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Determination of some Agricultural Characteristics of Domestic and Abroad Originated Bean Genotypes

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ABSRACT

Present research was realized during 2017 vegetation period in Konya ecological conditions according to Augmented Trial Design for the purpose of better yield, some superior traits and using in breeding programs of the bean genotypes, a total of 122 bean lines which are collected from domestic and abroad sources and 3 standard varieties – as control were used in the study. Results showed the minimum and maximum values as following; 3.01 – 392.96 g for yield per plant, 10.76 – 74.41 g for hundred seed weight, 6.67 – 246.67 cm for plant height, 1.78 – 3.44 cm for number of main branches per plant, 1.94 – 87.39 for number of pod per plant, 1.39 – 5.72 for number of seed per pod, 108 – 186 days for vegetation length. According to the results of the present study, bean genotypes presented a wide variation. Totally, 14 genotypes showed higher seed yield than the control varieties which means those genotypes are promising as genetic source for the breeding work.

1. Introduction

Hunger, insufficient and/or unbalanced nutrition are the main problems over the world. Limited content of some essential amino acids in cereals and higher prices of animal based foods makes the edible legumes as an essential alternative for providing protein requirement (Şehirali, 1988). Edible legumes are used for animal feeding as well.

Previously made studies showed that, one ton of legume hay contains 137.4 kg protein while that amount is only 70.5 kg in cereal hay (Şehirali, 1979). Additionally, legumes are able to symbiotic nitrogen fixation mechanism by *Rhizobium* bacteria that increase the organic matter in the soil and the root system prevents jamming of soil (Uysal, 2002) therefore, legumes are essential crops for sustainable agricultural systems and functional food production (Kahraman, 2017).

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Table 1
Used bean genotypes in the research.

No	Genotype	No	Genotype	No	Genotype
1	SECHREİBERS FRUHE	42	FRİJOL BLANCO	83	KORMOVOJ 16
2	SECHREİBERS FRUHE	43	PRİTKAS	84	SİYAH FASULYE
3	PİNTOS	44	EMPEREURE DE RUSİE	85	BASNAK
4	BELO ZRNO I	45	MULATİNHO CLARO L.	86	NO.1490
5	AYSE KADİN OTU-RAK	46	KLEINE WEISSE	87	ENFANT DE MONTCALME
6	BARBUNYA ALACA	47	GUARZO YARADO ARBOL	88	JAUNE DE CHALANDRY
7	AYSEKADİN	48	KATYA	89	FLAGEOLET AMARİLLO
8	SPIKA	49	TENZUNO	90	IVAJLOVGRAD 1
9	SNİEZNA KULA	50	G151	91	CARAOTAS AMARILLAS
10	FIN DE MONCHLAR	51	MARCELIN	92	MERVEILLE DU MARCHE
11	BARBUNYA	52	HUASCA HUALAGA COLO-RADO	93	NOIR DE L'HERMITAGE
12	NİZİK	53	GOLDEN HORN	94	BARRETON
13	CALI FASULYE	54	BLACK WANDER	95	RASTESKİ IV
14	ROSAMANSK	55	HOROZ	96	GRIS DEUL
15	LINGOT	56	KORA	97	NEYAZ FASULYE
16	SİRİK SİS	57	BAKLA	98	KONSTANTIN 15
17	NO.594	58	FRİJULE SİLLVESTRE	99	BALAROJO
18	SONNENGOLD	59	BRUİNE SOLDAAT	100	FRENCH BEANE
19	G-156	60	LYONNAIS A LONGUE COSSE	101	INCONPARAPLE
20	ZARZALENO DE AR-BOL	61	BELO ZRNO II	102	AYŞE KADIN FASÜLYE
21	106	62	NO.1474	103	EXTRA FIN DU PERREUX
22	BARBUNYA	63	G209	104	MOORTJE
23	SELİNİK FASULYE	64	SAXANOVA	105	FEVETTE DE ST. LAUD
24	OLTYN	65	BARRETON	106	SCHWEİZER MARKTBE-HERRSCHER
25	SONNENGOLD	66	BARBUNJA	107	SERERE
26	AYSEKADİN	67	RAGALLA	108	REYHANİYE
27	POCHA ROSADA	68	FIN DE MONTREUX	109	PANAYOTOV
28	CRİSTAL BAYO	69	NO.302	110	ZELENA
29	AYSEKADİN	70	NİSKA	111	KARATZOWO
30	AK FASULYE	71	G200	112	CARAOTAS NEGRAS
31	NO.31	72	RASTESKİ III	113	BARBUNYA
32	PAYAR	73	ZELENA	114	SARI BARBUNYA
33	FORTYDAYS	74	RİCO DE OURO	115	ZLOTA CONNA
34	SWART BOON	75	SANS RİVAL	116	INCONPARABLE HATIF
35	YESİL BARBUNYA	76	G100	117	KARAGEKİRDEK
36	SENORITA	77	REGENTE	118	PRİTKAS
37	SLAVİA	78	FASULYE ÇATAK	119	BAYNUS FASULYESİ TU
38	YAĞLİ FASULYE	79	YER AVSECSİ	120	LITTLE NAVY
39	MARKUS BOON	80	AYSEKADİN	121	BAYOS PALOS
40	CUBANOS	81	YER FASULYESİ	122	FIN DE BAGNOLS
41	AMARİLLOS	82	BARRETON		

