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Effect of Humic Acid Applications on the Yield Components in Chickpea

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Abstract: Chickpea is one of the most important legumes as human food over world. Using of humic acid based fertilizers has been increased for the last decade in Turkey. Therefore, a field trial was planned according to randomized blocks design in 2013 with 3 replications under Konya ecological conditions to evaluate effect of humic acid doses (0.0-conrol, 6.0-dose 1, 9.0-dose 2 and 12 kg da^{-1}-dose 3) on yield and yield related important characteristics of chickpea variety "Çağatay" were determined. Following ranges were obtained; 29.56 (dose 3) - 41.44 (dose 2) for pod/plant, 82.09% (control) - 89.66% (dose 3) for fertile pod, 38.33cm (control) - 54.44cm (dose 1) for plant height, 13.67cm (control) - 16.61cm (dose 1) for first pod height, 2.33 (control) - 3.00 (dose 2) for main branch/plant, 183.16 (control) - 245.53 kg da^{-1} (dose 2) for seed yield and 417.23g (dose 3) - 449.90g (dose 1) for thousand seed weight. Variance analysis showed significance ($p<0.01$) for pod/plant, plant height and seed yield. In general, present study showed an increasing tendency on the yield related parameters in Çağatay variety by application dose of 6.0 kg da^{-1} and 9.0 kg da^{-1} humic acid while increased dose caused to reduce in yield. There is a big demand for following studies still that are based on different varieties and application doses of fertilizers to improvement of yield and yield related parameters.

Keywords: *Cicer arietinum*, correlation, fertilize, Konya.

Humik Asit Uygulamalarının Nohutta Verim Bileşenleri Üzerine Etkileri

Özet: Nohut, insan gıdası olarak dünya çapında tüketilen önemli baklagillerden biridir. Humik asit içeren gübrelerin kullanımı Türkiye'de son on yılda artış göstermiştir. Humik asit dozlarının (0.0-kontrol, 6.0-doz 1, 9.0-doz 2 ve 12 kg da^{-1}-doz 3) "Çağatay" isimli tescilli nohut çeşidinde verim ve önemli verim unsurları üzerine etkilerini belirlemek amacıyla Konya ekolojik şartlarında 2013 yılında yapılan bu deneme "Tesadüf Blokları Deneme Desenine"ne göre 3 tekerrürlü olarak kurulmuştur. Araştırma sonucunda; 29.56 (doz 3) - 41.44 (doz 2) bakla/bitki, %82.09 (kontrol) - %89.66 (doz 3) fertil bakla, 38.33cm (kontrol) - 54.44cm (doz 1) bitki boyu, 13.67cm (kontrol) - 16.61cm (doz 1) ilk bakla yüksekliği, 2.33 (kontrol) - 3.00 (doz 2) ana dal/bitki, 183.16 (kontrol) - 245.53 kg da^{-1} (doz 2) tane verimi ve 417.23g (doz 3) - 449.90g (doz 1) bin tane ağırlığı özellikleri için belirtilen değerlerin aralığında değişim gösterdiği tespit edilmiştir. Varyans analizleri sonucunda bakla/bitki, bitki boyu ve tane verimi bakımından istatistiki olarak önemli farklılıklar ($p<0.01$) ortaya çıkmıştır. Yapılan araştırma sonucunda Çağatay nohut çeşidinde verimle ilgili özelliklerin genel olarak 6.0 kg da^{-1} ve 9.0 kg da^{-1} humik asit dozlarında artış gösterdiği, daha yüksek dozda tane veriminde düşüş olduğu belirlenmiştir. Verim ve verimle ilgili özelliklerin geliştirilmesi için, farklı çeşitlerde ve değişen gübre dozları ile ilgili araştırmaların yapılmasına ihtiyaç olduğu söylenebilir.

Anahtar kelimeler: *Cicer arietinum*, gübre, Konya, korelasyon.

