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Agronomic Characteristics of Domestic and Abroad Originated Bean (*Phaseolus vulgaris* L.) Genotypes

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ABSRACT

Present research was realized during 2017 vegetation period according to Augmented Trial Design under Konya - Tukey ecological conditions. Yield and some agricultural characteristics of totally 100 promising bean genotypes were determined for the purposes of using on selection and hybridization breeding programs. Results of the research were ranged as following; 3.23-57.28 g for seed yield, 8.28-61.94 g for 100 seed weight 5.28-218.61 cm for plant height, 1.16-4.16 for number of main branches per plant, 2.28-60.94 for number of pods per plant, 0.82-6.16 for number of seeds per pod and 95.94-137.27 days for vegetation length. A total of 20 bean genotypes which were used as material in the study were determined as promising for the seed yield and some agricultural characteristics which may be used as genetic source for the future breeding works.

1. Introduction

Genetic diversity of the plants is quite important for many purposes in agricultural production and achievement of nutritional quality that are serving on genetic studies and biotechnology, quality focused studies etc. agronomical and breeding works (Önder and Kahraman, 2008; Ceyhan and Kahraman, 2013; Joshi, 2015; Kahraman and Onder, 2018). There are many genotypes of the dry beans (*Phaseolus vulgaris* L.) over the world that is including the local ecotypes as well which are presenting quite different statues by view of shape, morphology, chemical composition, nutritional statues, genetic structure and diversity, adaptation statues especially for sowing time, phonological characteristics, morphological statues, cultivation necessaries (Ceyhan et al, 2012; 2014; Onder et al., 2013; Yadav et al., 2015; Harmankaya et al., 2016; Kahraman, 2017). It is well known that, dry bean – as a legume crop, is essential for human due to be an important protein source, vitamin, fiber, diet food, cheap price, easy cultivation and adaptation besides take a wide part in the markets over the world in addition to act on sustainability of healthy food production, improvement of soil characteristics and a well alternative for crop rotation programs etc. main concept of sustainable agriculture (Kahraman et al., 2015; Kosev and Naydenova, 2015; Kahraman, 2016; Öktem, 2016).

In Turkey, in the field of cultivation and production, after the chickpea and lentil in the edible legumes, the third place is beans. Dry beans is a legume plant known in our country for many years, cultivated and used in human nutrition, animal nutrition and soil improvement. In our country, dry bean cultivation areas have increased in general until 2002. Bean planting areas, which reached the highest level with 180,000 ha in 2002, have decreased gradually in the following years. The Dry bean production in our country was 84.763 ha area and have an average production capacity of 266/kg/da and 239.000 tons in 2017. (Anonymous, 2017). In Konya, where the most dry bean production was made, the cultivation area was 19.143 ha, the production was 70.242 tons and the average yield was 366.91 kg / da. In our country, until 1987, dry beans were not imported. Although 87.940 tons of dry

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beans were exported in 1997, Turkey has become an importer in recent years (Anonymous, 2012).

Nearly half of the total edible legumes cultivation area in the world belongs to dried beans (Anonymous, 2012). In general, 5 of the 50 Phaseolus species (*Phaseolus vulgaris, Phaseolus lunatus, Phaseolus coccineus, Phaseolus acutifolius and Phaseolus polianthus*) are cultivated for human consumption. In this species, *Phaseolus vulgaris* species is reported to cover 75% of the world's cultivated beans and is the most cultivated species (Singh, 1999; Broughton et al., 2003).

Dry bean cultivation is widespread in the temperate regions of the world and is carried out in Asia and South America continents, mostly in developing countries with a high rate of 94%. In the world in 2012, the total cultivation area of dried beans was 28.780.376 ha and the total production was 23.140.276 tons and the average yield was 80.40 kg / ha. Looking at the production of beans by country, Myanmar (5.190.000 tons), India (3.898.000 tons) and Brazil (2.616.000 tons); in terms of cultivation area, India (9.100.000 ha), Myanmar (2.845.662 ha) and Brazil (2.726.932 ha) respectively (Anonymous, 2016). When the data of FAO until 2012 are examined; in the last 5 years, there has been no significant decrease in dry bean cultivation areas around the world. (Dried bean plantation area in the world in 2011 was 30.411.203 ha, this value decreased to 28.780.376 ha in 2012 only) And the world's most cultivated field and production of edible grain legume plant has been again dry beans.