Table 2
Soil characteristics of the trial field.

Characteristic	Unit	Result
Texture	% Sand	38
	% Silt	35
	% Clay	27
	Category	Clay - Loamy
Field capacity - Volumetric	%	25.8
Fading point - Volumetric	%	14.4
Available moisture	%	11.4
Volume weight	g/cm^3	1.34
pH		7.84
E.C.	dS/m	0.658
Infiltration speed	mm/h	10.8
Organic matter	%	1.48
Lime	%	17.28

Table 3
Climatic data (data provided from: Turkish State Meteorological Service).

Months	Monthly Average Temperature (^oC)		Monthly Total Precipitation (mm)		Monthly Average Relative Humidity (%)	
	Long terms (30 years)	2017	Long terms (30 years)	2017	Long terms (30 years)	2017
April	10.9	10.3	35.9	34.2	57.7	58.5
May	15.5	14.7	38.6	42.0	55.4	64.0
June	20.1	19.7	20.5	21.4	47.2	59.0
July	23.4	24.8	7.8	0.0	42.3	38.6
August	23.0	23.7	5.6	28.0	42.7	49.0
September	18.6	21.1	11.3	0.0	46.1	36.9
October	12.4	11.8	29.7	13.7	58.5	56.9
Total/Mean	17.7	18.0	149.4	139.3	49.9	51.8

Table 4
Summarize of statistical analysis for the commercial varieties (Standard genotypes)

Characteristic	Mean square	Sum of square	Mean square of error	F
Seed Yield	10858.74	5429.38	4301.15	1.26
100 seed weight	187.68	93.84	21.25	4.42*
Plant height	2233.33	1116.67	330.00	3.38
Main branch	1.44	0.72	0.19	3.82
Pod number	133.78	66.89	25.22	2.65
Seed number	0.78	0.39	0.26	1.52
Vegetation length	284.33	142.17	33.17	4.29*

*: Significant on 5% level.

Table 5
Investigated data of the used bean genotypes (statistically corrected values).

