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INFLUENCES GROWTH INDEX AND YIELD IN DRACOCEPHALUM (*DRACOCEPHALUM MOLDAVICA* L.)

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Abstract

NEJATZADEH-BARANDOZI, F., E. H. SHAHVALADI and F. GHOLAMI-BORUJENI, 2015. Nitrogen fertilization and microelements influences growth index and yield in Dracocephalum *(Dracocephalum moldavica* L.) *Bulg. J. Agric. Sci.*, 21: 266–269

Dracocephalum (*Dracocephalum moldavica* L.) is a perennial herbaceous plant belonging to the Lamiaceae family, with high essential oil content, and traditionally used as a cardiotonic agent in the folk medicine. This study was conducted in 2010 and 2011 at Iran County, aiming to determine the effects of doses of nitrogen (0, 100, 150, and 160 kg ha^{-1}) and microelements such as Fe, Zn and Mn (0, 50, 50 and 50 kg ha^{-1}) on yield and essential oil content. A completely randomized block design with four replications was adopted. Increased doses of $NH_4 NO_3$ and microelements resulted in higher yield and essential oil content.

Key words: Dracocephalum moldavica, essential oil content, microelement, nitrogen fertilizer

Introduction

Dracocephalum moldavica (*D. moldavica*) is a perennial herb belongs to the Lamiaceae (Labiatae) family. In Iran, the plant known as *Badershoo* has traditionally been used for its culinary properties plus treatment of stomach and liver disorders, headache and congestion (Dastmalchi, 2007). *D. moldavica* is also used as a cardiotonic agent in the folk medicine of Iran (Anonymous, 2006). This species is native to central Asia and is naturalized in eastern and central Europe. Nevertheless it also grows in Egypt, China, Mongolia, and the Himalayas, at altitudes of up to 2700–3100 m above sea level. In these regions it has been used for ages in folk medicine to treat, mainly, heart disease, blood pressure, angina, atherosclerosis, neuralgia, migraine, headache and toothache (Dastmalchi et al., 2007). Additionally it has been reported, that *Dracocephalum moldavica* extracts possess sedative and analgesic activity (Sultan et al., 2008). This specie has a pleasant smell of lemon and it has been attributed relaxation properties, the analyses of its essential oil revealed the presence of geraniol and citral, which could account for its tranquilizer properties (Holm et al., 1988). In Iran, *Dracocephalum moldavica* has been adapted to the Northwestern region of the country, where nowadays it is systematically cultivated all the year, though it grows in environmental conditions different from those of its native land. Despite its intensive use in traditional Iranian medicine, little data on the effect of Nitrogen and Microelements on yield and essential oil content *Dracocephalum moldavica* are available.

In medicinal plants it is important to study the response to Nitrogen fertilizer, since this element may influence the essential oil content of this species. According to Rahbarian (2009), Nitrogen fertilization in adequate amounts stimulates root development, ensures a vigorous establishment, increases grain yield. Nitrogen is an essential element directly participating in vital biochemical reactions, including synthesis of proteins, oils and fats, forming structures such as nucleic acid, which are present in several cell components (Almodares et al., 2009). Therefore, Nitrogen application becomes a necessary practice for essential oil-producing plants.

Hussien (1995) showed that an increased supply of nutrients is essential to obtain a higher concentration of Coriander and Dill essential oils, however, this effect should be

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confirmed in other environments and genotypes. Our study aimed to determine the effect of rates of Nitrogen and Microelements at sowing on yield and essential oil content in *Dracocephalum moldavica.*

Materials and Methods

The experiment was conducted under field conditions during 2010 and 2011, at the Experimental field of Islamic Azad University, Khoy, Iran (38° 25′ 38″ N, 44° 58′ 24″ E, and 11.3 m of altitude). The climate is classified as semiarid climate, with an average annual temperature of 13.6°C. The soil is loamy clay texture (Almodares et al., 2009).

Table 1 presents information on the chemical characteristics of the soil from the experimental area. The experiment was conducted in a completely randomized block design with four replications. Nitrogen doses were applied at sowing [$N_0 = 0$, $N_1 = 100$, $N_2 = 150$ and $N_3 = 160$ kg ha^{-1} (NH_4NO_3)], microelements such as Fe, Zn and Mn [$M_0 = 0$, $M_1 = 30$ (10 + 10 + 10), $M_2 = 45$(15 + 15 + 15) and $M_3 = 60$ (20 + 20 + 20) kg ha^{-1}] respectively. Based on soil analysis, fertilization was carried out applying 9 kg ha^{-1} P_2O_5 (triple superphosphate) and 30 kg ha^{-1} K_2O (potassium chloride). Seeds of the Dracocephalum were provided by Institute of Seed and Plant, Karaj. Plots consisted of six rows 5 m long, spaced 0.25 m. The experiment was planted manually on April, 2010 and 13 May, 2011, at a rate of 800 000 plants per hectare. During the crop cycle manual weeding was performed, with no chemicals applied to control pests throughout the crop cycle.

