Turkish Journal of Agricultural and Natural Sciences
Special Issue: 1, 2014

TÜRK
TARIM ve DOĞA BİLİMLERİ
DERGİSİ

TURKISH
JOURNAL of AGRICULTURAL
and NATURAL SCIENCES

www.turkjans.com

Response of Dry Bean (*Phaseolus vulgaris* L.) Genotypes to Water Shortage

[a]Mustafa ONDER*, [a]Ali KAHRAMAN, [a]Ercan CEYHAN
[a]Department of Field Crops, Faculty of Agriculture, University of Selcuk, Turkey
*Corresponding author: monder@selcuk.edu.tr

Abstract

Excessive irrigation in Konya ecological conditions is a common application. This research was conducted to determine the effects of water shortage on dry bean genotypes. Field trial was conducted according to "Randomized Complete Blocks Design" with three replications in Selcuk University, Agricultural Faculty, Campus-Konya trial fields during the year of 2009. Sowings were made on 15th of May and harvest was made on September. After sowing, the plots were irrigated by sprinkler for only two hours to provide the emergence. A total of 40 common dry bean genotypes were grown in field conditions with only 2 drip irrigations during the flowering (50th day after sowing) and pod filling (58th day after sowing) periods for 6 hours (from 0am to 6am) per irrigation which was provided enough water to effective root depth. According to the results, number of main branch per plant was significant on the level of P<0,05 and, all the other investigated characteristics were significant on the level of P<0,01. Means of the investigated characteristics were ranged as following: number of main branch/plant 3,33-7,33; number of leave/plant 16-108; plant height 45cm-162cm; number of pod/plant 12-26; number of seed/pod 3,0-5,8; first pod height 3,56cm-6,67cm; biologic yield 2120kg ha^{-1}-6040kg ha^{-1}; seed yield 1140kg ha^{-1}-3550kg ha^{-1}; harvest index 46%-90% respectively.The results implicated that all the investigated characteristics were in parallel with the local farmers' applications that apply excessive and untimely irrigation. Therefore, it can be concluded that irrigation that more than necessity is unnecessary.

Keywords: Arid land agriculture, drought tolerance, water management, Turkey

Azaltılmış Su Uygulamasına Kuru Fasulye (*Phaseolus vulgaris* L.) Genotiplerinin Tepkileri

Özet

Konya ekolojisinde, kuru fasulye tarımında fazla su verilmesi, yaygın bir uygulamadır. Bu araştırma, su uygulamasının azaltılmasının kuru fasulye genotipleri üzerine etkilerini belirlemek amacıyla yapılmıştır. Tarla denemeleri tesadüf blokları deneme desenine göre 3 tekerrürlü olarak Selçuk Üniversitesi, Ziraat Fakültesi'nin Kampüs-Konya yerleşkesindeki arazide 2009 yılında yürütülmüştür. Ekim, 15 Mayıs tarihinde, hasat ise Eylül ayında yapılmıştır. Ekim sonrası parsellerde çıkışı sağlamak amacıyla 2 saat süreyle yağmurlama sulama yapılmıştır. Araştırmada toplam 40 farklı kuru fasulye genotipi materyal olarak kullanılmış, vejetasyon süresi boyunca sadece çiçeklenme dönemi (ekimden 50 gün sonra) ve bakla doldurma dönemi (ekimden 58 gün sonra) olmak üzere) efektif kök derinliğinde yeterli su sağlamak suretiyle 6'şar saat süreyle (gece 00:00'dan itibaren 06:00'a kadar) 2 defa damlama sulama yapılmıştır. Araştırma sonucunda genotipler arasında bitkide anadal sayısı istatistiki olarak %5 seviyesinde önemli çıkarken, incelenen diğer özellikler bakımından %1 seviyesinde farklılıklar belirlenmiştir. Araştırmada incelenen genotiplerin bitkide bakla sayısı 3.33-7.33; bitkide yaprak sayısı 16-108 adet; bitki boyu 45-162 cm, bitkide bakla sayısı 12-26 adet; baklada tane sayısı 2.0-5.8 adet; ilk bakla yüksekliği 3.56-6.67 cm; biyolojik verim 212.0-604.0 kg/da, tane verimi 114.0-355.0 kg/da ve hasat indeksi % 46-90 aralığında değişim gösterdiği belirlenmiştir. Araştırma neticesinde elde edilen değerlerin, bölge şartlarında aşırı ve zamansız sulama uygulaması ile elde edilen değerlere benzer sonuçlar gösterdiği, dolayısıyla gereğinden fazla su vermenin gereksiz olduğu sonucuna varılmıştır.