Character	**Seed Yield (g plant^{-1})**	**100 seed weight (g)**	**Plant height (cm)**	**Main branch (plant)**	**Pod number (plant)**	**Seed number (pod)**	**Vegetation (days)**
Min	3.01	10.76	16.67	1.78	1.94	1.39	108.00
Max	392.96	74.41	246.67	3.44	87.39	5.72	186.00
Mean	132.63	31.33	87.39	2.57	23.31	3.31	147.33
Kantar	263.46	34.52 ab	65.00 b	2.33 ab	16.17	3.17	145.33
Alberto	205.20	32.53 b	91.67 a	2.83 a	19.17	3.67	143.83
Elkoca	221.36	40.15 a	73.33 ab	2.17 b	12.50	3.33	149.83
LSD (0.05)	84.05	5.90	23.27	0.56	31.49	0.64	7.39

Bean a member of legumes is the most produced pulse crop in the world, has 50 species of *Phaseolus* genus while 5 species; *Phaseolus vulgaris, Phaseolus lunatus, Phaseolus coccineus, Phaseolus acutifolius* and *Phaseolus poliantus* are cultivated for human consumption. Among these species, *Phaseolus vulgaris* has 75% growing ratio in the global scale (Singh, 1999; Broughton et al., 2003).

In Turkey, dry bean has the third place by means of production quantity following to chickpea and lentil. Konya City has the first place in dry bean production in Turkey. It is fair that, getting higher yield from unit area has a big importance for both growers and national economy. As it seen on the other crops, dry bean is also sensitive for abiotic stress factors which causes to considerable decrease in seed yield. Genetically potential of dry bean is able to reach 500 kg da^{-1}

seed yield (Graham and Ranalli, 1997). Turkey and also Konya City has a rich genetic source of dry bean where it is possible to find various ecotypes all over the country (Kahraman and Onder, 2018). Sustainability of plant production dependent on conservation of the genetic sources.

Present research was realized to evaluation of plant characteristics and adaptation abilities on 122 bean genotypes gathered from domestic and abroad sources in addition to 3 standard varieties by evaluation of some important agricultural characteristics for the purpose of supporting breeders, growers and consumers to obtaining of the promising genotypes for the future studies.

2. Materials and Methods

Present research is realized under MSc thesis project. A total of 122 bean (*Phaseolus vulgaris* L.) genotypes were gathered from gene bank which are originated from domestic and abroad sources. In the field trial, 3 standard dry bean varieties (Alberto, Kantar, Elkoca) were used as control. Due to the limited quantities of the material, field trial was set up according to Augmented Design by 6 replications.

Seed sowing was made on 1st of April 2017 in Yarma District - Konya City. Each of the genotypes was randomly sown on each block without replication to the lines which are consisted from 1 m of length. Additionally, the standard varieties were replicated on every block. The used bean genotypes in the present research are shown on Table 1.

Plots were set up by 45 x 10 cm spaces. Before sowing, "DAP" fertilizer (18% nitrogen and 46% phosphorus content) was applied to the plots by 30 kg da^{-1} dose. Irrigation was made 5 times totally in addition to 2 times of hand hoeing. Measurements, observations and statistical analysis were realized by the relative literatures (Açıkgöz, 1993, Önder et al., 2014).

Soil characteristics of the trial field are presented on Table 2. It has 38% sand, 27% clay, pH was 7.84 and so showing clay-loamy structure.

Climatic data for the field trial that is located in Yarma District of Konya City is presented on Table 3. Comparison of the long terms and the trial season (2017) showed that; relatively higher average temperature (17.7 – 18.0 ^{o}C), lower total precipitation (149.4 – 139.3 mm) and higher average relative humidity (49.9 – 51.8 %) respectively.

3. Results and Discussion

Summarize of statistical analysis for the commercial varieties are presented on Table 4. According to the results, hundred seed weight and vegetation length showed statistically differences on the level of 5% among the used standard genotypes which were subjected as control varieties. Mean of the values were ranged as; 32.53 (Alberto) – 40.15 g (Elkoca) for hundred seed weight and, 143.83 (Alberto) – 149.83 (Elkoca) days for vegetation.

Mean values which were corrected by correction term in the statistical analysis of the investigated characteristics for the used totally 122 bean genotypes are summarized in the following lines. Minimum, maximum and average values of the investigated data are listed on Table 5 by presenting corrected values.

