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Effects of Nickel Contamination on Nutrient Contents of Daffodil (*Narcissus poeticus* L. c.v. *"Ice Folies"*)

Arzu ÇIĞ[1,*], Füsun GÜLSER[2], Tuğba Hasibe GÖKKAYA[2], Gülçinay BAŞDOĞAN[3]

[1]Department of Horticulture, Siirt University, Siirt, Turkey

[2]Department of Soil Science and Plant Nutrition, Yüzüncü Yıl University, Van, Turkey

[3]Department of Landscape Architecture, Yüzüncü Yıl University, Van, Turkey

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Abstract: The objective of this study was to determine the effects of nickel on nutrient contents of daffodil (*Narcissus poeticus* L. c.v. "*Ice Folies*") in nickel contaminated media. This research was carried out in a completely randomized experimental design with three replications in greenhouse conditions. Four different doses of nickel (control, 25 mg kg^{-1}, 50 mg kg^{-1}, 75 mg kg^{-1}) were applied to each pot having 500 g soil:sand mixture in 2:1 ratio. The distillate water was used in irrigation and ½ hoagland solution was applied for fertilization. At the end of experiment the highest K, Mg and Ca contents of daffodil bulbs were obtained as 0.90 %, 0.91 % and 2.72 % in control respectively. The highest Fe (27.42 mg kg^{-1}), Cu (7.62 mg kg^{-1}), and Zn (20.99 mg kg^{-1}) were in 50 mg kg-1, 75 mg kg^{-1} and 25 mg kg^{-1} nickel applications respectively. Similarly the highest K, Mg and Ca contents of daffodil leaves were obtained as 2.2 %, 1.72 % and 5.87 % in control. The highest Fe contents (66.62 mg kg^{-1}) was in 25 mg kg^{-1} nickel application, while Cu (41.29 mg kg^{-1}) and Zn contents (41.04 mg kg^{-1}) were in 75 mg kg^{-1} nickel application. Nickel applications increased micronutrients contents of daffodils except manganese.

Keywords: daffodil, nickel, nutrient content

1. INTRODUCTION

Environmental pollution through heavy metals is growing concern. The contamination of heavy metals as a by product of various human activities has been accompanied by large scale soil pollution. Heavy metals pollution in soils cause many environmental and human health problems. It reported that heavy metals are metalic elements with atomic number higher than 20 and widely known inhibitors of plant metabolism [1]. Heavy metals can be divided into two groups. First group cantains metals such as Fe, Cu, Zn, Co, Mo are necessary for plant metabolism as enzyme activitors, regulators, photosynthesis. The metals within second group such as Cd, Hg, Pb, Cr are not required for plant metabolism. Heavy metals are toxic to plants

*Corresponding Author E-mail: arzucig@yahoo.com

if their accumulation levels exceed the accetable levels of the plant tissues [2]. Nickel has been recognized as essential micronutrient in plant cells [3].

Nickel is also one of the more important metal pollutants contaminating the environment [4]. One of the most important factors in heavy metals influence on plant metabolism are their relationships with other mineral nutrients [5].

Narcissus spp. used as plant material in this study is an ornamental plant belongs on *Amaryllidaceae* family. It is known that some ornamental plants are hyperaccumulator plants and they are used for phytoremediation [6].

In this study, the effects of nickel applications on nutrient uptake of *Narcissus poeticus* in nickel contaminated media were investigated.

2. MATERIAL and METHODS

This research was conducted in a completely randomized experimental design with three replications in green house conditions. Four doses of nickel as control, 25 mg kg^{-1}, 50 mg kg^{-1}, 75 mg kg^{-1} were applied to each pot having 500 g soil:sand mixture in 2:1 ratio. Total number 60 plastic pots were used in the study. The distillate water was used in irrigation and ½ hoagland solution [7] was applied for fertilization. *Narcissus poeticus* belonging to the *Amaryllidaceae* family, is used as a plant variety. Daffodil bulbs were planted to each pot. The irrigation was made by distillate water and hoagland solution was applied for fertilization. The experiment was ended after four months. Harvested plant samples were washed, dried and crushed for macro and micro nutrient elements analysis. After wet digestion of plant samples, calcium, magnesium, potassium, iron, zinc, copper and manganese contents were analysed by using mixed of HNO_3+$HClO_4$ in 1:2 ratio reporetd by [8]. The macro and micro nutrients were determined in their extract solutions by using atomic absorption spectrophotometer. Statistical analyses was done using SPSS package programe to show difference among the mean values of nutrient contents from the different applications.

