

Original Research Article

The Effect of Different Doses of Calcium Nitrate Applications on some Phytonutrient Element Contents of Leafy Parsley (*Petroselinum crispum* (Mill.)) Plant

ABSTRACT

Aims: Leafy parsley (*Petroselinum crispum* (Mill.)) plant is an important Ca source for human. This research was done to determine the different doses calcium nitrate application on some macro and micro phytonutrient element contents of leafy parsley plants.

Study design: The experiment was done randomize block experiment design with three replications in unheated greenhouse conditions.

Place and Duration of Study: The experiment was carried out in November and January, 2014, Tekirdag city in Turkey.

Methodology: 1.5 gm⁻² plant seeds sowing each parcel. Four calcium nitrate application doses (I. dose: 0 ppm, II. dose: 15 ppm, III. dose: 30 ppm and IV. dose: 45 ppm) were applied to parsley plants. Parsley plants were harvested 65 day after of seed sowing. Some macro and micro phytonutrient element (N, P, K, Ca, Mg, S, Fe, Cu, Zn and Mn) contents of plants were determined.

Results: According to the analyzing results, average total N contents of plants samples were determined 3.93 %, 3.96 %, 4.01 % and 4.07 %, respectively. Other macro elements P (0.32 %, 0.33 %, 0.35 % and 0.33 %), K (5.78 %, 5.92 %, 6.09 % and 6.46 %), Ca (0.67 %, 0.76 %, 0.78 % and 0.79 %), Mg (0.10 %, 0.11 %, 0.11 % and 0.12 %) and S (0.26 %, 0.34 %, 0.39 % and 0.52 %), were determined, respectively. Some micro element (Fe, Cu, Zn and Mn) contents of parsley plants, Fe (59.06, 62.16, 65.01 and 72.07 mg.kg⁻¹), Cu (27.62, 32.03, 38.90 and 39.80 mg.kg⁻¹), Mn (24.70, 27.50, 29.03 and 31.87 mg.kg⁻¹) and Zn (21.97, 23.30, 29.60 and 57.17 mg.kg⁻¹) were obtained, respectively.

Conclusion: These increases were found statistically significant for each phytonutrient element.

Keywords: Leafy parsley (*Petroselinum crispum* (Mill.)), Ca(NO₃)₂, macro phytonutrient elements, micro phytonutrient elements.

1. INTRODUCTION

Vegetables play an important role in human nutrition which are mostly consumed as uncooked, whereas the green ones are also used as aroma source in dishes, one of which is leafy parsley. It can be found in all seasons, and has a special significance because of its high vitamin C content and unique aroma.

Leafy parsley is widely used as a salad vegetable whose mainland is represented by the Mediterranean countries. Besides its richness in protein, vitamins C and E, and beta carotene, it has high amounts of minerals, such as Ca and K. There is 203 mg Ca and 104 mg potassium in 100 grams fresh parsley [1, 2, 3, 4, 5, 6].

Calcium is used in large amounts by plants second only to N and K [7].

The role of calcium in plant nutrition is often eclipsed by interest in macronutrients or specific micronutrients. Many times, calcium fertilization has been overlooked and is only considered when deficiency disorders influence the economic threshold of produce quality and value. Calcium is a multifunctional nutrient in the physiology of crop plants and in the soluble form influences availability and uptake. Cell wall strength and thickness are increased by calcium addition. Calcium is a critical part of the cell wall that produces strong structural. With rapid plant growth, the structural integrity of stems that hold flowers and fruit, as well as the quality of the fruit produced, is strongly coupled to calcium availability [7, 8, 9, 10, 11].

Considering some fertilizer studies carried out at an increasing dose of plant in terms of evaluation of

plant nutrient elements; in a research carried out under greenhouse conditions, the effects of the increasing doses of molybdenum application on lettuce plant's nutrient elements are examined. Three different doses of molybdenum (Mo) (0, 0.25 and 0.50 mgkg⁻¹) are applied to the plants in (NH₄)₆Mo₇O₂·4H₂O form. It is observed that the increasing doses of Mo develop N, P and K contents of the plant. However, Fe, Zn and Mn contents of the plant are affected negatively from molybdenum fertilizer application. These increases and decreases were considered important with 1 % statistical degree. Cu content of the plant is not influenced from molybdenum fertilizer application [12].

