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# EFFECTS OF DIFFERENT NITROGEN DOSES ON THE NUTRITIONAL MINERAL CONTENT OF FIELD PEA SEEDS

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## Abstract

The purpose of this study was to determine the effects of different nitrogen doses (0-30-60-90 kg $ha^{-1}$), applied at different growth periods, on the nutritional ingredients of field pea seeds. In this experiment, Furkan cv. pea (*Pisum sativum ssp.* a*rvense*) as the plant material and ammonium sulfate (21% N) fertilizer as the nitrogen source were used. This study was established as a randomized complete block experimental design and was carried out in irrigation conditions in 2013. Plants were irrigated four times during the growing period; the first irrigation as sprinkler and the others as drip irrigation. Nitrogen applications were made, 30 kg $ha^{-1}$, at three different growing stages; one week after sowing, at the stage when the first bunch was flowering and at the time when 50% of the plots were flowering. According to result of this study, effects of the application of nitrogen doses were found significantly important ($P<0.05$) on calcium content of field pea seeds. The effects of the application of nitrogen doses were not significant ($P>0.05$) on the content of cobalt, molybdenum, boron, cadmium, copper, iron, potassium, magnesium, manganese, sodium, nickel, phosphorus, sulfur, zinc, and nitrogen in field pea seeds.

**Key words:** *Field pea, nitrogen doses, nutritional minerals, seed*

## Introduction

The population of Turkey is increasing as is also the world population. Malnutrition of human causes health and social problems in all over the world. In a balanced diet program 1g protein per kg needs to be consumed daily (Avcıoğlu et al., 2000). The products of animal origin are coming from 14.5 million bovine (cattle, cow etc.) and 38.5 million caprine in order to get a balanced diet for this ever increasing population (sheep or goats) (Anonymous, 2013). Turkey has 23.8 million hectares of arable land in total and 2.7 million hectares of this land is used for forage crops production (Anonymous, 2012). Most of the hay needed comes from forage crops in this country.

In Turkey mostly grown forage crops are silage maize, alfalfa, vetch and sainfoin. In recent years, some field pea varieties have been released in our country and field pea is started to become an important forage crop.

Field pea is a cool season plant and its adaptation ability is relatively high (McPhee, 2003). During field pea cultivation it does not need to use fertilizing support and also it is an important rotation crops with the ability of fixing into soil 5-15 kg per ha and leaving a clean land for the following crops. Field pea can be used as a dual purpose, as a forage and as a grain. Besides, it can be grown just as it is or as a mixture with wheatgrass for grazing, hay or silage production (McKenzie and Sponer, 1999). It is true that the hay harvested with highest protein and moisture content of leaves can be eaten well by animals (Tekeli and Ateş, 2007). The seeds of field pea are highly nutritive because of their high quality protein and energy. Protein content of field pea vary between 21-32% and its digestibility is relatively high, at

78% **(**Nikolopoulou et al., 2007; Ünver et al., 1999; Wang et al., 1998). On the other hand, its hay and seeds are rich in terms of vitamins (A,B,C,D) and some minerals (Fe, P, Ca) (Açıkgöz et al., 1985; Yıldırım et al., 2005). Especially soybean has been used as an important source of energy and protein for feed rations, but since most of the soybean products are considered GMO the field pea could be a reasonable alternative (Bourdillon, 1999).

Ecological conditions affect so much the yield and protein content of field pea seeds. The chemical composition of field pea grown in different ecologies have variations due to climate differences, soil types, agronomy practices and their genetic structures (Szwejkowska, 2005).

Aim of this study was to investigate the effects of different nitrogen applications, at various growing stages, on nutritional contents of field pea seed compositions.

## Material and Method

This study was conducted at the experimental field of the Selcuk University, Sarayönü Vocational High School from May 2nd to August 16th in 2013. Altitude of experimental location is 1055 m.

Climatic data of the experiment field (Table 1) were provided by TİGEM *((Konuklar Agricultural Institution) meteorology station- data of DMGM)* and soil analysis (Table 2) was made in soil laboratory of the chamber of agriculture in Sarayönü, Konya.

