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RESEARCH ARTICLE

Effects of Nano-Potassium and Nano-Calcium Chelated Fertilizers on Qualitative and Quantitative Characteristics of *Ocimum basilicum*

Aysan Ghahremani[1*], Kamran Akbari[1], Mohammadreza Yousefpour[2], Hamidreza Ardalani[3]

[1]*Department of Horticultural Sciences, Abhar Branch, Islamic Azad University, Abhar, Iran.*

[2]*M.Sc, Agriculture Engineering, Technical and Vocational Training Organization, Rasht, Iran.*

[3]*Department of Horticultural Sciences, Science and Research Branch, Islamic Azad University, Tehran, Iran.*

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ABSTRACT

This study was made up in order to investigate the effects of different levels of Nano calcium and Nano potassium chelate fertilizers on quantitative and qualitative characteristics of Basil. Basil (*Ocimum basilicum*), belongs to the *Lamiaceae* family. The study was conducted in a randomized complete design with four replications at a greenhouse in Gonbad Qabus city, Golestan province during 2011-2012 cropping season. The experimental treatments were Nano calcium foliar treatments with 1/1000 and 2/1000 concentrations and Nano potassium foliar treatments with 2/1000, 4/1000 and 6/1000 concentrations and control without any foliar. Results showed that performance increased in comparison with control in plants exposing to 2/1000 Nano calcium chelate fertilizer and different levels of Nano potassium chelate fertilizer. Treatments with 2/1000 Nano calcium and 6/1000 Nano potassium concentration had the highest One thousand seed weight ($P<0.05$). Calcium and potassium Nano fertilizers significantly increased basil dry matter ($P<0.05$). Moreover, in comparison with control, high levels foliar Nano calcium and Nano potassium treatments, showed better leaf area. Also, Nano calcium and Nano potassium fertilizer treatments, increased harvest index, grain yield, biological yield, calcium percentage, potassium percentage and Chlorophyll content in basil.

KEYWORDS

Ocimum Basilicum, Nano Calcium Chelate Fertilizer, Nano Potassium Chelate Fertilizer, Grain Yield, Biological Yield, Harvest Index

INTRODUCTION

The *Ocimum* genus belonging to the *Lamiaceae* family is characterized by a great variability of both morphology and chemotypes.[10,11] Among all the species, *Ocimum basilicum* L. (basil or sweet basil) has the most economic importance and is cultivated and utilized throughout the world.[11] Sweet basil is a well-known and appreciated spice and medicinal plant.[16]

***Address for Correspondence:**
Aysan Ghahremani
Department of Horticultural Sciences,
Abhar Branch, Islamic Azad University, Abhar, Iran.
E-Mail Id: ghahremanye@yahoo.com

O.basilicum L. is very popular and widely grown herbs in the worldwide.[6] Basil is an annual herb with 50-60 cm plant height and pink and white flowers. The useful parts of basil plant are leaves and seeds. The most component of basil is essential oil. Oil yield varies from 0.1 to 0.45% based on ecological and agronomical conditions.[1] Basil is widely used as a vegetable and as aromatic plant and was originated North West India, North East Africa and Middle Asia.[7] Basil has been utilized for its expectorant, carminative and stimulant properties in folk

medicine. In addition, it was used as insecticide.[3] Fresh and dry leaves of plant are used in food and spice industries. The oil of basil is used in food industries, perfumery, dental and oral products.[19,22,24] The main germicidal and fungicidal compound occurring in basil leaves and flowers is essential oil.[26,9] The oil of basil has antimicrobial effect.[4] Some of its oil components, such as 1, 8-cineole, linalool and campor are known to be biologically active.[11,12] Basil responds well to fertilization.[8]

As the approach of reducing or eliminating the use of chemical fertilizers has been proposed in recent years, using new products in this field has been considered by producers and researchers. Nanotechnology as a leading science, tries to produce less harmful and more effective Nano based fertilizers. One of the most important usages of nanotechnology in various fields of agriculture like soil and water is using Nano fertilizers for plant nutrition. Due to graduated release property, Nano fertilizers cause optimum usage of nutrients. Ecotype of *Ocimum* is morphologically diverse, and in the species of this genus, *Ocimum basilicum*, has an economic importance and is used as a medicinal plant, spice and fresh vegetable. In this research, the effects of using potassium and calcium chelate Nano fertilizers on basil's performance have been studied.

