



Managing the Humic Acid Fertilizing of Chickpea and Protein Status**

Ali Kahraman^{1,*}

¹ Selçuk University, Faculty of Agriculture, Department of Field Crops, Konya, Turkey

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ABSTRACT

Legumes are consumed for the nutrition of more than 2 billion people over the world. As a legume, chickpea presents valuable nutritional components especially welded by higher protein and dietary fiber that is resistant to enzymatic digestion in human body. Konya City is one of the most chickpea producers in Turkey. In recent years, application of humic acid based fertilizer is increased considerably. Aim of the study was determination of protein ratio and protein yield of the field released chickpea seeds. A total of 4 humic acid doses (from dose 1 to dose 4: 0, 6, 9 and 12 kg da⁻¹ respectively) were applied by 2 equal part (pre-sowing and pre-flowering periods) to the "Çağatay" chickpea variety in Konya ecology. Field trial was set up by randomized blocks design with 3 replications. According to results, protein ratio was detected between 20.56% (dose 4) and 25.89% (dose 3) while protein yield (kg da⁻¹) was ranged from 39.77 (dose 1) to 63.56 (dose 3) values. In the study, 9 kg da⁻¹ humic acid application presented the highest values for protein ratio and protein yield. On the other hand, change in humic acid doses resulted from variable values. Deep and long terms studies should evaluate more stable and trustable results to decide optimum fertilizing for desired protein statuses and sustainable agricultural systems.

1. Introduction

Nutrition means a behavior for the purposes that; protection of health, growing and development, increasing of life quality and required for the body using sufficient levels of nutritional components by accurate timing and consciously (Viola et al., 2016). Human being provides the nutritional needs of animal and plant based food sources. Nutrition should be balanced and healthy. Growing food sources is easier on plants compared by animals welded by climatic factors, providing, transporting, storage, processing, etc. components. Therefore, plant based food sources are more common than animal based types and cheaper (Topalak and Ceyhan 2015; Kahraman 2017; Kafadar et al., 2019). According to the long term data of FAO (Anonymous 2019), although legumes take second place in the production of field crops, consumption by per person is quite low. Additionally, chickpea is the most produced legume in Turkey.

Legumes are the second family following to cereals over the world production. As a legume, chickpea (*Cicer arietinum* L.) is a commonly consumed legume crop in the world and Turkey as well (Anonymous

2019). Seeds of chickpea contain 38-73% carbohydrate, 16-31% protein, 2-9% cellulose, 2-7% oil, 2-11% ash (Encan et al 2005). There are various types of chickpea consumption in the world (Attia et al 1994) such as; directly cooking, coffee, varied fermented foods, frying, appetizer (Sıkılı 2003), "leblebi" a kind of cookies and animal feeding (Kara 1996). Additionally, chickpea seeds include non-polymeric starch components which are an important healthy food source while most of the ingredients are formed by cellulose, hemi-cellulose and pectin. The mentioned contents are associated with prevention of some important diseases such as hearth, diabetes, obesity, some of the cancer types, decreasing of blood cholesterol, normalization of glucose and insulin ratio (Kahraman 2017).

Increasing to yield and quality in plant production strictly related to soil characteristics. One of the most important factors for soil yield is; reaction (pH) that is effecting availability of plant nutrition elements. Absorption of the soil elements by plants and soil micro-organism activity is optimum on pH; 6-7 levels (Özbek 1973). Soil humic matters act as directly or indirectly on plant nutrition. Indirect effects are; water keeping, drainage and ventilation, improvement of soil physical features, changing the availability of soil minerals and absorption by roots. Humic matters create water soluble forms of metallic hydroxide by metallic ions and, controlling to many of those elements. Direct effects

* Corresponding author email: kahramanali@selcuk.edu.tr

** Short communication

are; development of root, effecting of plant element metabolism in addition to fertilization causes to various prominent characteristics and mechanisms on plants (Lobartini et al 1997; Bozoglu et al 2007; Jankowski et al 2015; Toklu et al 2017; Sarı et al 2018).

Using organic fertilizers is an important component for sustainability systems in agricultural production. Humic acid is one of the most used fertilizers over the world. On the other hand, chickpea acts on suspending of agricultural sustainability welded by symbiotic nitrogen fixation mechanism, root system, etc. main features as a legume crop.

As one of the most chickpea producer, Konya City is selected as a location for the present research. Chickpea variety called “Çağatay” is commonly preferred by farmers. Using of humic acid based fertilizers is common in the region as well. So, various doses of humic acid applied to Çağatay chickpea variety in field conditions. The ratio of seed protein and protein yield is evaluated in the present manuscript.

2. Materials and Methods

In this paper, the unit dedicated as “da⁻¹” equal to 1000 m² and also equivalent to 0.1 ha⁻¹ surface area of soil.

The field trial was located in Sarnıç Village of Altnekin Town in Konya City-Turkey ecological conditions. A certified chickpea variety “Çağatay” was used as plant material. Sowing was realized by hand on 14th March 2013. Densities of seeds were 45x15 cm on 7 rows for each plot by 4 m length. Randomized blocks design was set up by 3 replications. A total of 4 humic acid doses consisted from 0.0 (control), 6.0, 9.0 and 12 kg da⁻¹ applied to soil by two equal parts as pre-sowing and pre-flowering periods.

