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Investigating Growth of *Araucaria excelsa* L. in Different Methods of Fertilization

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Abstract

A serious problem in cultivation of ornamental plants is a lack scientific and applied program in fertilization, so that the plant nutrition focused on growth medium. A randomized completely design with 8 different fertilization methods with the use of ammonium sulphate, potassium sulphate, di ammonium phosphate, ferrilene and kristalon was conducted in three replications in a greenhouse of Chaboksar, Guilan, Iran. The height of bush, number of lateral branches, floor distance, number of floor, fresh weight of root and shoot, total fresh and dry weight of root and shoot were measured. The results showed that the growth of plant increased in a treatment including foliar spray of ferrilene and kristalon fertilizers in 1:1000 ratio for three times. In treatment of ammonium sulphate, potassium sulphate and di ammonium phosphate as base fertilizers amounted 2, 1 and 0.5 g per pot, respectively, the growth traits of plant was same to ferrilene and kristalon treatment. In conclusion, the highest plant growth obtained of a treatment including foliar spray of ferrilen and kristalon in 1:1000 ratio for three times.

Keywords: Ammonium sulphate, Ferrilene, Fertilizer, Kristalon, Potassium sulphate.

INTRODUCTION

Due to diversity of climate, cheap labor, the amount of enough light, and proximity to consumption markets, the production flowers and ornamental plants have developed in Iran, but despite such natural susceptibilities, the ration of Iran in the world trade is low (Chizari *et al*., 2006). Given the importance of ornamental plants, their nutrient management plays a critical role in enhancing their production and quality. Due to the lack of scientific knowledge for the use of substrate and best fertilizing method in the growth of *Araucaria excelsa*, it is crucially important to find the most appropriate planting substrate and fertilizing method (Ashoorzadeh *et al*., 2016).

Correct nutrition not only improves the quality of the fruits, but also decreases the damages and increases the storage life of the products (Hargreaves *et al.*, 2008). The optimal use of fertilizers is the most effective and most economical way to increase the yield of agricultural products and the production sustainability (Malakooti *et al.*, 2008). Choosing the correct fertilizer source, adjustment of the fertilization dosage, and its optimal use can increase the yield (Shadmehr, 2008). Unfortunately, due to the imbalanced use of chemical fertilizers in Iran, most elements which are effective in plants' nutrition are not included in fertilizer recommendations. This, in turn, aggravates some shortcomings and soil fertility (Taherkhani and Golchin, 2011). Generally, in plant nutrition, not only does the sufficient amount of each element have to be available to the plant, but also it is of much importance to create a balance and to observe the ratio of nutritional elements. In case of the lack of nutrition balance, the addition of nutrients not only does not increase the yield, but also causes a disruption in the plant growth, and ultimately a reduction in the yield (Kholdbarin and Eslamzadeh, 2001). Sajid *et al.* (2009) examined the effect of foliar application of plant growth regulators and nutrients on lily flowers in which 19 mg L^{-1} KNO_3, 16.5 mg L^{-1} NH_4NO_3, 1.7 mg L^{-1} KH_2PO_4, 4.4 mg L^{-1} $CaCl_2$ and 3.7 mg L^{-1} $MgSO_4$ were sprayed. Also, gibberellic acid (GA_3) at the rate of 20 mg L_{-1} was applied. It was revealed that the application of nutrients increased stem length by 25% as compared to control and that the indices were improved by 33% when nutrients and GA_3 were applied.

In an examination of the effect of nitrogen (N), phosphorus (P) and potassium (K) fertilizers on marigold, Zhiping *et al*. (2008) stated that K increased leaf yield and plant dry weight as well as plant growth and longevity. In an evaluation of the impact of different planting media including rice husk, coco peat, perlite, and a mixture of perlite and vermiculite (1:1) and NPK rates including two NPK concentrations (25:7:7) of 1.75 and 2.5 g L^{-1} on chrysanthemum, the best quality of cut flowers were obtained from rice husk substrate sprayed with 2.5 g L^{-1} NPK (Budiarto *et al*., 2006).

Ornamental leaf plants have 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 are carried out 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 fertilization have caused to increase the cost of production and reduce the growth of the plant. Araucaria due to inappropriate root system need to bed good and high nutrition. The aim of this study is to evaluate effect of some fertilization methods of NPK fertilizers and ferrilen and kristalon on *Araucaria*.

MATERIALS AND METHODS

The experiment was carried out in a greenhouse of 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 (Fig. 1). The transplants with same height and cover were selected. In order to disinfection pathogens such as phytophtora, all transplants were sprayed with fungicides copper oxy chloride in 1/1000. The experiment was conducted based on randomized complete design with three replications. Treatments were 8 fertilization methods as followed in Table 1. Therefore, 8 treatments in 3 replicates applied in this study in pots 3 L. The medium was

Fig. 1. The cultivation of transplant in medium.

Table 1. The treatments used in experiment.