At around 90 days in both agricultural years, a manual harvest was conducted of the two central rows in each plot. Impurities were removed using sieves, the grain then cleaned, essential oil content and yield determined, and data converted to kg ha^{-1}.

For the evaluation of Essential oil content, the extraction was performed under laboratory conditions according to the methodology proposed by IAL – Adolfo Lutz Institute, with Soxhlet extraction (IAL, 1985), through the use of petroleum ether solvent. Extraction was carried out in all replicates of each treatment with 2 g of milled plant material. Thus, it was possible to obtain the results in percentage, by sample weight differences.

Statistical analyses were performed following analysis of variance and means, at the 1% significance level, with the SPSS computational program.

Results and Discussion

There was a significant effect of treatments on yield and essential oil content. Treatments with higher Nitrogen levels resulted in increased yield (Figure 1). Essential oil yield, achieved agree with the results obtained by Rahbarian et al. (2009), who also noted a significant increase in (*Dracocephalum moldavica* L.) and grain yield, with elevated Nitrogen concentrations. Nitrogen is essential for increasing yield, as

Table 1

Soil chemical characteristics from in experimental area at 0÷20 cm depth (Khoy, 2011)

pH	P	O.M.	Ca	K	Mn	Fe	Zn	C.C.C.	V
$CaCl_2$	mg dm^{-3}		cmolc dm^{-3}						%
7.5	10.2	8.50	1.40	0.52	0.75	0.61	0.71	7.02	33.21

O.M. = organic matter. C.C.C. = cationic change capacity. V = basis saturation.

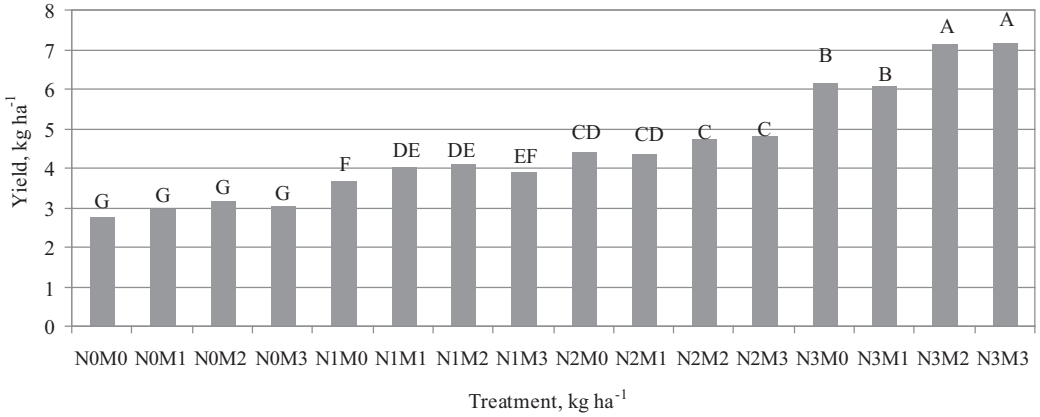

Fig.1. Yield under fertilizers treatment in *Dracocephalum moldavica*
****significant at 1% probability**

part of the production of Protein (Almodares et al., 2009). In 2011, the yield increased from 289.73 kg ha^{-1} without fertilization to 1224.98 kg ha^{-1} when 100 kg ha^{-1} of NH_4NO_3 was provided.

In this condition the yield values obtained were below the vegetable specie production capacity, according Rahbarian et al. (2009) it is about 1500 kg ha^{-1}, due the occurrence of freezing temperatures limited plant growth. According to Rahbarian et al. (2009), increased essential oil yields are achieved only with Nitrogen supply in quantities compatible with crop demands, thus excessive NH_4NO_3 applications are required, since no other nutrient limits production. This explains the high essential oil yields from higher NH_4NO_3 rates applied, as occurred in studies conducted by Aziz et al. (2012) and Rahbarian et al. (2009), where the authors observed average yields around 1500 kg ha^{-1} in *Dracocephalum* plants. It becomes evident that Nitrogen fertilization is responsible for higher yield essential oil, as is confirmed by several studies performed with other species and environmental conditions, as described by Galambosi et al. (2002) in Finland. For oil production, there was significant effect due to NH_4NO_3 and microelements rates (Figure 2).

