plant growth (Esmaeilpour and Chamani, 2009). Different factors influence the quality and growth of flowers, which growth mediaare the most important agent (shahbazi *et al.*, 2012). The amount of irrigation water, irrigation number and duration are important parameters for use of substrates as an alternative to soil (Lizarraga *et al.*, 2003). The number of irrigation depends on the physical properties of substrates and it influences on the quantitative and qualitative characteristics in soilless culture systems (Mitchell *et al.*, 1991; Peet and Willits, 1995; Traka-Mavrona *et al.,* 2001).

CONCLUSION

Based on results, the bed of vermicompost was the most appropriate bed for *Araucaria.* Municipal waste could not be an appropriate bed in the production *Araucaria* due to high salinity in medium but its effect was adjusted when it was mixed by cocopeat, perlite, soil and vermicompost. The 100% vermicompost bed had a better response to 6 days irrigation than in the other beds, but it was observed a considerable difference in the growth indices between 6 days and 2 days periods of irrigation. The treatment I1M3 (100 % vermicompost in 2 days period of irrigation) was the best treatment in the growth of plant.

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