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# NUTRIENT CONTENT OF FENUGREEK (TRIGONELLA FOENUM-GRAECUM L.) ON THE EFFECT OF DIFFERENT FERTILIZATION TREATMENTS

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***Abstract***
*Fenugreek (Trigonella foenum-graecum L.) belonging to the legumes (Fabaceae) family is an annual plant. The plant is of Mediterranean origin, native to the Mediterranean coast. A multi-use plant that is used as a herb, spice and fodder plant. Fenugreek has high protein content and is well suited for feeding domestic and wild animals. Our open-field experiment was set up at the beginning of April 2018 in John von Neumann University, Faculty of Horticulture and Rural Development, Kecskemét, Hungary. The experiment was set with different magnesium fertilization treatments (Treatment 1 = 150 kg Ha$^{-1}$, Treatment 2 = 300 kg Ha$^{-1}$, Treatment 3 = 450 kg Ha$^{-1}$). The aim of the treatments is to show how macro element (nitrogen, magnesium, calcium, potassium and phosphorus) values (m/m% dry matter) of the stem and leaves are changing.*

## 1 Introduction

Fenugreek *(Trigonella foenum-graecum* L.) belonging to the legumes *(Fabaceae)* family is an annual plant [1]. Leaves are like alfalfa, the leaves are scattered along the stem [2]. The plant is primarily self- pollinating, but can also be extraneous pollinating [3]. Mediterranean, native to the Mediterranean coast. It is cultivated as a spring-sown plant in temperate climate countries. It is grown as an autumn sown plant in Egypt, Morocco and India [4]. A multiuse plant that is used as an herb, spice and fodder plant. In Hungary, Sámuel Diószegi and Mihály Fazekas published the Hungarian Phenomenon in 1807 as a wild herb [5]. Hungary before 1945 years, the southern part of the country was cultivated fenugreek, horticultural crops. Later, in 1969-1970, the Tápiószelei Agrobotany Institute started the experimental cultivation. From 1982, research on the technology of cultivating fenugreek and the production of new, intensive varieties began in Mosonmagyaróvár. Then in 1987, a new Hungarian fenugreek breed has been generated, known under the name "Óvári-4". This variety was accepted by the state later, in 1994.

It is mainly used to promote digestion, compress inflammation, fattening, and milk selection. In North America, the settlers took fenugreek and used as fodder plant. The *T. foenum-graecum* crop has several advantages. *Rhisobium meliloti* is a nitrogen-binding bacterium on its roots that can bind about 70-90 kg/ha of nitrogen in the soil [4]. Due to its high protein content, fenugreek is well suited for feeding of domestic and wild animals.

Our experiment was set with different fertilization treatments; the aim of which is to show how nutritional values of the stem and leaves are changing.

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## 2 Material and methods

The experiment was carried out in the pilot farm of John von Neumann University, Faculty of Horticulture and Rural Development, in Kecskemét, Hungary in 2018. Our test plant was fenugreek (*Trigonella foenum-graecum* L.). In the course of the open field trials different nutrient doses were applied. Seed sowing was performed in open field on 9$^{th}$ of April 2018. The treatments were carried out in plots of 50-50 $m^2$, according to the following methods: treatment 1 = 150 kg $Ha^{-1}$; treatment 2 = 300 kg $Ha^{-1}$; treatment 3 = 450 kg $Ha^{-1}$ complex base fertilizer. Mechanical weed control was applied. No chemicals or herbicides were applied. The harvest took place from June 25$^{th}$ to July 9$^{th}$.

The soil analysis of the experimental area (*Table 1*) and its evaluation was carried out by Soil and Plant Testing Laboratory of Faculty of Horticulture and Rural Development (Kecskemét).