MATERIALS AND METHOD

To study the effects of Nano calcium and Nano potassium fertilizers on quantitative and qualitative traits of basil, an experiment was conducted in a greenhouse in Gonbad Qabus city in summer of 2012. Soil samples used in experimental pots were analyzed by A.A.S method; the results are shown in table 1.

Basil variety used in this experiment was Ardestan. Experimental pots were prepared with similar condition in a standard greenhouse. After germination, plants were thinned. The experimental design was completely randomized with four replicates. The experimental treatments were Nano calcium foliar treatments with 1/1000 and 2/1000 concentrations and Nano potassium foliar treatments with 2/1000, 4/1000 and 6/1000 concentrations and control without any foliar. Basil plants were sprayed with nano fertilizers in four leaf stage. Foliar feeding is an effective method of supplying plants with nutrients, much faster than soil fertilization. The effectiveness of this procedure may result from quick penetration and transfer of the applied nutrients inside the plant.[14]

According to the manufacturer recommendation, chelated potassium and calcium nano fertilizers were used together simultaneously. Harvesting of vegetative organs was done in late September. Traits of each pot were measured during vegetative period and in the end of flowering and seed production. After determination of data normality, results were analyzed using SPSS 18.[23] Duncan test was performed to compare the mean difference between the different treatments with a confidence level of $P<0.05$.

RESULTS AND DISCUSSION

Results show that applying nano calcium and nano potassium fertilizer treatments affected most growth indicators in basil. Measuring the seed weight in inflorescences, showed that use of 2/1000 nano calcium fertilizer simultaneously with 2, 4 and 6/1000 of nano potassium fertilizer significantly showed higher performance in basil compared with control.

Table 1: Analysis of soil sample used in the experimental pots (20)

Saturation %	Electrical conductivity EC×7.6	Total Saturated Acid	Organic Carbon %	Absorbable Potassium p.p.m	Clay %	Silt %	Sand %	Type of Soil	Calcium p.p.m	Organic Materials % O.M
68.8	4.4	7.6	3.49	244	24	60	16	Si-L	3372	6.01

Nazaran *et al* (2009) studied the effect of Nano iron chelate fertilizer on quantitative and qualitative characteristics in dry land wheat and expressed that Nano iron chelate foliar fertilizers, increase the quantity and quality of wheat compared with control .[13] Sharafzadeh and Alizadeh (2011) expressed that basil grown in greenhouse seemed to be sensitive to high concentration of fertilizers and utilization of biofertilizers can enhance plant growth.[21]

According to higher performance of seed yield (g/plant) in treatments with 2/1000 nano calcium fertilizer simultaneously with different levels of nano potassium fertilizer in comparison with control ($P<0.05$), we can conclude that appropriate level of calcium nano fertilizer is 2/1000 use of nano fertilizer.

Highest performance in seed yield observed in treatments with 2/1000 nano calcium simultaneously used with 6/1000 nano potassium fertilizers.

Nano fertilizers release their nutrients slowly and steadily. Therefore, nano fertilizers are able to adjust the speed of nutrient release. This issue improves nano fertilizer use efficiency.[5] In an experiment, Beigi *et al* (2010) stated that soybean yield significantly increased with increasing spray of nano Fe fertilizer.[2]

Except 1/1000 nano calcium simultaneously used with 2/1000 potassium nano fertilizer, the rest of nano fertilizer treatments, had better one thousand seed weight in comparison with control. So it can be concluded that the use of calcium and potassium chelated nano fertilizers, increased one thousand seed weight in basil.

Parandeh *et al* (2011) expressed that Growth parameters in plants exposed to high concentrations of Nano Fe (5 $Kg.ha^{-1}$) were significantly increased.[17] Wright *et al* (1998) expressed that improved nutrient uptake in host plants, leading to positive growth responses.[25]

Control treatment had the lowest total chlorophyll. Among the Nano fertilizer treatments, 1/1000 nano calcium simultaneously used with 2/1000 potassium nano fertilizer treatment had the lowest chlorophyll and 2/1000 nano calcium simultaneously used with 6/1000 nano potassium fertilizer treatment had the highest chlorophyll content. These results showed that high levels of nano calcium and nano potassium fertilizers increased chlorophyll content. Peyvandi *et al* (2011) expressed that the use of nano iron chelate fertilizer in savory, increased *a* and *b* chlorophyll content.[18]

Treatments containing 2/1000 nano calcium fertilizer used simultaneously with different levels of nano potassium fertilizer, significantly showed more leaf area in comparison with control ($P<0.05$). It showed that use of high level of nano calcium fertilizer with nano potassium fertilizer, increased leaf area in basil. Treatment containing 2/1000 nano calcium fertilizer and 6/1000 nano potassium fertilizer had the highest leaf area.

