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The Effect of Medium Containing Zeolite and Nutrient Solution on the Growth of *Dieffenbachia Amoena*

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ABSTRACT

This research was conducted to evaluate the possibility using zeolite as appropriate medium in the cultivation of ornamental plants by a completely randomized design in three replications in Export Terminal of Plant and Flower, Salmanshahr, Mazandaran, Iran. A 2:1 ratio of peat to perlite and peat was used as control treatment and peat was replaced by 10, 20, 30, 40 and 50% v/v of zeolite in two methods: 1. treatments with nutrient solution and 2. treatments without nutrient solution. Growth indexes include height, leaves number, stem diameter, dry weights of leaf were measured in Dieffenbachia plant. Nutrients concentration of nitrogen, phosphorus and potassium in leaf were also measured. Results showed that nutrient solution had a considerable effect on plant growth in all treatments than without nutrient solution. Zeolite decreased the plant growth without nutrient solution, but when it is used with nutrient solution caused to increases leaf number and stem diameter than in the control.

Keywords: Flower, Ornamental, Peat, Perlite, Zeolite.

INTRODUCTION

The selection of a planting bed is an important factor influencing on the quality of seed plants [1]. Optimum plant growth and economic continued availability are the first criterions for a commercial bed. Every commercial cultivation medium in addition to maintaining water, appropriate drainage and a suitable place to establish roots should be free from toxic substances, pests and diseases [2]. One of the main production inputs for growing ornamental plants especially pot plants is appropriate cultivation medium. One of the main factors limiting exports

of pot plants, lack of proper and standard cultivation bed in the country. The pot substrates and their compounds are a vital source for greenhouse industry [3].

The use of peat is doubtful due to ecological damages to environmental and economic advantageous for ornamental plants producers. These factors caused those researchers think to beds with high quality and cheap instead of peat [4]. Some studies showed that the peat can be replaced by organic wastes such as municipal wastes, sewage sludge, livestock manure, paper, waste of pruning and fungi beds and other organic waste after composting [5]. Investigations on *Ficus benjamina* variety Starlight in a growth medium contains one part peat and one olive waste (as volume) showed that the highest height of plant has obtained during 10 month growth [6]. Papafotiou et al. [7] used olive wastes compost as alternative of peat to cultivate some ornamental plants and suggested that this compost can be replaced amounted 25%, 75% and 75% v/v instead of peat for cultivating *Ficus benjamina*, *Cordyline* and *Syngonium podophyllum*, respectively.

Natural zeolite mineral are often used to build new beds for planting and plant breeding, seed production and seedling, root cuttings, pot ornamentals plants etc. [8]. In recent years pay attention to the development of sustainable agriculture, using natural minerals as amendments are common to improve soil physical and chemical properties [9]. The study of Perez et al. [10] on olive plant showed that zeolites had a positive impact in reducing nitrate leaching, increase in soil water holding capacity, water use efficiency and a reduction in using fertilization. Increased use of zeolite had a significant effect on weight and amount of olive oil. Nabila et al. [11] in the perlite-peat medium amended by zeolite reported that the need of plant for water and fertilizer decreased by about 29 percent without a reduction in plant growth and Kroton ornamental plant quality.

Zeolites because of high cation exchange capacity can be used successfully in the cultivation of various crops such as cereals, forage crops, vegetables, grapes and fruit [12]. The purpose of this study is to investigate the possibility of replacing zeolite mineral modifier as the part of the peat in ornamental plants bed.

MATERIALS AND METHODS

This research was conducted at the export terminal of flower and plant, Salmanshahr, Mazandaran province, Iran. In a completely randomized design, the possibility of replacing peat by six levels of zeolite was investigated at the zero level (a 2:1 ratio of peat-perlite as control) and five level of zeolite so that peat was replaced by 10, 20, 30, 40 and 50% v/v of zeolite.

Every treatment applied in three replicates and *Dieffenbachia amoena* was selected as the test plant. 108 cuttings of *Dieffenbachia amoena* were prepared in July 2010 so that all seedling of plant were the same size. First all cutting were disinfected by fungicides (Mancozeb) and were planted on leaf litter pots that after one month were fully rooted. The treatments as following:

1. Control: Basic medium of *Dieffenbachia* ornamental plant was a 2:1 v/v ratio peat to perlite without nutrient solution.