The study conducted by Adiloglu et al., (2015) [13] investigates the effects of the increasing doses of nitrogen fertilizer application on the exotic plants mibuna (*Brassica rapa* var. *nipposinica*) and mizuna (*Brassica rapa* var. *japonica*)'s biological characteristics, vitamin C, protein, and mineral contents. In the experiment, NH₄NO₃ fertilizer is applied as N₀: 0 kgda⁻¹, N₁: 10 kgda⁻¹, N₂: 15 kgda⁻¹ and N₃: 20 kgda⁻¹. The highest biological parameters for the mibuna plant (N₂ dose) are 1500.61 kgda⁻¹ yield, 155.34 g wet weight, and 53.21 g dry weight; for the mizuna plant, 1330.65 kgda⁻¹ yield, 162.58 g wet weight, and 51.03 g dry weight. According to the results, 15 kg nitrogen application to per decare for mibuna and mizuna plants is sufficient.

In another study by Adiloglu et al., (2013) [14] order to determine the effect of increasing doses of sulfur (S) application on some macro and micro nutrient elements, vitamin C, protein contents and biological properties of canola plant. In the experiment four doses of S (S₀: 0 mg.kg⁻¹, S₁:20 mg.kg⁻¹, S₂:40 mg.kg⁻¹, S₃:60 mg.kg⁻¹) were applied as NH₄SO₄ fertilizer in greenhouse conditions. Potassium (K), Calcium (Ca), Magnesium (Mg), Iron (Fe) and Copper (Cu) nutrient elements contents of canola plant increased with S application but the increases were not found statistically significant. The highest Nitrogen (N) (6.68 %), Phosphorus (P) (0.80 %) and Zinc (Zn) (47.4 mg.kg⁻¹) contents were obtained with S₂ dose and the highest Manganese (Mn) (70.6 mg.kg⁻¹) content were obtained with S₃ dose of canola plant.

Another of the early research investigated by Eryilmaz Acikgoz et al., (2014) [15] to determine the effect of increasing nitrogen (N) application on some macro and micro elements, vitamin C, and protein contents of Komatsuna. Four doses of N (N₀: 0 kg.da⁻¹, N₁: 10 kg.da⁻¹, N₂: 15 kg.da⁻¹ and N₃: 20 kg.da⁻¹) were applied as NH₄NO₃ fertilizer in greenhouse conditions. And K, Ca, Mg, Fe and Cu nutrient elements were found statistically insignificant, for N₂ dose under increasing doses of N application; N found as 5.85 %, P 0.81 %, Zn 50 ppm.

In this research, the effects of different doses of calcium nitrate Ca(NO₃)₂ applications on parsley some macro and micro nutrient element contents are examined.

2. MATERIAL AND METHOD

The experiment was carried out in November and January, 2014, Tekirdag city in Turkey (40°97' N, 27°51' E) using unheated high tunnel greenhouse covered by polyetilen (PE) with UV additive, which belongs to Namik Kemal University, Vocational School of Technical Sciences, Plant and Animal Production Department.

The large leaf parsley seeds (Vilmorin Firm) were used for the experiment. The general view of the experiment is presented in the Figure 1.

The experiment is designed according to the randomized block design with three replicates. Sowing was designed as 1.5 g/m², and 4 doses of calcium nitrate fertilizer are applied (I. dose: 0 ppm, II. dose: 15 ppm, III. dose: 30 ppm and IV. dose: 45 ppm). 65 days after of seed sowing, leaves with stalk were cut 5 cm over the ground with a sharp knife. Single harvest was done in the experiment. Some chemical and physical characteristics of the research area soil are presented on the Table 1. The climate data measured inside the tunnel during the growing of the plants can be seen in Table 2. In addition no pesticides were used during the growing period.

According to Table 1, the test soil was identified as having neutral reaction, no salt, medium lime, organic matter amount insufficiency, medium available phosphorus content, and potassium, Mg, Fe,

Cu, Mn and Zn content were sufficiency.

The harvested plants were brought to the laboratory immediately, washed with distilled water two times and they were dried in 65 °C drying-oven till their weights get stabilized for mineral content. They were ground and prepared for the analysis. Total N analysis was carried out with Kjeldahl method, and for their P, K, Ca, Mg, S, Fe, Cu, Zn and Mn analysis, ICP-OES device was used [16].

Then experiment analysis results were evaluated SPSS 21 statistically program. ANOVA variance analysis was done and Duncan multiple comparison tests were done on this research results.