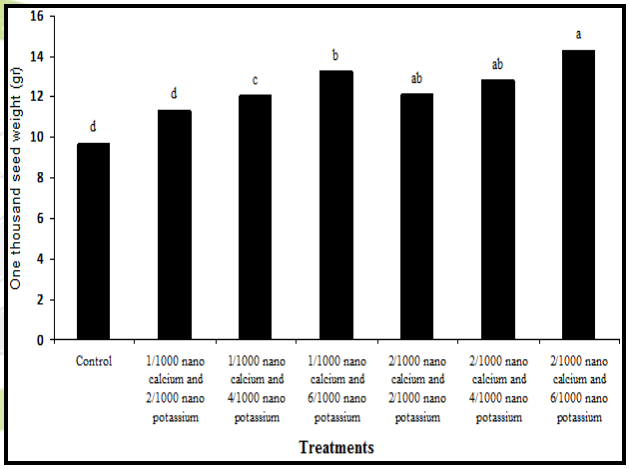

Figure 1: Comparison of One thousand seed weight in different treatments

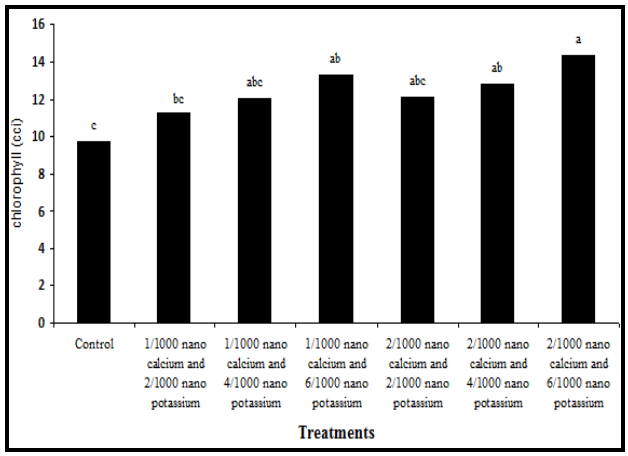

Figure 2: Comparison of chorophyll content of leaf in different treatments

Treatments containing 2/1000 nano calcium fertilizer used simultaneously with different levels of nano potassium fertilizer, significantly showed more basil calcium content in comparison with control (P<0.05). Treatment containing 2/1000 nano calcium fertilizer and 6/1000 nano potassium fertilizer had the highest calcium content. Control treatment had the lowest calcium content. Treatments containing 2/1000 nano calcium fertilizer used simultaneously with different levels of nano potassium fertilizer, significantly showed more basil potassium content in comparison with control (P<0.05). Nurzynska *et al* (2011) showed that basil plants receiving the most potassium had more protein in the herb than plants receiving less of that nutrient.[15] Control treatment had the lowest potassium content. These results showed that use of nano calcium chelate fertilizer simultaneously with nano potassium chelate fertilizer, increased calcium and potassium content of basil compared with control.

Treatment containing 1/1000 nano calcium fertilizer simultaneously with 6/1000 nano potassium fertilizer, significantly had better harvest index in comparison with control (P<0.05).

Also treatments containing 2/1000 nano calcium fertilizer simultaneously with different levels of nano potassium fertilizer showed better harvest index in comparison with control (P>0.05). According to these results, use of nano calcium chelate fertilizer simultaneously with nano potassium chelate fertilizer increased basil harvest index in comparison with control.

Treatment containing 2/1000 nano calcium fertilizer used simultaneously with 6/1000 level of nano potassium fertilizer, significantly showed more grain yield in comparison with control (P<0.05). Treatments containing 2/1000 nano calcium fertilizer used simultaneously with different levels of nano potassium fertilizer had better grain yield in comparison with control.