2. Control: Basic medium of *Dieffenbachia* ornamental plant was a 2:1 v/v ratio peat to perlite with nutrient solution.
3. The treatments of zeolite: peat was replaced by 10, 20, 30, 40 and 50% v/v of zeolite in media without nutrient solution.
4. The treatments of zeolite: peat was replaced by 10, 20, 30, 40 and 50% v/v of zeolite in media with nutrient solution.

The used peat was provided from the German SAB company that was purchased as a ready. After preparing media, the rooted cutting of *Dieffenbachia amoena* was transferred to 4 liters pots. Plant height and stem diameter were measured once every 14 days. Dry weight of leaves and leaves numbers was evaluated at the end of experiment. In an extraction of leaves of plant, nitrogen by Kjeldal method [13, 14], phosphorus by spectrophotometry method and potassium by flame photometry was measured. MSTATC software was used for variance analysis of data by Least Significant Difference (LSD) test.

RESULTS

Table 1. The effect of treatments on the growth of plants

Treatments	Zeolite (%)	Nutrient solution	Stem Height (cm)	Stem Diameter (mm)	Leaf number	Leaf dry Weight (g)
2 Peat + 1 Perlite (control)	0	With	14.60 ab*	10.90 c	4.66 a	21.05 ab
0.2 Zeolite + 1.8 Peat + 1 Perlite	10		13.83 bc	8.75 e	3.90 b	17.9 cd
0.4 Zeolite + 1.6 Peat + 1 Perlite	20		15.10 a	10.50 cd	5.33 a	21.9 a
0.6 Zeolite + 1.4 Peat + 1 Perlite	30		13.40 c	11.03 c	4.66 a	20.55 b
0.8 Zeolite + 1.2 Peat + 1 Perlite	40		13.63 c	11.90 b	3.66 b	17.41 d
1 Zeolite + 1 Peat + 1 Perlite	50		13.20 c	13.23 a	5.20 a	18.67 c
2 Peat + 1 Perlite (control)	0	Without	4.86 d	9.75 d	0.70 cd	7.71 ef
0.2 Zeolite + 1.8 Peat + 1 Perlite	10		4.25 d	3.85 g	1.13 c	8.14 e
0.4 Zeolite + 1.6 Peat + 1 Perlite	20		3.00 e	6.80 f	0.33 d	5.94 g
0.6 Zeolite + 1.4 Peat + 1 Perlite	30		3.20 e	6.85 f	0.32 d	6.73 fg
0.8 Zeolite + 1.2 Peat + 1 Perlite	40		4.75 d	7.35 f	0.30 d	6.38 g
1 Zeolite + 1 Peat + 1 Perlite	50		2.83 e	3.05 h	0.60 cd	7.90 e

**LSD (least significant difference) shows the significant difference (ρ = 0.05) among the different treatments.*
Values followed by the same letters in each column are not significantly different at the 0.05 level (least significant difference).

Pay attention to Table 1, the effect of nutrient solution on the growth indexes of plant was more as compared without nutrient solution in all treatments. The highest height of stem (15.10 cm) obtained in 20% treatment of zeolite with nutrient solution which had a significant difference with other treatment of zeolite (25.5 cm), but it had not a remarkable difference than in the control (14.60 cm) with nutrient solution. Likewise, it had a significant difference with control (4.86 cm) without nutrient solution. The lowest height was related to 50% treatment of zeolite with and without nutrient solution. When nutrient solution was used caused to the largest stem diameter (8.75 cm) in 10% treatment of zeolite that had a significant difference than in the control and other treatments of zeolite.

The greatest dry weight of leaf (21.9 g) was related to 20% treatment of zeolite with nutrient solution which had a difference with other treatments of zeolite, but it is observed any difference than in the control. Results showed that the zeolite did not increase the leaf number than in the control, significantly. Off course, the leaf number increased in 10 and 50% zeolite with nutrient solution; and 10% zeolite without nutrient solution, but these increases were not significant.