Present research is realized to determine some agronomic characteristics of the dry bean genotypes which are originated from domestic and abroad sources under Konya – Turkey ecology that is an important producer over the country for the aim of scanning the significant characteristics for future breeding programs.

2. Materials and Methods

This research was carried out in a farmer field in Konya Province, Çumra District and İçeri Çumra Province in 2017. In the research, 100 bean genotypes (*Phaseolus vulgaris L.*) and 3 standard varieties (*Alberto, Kantar, Elkoca*) obtained from Selcuk University Faculty of Agriculture Department of Field Crops were used as materials. (Table 1)

Table 1
Local names and numbers of bean genotypes used in research

No	Local Name	No	Local Name	No	Local Name	No	Local Name
1	Bonvert	26	O-683	51	Bayo	76	Canario
2	Cuarenteno	27	Negro	52	Brown	77	Pinto Mestizo
3	G47	28	Chase	53	Coulee	78	Ac Argonaut
4	Rice	29	California LRK	54	Colorado de Comitan	79	Fiero
5	Idaho Brown	30	White Seeded Tendergreen	55	Callacatlan Frijol	80	Red-white
6	Ayufracho	31	Green Isle	56	Burros Argentinos	81	Ac Black Diamond
7	Golden Shower	32	Mammoth Stringless	57	Early Rose	82	G62
8	Alubia Cerrillos	33	Lapin	58	Golden Early	83	Bonanza
9	G18706	34	Great Northern 1140	59	Berrenclo	84	Q-719
10	Roger Stringless green refugee	35	Jalo EEP558	60	Talete	85	Radical San Gil
11	Norida	36	Blue Victor	61	Pole bean	86	Cameleon
12	Cuarenteno	37	Yamal	62	Redswan	87	Amadeus 77
13	Frijol Tinequito	38	Dresden	63	Richgreen	88	Mecosta
14	Louisiana	39	Montequilla	64	Dwarf	89	Ac Scarlet
15	Bayo	40	G1924	65	Hungarian	90	Salem
16	Pinto Bayacora	41	Dwarf Green Round Pod	66	Swedish Brown	91	Round Pod Kidney Wax
17	Montequilla	42	San Juan	67	Drought Resistant	92	Arikara Yellow
18	Toramane	43	G31	68	Mortino	93	Black Turtle Soup
19	Blue Danube	44	Bush Bean	69	Acotlanero Negro	94	G V 50
20	Chile	45	Polaris	70	G2453	95	Lakette
21	Holberg	46	Monument	71	Blush	96	Brown Dwarf
22	Emerson	47	İmperial Pea Bean	72	Golden	97	Frijol Aluvia
23	Genetic Marker 17	48	Frijol Tinequito	73	Oregon Brown Greasy	98	No.1072
24	Norwegian Brown	49	Colombia	74	Claret	99	Delgado
25	Horticultural	50	Talete	75	Bigbend	100	Niagara 773

Some physical and chemical properties were determined as a result of the analysis of the experimental area soil. The soil of the trial area has a slightly alkaline structure and pH is 7.86 and the ratio of organic

matter is 0.91%. Available Phosphorus content is 13.66 kg / ha, Available Potassium ratio is 190.55 kg / da and the micro element ratios are sufficient (Table 2).

Table 2
Important Soil Properties of the Trial Field

Analysis Name	Unit	Results
Structure	%	55
Salinty	%	0,02
pH		7.86
E.C.		489
Organic Matter	%	0.91
Lime	%	9.47
Availabe Phosphorus ($P_2O_{5)}$	Kg/da	13.66
Availabe Potassium(K_2O)	Kg/da	190.55
Calcium	Ppm	5629
Magnesium	Ppm	741
Iron	Ppm	2.55
Copper	ppm	0.60

The average temperature demand of beans during the developments and flovering period is 20-25 ^{0}C (Şehirali 1979). In 2017, the average temperature was suitable for bean cultivation.(Table 3).

