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# Determination of some parameters of landrace green bean (*Phaseolus vulgaris* L.) genotypes collected from Western Mediterranean Region of Turkey

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**Abstract**
Being one of the agricultural products to be commonly grown and consumed in the world, beans display a wide range of production and sort in Turkey though it is not a native land. Although the beans production is limited to some parts of Turkey, it is commonly cultivated for family consumption both at low and high-altitude territories. However, the demand towards the commercial seeds seems to increase today, and this situation threatens the presence of landrace genotypes. The landrace genotypes, one of the genetic sources, are crucial for maintaining the genetic variability, food safety and breeding applications. From this point of view, this study was conducted in order to determine some parameters of landrace green bean (*Phaseolus vulgaris* L.) genotypes collected from Antalya, Isparta, and Burdur in Western-Mediterranean of Turkey between 2013 and 2014. In order to develop a gene pool and to make a beginning material for breeding studies, 124 landrace common bean genotypes adapted to both coastal line and highlands have been gathered, recorded and taken under protection with the detected locations. As a result of the study, the most genotypes were collected from Antalya province. It has been determined that there are more landrace common bean varieties (56.5%) in higher altitude areas and it is detected that the pole type (5.5%) is more common than the bush type. Furthermore, the seeds of 62.9% of the collected genotypes were unicolor and white color was predominant in the seed color.

**Keywords:** Green bean; Collection; Landrace cultivar; Turkey; *Phaseolus vulgaris* L.

**Batı Akdeniz Bölgesinden toplanan yerel taze fasulye (*Phaseolus vulgaris* L.) genotiplerinin bazı özelliklerinin belirlenmesi**

**Öz**
Dünyada en fazla yetiştirilen ve tüketilen tarımsal ürünlerden biri olan fasulye, anavatanı olmamasına rağmen Türkiye'de geniş bir üretim alanı ve çeşitlilik sergilemektedir. Türkiye'de fasulye üretimi, bazı bölgelerle sınırlı olsa da hem düşük hem de yüksek rakımlı alanlarda genellikle aile tüketimi için yetiştirilmektedir. Bununla birlikte, günümüzde ticari tohumlara olan talep artmaktadır ve bu durum yerel taze fasulye genotiplerinin varlığını tehdit etmektedir. Genetik kaynaklardan bir tanesi olan yerel genotipler, genetik değişkenlik, gıda güvenliği ve ıslah uygulamaları için oldukça önemlidir. Bu açıdan bakıldığında çalışma, 2013-2014 yılları arasında Batı Akdeniz'de yer alan Antalya, Burdur ve Isparta illerinden toplanan yerel taze fasulye (*Phaseolus vulgaris* L.) genotiplerinin bazı özelliklerini belirlemek amacıyla yürütülmüştür. Gen havuzu ve ıslah çalışmalarına başlangıç materyali oluşturmak için hem düşük hem de yüksek rakımlı alanlara adapte olmuş 124 tane fasulye genotipi toplanmış ve kayıt altına alınmış. Çalışma sonucunda en fazla genotip Antalya ilinden toplanmıştır. Yüksek rakımlı bölgelerde daha fazla yerel fasulye çeşidi bulunduğu (%56.5) ve tırmanıcı büyüme özelliğine sahip olan çeşitlerin(%85.5) bodur büyüme özelliğinde ki çeşitlerden daha yaygın olduğu belirlenmiştir. Ayrıca, toplanan genotiplerin %62.9'unun tohumları tek renklidir ve tohum renginde beyaz rengin baskın olduğu tespit edilmiştir.

**Anahtar Kelimeler:** Taze fasulye; Toplama; Yerel çeşit; Türkiye; *Phaseolus vulgaris* L.

## 1. Introduction

Common bean (*Phaseolus vulgaris* L.) is one of the most important crops in terms of human consumption, animal feeding and sustainable agriculture and holds the 90.0% share of cultivated beans. According to the 2013 data, a total of 21 365 919 tons of common beans are produced throughout the world and Turkey is the 3rd country producing the highest common beans with 632 301 tons (FAO, 2016). Despite the fact that Turkey is not the native country of common bean, its production and variety are shown richness. Common cultivation of

common bean is made with commercial seeds but especially landrace cultivars are grown on the edge of greenhouses or with crops such as corn in fields in both low and high-altitude territories for family consumption.