According to climatic parameters in experimental year, mean temperatures were usually below than long term temperatures. Annual rainfall was also lower compare to long term rainfall during the experiment season.

Table 1. Climatic data of the experiment field

| ***Climatic parameters*** | ***Years*** | ***Months*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | **5** | **6** | **7** | **8** | 9 |
| *Average maximum Temperature* (°C) | 2013 | 11.5 | 17.8 | 24.7 | 26.9 | **30.1** | **34.4** | **33.4** | **27.4** | 32.5 |
| | Long years | 4.7 | 6.8 | 12.0 | 17.4 | **22.2** | **26.8** | **30.2** | **30.0** | 26.1 |
| *Average temperature* (°C) | 2013 | 2 | 4.9 | 7 | 10.6 | **17.2** | **20.1** | **21.2** | **19.8** | 24.2 |
| | Long years | -0.2 | 1.2 | 5.7 | 11.0 | **15.7** | **20.2** | **23.6** | **23.0** | 18.6 |
| *Average minimum temperature* (°C) | 2013 | -11.5 | -6.1 | -9.4 | -0.1 | **5.3** | **6.7** | **7.9** | **11.4** | 2.4 |
| | Long years | -4.1 | -3.3 | 0.0 | 4.5 | **8.6** | **12.9** | **16.2** | **15.7** | 11.2 |
| *Rainfall* (mm) | 2013 | 22.0 | 25.3 | 26.9 | 39.5 | **57.0** | **28.8** | **5.0** | **0.0** | 11.0 |
| | Long years | 35.3 | 28.2 | 27.1 | 34.0 | **43.6** | **23.2** | **6.9** | **5.6** | 11.2 |

*Source: TİGEM (Konuklar Agricultural Institution) meteorology station- data of DMGM*

The soil of the experimental side had a clay-loam texture, and it was slightly alkaline and salty, with medium level of organic matter but highly calcareous (Table 2).

Table 2. Soil characteristics of the experimental fields *

| **Texture** | **pH** | **EC (mS/cm)** | **Lime (%)** | **Organic matter (%)** | **Phosphorus ( kg ha$^{-1}$ )** | **Potassium ( kg ha$^{-1}$ )** |
|---|---|---|---|---|---|---|
| Clay loam | 7.75 | 4.34 | 18.91 | 2.35 | 63.3 | 2016.0 |

**: Soil laboratory of the chamber of agriculture in Sarayönü, Konya*

Furkan winter field pea variety was used as the research material. Field experiment was made according to “Randomized Blocks Design” with four replications (Düzgüneş et al. 1987). Plot sizes were 9 m$^2$ (3 m x 3 m).

Sowing was made by hand and seeding rate was 100 seeds per $m^2$ with 50 cm row space. 50 kg per ha phosphorous was applied during the sowing time in the form of triple superphosphate ( Zabunoğlu and Karaçal, 1986 ). The nitrogen doses were applied as 30 kg $ha^{-1}$ doses in three different periods; at one week after sowing, at the stage when the first bunch was flowering and at the time of 50% plot flowering.

Nutrition was applied at three different growing stages. First one was after one week from planting, whole of N3 (30 kg $ha^{-1}$) dose, half of N6 (60 kg $ha^{-1}$) dose and 1/3 of N9 (90 kg $ha^{-1}$) dose. Second one was when flowering started at first branch half of N6 (60 kg $ha^{-1}$) dose, and 1/3 of N9 (90 kg $ha^{-1}$) dose. Third one was 50% flowering of plot 1/3 of N9 (90 kg $ha^{-1}$) dose. Ammonium sulphate fertilizer was used as the nitrogen source.

Experimental site was irrigated with sprinkler after sowing in order to get emergence. After that according to the needs of field pea the experimental site was irrigated three more times with drip irrigation. After all pods matured, plants were harvested manually on 16th of August 2013 for grain. ICP were used to analyze the contents of elements within the grain in order to identify the possible effects due to nitrogen applications. The nitrogen ratio was determined by Kjedahl method.