*Table 1. Soil characteristics of the experimental area (2018)*

| Denomination | Measurement unit | Value |
|---|---|---|
| $pH_{KCL}$ | - | 7.61 |
| $K_A$ | - | 28 |
| Water soluble salt | m/m% | <0.02 |
| Humus | m/m% | 1.43 |
| $CaCO_3$ | m/m% | 2.62 |
| $NO_2$-$NO_3$-N | mg/kg | 1.43 |
| $P_2O_5$ | mg/kg | 548 |
| $K_2O$ | mg/kg | 104 |
| Mg | mg/kg | 106 |
| Na | mg/kg | 6.61 |
| Cu | mg/kg | 13.1 |
| Mn | mg/kg | 55 |
| Zn | mg/kg | 9.72 |
| Fe | mg/kg | 64.1 |
| $SO_4$ | mg/kg | 8.4 |

Fertilizer used in research: NovaTec premium 15-3-20 (+2MgO+10S) + TE. Technical data of fertilizer: 15.0% total nitrogen (N); 8.0% ammoniacal nitrogen ($NH_4$-N); 7.0% nitrate nitrogen ($NO_3$-N); 0.0% carbamide nitrogen ($NH_2$-N); 3.0% phosphate ($P_2O_5$) soluble in neutral ammonium citrate and water; 2.4% phosphate ($P_2O_5$), water soluble; 20.0% potassium oxide ($K_2O$), water soluble; 2.0% total magnesium oxide (MgO); 1.6% magnesium oxide (MgO), water soluble; 10.0% total sulphur (S); 8.0% sulphur (S), water soluble; 0.02% total boron (B); 0.0% total copper (Cu); 0.06% total iron (Fe); 0.0% total manganese (Mn); 0.01% total zinc (Zn); 0.8% nitrification inhibitor 3.4-dimethyl-pyrazole-phosphate (DMPP) related to total of $NH_4$-N and $NH_2$-N; low in chlorine (Cl).

Physical properties: 1, physical appearance: solid, granulated; 2, colour: purple; 3, bulk density: 1,250 ± 100 kg/$m^3$; 4, granulometry: 90 % = 2-4 mm; 5, average granule size (d50): 3.2 ± 0.4 mm; 6, pH (1:10 in water): 4.5-5.5 [6].

Leaf- and stem samples were dried at 70 °C. The air-dry samples were thoroughly minced. For elemental studies powdered samples were digested in a microwave device by means of concentrated nitric acid and hydrogen peroxide (Milestone Ethos Plus). Macro element content was measured by optical emission spectrometer (ICP-AES method) [7]. Nitrogen content in leaf and stem was determined using the Kjeldahl method after sulphuric acid digestion (FOSS Kjeltec 2300). Macro element (N, P, K, Ca, Mg, Na) contents were calculated in m/m% dry matter.

The required tests were made according to the regulation including measurement of the N, P, K, Ca, Mg content.

## 3 Results

During the study we determined (m/m% dry matter) the concentration of some nutrients (nitrogen, magnesium, calcium, potassium and phosphorus) of fenugreek in the parts of the plants above the ground (stem, leaf) (*Figure 1*). For all three treatments (150-, 300- and 450 kg Ha$^{-1}$), the highest macro element values were measured for nitrogen (from 2.91 m/m% till 3.5 m/m%) and calcium (from 2.75 m/m% till 3.44 m/m%) in dry matter. The Treatment 1, Treatment 2 and Treatment 3 were measured the lowest macro element values for phosphorus (from 0.31 m/m% till 0.53 m/m%) and magnesium (from 0.40 m/m% till 0.47 m/m%) in dry matter.