Progress in plant breeding, especially after the green revolution, resulted in the extinction of landrace cultivars and modern cultivars has taken the place of landrace cultivars (Engels, 2004). Nowadays it is seen that commercial seeds are increasing in demand in terms of uniformity, so that threatens the existence of landrace genotypes. Landrace genotypes are one of the important genetic sources in terms of food security, breeding studies and sustainable genetic diversity.

Genetic erosion, a term that refers to the disappearance of gene or gene combinations in locally adapted landrace varieties, is threatened plant diversity. The first stage causing the genetic erosion is modern cultivars take the place of landrace cultivars, the second stage is modern breeding applications. Therefore, especially, landraces genotypes in vulnerable or threatened regions, they need to be produced for immediate use and protected for future use (Matur, 2011).

Although natural resources have undergone changes by natural and artificial selection for thousands of years, wild habitats and farms have been sufficient to protect plant genetic diversity. Today, it is under the pressure of demographic, socio-economic and technological changes. Uniformity is preferred instead of diversity. The loss of genetic material leads to irreversible erosion of genetic diversity. In the near future, extreme changes due to climate change are predicted. However, it is thought that there will also be changes in abiotic and biotic conditions. In addition to climate change, the world population is expected to reach 9 billion by 2050. It is clear that the collection and conservation of genetic diversity are necessary to solve the problem of agricultural land and water deficiency caused by population growth. Plant genetic resources are of the essence material for sustainable agriculture. Their hiding and use are critical to food security both today and in the future. A collection of germplasm is a prerequisite for the use of genetic materials and is the first step for their ex-situ storage. (Frison, 2011).

This study was carried out using the landrace common bean genotypes were grown in districts and villages of Antalya, Burdur and Isparta provinces in the Western Mediterranean Region between 2013 and 2014. 124 landrace common bean genotypes were adapted in both low and high altitude territory were collected and recorded and taken under protection with the detected locations in order to develop the gene pool and to form the starting material for breeding trials.

## 2. Materials and Methods

The Mediterranean Region is divided into east and west. The West Mediterranean Region, where the landrace common bean genotypes are collected, constitutes 4.7% of Turkey's surface area with an area of 36.797 $km^2$ (Anonim, 2009).

The Real Mediterranean climate prevails in the coastal part of the Mediterranean. The Mediterranean Mountain Climate is emerging in areas where the Real Mediterranean climate is deteriorated due to altitude. Areas farther from the sea where the Mediterranean effect has weakened are called Continental Mediterranean Climates. The Middle Anatolia Continental Climate prevails in areas where the sea effect has disappeared significantly and the precipitation regime has changed (Sarı, 2009). This diversity of climate seen in the Mediterranean Region can be expressed in the Western Mediterranean region. This is one of the reasons for the variation in the landrace common bean varieties cultured in the Western Mediterranean Region. The IBPGR collection form (general) used during the collection of the landrace common bean genotypes is given in part in Table 1 below was used (Anonymous, 2017).

The study was conducted in 2013-2014. Through the study, Antalya, Burdur and Isparta cities, which are significant centers for bean production and towns, including 39 districts at the total, where bean plantation is widely maintained and villages which belong to these cities above; were visited and landrace genotypes were collected (Figure 1). At the first stage of the genotype detection, each village was considered as a station. But only, the stations where the landrace genotypes were

Table 1. IBPGR collection form (general)

| Descriptors in this column must be filled in | Descriptors in this column should be filled in |
|---|---|
| Genus: | Cultural practices: |
| Species: | Shifting (circle one): yes no |
| Subspecies: | Irrigated (circle one): yes no |
| Collector's number: | Transplanted (circle one): yes no |
| Collecting institute: | Terraced (circle one): yes no |
| Date of collection: | Sowing month: |
| Country of collection: | Harvest month: |