Anahtar Kelimeler: Kurak alanlarda tarım, kuraklık toleransı, sulama yönetimi, Türkiye.

Introduction

Nutrition has been a problem for human over the history of humankind. People have been seeking to find solutions for providing the food requirements. For this purpose, some innovations cause to disadvantages beside their essential benefits. Some of the improvements in food production gave rise to problems in sustainability

while another part of the methods cause to degradation in natural balance. Human being needs to develop new agricultural techniques which are environment friendly.

Pulse crops have an importance between the plants with the consumption ratios of 22% protein and 7% carbohydrates in human nutrition while these ratios are 38% and 5% in animal feeding respectively (Wery and Grinac, 1983). Daily consumption of protein per person is 70.9g in the world, 85.0g in Turkey, 104.0g in developed countries and 61.0g in the developing countries (Anonymous, 2009).

Dry bean is the main pulse crop which is used to human nutrition over the world. Bean farming has a wide range of area especially on the warm regions and almost 94% of bean growing is in Asia, South America and developing countries (Anonymous, 2006).

Table 1. Dry bean quantities for 2009 (Anonymous 2011a, Anonymous 2011b)

Place	Area (ha)	Production (ton)	Yield (kg ha^{-1})
World	25.211.000	19.723.000	782
Turkey	94.928	181.205	1909
Konya	13.059	21.072	1613

Dry bean farming have many problems such as cultural practices and breeding in different agricultural lands. Main purpose of plant breeding should be development of the quality and yield for different climates. It will be possible by determination of the present genotypes. Dry bean farming is made in all the ecologic regions of Turkey. Central Anatolian Region is the main place in terms of bean production. But, the yield in the region is under the average value of Turkey (Çiftçi, 2004). The main problem in the region seems excessive and sprinkler irrigation with a total amount of 7-8 times. Irrigation that more than enough cause to root fungal diseases. Sprinkler irrigation methods cause to flower loss and fungal diseases as well (Önder and Ceyhan, 2011). As it seen all the other plants, the growing techniques have positive or negative effects on the yield and quality of dry bean. It is recommended that; the wrong applications and mistakes are supposed to be improved (Önder et al., 2012). Table 1 shows the statistics for dry bean production for the year of 2009.

Drought is a stress factor that cause of limitation in life activities and effects the vegetal production. Plants are the most important source that feeding necessity of the human population (Kahraman and Önder, 2010). Plant breeding has been focused on drought stress in recent years. Drought is also one of the main limiting factors on plant yield in Konya city where dry bean production is made in the first place of Turkey. This study was made to determine effect of irrigation period and method on common bean yield components in Konya ecological conditions.

Materials and Methods

A total of 40 common dry bean genotypes (Table 2) were grown in the research field of Selcuk University, Agricultural Faculty, Campus-Konya (37^{o} 51' 56N, 32^{o} 28' 57E, 1020 m above the sea level). Field experiment was conducted according to "Randomized Complete Blocks Design" with three replications during the year of 2009. Before sowing, 120kg ha^{-1} of Diammoniumphosphate (18% nitrogen, 46% phosphorus) was applied to soil. Row distances were 45cm, upper levels were 20cm with a length of 3m and 2.25m of width. Sowings were made by hand on 15th of May and harvest was made on September. Irrigation to provide emergence was made by sprinkler for only two hours after sowing. A total of 2 drip irrigations were made during the flowering (50th day after sowing) and pod filling (58th day after sowing) periods for 6 hours (from 0am to 6am) per irrigation which was provided enough water to effective root depth.