Treatment	Used fertilizer	Method
N1	Ammonium sulphate, Potassium sulphate, Di ammonium phosphate	Ammonium sulphate, Potassium sulphate and di ammonium phosphate were used as base amounted 2, 1 and 0.5 g per pot.
N2	Ferrilene, Kristalon	Foliar spray of each fertilizer in 1:1000 ratio for three times.
N3	Ammonium sulphate, Ferrilene, Kristalon	Ammonium sulphate as base amounted 2 g per pot, Foliar spray of Ammonium sulphate, Ferrilene and Kristalon in 1:1000 ratio for three times.
N4	Ammonium sulphate, Ferrilene, Kristalon	Ammonium sulphate as base amounted 2 g per pot, Foliar spray of Ammonium sulphate, Ferrilene and Kristalon in 1:1000 ratio for two times.
N5	Ammonium sulphate,	Ammonium sulphate, Potassium sulphate and di ammonium phosphate
N6	Potassium sulphate, di ammonium phosphate	were used as base amounted 2, 1 and 0.5 g per pot, Foliar spray of Ammonium sulphate in 2:1000 ratio for one time.
N7	Ammonium sulphate, Potassium sulphate, di ammonium phosphate	Ammonium sulphate, Potassium sulphate and di ammonium phosphate were used as base amounted 2, 1 and 0.5 g per pot, Foliar spray of Ammonium sulphate in 2:1000 ratio for three times.
	Ammonium sulphate, Potassium sulphate, di ammonium phosphate, Ferrilene, Kristalon	Ammonium sulphate, Potassium sulphate and di ammonium phosphate were used as base amounted 2, 1 and 0.5 g per pot, Foliar spray of Ammonium sulphate in 2:1000 ratio, Ferrilene and Kristalon in 1:1000 ratio for one time.
N8	Ammonium sulphate,	Ammonium sulphate as base amounted 2 g per pot, Foliar spray of Ammonium sulphate in 2:1000 ratio for three times.

a mixture of coccopeat, municipal waste compost, perlite and sandy soil with equal ratios.

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 75 ºC for 48 hours. After drying the samples, dry weight of roots and shoots were measured by the digital scale. Data were analyzed by software SPSS, and mean comparisons were performed by Least Significant Differences (LSD) at 5% level.

RESULTS AND DISCUSSION

Analysis variance of data showed that the effect of treatments on the measured growth traits of plant were significant in 1 or 5% percent level. Fig. 2-6 show the impact of treatments on bush height, lateral branches number, branches length, number and distance of floor in *Araucaria excelsa* L. The highest amount of cited traits were observed in N2 including use of ferrilene and kristalon. The kistalone contains NPK at ratios 18-18-18 and sufficient amounts of microelements with a chelate basic (EDTA), and also ferrilene have the high amount of iron as Fe-EDDHA. It seems that the use of these fertilizers have supplied full nutritional need of plant, consequently, the plant

Table 2. Analysis variance of the effect of treatments on some growth traits of plant.

S.O.V	df	Mean square										
		Bush height	Lateral branches No.	Branch length	Floor No.	Floor distance	Fresh weight of root	Fresh weight of shoot	Total fresh weight	Dry weight of root	Dry weight of shoot	Total dry weight
Treatment	7	24.3*	25.8**	394.0*	2.6*	230.3*	0.33**	2.73**	4.9**	0.023*	0.27**	0.45**
Error	14	6.5	3.9	86.3	0.37	65.3	0.05	0.25	0.53	0.005	0.03	0.050
CV (%)		26.2	24.5	26.3	41.0	55.2	63.4	57.9	59.5	48.1	46.2	43.5

*, **: Significant at P<0.05, P<0.01 respectively.

has responded better to this treatment in compared other treatments. Of course, the response of plant to the treatment including use of ammonium sulphate, potassium sulphate and di ammonium phosphate as base amounted 2, 1 and 0.5 g per pot, respectively, was same ferrilene and kristalon treatment. The branch number and the height of plant are the favorable factors in the ornamental araucaria. Plant growth and development is highly depends on soil fertility (Chanda *et al.*, 2011).

The trend of variation in dry and fresh weight of root and shoot was same to above traits. nitrogen is one of the constituent elements of many important molecules such as proteins, nucleic acids, some hormones, and chlorophyll (Hopkins, 2004); and phosphorus, plays an important role in the cellular structure and is the general source of energy in all biochemical activities in live cells (Jamshidi, 1999). Gonzalez-Garcia *et al.* (1976) declared that potassium plays an important role in the enzyme activities and the synthesis of amino-acids and phenol-acids.

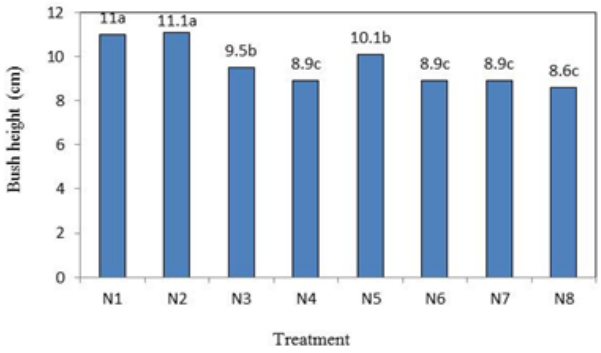

Fig. 2. The effect of treatments on the bush height of plant.