Seed yield showed the maximum value as 392.96 g plant^{-1} on the genotype 30 which was followed by genotype 31 (362.61 g plant^{-1}) and genotype 17 (353.14 g plant^{-1}) while the general mean was equal to 132.63 g plant^{-1} value. The used genotypes in the present research showed a wide range for seed yield. Former report about the seed yield per plant are as following; 14.35 – 26.10 g (Özcan and Özdemir, 1996), 9.59 – 119.28 g (Çiftçi et al., 2009), 15.17 – 23.19 g (Anonymous, 2018), 25.41 – 96.83 g (Yeken et al., 2018). Results of the present study for seed yield per plant presented a huge range. As it reported in the material section of the paper, the used bean lines were gathered from very different part over the world. Similarly, differences among the used bean genotypes were quite different as just evaluation of the seed morphology. Therefore, the differences among the used bean genotypes strongly welded by genetic structure in addition to various origins and ecology as well.

Hundred seed weight of the used bean genotypes were ranged from 10.76 to 74.41 g values. The genotypes with registration number; 13, 32 and 6 showed the highest values for hundred seed weight in the study. Related previous reports are giving a wide range from 13.42 to 80.60 g values for hundred seed weight (Çiftçi and Şehirali, 1984; Bozoğlu and Sözen, 2007; Kahraman and Önder, 2009; Güneş, 2011; Başçiftçi, 2012; Işık, 2012).

Plant height of the used bean genotypes in the research were changed from 16.67 cm to 246.67 cm. A former study in the same location obtained

these values as; 45-162 cm (Önder et al., 2013) that means there may be a wide variation of plant height in bean genotypes.

Number of main branches on the plant was ranged between 1.78 – 3.44 values. This character is reported as an important component for seed yield (Singh, 1999). Related studies gave the data between 1.27 – 12.04 ranges (Anlarsal et al., 2000; Pekşen, 2005; Ülker and Ceyhan, 2008; Kahraman and Önder, 2009; Önder et al., 2013).

Number of pods per plant showed the values as 1.94 – 87.39 in the present research. This trait has impact on seed yield (Chung and Goulden, 1971; Duarte and Adams, 1972). Previously related studies showed the data between 1 and 163 (Önder and Sade, 1996, Düzdemir, 1998; Bozoğlu and Gülümser, 2000; Kaçar et al. 2004; Bozoğlu and Sözen, 2007; Kahraman and Önder, 2009; Önder et al., 2013). Results are compatible with previous findings.

Number of seeds per pod showed the minimm value as 1.39 while it was maximum by 5.72 values. This feature has effect on seed yield as well (Adams, 1967). Relative subjects which were realized before gave the data as; 1.6 – 6.3 (Çiftçi and Şehirali, 1984), 1-9 (Anlarsal et al., 2000), 3-7 (Kahraman and Önder, 2009) and 3.0-5.8 (Önder et al., 2013) which are similar with the findings of this research.

Vegetation length of the present research showed the values between 108 and 186 days (from sowing to harvest maturing). Length of vegetation was reported as 90 – 100 days (Geig and Gwin, 1966), 77 – 100 days (Perea et al., 2006) and 99 – 135 days (Güneş, 2011). A small amount of changes on the vegetation length may be welded by genetic variation of the used bean genotypes and environment factors as well.

As a conclusion, a total of 14 bean lines presented superior characteristics than the control varieties. Although the global climate change seems like responsible to extension of biodiversity, the fact is that main responsible for the situation is human being. Conservation of genetic structure of the all living organism is essential for breeding works and human has to concern about it. Genetic diversity is an essential component to sustainability of biodiversity and so sustainability of agriculture. Therefore, it is necessary to conservation and evaluation of the local genotypes and focus on the desired characteristics to achievement of the breeding purposes.

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