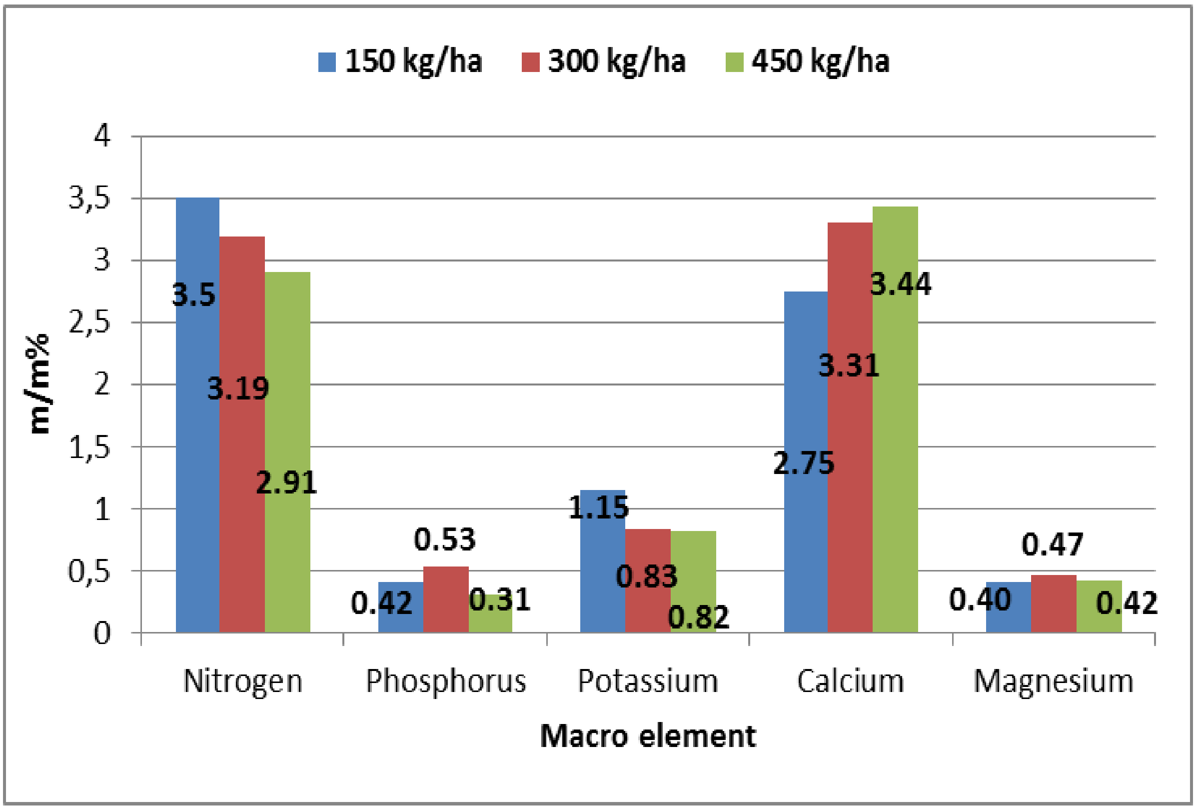


*Figure 1. Macro element (N, P, K, Ca, Mg, Na) contents were calculated in m/m% dry matter.*

The spring-type *T. foenum-graecum* can be harvested in 80-90 days after seeding (*Figure 2*).

*Figure 2. Fenugreek stock on 4th of June 2018.*

## 4 Conclusions

The aim of the treatments is to show how macro element (nitrogen, magnesium, calcium, potassium and phosphorus) values (m/m% dry matter) of the stem and leaves are changing.

The calcium content in the dry matter (m/m%) increased linearly from Treatment 1 (150 kg $Ha^{-1}$) to Treatment 3 (450 kg $Ha^{-1}$) in the examined fenugreek stems and leaves. The highest calcium was 3.44 m/m% in Treatment 3.

In the tested *T. foenum-graecum* plants, nitrogen and potassium contents of air-dry substance (% m/m) decreased steadily by increasing the fertilizer doses from 150 kg $Ha^{-1}$ to 450 kg $Ha^{-1}$. The highest nitrogen was 3.50 m/m% in Treatment 1. The value of highest potassium contents was in Treatment 1 (1.15 m/m%).

After the initial growth, phosphorus and magnesium concentration decreased with increasing fertilizer use.

For all three treatments (150-, 300- and 450 kg Ha-1), were measured the lowest macro element values for phosphorus (from 0.31 m/m% till 0.53 m/m%) and magnesium (from 0.40 m/m% till 0.47 m/m%) in dry matter.

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