Statistical analyses were made by using MSTAT-C computerized program.

## Results and Discussion

This study was investigated the effects of application of three different nitrogen dosages at various growing stages on macro and micro nutritional contents of seed composition of field pea Furkan cv. The results of this research are shown in Table 3.

Table 3. The nutritional minerals content of seeds composition of field pea Furkan cv.

| Application | N (%) | Ca (%) | B (ppm) | Cu (ppm) | Fe (ppm) | K (%) | Mg (%) | Mn (ppm) | Na (ppm) | P (%) | S (%) | Zn (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **N0** | 3.64 | 0.11 AB | 9.66 | 8.03 | 49.30 | 1.11 | 0.13 | 9.91 | 319.15 | 0.31 | 0.23 | 31.67 |
| **N3** | 3.69 | 0.10 B | 9.41 | 8.02 | 45.58 | 1.07 | 0.12 | 8.74 | 296.75 | 0.31 | 0.25 | 30.16 |
| **N6** | 3.60 | 0.12 A | 10.41 | 7.75 | 45.53 | 1.14 | 0.12 | 9.24 | 306.60 | 0.32 | 0.20 | 31.43 |
| **N9** | 3.63 | 0.13 A | 10.36 | 7.91 | 49.20 | 1.12 | 0.13 | 9.66 | 310.23 | 0.32 | 0.20 | 30.81 |
| ***Average*** | 3.64 | 0.12 | 9.96 | 7.93 | 47.40 | 1.11 | 0.125 | 9.39 | 308.18 | 0.315 | 0.22 | 31.02 |
| **Variation Range** | 3.60<br>3.69 | 0.10<br>0.13 | 9.41<br>10.41 | 7.75<br>8.03 | 45.53<br>49.30 | 1.07<br>1.14 | 0.12<br>0.13 | 8.74<br>9.91 | 296.75<br>319.15 | 0.31<br>0.32 | 0.20<br>0.25 | 30.16<br>31.67 |
| **P** | NS | * | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| **CV(%)** | 4.18 | 9.30 | 7.76 | 11.60 | 6.84 | 3.06 | 4.52 | 7.43 | 8.42 | 4.36 | 16.00 | 7.23 |
| *** P<0.05, NS: nonsignificant** | | | | | | | | | | | | |

The effect of nitrogen doses on the contents of calcium (Ca) was found statistically important ($P<0.05$). The highest Ca content was obtained with application of N9 nutrition dose (90 kg $ha^{-1}$). However, the differences among N0 (0 kg $ha^{-1}$), N6 (60 kg $ha^{-1}$) and N9 (90 kg $ha^{-1}$) nitrogen doses at $P>0.05$ level were not significant. It was also found that the effects of nitrogen doses on the contents of the other elements were not significant ($P>0.05$). The contents of those elements due to nitrogen application varied between 0.11 - 0.13% for Ca, 12 - 0.13% for Mg, 1.07 - 1.14 for K, 0.31 - 0.32% for P, 45.53 - 49.30 ppm for Fe, 30.16 - 31.67 ppm for Zn, 8.74 - 9.91 ppm for Mn and 7.75 - 8.03 ppm for Cu. All the findings at the variations of minerals in this research were in agreement with the results of Grusak et al. (2004). On the other hand, results of the contents of elements in this research compared to the results of Bastianelli et al. (1995); content of Ca ad Na are higher, content of P, Mg, Zn, Cu and Fe were lower, and content of K and Mn were the same. According to the results of

Kotlarz et al. (2011) where the effects of variety and harvest year on protein contents, chemical compositions of pea, Ca and P levels of the seeds were investigated our results demonstrated similarity while Na and K levels were found lower in this study.

## Conclusions

The effect of the application of different nitrogen dosages at various growing stages on Ca content of seed composition of winter field pea Furkan cv. was found significant; however, there were no significant effects of the applications that analysed the other elements.

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