Table 3
Climate Data In Çumra District Of Konya Province Of Vegetation Period

Montths	Monthly Average Temperature (^{0}C)		Monthly Total Rainfall (mm)	
	Long Term (30 Years)	2017	Long Term (30 Years)	2017
April	11,3	11,4	36,6	60,4
May	15,7	15,8	35,5	58,6
June	19,8	20,3	19,8	14,0
July	22,9	24,5	6,9	0,0
August	22,6	23,4	4,5	2,2
September	18,4	21,2	11,2	0,0
Total			110,4	135,2
Average	16,11	19,43		

Due to the fact that all of the bean genotypes used as materials in the research were obtained from the gene banks and the amount of seed was low and a large number of genotypes were used in the experiment. This research was established according to the Augmented Trial Pattern. In accordance with the characteristics of the Augmented Trial Pattern, in this experiment, which was planned as 6 replicates, the standard varieties were repeated in each block while the genotypes were randomly distributed to the blocks. Each of the genotypes was planted in 1 row of 1 m. Standard varieties were planted in 4 rows of 1 m. Hand plantings were made between 45 cm in row, 10 cm over row and 60 cm between the blocks On the 1st of May 2017. In the 30 kg DAP formulation (18.46.0), the base fertilizer was applied before the planting. In the trial, totally 6 sprinkler irrigation were applied in the season. In the trial weed control was carried out twice by grubbing.

Hand harvesting and blending were performed on different days in the period when the beans of a large part of each genotype and standard type were yellowed and grains were matured. All the observations were realized according to the UPOV statues. These cultivars and varieties cultivated in the Central Anatolia climate yield, 100 grain weight, plant height, number of branches, number of vetches, number of vetches per plant, vegetation time, such as observations and measurements were made. The statistical analyzes were performed according to "Augmented Design" on these results to determine the performance of some genotypes and some agricultural properties by "JUMP" computer based statistical analysis program.

3. Results and Discussion

When the genotypes were evaluated for grain yield, the highest grain yield was obtained from the genotype 2 with 57.28 g / plant. This was followed by the genotypes 56 (51.9 g / plant) and 75 (50.34 g / plant) in descending order. According to the adaptation to the ecological conditions of Konya, there were genotypes that did not yield, and there were also genotypes giving about 60 g / plant yield. As a matter of fact, Önder et al. (2013) stated that 41 bean genotype yields varied between 114 and 355 kg / da. Ülker and Ceyhan (2008) stated that 19 bean genotype yields varied between 162.92-476.85 kg/da. Önder and Özkaynak (1994) stated that 10 bean genotype yields varied between 264.23-358.47 kg/da. When these results are considered, lines 2, 56 and 75 can be used as genetic source in studies to be made for bean improvement. Variance analysis results of the standard varieties used were given (Table 4).

It was determined that there were positive-significant relationships between seed yield and seed weight in shortie beans. It was determined that the facial weight values showed a wide variation. And this value has ranged from 13.42 to 80.6 g in various studies. (Çiftçi and Şehirali, 1984; Bozoglu and Sozen, 2007; Kahraman & Önder, 2009; Gunes, 2011; Basciftci, 2012; Isik, 2012). Amont the Genotypes number18 genotype (61.94 g / plant), genotype 8 (47.94 g / plant) and number 72 genotype (72.61 g / plant) are the most prominent genotypes.

Table 4
Analysis of variance of the properties examined in the research

Source of variation	DF	Seed yield	One hundred seed weight	Plant height	First pod height	Vegetation length
Standard	3	**	**	**	*	*

*: p<0.05; **: p < 0.01

Among the genotypes used in the study, the plant height was found between 5.28 and 218.61 cm. Similarly to our study results, it has been found that this value changes in a wide range of 1770-310 cm in various studies in which the plant height is determined in beans. (Şehirali, 1965; Akçin, 1971; Çiftçi and Şehirali, 1984; Önder and Özkaynak, 1994; Anlarsal et al., 2000; Kaçar et al., 2004; Karadavut et al., 2005; Pekşen, 2005; Bozoğlu and Sözen, 2007; Ülker and Ceyhan, 2008; Kahraman & Önder, 2009; Güneş, 2011).

Table 5
Standard types and genotypes according to the characteristics discussed in the minimum-highest values and lsd values.