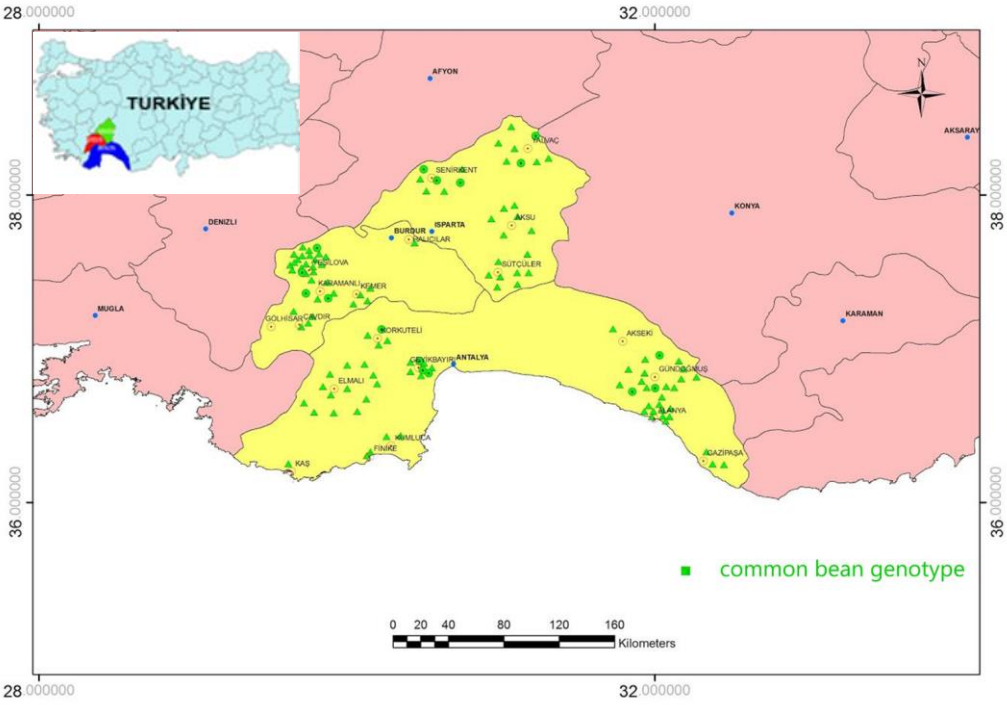


Figure 1. The map of the West Mediterranean Region and the areas where the landrace common bean genotypes are collected

found and collected were numbered and recorded. Before the stations were determined, was contacted with the Provincial Food Agriculture and Livestock and producer associations of these cities and towns. Areas where common bean production was widely cultivated were determined and all landrace genotypes were collected through face to face communication with local growers. When collecting; Genotypes growth patterns, seed shapes and colors, local names and location information were recorded.

## 3. Results and Discussion

As a result of the population surveys, a total of 124 different populations of green beans were collected, 60 from Antalya, 35 from Burdur and 29 from Isparta. The collected coordinates and altitudes of the landrace genotypes, the locations and the number of genotypes collected from these locations were given in Table 2. As seen in Table 2, it can be said that Antalya is richer than the other cities in terms of landrace common bean genotypes. When the collected genotypes were examined, it is observed that the landrace common bean genotypes in the Western Mediterranean Region were generally grown in pole type and landrace varieties production is more prevalent in higher altitudes areas. A total of 18 genotypes (14.5%) were collected from low altitude regions. The number of genotypes collected from high altitude regions is 106. Of these, 36 genotypes (29.0%) were collected from 500-1000 m and 70 genotypes (56.5%) were collected at altitudes of 1000-1500 m.

Table 2. Genotype numbers, locations and coordinates of collected landrace common beans in West Mediterranean Region of Turkey

| Genotype number | Location | Coordinates | Altitude (m) |
|---|---|---|---|
| 4 | Antalya-Korkuteli | 37°04'23.6"N-30°11'53.0"E | 998 (HT)* |
| 8 | Antalya-Geyikbayırı | 36°52'37.8"N-30°27'52.8"E | 609 (HT) |
| 2 | Antalya-Finike | 36°18′11.5″ N-30°08′20.8″E | 113 (LT) |
| 16 | Antalya-Gündoğmuş | 36°48′36.6″N-31°59′43.6″E | 890 (HT) |
| 1 | Antalya-Akseki | 37°03′03.6″N-31°47′30.7″E | 1175 (HT) |
| 1 | Antalya-Kaş | 36°12'00.8"N-29°38'21.4"E | 14 (LT) |
| 10 | Antalya-Alanya | 36°33′20.8″N-32°01′13.8″E | 64 (LT) |
| 2 | Antalya-Kumluca | 36°21'06.8"N-30°16'37.5"E | 11 (LT) |
| 3 | Antalya-Gazipaşa | 36°16'23.7"N-32°18'24.8"E | 29 (LT) |
| 13 | Antalya-Elmalı | 36°44'12.4"N-29°55'05.5"E | 1085 (HT) |
| 3 | Burdur-Çavdır | 37°09′07.2″N-29°41′44.2″E | 1078 (HT) |
| 1 | Burdur-Halıcılar | 37°35'00.6"N-30°05'33.2"E | 925 (HT) |
| 2 | Burdur-Gölhisar | 37°08'46.1"N-29°30'32.3"E | 1005 (HT) |
| 6 | Burdur-Karamanlı | 37°22'02.8"N-29°48'30.1"E | 1295 (HT) |
| 4 | Burdur-Kemer Belenli | 37°18'13.5"N-29°59'56.8"E | 1299 (HT) |
| 19 | Burdur-Yeşilova | 37°30'23.9"N-29°45'08.7"E | 1207 (HT) |
| 8 | Isparta-Sütçüler | 37°29'52.3"N-30°58'26.0"E | 1015 (HT) |
| 6 | Isparta-Aksu | 37°48'03.4"N-31°04'06.0"E | 1222 (HT) |
| 7 | Isparta-Senirkent | 38°06'33.9"N-30°32'59.1"E | 963 (HT) |
| 8 | Isparta-Yalvaç | 38°17'55.9"N-31°10'43.4"E | 1107 (HT) |