1. Introduction

Chickpea (*Cicer arietinum* L.) is an ancient legume that is also known as "garbanzo bean" or "Bengal gram" names. Chickpea is originated from South-East part of Turkey and North of Syria (Van der Maesen, 1987; Akçin, 1988). Chickpea has economic importance over the world economy and as it be a legume crop, it has specifications such as reducing of poverty and hunger, improvement of human health and nutrition, providing of soil quality by nitrogen fixation mechanism and root system besides

valuable organic residues, enhancing of ecosystem and it is known as "not elsewhere specified" plant which are essential for sustainability. Chickpea is grown more than 50 countries in the world, and takes the 3rd place of total pulse production following to dry bean and field pea, respectively. Main reasons for widely growing of chickpea welded by higher nutritional value (Ceyhan et al. 2008; Kahraman et al. 2015), drought tolerance and soil improving features. Data of FAO statistics presents that; the global chickpea production area is about 12.53 million ha, with production of 11.60 million metric tons and average yield of 924.72 kg ha^{-1} for 2009-2013 years while the global chickpea trade is about $771.253.000 for import and $748.788.000 for export values for 2007-2011 years (Anoymous, 2016a).

Fertilizers are the main components of agricultural production systems which are effective on productions costs, yield values and quality features. Humic acid based fertilizers have been remarkable usages in the world and Turkey as well. Sustainability of systems is the main aspect of human efforts. From this perspective, effect of humic acid doses on yield characteristics of Çağatay chickpea variety was investigated to contribute sustainable agricultural systems and sustainable functional food production.

2. Materials and Methods

Present research was made in Sarnıç Village/Altınekin Town of Konya City in Turkey. Certified chickpea variety of "Çağatay" was used as material due to be widely preferred by farmers and customers. Field trial was set up according to randomized blocks design with 3 replications. Seed sowing was made on 14^{th} of March 2013 by 45x15 cm density of 7 rows which had 4 m length per plot. Humic acid doses were applied to the soil by two equal parts as: pre-sowing and pre-flowering of plants which were consisted from 0.0, 6.0, 9.0 and 12.0 kg da^{-1} (control, dose 1, dose 2 and dose 3, respectively) in total.

Meteorological data of Konya City for long term (1950-2014) between March and July are; $15.26^{O}C$ for average temperature, 26.80 mm for total precipitation (mm). Sarnıç Village of Altınekin Town has 11 for average temperature and 395 mm of precipitation over year while July has the maximum (22.0) temperature (Anoymous, 2016b).

Trial soil characteristics were as following; 57.20% for saturation (clay loam character) in 0-20 cm of depth, 3.08% organic matter (good), 7.87 for pH (slightly alkali), 0.04% for total salt (saltless), 15.90% for lime (over limy), 216.67 kg da^{-1} for potassium (higher) and 17.97 kg da^{-1} for phosphorus (very high), respectively. Soil tillage was made to the cereal fallow on autumn in 20 cm depth, furthermore, 15 kg da^{-1} DAP (18% nitrogen and 46% phosphorus) was applied to the soil and tillage was made to prepare the soil to sowing. Hand hoeing was made for 2 times besides 2 times of sprinkler irrigation that was based on plant demand. There was not disease or insect problem so pesticide was not applied. Hand harvest was made on 20th of July 2013 which was taken account two of the first rows in addition to 45 cm both sides of the rows were eliminated as side effect.

Following characteristics were determined; number of pod per plant, fertile pod per plant (%), plant height (cm), first pod height (cm), number of main branch per plant, seed yield (kg da^{-1}) and 1000 seed weight (g). Statistical analysis was made by using JUMP computer based program (Kahraman, 2017).

3. Results and Discussion

Application of different humic acid doses on certified chickpea variety of Çağatay presented statistically significance ($p<0.01$) for number of pod per plant, plant height and seed yield as it seen on Table 1.

Number of pod per plant varied from 29.56 (dose 3) to 41.44 (dose 2). Fertile pod per plant showed a range from 82.09% (control) to 89.66 (dose 3). Height of plants presented a wide range from 38.33 cm (control) to 54.44 (dose 1) in the study while first pod height varied from 13.67 cm (control) to 16.61 cm (dose 1). Number of main branch per plant showed a range of 2.33 (control) and 3.00 (dose 2) values. According to the reports