3. RESULTS and DISCUSSIONS

The effects of applications of nickel on nutrient contents of daffodil bulbs and leaves were found significant (Table 1, 2).

Table 1. Effects of Ni application on macro element contents in bulb and leaf parts of daffodil

Plant part	Ni doses mg kg^{-1}	K %	Mg %	Ca %
Bulb	0 (control)	0.89 b	0.09 c	0.27 d
	25	0.81 b	0.07 d	0.22 e
	50	0.75 b	0.08 d	0.22 e
	75	0.89 b	0.07 d	0.23 e
Leaf	0 (control)	2.20 a	0.17 a	0.59 a
	25	2.15 a	0.17 a	0.57 a
	50	2.19 a	0.14 b	0.48 c
	75	2.06 a	0.15 b	0.53 b
Sign. level		at 1%	at 1%	at 1%

Increasing nickel doses generally decreased macronutrient contents of daffodil bulbs and leaves. The highest Mg (0.09 %) and Ca (0.27 %) contents of bulbs were obtained in control while the highest. K (0.89 %) contents were in control and 75 mg kg^{-1} Ni applications.

Table 2. Effects of Ni application on micro element contents in bulb and leaf parts of daffodil

Plant part	Ni doses mg kg^{-1}	Fe mg kg^{-1}	Cu mg kg^{-1}	Zn mg kg^{-1}	Mn mg kg^{-1}
Bulb	0 (control)	23.0	6.3 c	18.9	10.3 d
	25	14.7	5.4 c	21.0	8.7 d
	50	27.4	5.5 c	19.2	9.1 d
	75	21.1	7.6 c	19.2	10.0 d
Leaf	0 (control)	56.5	15.1 b	32.6	48.8 a
	25	66.6	11.0 bc	35.9	37.5 b
	50	59.4	12.1 bc	28.7	30.1 c
	75	62.9	41.3 a	41.0	39.7 b
Sign. level		at 5%	at 1%	ns	at 1%

Similarly, the highest Mg and Ca contents of daffodil leaves were determined as 0.17 % and 0.59 % in both of control and 25 mg kg^{-1} Ni applications while the highest K content was in control as 2.20 %. The highest Fe (27.4 mg kg^{-1}), Cu (7.6 mg kg^{-1}), Zn (21.0 mg kg^{-1}) and Mn (10.3 mg kg^{-1}) contents of daffodil bulbs were obtained 50 mg kg^{-1} Ni, 75 mg kg^{-1} Ni, 25 mg kg^{-1} Ni and control applications respectively. Generally Ni applications increased micronutrient contents of daffodil bulbs except manganese contents.

The macronutrient contents of daffodil leaves generally decreased by increasing nickel doses. The highest means of K, Mg and Ca contents of leaves were obtained in control as 2.20 %, 0.17 % and 0.59 % respectively.

Zinc and copper contents of daffodil leaves increased by 75 mg kg^{-1} Ni application. Iron contents of daffodil also increased by nickel applications. Contrary, Mn contents of daffodil leaves decreased by nickel applications.

The highest Fe (66.6 mg kg^{-1}), Cu (41.30 mg kg^{-1}), Zn (41.0 mg kg^{-1}) and Mn (48.8 mg kg^{-1}) were in 25 mg kg^{-1} Ni application, 75 mg kg^{-1} Ni application, 75 mg kg^{-1} Ni application and control respectively.

The interactions among nickel doses and plant organs had significant effects on nutrient contents of daffodil except Zn contents. The nutrient contents of daffodil leaves were found higher than those in the bulbs.

In this study increasing nickel doses generally decreased macronutrients contents while micronutrient contents increased by nickel applications. It was reported that nickel toxicity was increased in the presence of Co, Cr, Zn, Mn, Mo [9].

It was reported that nickel toxicity decreased contents of divalent cations (Ca^{++} and Mg^{++}) in rice plant [10]. The results obtained in this study belong Zn and macronutrients contents showed correspond with presented literature knowledges. Many non spesific as well as spesific interactions between mineral nutrients of plants were reported by [11].

The nutrient levels determined in this study in nickel contaminated media can be related reported interactions, e.g. competition between nutrients at the celular level or replacement of one nutrient by another.

4. REFERENCES

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