Soil characteristics of the experimental field were as follows: clay structure, pH 8.03, lime 37.6 %, organic matter 2.25 %, potassium 17.9 kg ha^{-1}, iron 14.74 ppm and zinc 0.32 ppm.

Mean of climate data between May and August was; 21^{o}C for temperature, 42% for relative humidity and, precipitation was 55.8mm in May, 2.7mm in June, 11.7mm in July and there was not any rainfall during the August.

The fallowing characteristics were recorded: number of branch/plant; number of leave/plant; plant height (cm); number of pod/plant; number of seed/pod; first pod height (cm); biologic yield (kg ha^{-1}); seed yield and harvest index (kg ha^{-1}). Only the abstract part of the present study was presented as a poster presentation in a conference (Onder et al., 2013).

All the data were subjected to variance analyze was made using the JUMP program and Duncan multiple comparison test in the significance level of 1% was made by MINITAB computerize based program.

Table 2. Collection number (no), place (source) of collection and local names of the investigated dry bean genotypes

No	Place of Collection	Local Name
1	Başarakavak Town	Horoz Fasulye
2	Başarakavak Town	Sarıkız
3	Başarakavak Town	Kanada
4	Çumra	Şeker Fasulye (Bıyıklı)
5	Çumra	Kirgiz Çalısı
6	Çumra	Horoz Fasulye
7	Çumra	Beyşehir Çalısı
8	Çumra	Bombay (Bomba)
9	Çumra	Kanada
10	Altinekin	Amerikan Kollu
11	Altinekin	Sarnıç
12	Altinekin (Mantar Village)	Amerikan Çalısı
14	Konya (Centrum)	Gina
16	Ereğli (Centrum)	Horoz
17	Kadinhani (1)	Weihing
18	Kadinhani (2)	Kanada
19	Kadinhani (3)	Akman 98* (originated from private company)
20	Derbent (1)	Amerikan (Beretta)
22	Derbent (5)	Şeker
23	Beyşehir (1) (Göçü Village)	Horoz
24	Seydişehir (1)	Sıra Fasulye (originated from Çumra)
25	Ilgin (1) (Beykonak Village)	Beyaz Horoz
27	Sarayönü (1)	Kanada
28	Sarayönü (2) (Bayramlı Köyü)	Amerikan Çalısı
29	Yunak (2)	Üveynk (Veynk)
30	Yunak (4)	Kanada
31	Çumra	Kırgız Yuvarlak (Kollu Barbunya)
32	Derbent (2)	Yuvarlak Barbunya
33	Akşehir (4)	Dermason
34	Akşehir (5) (Sorkun Village)	Ayşe Kadın
35	Akşehir (6)	Horoz (Oturak)
36	Akşehir (7)	Dermason (Oturak)
37	Kazim Karabekir	Kanada (Kara Yaprak)
38	Kazim Karabekir	Dermason (Kırgız)
39	Eskişehir- Anadolu Agr. Res. Inst.	Akman-98*
40	Eskişehir- Anadolu Agr. Res. Inst.	Eskişehir-855*
41	Erzurum- Atatürk University	Elkoca-2005*
42	Erzurum- Atatürk University	Kantar-2005*
43	Çumra	Amerikan Çalısı
44	Derbent (3)	Horoz

*: Certified line

Table 3. Means of the used dry bean genotypes in terms of the investigated characteristics