of similar studies in Konya ecology, the following ranges were reported: 20.12-30.42 for number of pod per plant, 30.45-40.05 cm for plant height, 15.08-22.33 cm for first pod height, 2.68-3.78 for number of main branch per plant (Bayrak, 2010); 22.55-29.53 for number of pod per plant, 77.78%-84.09% for ratio of fertile pod, 42.78-45.92 cm for plant height (Ceyhan et al. 2012); 20.33-36.67 for number of pod per plant, 34.67-57.33 cm for plant height, 15.33-27.67 cm for first pod height (Ceran and Onder, 2015), 39.6-41.8 cm for plant height, 21.1-25.4 cm for first pod height, 3.4-4.1 for number of main branch per plant, 8.3-18.5 for number of pod per plant (Topalak and Ceyhan, 2015).

Table 1. Mean values of the investigated characteristics in the chickpea (Çağatay variety) and significance levels

Çizelge 1. *Nohut bitkisinin ele alınan özelliklerine ait ortalama değerler (Çağatay çeşidi) ve önem seviyesi*

	Humic acid doses (kg da^{-1})			
Characteristics	0.0 (Control)	6.0 (Dose 1)	9.0 (Dose 2)	12.0 (Dose 3)
Pod/Plant (number)**	31.00 b	40.33 a	41.44 a	29.56 b
Fertile pod (%)	82.09	85.73	83.58	89.66
Plant height (cm)**	38.33 b	54.44 a	52.44 a	52.44 a
First pod height (cm)	13.67	16.61	15.50	16.11
Main branch/Plant (number)	2.33	2.67	3.00	2.67
Seed yield (kg da^{-1})**	183.16 b	243.04 a	245.53 a	236.40 a
1000 seed weight (g)	426.17	449.90	438.17	417.23

**: $p<0.01$

Humic acid application to the chickpea showed the highest seed yield as 245.53 kg da^{-1} on dose 2 application and it was followed by 243.04 (dose 1), 236.40 (dose 3) and 183.16 (control) respectively. Similar results were reported as (unit: kg da^{-1}): 78.14-154.12 (Bayrak, 2010), 106.93-207.47 (Ceyhan et al. 2012), 182.63-277.77 (Ceran and Onder, 2015), 180.2-217.1 (Topalak and Ceyhan, 2015) in the previous studies under Konya ecology. Other studies in chickpea reported the following data for seed yield (unit: kg da^{-1}): 98.00-178.20 (Saxena, 1981), 132.00-281.00 (Güner and Sepetoğlu, 1994), 142.10-277.80 (Müderriszade, 1996), 40.70-203.30 (Çiftçi and Türk, 1998), 168.20-185.90 (Azkan et al. 1999); 158.00-205.00 (Tayyar et al. 2008), 156.00-203.00 (Aydoğan, 2012), 97.70-153.93 (Erdin and Kulaz, 2014).

Humic acid doses showed the values for 1000 seed weight of the Çağatay chickpea variety that were changed from 417.23 g (dose 3) to 449.90 g (dose 1). Similar results were reported for Konya ecological conditions in the relative studies for 1000 seed weight of chickpeas: 363.00-512.17 g (Bayrak, 2010), 348.02-431.89 g (Ceyhan et al. 2012), 346.70-434.40 g (Ceran and Onder, 2015), 337-378 g (Topalak and Ceyhan, 2015). Weight of 1000 seed in chickpea showed a wide range in other studies such as: 12.60-48.10 g (Eser et al. 1989), 25.80-27.90 g (Güner and Sepetoğlu, 1994), 35.21-48.97 g (Müderriszade, 1996), 29.35-44.40 g (Çiftçi and Türk, 1998), 41.46 g (Azkan et al. 1999), 30.63-47.56 g (Erdin and Kulaz, 2014).

Applications of humic acid based fertilizers have been shown an increase for the last decade in Turkey. Therefore, present study was made to evaluation of humic acid fertilizer doses for the yield and related parameters in chickpea. Yield related characteristics of the plants are directly related with fertilizers. As it reported in many reports (Bozoglu and Gulumser, 2000; Onder and Babaoğlu, 2001; Pekşen, 2005; Bozoglu et al. 2007; Krzebietke and Sienkiwixz, 2010; Jankowski et al. 2014; 2015, Kahraman and Ozkan, 2015; Uzun et al. 2015; Harmankaya et al. 2016); genetic variation, environment conditions and growing techniques-especially fertilization effects the agronomic characteristics and chemical composition of plants. Differences of the present

results from previous reports may be welded by the genetic variation, sowing time, cultural practices, doses of fertilizer, harvest time and ecological conditions of the trial field.