Tillage of soil had 20 cm of depth following to cereal harvest on autumn season. A total of 15 kg da⁻¹ DAP fertilizer (18% Nitrogen and 46% phosphorus content) was applied to soil before sowing. Hoeing was made by hand for 2 times and irrigation was realized sprinkler for 2 times as well. Harvest was made on 20th July 2013 by side effects of 45 cm from both sides.

According to meteorological data for long terms in Konya from March to July are reported as following: average temperature is 15.26°C, total precipitation is 26.80 mm (Anonymous, 2016). characteristics of the trial soil presented a clay loam structure (57.20% saturation) for depth of 0-20 cm, good level of organic matter (3.08%), slightly alkali (pH: 7.87), saltless (0.04% total salt), over limy (15.90% for lime), higher content of potassium (216.67 kg da⁻¹), very high content of phosphorus (17.97 kg da⁻¹).

Protein analyzes in seeds was realized by Kjeldahl method while protein yield was calculated by taking into account seed yield. Some of the results wholly independent from this paper were discussed in another report (Kahraman 2017) while present research was

realized to the aim of protein ratio and protein yield of the field released Çağatay chickpea variety seeds.

3. Results and Discussion

Results of the presented study that was realized in Altnekin/Konya-Turkey ecological conditions by using “Çağatay” certified chickpea variety and application of 4 humic acid doses are summarized in this part.

In the present research, analysis of variance for protein ratio was statistically significant on the level of 5% for protein ratio of the chickpea seeds. Protein ratio was detected; 20.56% on dose 4 (12.0 kg da⁻¹ humic acid application), 21.72% on control (0.0 kg da⁻¹ humic acid application – dose 1), 22.20% on dose 2 (6.0 kg da⁻¹ humic acid application) and 25.88% on dose 3 (9.0 kg da⁻¹ humic acid application), respectively. Results of the present research about protein ratio of the Çağatay chickpea seed showed that; overdose of humic acid application was not effective while recommended doses gave rise to an increase in the protein ratio of the chickpea seeds.

Protein ratio of chickpea seeds were reported in the previous researches as following; 22.53-23.69% (Carillo et al 2000), 26.91% (Brkic et al 2004), 16-31% (Encan et al 2005), 20.60-26.70% (Kaur and Singh 2004), 20.50-23.20% (Tayyar et al 2008), 21.00-24.00% (Kopaç Kork 2009), 21.99-27.15% (Doğan 2011), 18.83-20.43% (Erdin and Kulaz 2014), 17.90-22.06% (Bayrak and Onder 2017), while digestibility is 76-88% (Akçin 1988) besides biological value of egg is 100 and chickpea is 62 (Bayrak et al 2005). Slightly differences of the previous findings may be explained by; genetic structure, ecological conditions, cultural practices and especially by the humic acid application doses.

According to the results of this research, variance analysis was important for protein yield on 1% significance level. Protein yield of the Çağatay chickpea variety showed a wide range depending on the humic acid application doses as following; 39.77 kg da⁻¹ on control (0.0 kg da⁻¹ humic acid application – dose 1), 48.68 kg da⁻¹ on dose 4 (12.0 kg da⁻¹ humic acid application), 53.99 kg da⁻¹ on dose 2 (6.0 kg da⁻¹ humic acid application) and 63.56 kg da⁻¹ on dose 3 (9.0 kg da⁻¹ humic acid application). Present results introduced that; application of humic acid fertilizer was effective on protein yield of the chickpea that is limited by the usable values as obtaining the minimum value on control application and highest value on 9.0 kg da⁻¹ application. Former studies on chickpea showed the protein yield as; 24.68 kg da⁻¹ (Önder and Üçer 1999), 13.72-26.45 kg da⁻¹ (Bayrak and Onder 2017), 47.75-71.08 kg da⁻¹ (Ceran and Önder 2016). The mentioned values are quite similar with data collected from the present study.

Previous research (Kıraç 2016) on peanut which was subjected to humic and fulvic acid (HFA) applications showed that; application of HFA was significantly effected by symbiotic nitrogen fixation while in-

creased dose was adversely affected to several parameters. As a report of the study, the HFA application was positively affected by some of the investigated parameters and lower doses of HFA application were recommended. On the other hand, agronomic characteristics of plants are strictly related to genotype in addition to environmental factors (temperature and sunlight) and plant nutrition (Alam and Haider 2006). The content of dry matter is affected by photosynthetic activity, leaf area and leaf protein ratio (Ali et al 2004). On the other perspective, it is clear that fertilizing gives a lead to distinct changes in plant responses that are pointed out in another study as it stated in the following line. Phosphorus and zinc application to chickpea in Iran ecology proved that; plant height, number of main branch, 100 seed weight, seed yield, biological yield and protein concentration was significantly affected (Khourgamy and Farnia 2009). In another similar study in Iran (Mir et al 2014), phosphate and biologic biosuper phosphate application were also effected to 100 seed weight, seed yield and protein ratio.

4. Conclusions

Results of the present research showed remarkable effects such as; humic acid application level of overdose was not effective in the mean time recommended doses caused to increasing of the protein ratio.

According to the findings of the study, humic acid doses were effective and statistically significant on protein yield of Çağatay chickpea variety by the minimum value on control dose and highest value on 9.0 kg da⁻¹ dose.

Application of several humic acid doses on chickpea variety Çağatay presented statistically significant statues on protein ratio and protein yield in the present research while 9 kg da⁻¹ humic acid application presented the highest values for protein ratio and protein yield as well. Deep and changed/modified studies on the subject which may be summarized by; various genotypes, ecologies, cultural practices, doses and application methods would be guided to more stable and trustable results.

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