*:HT: High-altitude territory, LT: Low-altitude territory

Similar to the results of this study, Bozoğlu and Sözen (2013) collected 44.1% of genotypes from 1001-1500 altitudes, which is the largest group. Dutta et al. (2016) collected 23 landrace bean varieties from Lushai hill (India). Similar to this study, a significant portion of genotypes were collected from high altitude locations, and they noted that especially high-value crops were one of the reasons for the loss of landrace varieties. Researchers who indicated that landrace beans are a large variation between genotypes in the form of seeds, size and color (Dutta et al., 2013). Greenhouse cultivation is common on coastal regions and commercial varieties cultivars are preferable in greenhouse cultivation in terms of uniformity all around the world. This causes the disappearance of landrace varieties. Although the price of common beans tends to increase, it cannot compete with vegetables such as tomato, pepper, eggplant which are widely grown in the greenhouses. In addition, separation of the first pods of the plant as seed for next growing season, removal of seeds and spreading and drying of the seeds in the landrace varieties lead farmers to use commercial seeds.

The seeds were collected genotypes were stored by giving registration numbers for molecular and morphological characterization. Using Madakbaş (2006)'s work as an example, recorded information was given to the genotypes. At this stage, the traffic code of the city in which seeds collected was written in the beginning. Then, The CB abbreviation was used to indicate that the collected genotype was a common bean. The name of the collected region was coded by abbreviated (e.g Kumluca: KU) and finally the generations were numbered (e.g 07CBKU). In some populations, differences in growth characteristics were observed after planting. These populations were separated from each other by the letters A, B at the end of the registration numbers (e.g 07CBKU1-A). Similarly, in Çirka and Çiftçi (2016), a total of 378 bean genotypes collected from the south of the Eastern Anatolia Region was named with the abbreviated names (Malatya: ML) and the number of the samples added at the end. They also recorded the names of the villages, the identity of the farmers, the local name of the variety and the purpose of growing the variety during the collection. Places where genetic resources are collected are called 'station'. This term refers to the area where a mixture of samples is taken and ecological records are kept once in a single collection. It is quite easy to determine a location of a station for annual plants. In plants, although genetic differences occur as a result of selection during the growing season, these differences usually occur at low levels. While farmers who use different seeds collect samples from each farm, single samples are taken from the farms using the same seed to represent the whole area (Şehirali and

Özgen, 2012). Sözen et al. (2014), collected 54 landrace bean populations considering the seed color and shape from the Central Black Sea Region. When collecting, they took into consideration the cultivation areas of bean and determined the survey points according to the gradual sampling method. In the study, after the farms that had been cultivating the landrace varieties were identified and then the seeds taken from the farms where the same kind of seeds was used were recorded as the same population. This is often the case, especially in the same village and neighboring villages due to seed exchange is common. Rao et al. (2006) stated that morphological characterization studies should be conducted in two or three seasons, and beside this may not be practical due to the high accession diversity in landrace varieties. In this study, collected common bean genotypes were grown for 2 years and characterized morphologically. In the first year of characterization, the different genotypes identified within the populations were separated and renamed and re-recorded. During the collection of genetic material; orientations of local authorities, face-to-face interviews with farmers, seed features, local names of landrace varieties, plant growth habits.