4. Conclusions and Recommendations

A general evaluation of the present study may be summarized by view of effects of humic acid doses on the investigated characteristics in chickpea:

1-Increasing dose of humic acid up to 9.0 kg da^{-1} resulted by an increase in number of pod per plant, number of main branch per plant, and seed yield values,

2-Highest values for plant height, first pod height and thousand seed weight were obtained from 6.0 (dose 1) kg da^{-1} application dose,

3- An increase in fertile pod was obtained by increasing of humic acid dose.

Overall, 9.0 kg da^{-1} of humic acid application (dose 2) promises for enhancing of number of pod per plant, number of main branch per plant and seed yield. Additionally, 6.0 kg da^{-1} of humic acid application (dose 1) showed an increase in plant height, first pod height and thousand seed weight.

Consequently, results of the present study are promising to provide a combined data for desired characteristics in chickpea that should be take into account for seed yield. As chickpea is a member of legumes, growing and consuming need to be extended over the world to provide sustainability of agriculture, agroecology, economy, functional food and human health.

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References

Akçin A (1988). Yemeklik Tane Baklagiller (Academic Press in Turkish). University of Selcuk, Publication No: 43, Faculty of Agriculture, Publication No: 8, 377pp, Konya.

Anoymous (2016a). www.faostat.org (Access date: 20.02.2016).

Anoymous (2016b). http://tr.climate-data.org/location/497828/ (Access date: 20.02.2016).

Aydoğan A (2012). Determination of yield and quality traits of normal and simple leaved kabuli chickpea (*Cicer arietinum* L.) cultivars and lines. Ankara University Graduate School of Natural and Applied Sciences, PhD Thesis, Ankara.

Azkan N, Kaçar O, Doğangüzel E, Sincik M and Çöplü N (1999). Bursa ekolojik koşullarında farklı ekim zamanlarının nohut hat ve çeşitlerinde verim ve verim öğeleri üzerine etkisi. Türkiye 3.Tarla Bitkileri Kongresi, 15-18 Kasım 1999, 3: 318-323, Adana.

Bayrak H (2010). Determining agricultural, technological and nutritional characteristics of local populations and varieties of chickpea cultivated in Konya ecology. Selcuk University Graduate School of Natural and Applied Sciences, PhD Thesis, Konya.

Bozoglu H and Gulumser A (2000). Determination of genotype x environment interactions of some agronomic characters in dry bean (*Phaseolus vulgaris* L.). Turk J. Agric. For., 24: 211–220.

Bozoglu H, Peksen E, Peksen A and Gulumser A (2007). Determination of the yield performance and harvesting periods of fifteen pea (*Pisum sativum* L.) cultivars sown in autumn and spring. Pak. J. Bot., 39 (6): 2017-2025.

Ceran F and Onder M (2015). Determination of some agricultural characteristics on chickpea (*Cicer arietinum* L.) cultivars that are sown at different periods. Selcuk Journal of Agricultural Sciences, in press.

Ceyhan E, Harmankaya M and Avcı MA (2008). Effects of sowing dates and cultivars on protein and mineral contents of bean (*Phaseolus vulgaris* L.). Asian Journal of Chemistry, 20 (7): 5601-5613.

Ceyhan E, Önder M, Kahraman A, Topak R, Ateş MK, Karadaş S and Avcı MA (2012). Effects of drought on yield and some yield components of chickpea. World Academy of Science, Engineering and Technology, (6) 6: 33-37.

Çiftçi V and Türk Z (1998). Güneydoğu Anadolu koşullarında ekim zamanının nohutta verim ve verim öğelerine etkisi. Doğu Anadolu Kongresi, 14-18 Eylül 1998, 1. Cilt: 483-487.

Erdin F and Kulaz H (2014). Van–Gevaş ekolojik koşullarında bazı nohut (*Cicer arietinum* L.) çeşitlerinin ikinci ürün olarak yetiştirilmesi. Turkish Journal of Agricultural and Natural Sciences, Special Issue 1: 910-914.