Genotype	Branch/ Plant	Leaf/ Plant	Plant height (cm)	Pod/Plant	Seed/Pod	First pod height (cm)	Bioyield (kg ha^{-1})	Seed yield (kg ha^{-1})	Harvest index (%)
1	5,50	52	84	23	4,7	4,33	4914	3365	0,68
2	4,67	29	61	16	5,6	4,00	3266	2483	0,76
3	5,83	25	47	**12**	4,5	4,17	2456	2228	**0,90**
4	4,67	62	86	19	**5,8**	4,83	3817	2491	0,65
5	6,00	30	60	19	5,0	5,66	2904	1943	0,67
6	4,50	39	82	**26**	4,9	3,67	5529	**3550**	0,64
7	4,67	54	**162**	**26**	**5,8**	4,67	4506	2964	0,66
8	4,83	24	56	15	5,0	4,32	**2120**	1640	0,76
9	4,33	27	51	14	4,5	4,00	2560	2286	**0,90**
10	4,33	37	59	23	4,9	3,67	4480	3384	0,76
11	5,17	29	64	17	4,7	3,67	3467	3389	0,80
12	5,00	29	49	20	5,1	5,50	4591	3086	0,68
14	4,83	58	114	16	5,6	**6,67**	2537	1389	0,55
16	**7,33**	31	**45**	18	4,2	5,00	**6040**	2453	**0,46**
17	6,17	25	49	25	5,4	**3,56**	4801	2773	0,58
18	6,17	43	74	19	5,5	5,33	2145	1507	0,70
19	6,83	48	68	23	5,1	4,16	4198	2956	0,72
20	5,50	**16**	51	17	5,4	4,00	2250	1841	0,80
22	3,75	63	78	14	5,6	4,68	3364	2114	0,62
23	6,50	25	63	19	4,9	6,00	3756	2167	0,73
24	5,75	32	52	23	5,4	4,67	3083	2333	0,75
25	6,50	38	53	19	4,0	3,82	3661	2892	0,77
27	4,33	25	58	24	5,4	4,67	3429	2591	0,82
28	5,17	27	51	18	5,3	5,17	4130	2834	0,69
29	5,17	25	46	21	5,2	5,17	4158	2897	0,73
30	4,83	50	68	15	5,0	4,66	2705	2024	0,75
31	**3,33**	40	99	14	4,6	5,17	2685	1628	0,62
32	4,83	51	100	18	**3,0**	5,17	2208	1581	0,72
33	5,17	28	48	24	5,6	5,17	3767	2637	0,70
34	6,00	66	75	18	5,3	6,00	3533	2037	0,54
35	6,83	32	59	19	4,7	4,17	3083	2374	0,78
36	5,67	33	54	16	5,1	4,00	2861	2446	0,86
37	4,33	27	66	15	5,0	4,11	2950	1994	0,69
38	5,00	55	67	13	4,6	4,43	2893	1956	0,68
39	5,67	43	60	22	4,5	5,67	3828	2461	0,65
40	5,83	30	**45**	16	4,2	4,98	4235	2326	0,56
41	5,67	**108**	69	18	4,2	4,18	4589	2699	0,61
42	4,67	30	56	16	4,7	5,50	3280	2154	0,65
43	5,00	44	63	25	5,3	4,17	2354	1765	0,55
44	6,00	40	77	23	4,6	4,67	2379	**1140**	0,48

Results and Discussion

Statistical analysis showed that, number of main branch per plant was significant on the level of P<0,05 and, all the other investigated characteristics were significant on the level of P<0,01. Determination of the characteristics were in between the following values: number of main branch/plant 3,33-7,33; number of leave/plant 16-108; plant height 45cm-162cm; number of pod/plant 12-26; number of seed/pod 3,0-5,8; first pod height 3,56cm-6,67cm; biologic yield 2120kg ha^{-1}-6040kg ha^{-1}; seed yield 1140kg ha^{-1}-3550kg ha^{-1}; harvest index 46%-90% as the means of the genotypes. Table 3 shows means of the used dry bean genotypes in terms of the investigated characteristics.