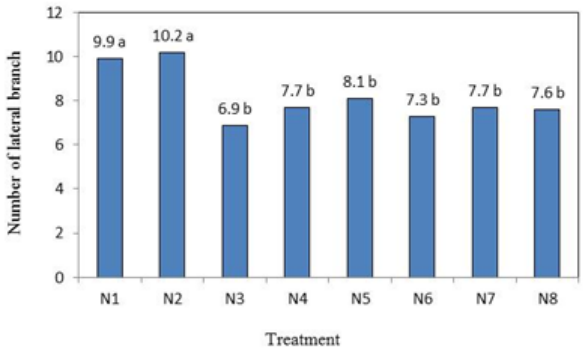

Fig. 3. The effect of treatments on the number of lateral branches.

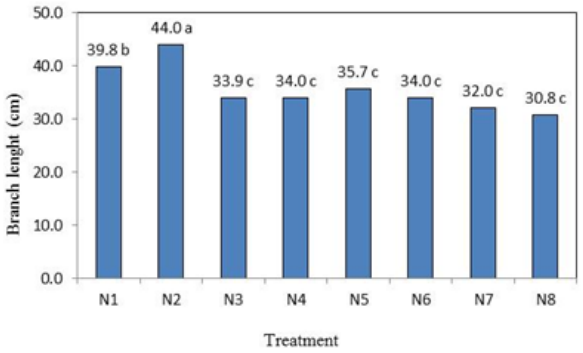

Fig. 4. The effect of treatments on the branch lenght of plant.

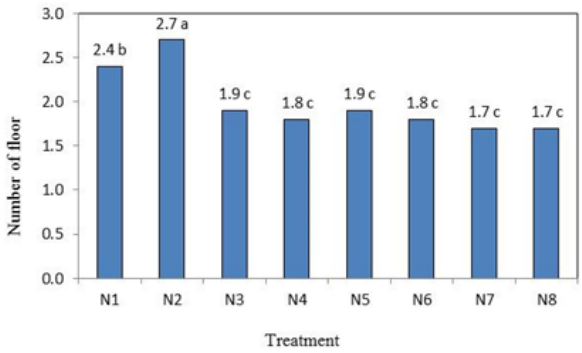

Fig. 5. The effect of treatments on the number of floor.

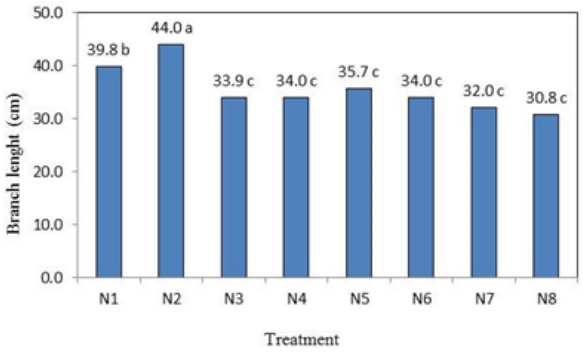

Fig. 4. The effect of treatments on the branch lenght of plant.

Table 3. The effect of treatments on the fresh and dry weight of plant.

Treatment	Root fresh weight (g)	Root fresh weight (g)	Total fresh weight (g)	Root dry weight (g)	Shoot dry weight (g)	Total dry weight (g)
N_1	0.55 ^{a}	1.34 ^{a}	1.89 ^{a}	0.18 ^{a}	0.51 ^{a}	0.68 ^{a}
N_2	0.59 ^{a}	1.60 ^{a}	2.19 ^{a}	0.22 ^{a}	0.61 ^{a}	0.83 ^{a}
N_3	0.27 ^{b}	0.64 ^{b}	0.91 ^{b}	0.12 ^{c}	0.30 ^{c}	0.42 ^{c}
N_4	0.32 ^{b}	0.83 ^{b}	1.15 ^{b}	0.14 ^{b}	0.41 ^{b}	0.55 ^{b}
N_5	0.33 ^{b}	0.83 ^{b}	1.16 ^{b}	0.14 ^{b}	0.34 ^{c}	0.48 ^{b}
N_6	0.29 ^{b}	0.69 ^{b}	0.98 ^{b}	0.12 ^{c}	0.32 ^{c}	0.44 ^{c}
N_7	0.27 ^{b}	0.58 ^{b}	0.85 ^{b}	0.14 ^{b}	0.30 ^{c}	0.43 ^{c}
N_8	0.25 ^{b}	0.50 ^{b}	0.75 ^{b}	0.11 ^{c}	0.24 ^{d}	0.36 ^{d}

The growth of plant influenced by ferrilene and kristalon alone, or influenced by ammonium sulphate, potassium sulphate and di ammonium phosphate. Therefore, the use of integrated fertilizers has not been affected on the growth of plant. It seems that these fertilizers have not positive interaction (Table 3).

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