Table 2 shows the impacts of treatments on the nutrients concentration in the Dieffenbachia leaves. The results showed that the effect of zeolite was not significant in both statuses of nutrient solution (with and without nutrient solution). There is a same result for phosphorus concentration in leaf at zeolite treatments than control. zeolite treatments caused to a significant difference of potassium concentration as compared with control. zeolite increased K concentration significantly by 20, 30, 40 and 50% v/v with nutrient solution than in the control. This increase was remarkable at 30% zeolite and more than it without nutrient solution.

Table 2. The effect of treatments on NPK concentration of plant leaves

Treatments	Zeolite (%)	Nutrient solution	Nitrogen (%)	Phosphorus (%)	Potassium (%)
2 Peat + 1 Perlite (control)	0	With	3.20 a	0.50 abc	3.4 c
0.2 Zeolite + 1.8 Peat + 1 Perlite	10		3.18 a	0.52 abc	4.6 bc
0.4 Zeolite + 1.6 Peat + 1 Perlite	20		3.23 a	0.56 ab	4.9 a
0.6 Zeolite + 1.4 Peat + 1 Perlite	30		3.72 a	0.60 ab	5.2 a
0.8 Zeolite + 1.2 Peat + 1 Perlite	40		3.19 a	0.70 a	5.6 a
1 Zeolite + 1 Peat + 1 Perlite	50		3.28 a	0.47 abc	5.1 ab
2 Peat + 1 Perlite (control)	0	Without	2.67 a	0.40 abc	3.4 c
0.2 Zeolite + 1.8 Peat + 1 Perlite	10		2.79 a	0.35 bc	3.96 ab
0.4 Zeolite + 1.6 Peat + 1 Perlite	20		2.90 a	0.49 abc	3.4 a
0.6 Zeolite + 1.4 Peat + 1 Perlite	30		2.75 a	0.24 c	4.8 a
0.8 Zeolite + 1.2 Peat + 1 Perlite	40		2.81 a	0.41 abc	5.1 a
1 Zeolite + 1 Peat + 1 Perlite	50		2.79 a	0.50 abc	4.6 a

DISCUSSION

Nutrient solution increased the growth indexes of plant than in the treatments without nutrient solution. Nutrient solution for supplying nutrients helped to improve plant growth. Zeolite increased the leaves number and dry weight of leaf. Maloupa et al. [15] reported that the best yield of rose flower variety bianca obtained by the use of zeolite with perlite (1:3 ratio).

Munir et al [16] stated that zeolite as slow-release fertilizer decreases the contamination of groundwater and leaching losses by the absorption and trapping nutrients. Fotouhi Ghazvini et al. [17] reported that a mixture of zeolite and perlite at the growth medium of strawberry caused to increase yield due to high water holding capacity and supplying nutrients. Potassium concentration of leaf significantly increased in media. Zeolite can absorb potassium and reduces leaching of this nutrient of the growth medium, and then releases it gradually as available to plants. Off course, concentrations variations in the most cases don't follow from the values of these elements in cultivation beds. The increase in potassium concentration of leaf is consistent

Gul et al. [18] studies that showed the use of zeolite at the growth medium of lettuce with perlite tend to increase in plant growth, nitrogen and potassium of plant tissue and decrease in leaching K. It has been proved that zeolite has a potential in attracting potassium of fertilizers. The added clinoptilolite to a pot cultivation bed of Chrysanthemum has served as a slow-release fertilizera and tend to same growth of plant due to the use of Hoagland nutrient solution [19].

Regards that nutrients concentration in the plant organs are imposed of different factors such as plant growth, ionic competition and deposition, so, sometimes it is impossible to use nutrients concentration in plant as reliable parameter in assessing plant growth. Impact of nutrients dilution in resulting further yield is also sometimes led to confusion. It should be regarded that using zeolite don't created a clear difference in plant growth as compared with control, but it is important that can be appropriate alternative for peat because it provides suitable environ for plant growth same peat.

CONCLUSION

Zeolite can be used as an appropriate alternative in replacing peat in the growth medium of ornamental plants especially dieffenbachia, but the higher amount of zeolite not proposed. It is suggested that more assessments being done about the use of zeolite in the other ornamental plant beds.

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