Other recent research findings are as fallowing. Number of main branch per plant 1.27-12.04 (Anlarsal et al., 2000; Karakuş et al., 2005; Pekşen, 2005; Ülker and Ceyhan, 2008; Kahraman and Önder, 2009); number of leave per plant: 12.16-46.55 (Önder and Şentürk, 1996; Ülker and Ceyhan, 2008; Kahraman and Önder, 2009); plant height: 17.70-310.00 cm (Anlarsal et al., 2000; Kaçar et al., 2004; Karadavut et al., 2005; Pekşen, 2005; Pekşen and Gülümser, 2005; Bozoğlu and Sözen, 2007; Ülker and Ceyhan, 2008; Kahraman and Önder, 2009); number of pod per plant: 1-163 (Önder and Sade, 1996; Düzdemir, 1998; Kaçar et al., 2004; Kahraman and Önder, 2009); number of seed per pod: 1-9 (Şehirali, 1971; Anlarsal et al., 2000; Kahraman and Önder, 2009); first pod height: 4.6-42.6cm (Anlarsal et al., 2000; Pekşen, 2005; Pekşen and Gülümser, 2005; Kahraman and Önder, 2009); seed yield 657.0-3584.7 kg ha^{-1} (Mishra and Dash 1991; Önder and Özkaynak, 1994; Düzdemir, 1998; Kahraman and Önder, 2009); harvest index: 18.5-58.33% (Düzdemir, 1998; Karakuş et al., 2005; Ülker and Ceyhan, 2008; Kahraman and Önder, 2009) respectively. The findings of the present research were in agreement with previous results. Number of leave per plant seems more than prospects. The certified line Elkoca-2005 which is recorded as genotype 41 is a new dry bean genotype. The reason for the variation on number of leave per plant might be due to genetic structure, environment conditions or cultural practices. As it well known; leave is an important factor for photosynthesis in the plants. Therefore, this genotype looks a promising variety.

Conclusion

As a result of this research, it can be concluded that the investigated dry genotypes had a wide range of variety in terms of yield and yield components. Irrigation period and method are important factors that can also reach the more yield related quantities compared by untimely and wrong irrigation methods. Selection criteria for breeding works in the future might be determined according to the present results.

Acknowledgement

We are thankful to Selcuk University, Coordinator of BAP for their financial support and Prof. Dr. Önder TURKMEN and Expert Musa SEYMEN who works for Selcuk University, Faculty of Agriculture, Department of Horticulture for their incontrovertible contributions.

References

Anlarsal, A. E., Yücel, C. and Özveren, D., 2000. The determination of seed yield and yield components in some bean (*Ph. vulgaris*) cultivars and correlations between these characters under the Çukurova conditions. Turk J Agric For 24: 19–29.

Anonymous, 2006. Summary of agricultural statistics, Government Statistics Institute Publish, No;12, Ankara, 22-23.

Anonymous, 2009. http://www.who.int/research/en/

Anonymous, 2011a. www.fao.org.

Anonymous, 2011b. www.tuik.gov.tr

Bozoğlu, H. and H. Sözen, 2007. Some agronomic properties of the local population of common bean (Phaseolus Vulgaris L.) of Artvin Province. Turk J. Agric For 31 327-334.

Çiftçi, C. Y.. 2004. Dünyada ve Türkiye'de yemeklik tane baklagiller tarımı. TMMOB Ziraat Mühendisleri Odası Teknik Yayınlar Dizisi No: 5, 197 s. ANKARA.

Düzdemir, O., 1998. Kuru fasulye (*Phaseolus vulgaris* L.) genotiplerinde verim ve diğer bazı özellikler üzerine bir araştırma. Gazi Osman Paşa Ün. F.B.E. Yüksek Lisans Tezi, Tokat.

Kaçar, O., Çakmak, F., Çöplü, N. and Azkan, N., 2004. The effect of bacterial inoculation and different nitrogen doses on yield and yield components of some dry beans (*Phaseolus vulgaris* L.) in Bursa Province. U. Ün. Zir. Fak. Dergisi, 18(1): 207-218 .