3. RESULTS AND DISCUSSION

3.1. The Effects of the Calcium Nitrate Application on Parsley's Macro Phytonutrient Element (N, P, K, Ca, Mg, S) Contents

The effects of the increasing doses of calcium nitrate application on parsley's some macro nutrient elements are presented on the Table 3. When Table 3 is examined, significant increases can be observed (5 % degree) in N, P, K, Ca, Mg and S contents of parsley with calcium nitrate applications.

It can be observed that the increasing calcium nitrate doses make the plant's nitrogen nutrient elements. Nitrogen use efficiency is also increased with soluble calcium sources such as calcium nitrate [8]. Effect of calcium nitrate foliar application was statistically significant for N, P, K, Ca, Mg contents of leaves. These effects were generally increased on N and Ca amount of leaves but decreased at 1.5% dose on P, K, Mg contents of leaves. As a result, the 1.0% dose of foliar application can be practically recommended [17]. Calcium nitrate applications increased the contents of Ca, K and P of leaves in potato plant [18]. In earlier researches, the amount of calcium fertilization that has been increased has been caused to increase in potassium. In this research the amount of calcium fertilization that has been increased has been caused to increase in manganese and sulfur [19, 20].

The effects of the increasing doses of calcium nitrate application on parsley's some macro nutrient elements are presented on the Figure 2, in which it can be observed that the increasing calcium nitrate doses make the plant's nutrient elements rise.

3.2. The Effects of Calcium Nitrate Application on Parsley's Some Micro Phytonutrient Element (Fe, Cu, Zn, Mn) Contents

The effects of the increasing doses calcium nitrate application on parsley's micro nutrient element contents are given on the Table 4. When Table 4 is examined, it can be observed significant increases (5 % degree) in Fe, Cu, Mn and Zn contents of parsley plant with calcium nitrate applications.

Increasing amounts of calcium fertilizer application in tomatoes resulted in decrease in leaf amounts of Fe, Zn, Cu and Mn depending on the variety [20].

All of the micro elements sufficiency limits at the application levels of both calcium compounds respectively [21].

The effects of the increasing doses calcium nitrate application on parsley's micro nutrient element contents are given on the Figure 3. As it can be seen in the Figure 3, with the increasing calcium nitrate fertilization, the plant's micro nutrient elements increase.

4. CONCLUSIONS

In this research which aims to investigate the effects of the increasing doses of calcium nitrate application on parsley's some macro and micro nutrient element contents under unheated greenhouse conditions, significant increases in parsley's N, P, K, Ca, Mg, S, Fe, Cu, Mn and Zn nutrient elements have been identified compared to the control group. According to the results, the

increasing doses of calcium nitrate application provide the increasing of parsley's some macro and micro nutrient element contents. These increases have been considered important with 5 % statistical degree.

On the other hand, the excessive and unconscious use of chemical fertilizers in agriculture has caused serious problems in the quality of agricultural products. For this reason, the amount, time and using method of chemical fertilizers that will be applied to soil and plant must be arranged according to soil and plant analyses. If not, serious deteriorations will keep rising day by day in the quality of vegetables and all cultigens although high yield is obtained.

ETHICAL APPROVAL

As per international standard or university standard ethical approval has been collected and preserved by the authors.

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Figure 1. A general view from parsley plant experiment (Original).

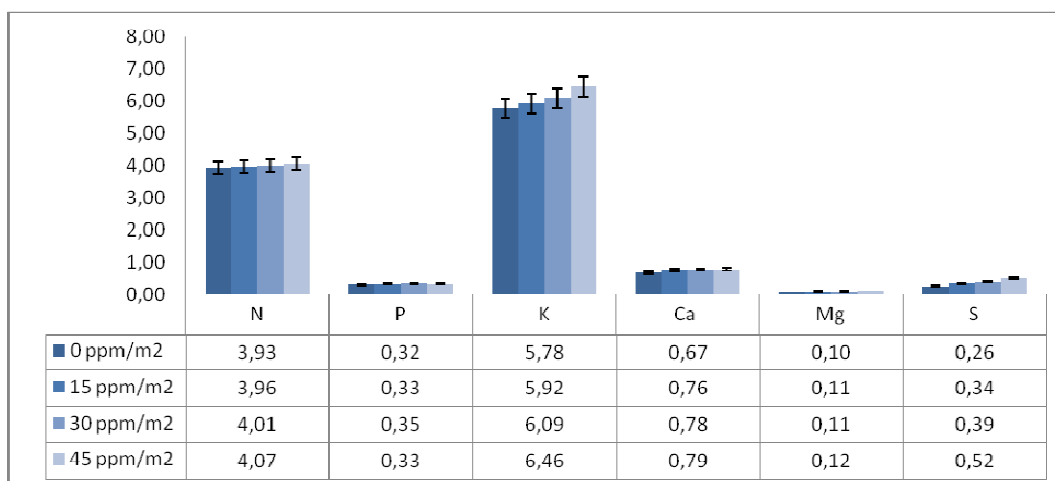


Figure 2. The effect of calcium nitrate application on some macro phytonutrient elements contents of parsley plant, (%).