Characteristics	Seed Yield (g plant^{-1})	One Hundred Seed Weight (g)	Plant Height (cm)	Vegetation of Length (days)	First Pod Height
Min.	1.9	8.28	5.28	95.94	6.78
Max.	57.28	61.94	218.61	138.27	24.45
Alberto	45.02 a	33.83 b	101.66 a	109.66 b	16.17 a
Elkoca	23.665 b	39.83 a	69.16 b	115.66 a	12.34 b
Kantar	49.83a	40.16 a	75 b	109.5 b	12.83 b
LSD (0.05)	9.043	1.887	18.247	4.527	2.985

The number of branches in the plants used in the study was found to be 1.16-4.16 / plant range. Singh et al. (1976) stated that the number of major branch in the plant was an important factor affecting grain yield in dry beans.

The number of vetch in the plant has a significant effect on yield. In genotype analysis, genotype 97 was the genotype with the highest vetch number with 60.94 units / plant. In descending order, genotype 21 followed 53.94 pieces / plant and 80 genotypes with 43.28 pieces / plant. In previous studies, it was determined that beans had a wide variation in terms of vetch number and this value could be in the range of 1-163 pieces / plant. (Önder and Sade, 1996, Düzdemir, 1998; Bozoğlu and Gülümser, 2000; Kaçar et al. 2004; Bozoğlu and Sözen, 2007; Kahraman & Önder, 2009; Önder et al., 2013)

In the study, the number of grain in the bean was determined as 0.82-6.16 pieces/vetch. The number of vetch grains in the dry bean plant is an important yield component (Adams, 1967). In the studies on the subject, the number of vetch beans in beans was found to be 1.6-6.3. (Çiftçi & Şehirali, 1984), 1-9 (Anlarsal et al., 2000), 3-7 (Kahraman & Önder, 2009) and 3.0-5.8 pieces /vetch (Önder et al., 2013). The results of our thesis are similar with previous studies.

The highest initial vetch height was obtained from Alberto variety with 16.17 cm height as the average of blocks. This was followed by Elkoca and 12.34 cm Kantar with 12.83 cm in descending order. Of the genotypes used in the trial, the lowest genotype was number 58 (6.78 cm) measured and the highest genotype was number 97 (25.45 cm).

There was no significant difference in flowering time between genotypes used in the study. The number 89 genotype (37.94 days), the shortest flowering period of genotypes, and the longest flowering time number 26 genotype (60.94 days) were measured.

The time to flowering in dry beans has been found to have a significant effect on yield (Singh and Malhotra, 1970). And according to the results of the research (Anlarsal et al., 2000; Karadavut et al., 2005; Pekşen, 2005; Ülker and Ceyhan, 2008; Kahraman & Önder, 2009a; Güneş, 2011), the time to flowering in dry beans varies according to the ecological factors and genotypes and has been found to vary between 36-72 days. Mendes et al. (2008) stated that crossbreeding in dry beans can reduce flowering time from 33.2 to 25.0 days.

The vegetation period was determined as 95.94-138.27 days. Gillard et al (2012) in their report on the study of dry beans for 4 years Although the harvest time is commonly referred to as 90% of the pods in the period of maturation, they stated that this situation is difficult in field conditions, and that if harvest time is not determined correctly, significant decreases in yield and quality may occur.

4. Conclusion and Suggestions

This study was carried out in 2017 together with Kantar, Alberto and Elkoca varieties of 100 different dry and fresh bean lines provided by Prof Dr. Mustafa Önder with the introduction method from different countries and regions under the conditions of farmers in the İçeriçumra neighborhood of Çumra district of Konya Province. Results of the study is summarized in the following lines.

Test results showed highest yield in terms of grain yield per plant of 49.83 g / plant was obtained from the

Kantar variety. The yields of the genotypes 2, 25, 34, 39, 55, 56, 69, 75, 89 and 94 used were close to or high. Similarly, 8 genotypes (8, 18, 29, 51, 71, 77, 79, 86) were found in the coarse grains, which weighed 40.16 g in one hundred grains.

In light of these results genotypes used in this experiment can be used, in the field of cultivation development, which is better in terms of grain yield and important agricultural characteristics used in the experiment.

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