Table 2a: Factors measured in different experimental groups (Mean ± SE**)**

Experimental Groups	**Seed weight in inflorescences (g)**	**Seed yield (g/plant)**	**Dry matter (%)**	**Leaf area (cm^2)**
Control without nano fertilizer	0.341±0.0008 c	0.3728±0.022 c	88.6±0.7789 c	5.714±0.69 c
1/1000 nano calcium and 2/1000 nano potassium	0.3478±0.0033 c	0.3978±0.014 bc	94.93±0.3987 a	7.6065±1.28 c
1/1000 nano calcium and 4/1000 nano potassium	0.3552±0.0009 c	0.4272±0.011 b	93.87±0.629 ab	9.673±0.67 bc
1/1000 nano calcium and 6/1000 nano potassium	0.4398±0.0307 b	0.4758±0.022 a	94.21±0.428 ab	12.1805±3.28 ab
2/1000 nano calcium and 2/1000 nano potassium	0.4558±0.0017 ab	0.4778±0.015 a	92.72±1.87 b	14.2142±0.35 a
2/1000 nano calcium and 4/1000 nano potassium	0.4598±0.0039 ab	0.4898±0.021 a	94.21±0.555 ab	14.1730±2.77 a
2/1000 nano calcium and 6/1000 nano potassium	0.4770±0.0059 a	0.5048±0.0064 a	94.64±0.539 ab	15.407±0.125 a

Means followed by dissimilar letter(s) in a column are significantly different from each other at p=0.05

Results showed that use of nano calcium chelate fertilizer simultaneously with nano potassium chelate fertilizer increased basil grain yield in comparison with control.

Treatments containing 2/1000 nano calcium fertilizer used simultaneously with different levels of nano potassium fertilizer, significantly showed more basil biological yield in comparison with control ($P<0.05$). Treatment containing 2/1000 nano calcium fertilizer used simultaneously with 6/1000 level of nano potassium fertilizer, showed more grain yield in comparison with other experimental treatments. According to results, use of nano calcium chelate fertilizer simultaneously with different levels of nano potassium chelate fertilizer increased basil biological yield in comparison with control.

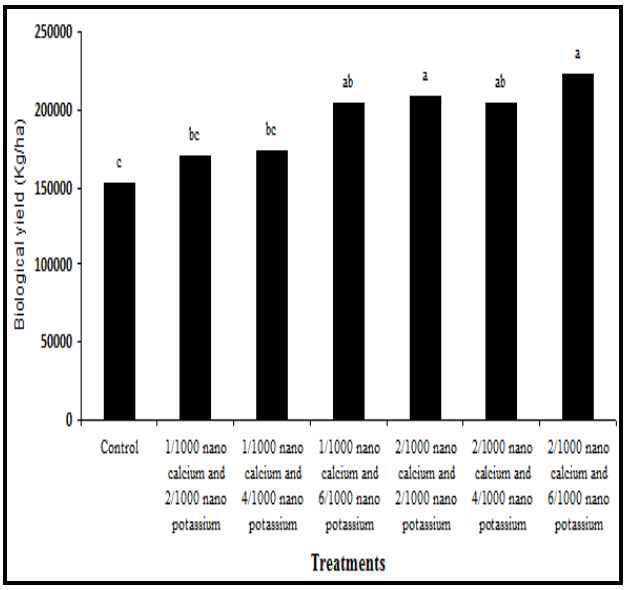

Figure 3: Comparison of biological yield in different Treatments

Table 2b: Factors measured in different experimental groups (Mean ± SE)

Experimental Groups	Calcium (%)	Potassium (%)	Grain yield (Kg/ha)	Harvest index (%)
Control without nano fertilizer	2.46±0.05 c	1.815±0.02 c	85.357±41.28 b	77.4±7.23 b
1/1000 nano calcium and 2/1000 nano potassium	2.537±0.06 bc	1.8325±0.305 bc	85.321±35.28 b	77.9±6.49 b
1/1000 nano calcium and 4/1000 nano potassium	2.61±0.03 ab	1.855±0.04 bc	95.142±30.14 b	77.8±7.72 b
1/1000 nano calcium and 6/1000 nano potassium	2.587±0.075 bc	1.8725±0.017 bc	169.82±46.87 ab	80.7±5.03 a
2/1000 nano calcium and 2/1000 nano potassium	2.67±0.05 ab	1.89±0.014 b	149.87±17.85 ab	78.6±6.08 ab
2/1000 nano calcium and 4/1000 nano potassium	2.68±0.067 ab	1.895±0.03 b	177.1±27.85 ab	79.8±3.19 ab
2/1000 nano calcium and 6/1000 nano potassium	2.795±0.01 a	1.9875±0.03 a	199.89±35.14 a	78.5±4.85 ab

Means followed by dissimilar letter(s) in a column are significantly different from each other at p=0.05

CONCLUSION

Results of this experiment suggest that applying nano calcium chelate fertilizer simultaneously with nano potassium chelate fertilizer, improve basil performance in comparison with control. Treatment containing 2/1000 nano calcium fertilizer used simultaneously with 6/1000 level of nano potassium fertilizer showed better performance compared with control.

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