Eser D, Geçit HH, Emeklier HY and Kavuncu O (1989). Nohut gen materyalinin zenginleştirilmesi ve değerlendirilmesi. Turkish Journal of Agriculture and Forestry, 13 (2): 246-253.

Güner Ü and Sepetoğlu H (1994). Nohutta yazlık ve kışlık ekim ile bitki sıklığının besin elementleri alımı, büyüme ve verime etkileri üzerine bir araştırma. Tarla Bitkileri Kongresi, 25-29 Nisan 1994, Agronomi Bildirileri, 1: 105-108, İzmir.

Harmankaya M, Ceyhan E, Celik AS, Sert H, Kahraman A and Ozcan MM (2016). Some chemical properties, mineral content and aminoacid composition of cowpeas [*Vigna sinensis* (L.) Savi]. Quality Assurance and Safety of Crops & Foods, 8 (1): 111-116.

Jankowski KJ, Kijewski L, Krzebietke S and Budzynski WS (2015). The effect of sulphur fertilization on macronutrient concentrations in the post-harvest biomass of mustard. Plant Soil Environment, 61 (6): 266-272.

Jankowski KJ, Kijewski L, Skwierawska M, Krzebietke S and Walec EM (2014). Effect of sulfur fertilization on the concentrations of copper, zinc and manganese in the roots, straw and oil cake of rapeseed (*Brassica napus* L. ssp. *oleifera* Metzg). Journal of Elementology, 19 (2): 433-446.

Kahraman A (2017). Nutritional value and foliar fertilization in soybean. Journal of Elementology, 22 (1): 55-66, DOI: 10.5601/jelem.2016.21.1.1106.

Kahraman A, Harmankaya M and Ceyhan E (2015). Nutritional Variation and Drought Tolerance in Chickpeas (*Cicer arietinum* L.). Journal of Elementology, 20 (2): 331-341, ISSN: 1644-2296, DOI: 10.5601/jelem.2014.19.2.674.

Kahraman A and Ozkan Z (2015). Ascochyta blight of chickpea. Selcuk Journal of Agriculture and Food Sciences, 29 (2): 62-66.

Krzebietke SJ and Sienkiewixz S (2010). Effect of foliar application of anthracene and pyrene (PAH) on yields and chemical composition of butterhead lettuce (*Lactuca sativa* L.) grown under varied abundance of substrate in nutrients. Journal of Elementology, 15 (3): 531-538.

Müderriszade HÖ (1996). İri ve orta taneli nohutlarda büyüme verim ve verim öğeleri ile bunlar arasındaki ilişkiler. MSc Thesis, Ege University Graduate School of Natural and Applied Sciences, İzmir, TURKEY.

Onder M and Babaoğlu M (2001). Interactions amongst grain variables in various dwarf dry bean (*Phaseolus vulgaris* L.) cultivars. Journal Agronomy and Crop Science, 187: 19–23.

Pekşen E (2005). Comparison of some common bean (*Phaseolus vulgaris* L.) genotypes for seed yield and related characteristics under Samsun conditions. *J*. of Fac. of Agric., OMÜ, 20 (3): 88-95.

Saxena MC (1981). ICARDA Research Highlights, p. 27–29.

Tayyar Ş, Egesel CÖ, Gül KM and Turhan H (2008). The effect of autumn and spring planting time on seed yield and protein content of chickpea genotypes. African Journal of Biotechnology, 7 (11), 1655- 1661.

Topalak C and Ceyhan E (2015). The effects of seed yield and some agricultural characters of different sowing dates on chickpea. Selcuk Journal of Agricultural Sciences, 2 (2): 128-135.

Van der Maesen LJG (1987). Origin, history and taxonomy of chickpea. In: Saxena M.C., Singh K.B. (eds.): The Chickpea. CAB Inter., Wallingford: 11–34.

Uzun F, Donmez HB and Ocak N (2015). Genetic potential of wild birdsfoot trefoil (*Lotus corniculatus* L.) seeds collected from different geographical locations regarding to nutrient composition and nutritive value. Agroforest Sys., 89: 963–972.