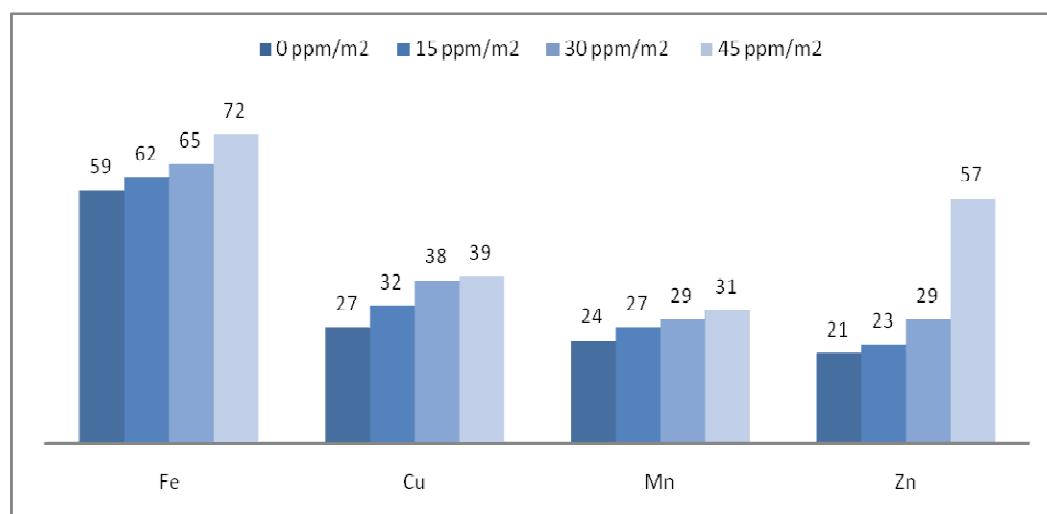


Figure 3. The effect of calcium nitrate application on some micro phytonutrient elements contents of parsley plant, (mgkg⁻¹).

Table 1. Some chemical and physical properties of experiment area soil.

Soil property	Analysis result
pH, 1: 2.5	6.75
EC x 10 ⁶	156
Lime (CaCO ₃), %	6.20
Organic matter, %	1.10
Ca, %	0.73
P ₂ O ₅ , kgda ⁻¹	12.10
K ₂ O, kgda ⁻¹	63.41
Mg, mgkg ⁻¹	320.60
Fe, mgkg ⁻¹	8.95
Cu, mgkg ⁻¹	1.43
Zn, mgkg ⁻¹	0.87
Mn, mgkg ⁻¹	10.72

Table 2. Average climate data in unheated greenhouse during the months of the experiment.

Month	Average Temperature (°C)	Maximum Temperature (°C)	Minimum Temperature (°C)	Average Humidity (%)
November	12.4	14.8	10.0	87
December	9.4	12.5	6.4	88
January	8.3	10.3	6.2	91

Table 3. The effect of calcium nitrate application on some macro phytonutrient elements contents of parsley plant, %, *, **

Doses	N	P	K	Ca	Mg	S
I	3.93c	0.32b	5.78d	0.67b	0.10b	0.26c
II	3.96c	0.33b	5.92c	0.76a	0.11ab	0.34b
III	4.01b	0.35a	6.09b	0.78a	0.11ab	0.39b
VI	4.07a	0.33b	6.46a	0.79a	0.12a	0.52a

*: The values mean of three replications, **: each elements were evaluated individually and values in the same column with different letters are statistically significant at the level of 5 %.

Table 4. The effect of calcium nitrate application on some micro phytonutrient elements contents of parsley plant, mgkg⁻¹, *, **

Doses	Fe	Cu	Mn	Zn
I	59.06d	27.62c	24.70c	21.97c
II	62.16c	32.03b	27.50b	23.30c
III	65.01b	38.90ab	29.03b	29.60b
VI	72.07a	39.80a	31.87a	57.17a

*: The values mean of three replications, **: each elements were evaluated individually and values in the same column with different letters are statistically significant at the level of 5 %.