Kahraman, A. and M. Önder, 2009. Determination of yield and some yield components of common bean (*Phaseolus vulgaris* L.) genotypes that grown in Konya province. *Türkiye VIII. Tarla Bitkileri Kongresi*, Cilt 1, s. 309-313 (Sözlü Sunum). 19 – 22 Ekim, Hatay, 2009.

Kahraman, A. and Önder, M., 2010. Drought and its physiological effects on plants. 10th International Multidisciplinary

GeoConference SGEM, Coference Proceedings, Volume II, Page 515-519, 20-26 June, Bulgaria.

Karadavut U, S. Özdemir and A. Genç, 2005. Comparison of regression equations and character decreasing in dry bean (*Phaseolus vulgaris* L.). *Bitkisel Araştırma Dergisi (2005) 1: 11–16.*

Karakuş, M., Çiftçi, V., Toğay, Y. and Toğay, N., 2005. Effects of different row spacing on the yield and yield components of bean *(Phaseolus vulgaris* L.*)* in Van- Gevaş condition. Yüzüncü Yıl Ün., Zir. Fak., Tarım Bilimleri Dergisi , 15(1): 57-62.

Mishra, S. N. and Dash, S. N., 1991. Variability For quantitative characters in french bean (*Phaseolus vulgaris* L.). Plant Breeding Abstracts 63 (1): 64.

Onder, M, Kahraman, A., Ceyhan, E., 2013. Response of dry bean (Phaseolus vulgaris L.) genotypes to water shortage. Book of Abstracts . First Legume Society Conference *2013: A Legume Odyssey* . Novi Sad, Serbia, 9-11 May 2013, pp: 210.

Önder M. and Ceyhan E. 2011. Türkiye'de yemeklik tane baklagillerin önemi, üretici sorunları ve çözüm önerileri. Konya Ticaret Odası Dergisi Sayı:39, 4-9.

Önder, M. and Özkaynak, İ., 1994. Bakteri aşılaması ve azot uygulamasının bodur kuru fasulye çeşitlerinin tane verimi ve bazı özellikleri üzerine etkileri. TÜBİTAK, Doğa-Tr. J. of Agriculture and Forestry, 18: 463–471.

Önder, M. and Sade, A., 1996. "Yunus 90" bodur kuru fasulye çeşidinde farklı bitki sıklıklarının dane verimi ve verim unsurları üzerine etkileri. S.Ü. Zir. Fak. Dergisi, 9 (11): 71-82.

Önder, M. and Şentürk, D., 1996. Ekim zamanlarının bodur kuru fasulye çeşitlerinde dane ve protein verimi ile verim unsurlarına etkisi. S. Ü. Ziraat Fakültesi Dergisi, 10 (13): 7-18.

Önder, M., Ateş, M. K., Kahraman, A. and Ceyhan, E., 2012. The problems and suggestions to dry bean farming in Konya Region", TABAD (Research Journal of Agricultural Sciences), 5 (1): 143-148.

Pekşen, E. and Gülümser, A. 2005. Relationships between seed yield and yield components and path analysis in some common bean (*Phaseolus vulgaris* L.) genotypes. *Omü Z. F. Dergisi, 20(3):82-87.*

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

Şehirali, S., 1971. Türkiyede yetistirilen bodur fasulye çesitlerinin tarla ziraatı, yönünden önemli baslıca morfolojik ve biyolojik vasıfları üzerinde arastırmalar. A.Ü. Ziraat Fakültesi Yayınları: 474 Bilimsel Araştırma ve İncelemeler : 275, Ankara.

Ülker, M. and Ceyhan, E., 2008. Orta Anadolu şartlarında yetiştirilen fasulye (*Phaseolus vulgaris* L.) genotiplerinin bazı tarımsal özelliklerinin belirlenmesi. S.Ü. Zir. Fak. Dergisi 22 (46): 83-96.

Wery, J. and Grinac, P., 1983. Use of legunes and their economic importance. In: Technical Handbook on Symbiotic Nitrogen Fixation. FAO, Rome, Italy.