According to Almodares et al. (2009), Nitrogen is connected with protein synthesis, production of oils and fats, forming structures such as nucleic acid that are present in various parts of the cell. In studies with Aziz et al. (2012) and Marotti et al. (1993) find a significant difference between Nitrogen rates applied in relation to essential oil content and increase leaf yield per plant. Values observed for essential oil production were within the potential oil production of *Deracocephalum,* which according Safikhani et al. (2007), ranges from 35 to 60%, suggesting similar values to the ones obtained in this work, and agreeing with Almodares et al. (2009), who found a range in essential oil content from 35 to 45%. Higher Nitrogen and microelements rates may not act directly on oil content (%) in leaves, but does result in higher grain yield and consequently higher essential oil production per hectare, as shown in Figure 3. Increased Nitrogen and

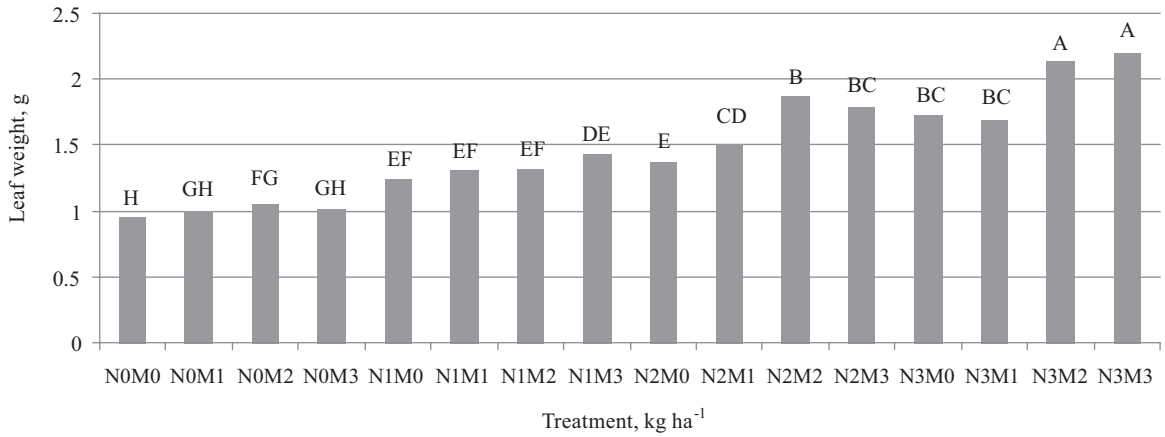

Fig. 2. Leaf weight (g) *Dracocephalum moldavica* under fertilizers treatment

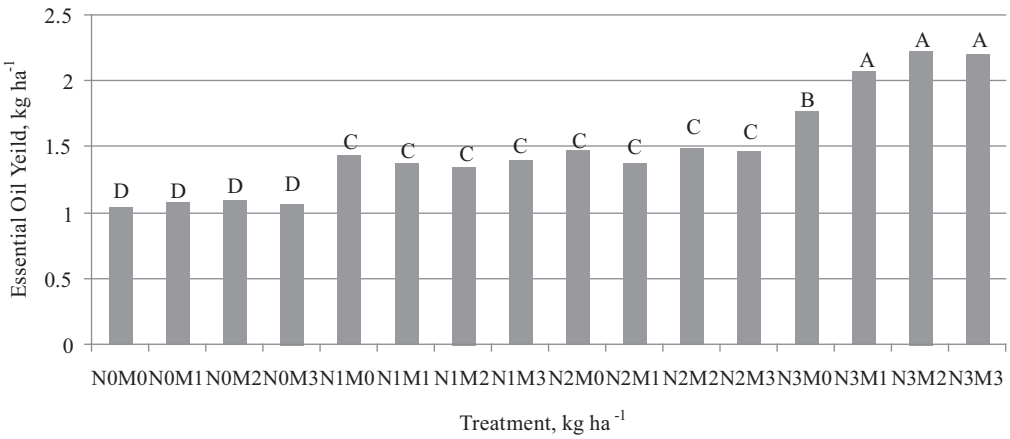

Fig. 3. Essential oil yield (kg ha^{-1}) under fertilizers treatment on *Dracocephalum moldavica*

microelements rates resulted in higher essential oil production per hectare, and this effect was observed in 160 kg ha^{-1} of NH_4NO_3 and 30, 45 and 60 kg ha^{-1} of microelements. Suggesting the importance of thesis elements for the development of this species, as observed in studies conducted for Yadav and Khurana (1999) where lower manure rates limited plant development of fennel, resulting in inferior oil yield, the most important characteristic of this crop.

Other authors have investigated Dracocephalum's response to fertilizers rates (Figure 3). Davazdahemami et al. (2008) evaluated four Nitrogen rates and five zinc rates as fertilizers, with application in a soil containing 10 mg kg^{-1} NH_4NO_3. They observed that Nitrogen and microelement fertilizer increased dry matter yield in superior parts of the plants.

Conclusion

Data obtained revealed that increased rates of NH_4NO_3 and microelements resulted in higher leaf yield and higher essential oil production per hectare. Based on results it can be said application of NH_4NO_3 and microelements, it can be an important role in increasing essential oil content of Moldavian balm.

Acknowledgments

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