The distribution of 124 landrace bean genotype collected in the Antalya, Burdur and Isparta by province and growing type ratio was given in Table 3. As seen in Table 3, most landrace beans were collected from Antalya province (60) and least from Isparta province (29). In the evaluation of the collection, it was seen that the landrace beans showing the pole growth feature was in the majority in all three provinces. In general, when all genotypes were examined, a similar ratio (85.5%) were obtained with the results obtained from provinces. Burdur was the province that grew most of the landrace bush variety (17.24%). The results obtained indicate that mainly climbing varieties are grown in the Western Mediterranean Region. Bozoğlu and Sözen (2007) collected 400 samples from 200-2100 altimeters from Artvin according to the color and shape of the seed. The researchers evaluated 292 of these samples in terms of different characteristics. They reported that 30.0% of these samples were bush types and 70.0% of them had semi-climbing or climbing types. In another study, the researchers found that 34.7% of the 72 landrace bean genotypes were bush types, 56.9% were semi-climbing and 8.4% were climbing (Bozoğlu and Sözen, 2013). Bozoğlu and Gülümser (1999) stated that there is a positive and significant relationship between yield and plant length. Rana et al. (2015) reported that climbing bean cultivars were preferred, especially high altitudes, because they were grown together with maize and amaranth. However, they stated that the change of growth type of bean according to the regions determined in ecological conditions as well as the growing system. The reasons why climbing bean cultivars; In the winter months, it is used to evaluate the edges of the greenhouses in low altitudes and thus it is possible for the farmer to earn income from these empty areas and in the summer months it is possible to grow more than one product at the same time with multiple cultivation with plants such as corn at high altitudes. Studies carried out, including this study, show that climbing-type landrace bean genotypes are more than bush genotypes in Turkey. In a study in Uganda, 268 local beans were examined and they indicated that the dominant growth type was indeterminate bush - types II (49.0%) followed by determinate bush - type I, then semi - climbing - type III and climbing - type IV least (5.0%) (Okii et al., 2014). Landrace varieties can easily undergo genetic erosion. The genetic resources are usually protected by the cultivation by farmers. Thanks to their cultivation in the same area for years, they also reflect the preferences of producers and consumers where they grow up. One of the criteria considered during the collection of landrace bean genotypes was seed characteristics. The seed characteristics determined according to the UPOV criteria were utilized both for the collection of the seeds and for the morphological characterization of the genotypes. The distribution of landrace bean genotypes collected in the Antalya, Burdur and Isparta province by the color of the seeds and diversity of seed morphology were given in Table 4 and Figure 2, respectively. As shown in Table 4, there are more genotypes with unicolor seed characteristics. When analyzed as a percentage, it was determined that the multicolor seeds constitute 37.1% of all populations, whereas the unicolor seeds constitute 62.9% and the white dominates the seed colors. However, the main color of the seeds and the second main color of the seeds differ according to the provinces.

Table 3. The distribution of 124 landrace bean genotype collected in the Antalya, Burdur and Isparta by province and growing type ratio

| Province | Total number | Growing type | Pole ratio (%) | Bush ratio (%) |
|---|---|---|---|---|
| Antalya | 60 | 53 pole, 7 bush | 88.33 | 11.66 |
| Burdur | 35 | 31 pole, 4 bush | 88.57 | 11.43 |
| Isparta | 29 | 24 pole, 5 bush | 82.76 | 17.24 |

Table 4. The distribution of landrace bean genotypes collected in the Antalya, Burdur and Isparta province by color of the seeds

| Province | Color | Main color | Second main color |
|---|---|---|---|
| Antalya | Unicolor: 35<br>Multicolor: 25 | White: 20<br>Mustard color: 1<br>Yellow: 19<br>Buff color: 1<br>Brown: 7<br>Red: 8<br>Purple: -<br>Black: 3<br>Light pink: 1 | None: 35<br>Brown: 8<br>Red: 15<br>Black: 1<br>Light pink: 1 |
| Burdur | Unicolor: 26<br>Multicolor: 10 | White: 12<br>Mustard color: 6<br>Yellow: 2<br>Buff color: 1<br>Brown: 8<br>Red: 2<br>Purple: 1<br>Black: 2<br>Light pink: 1 | None: 26<br>Brown: 4<br>Red: 1<br>Black: 2<br>Light pink: 2 |
| Isparta | Unicolor: 18<br>Multicolor: 11 | White: 9<br>Mustard color: 2<br>Yellow: 8<br>Buff color: 4<br>Brown: 3<br>Red: -<br>Purple: -<br>Black: 3<br>Light pink: - | None: 18<br>Brown: 5<br>Red: 4<br>Black: -<br>Light pink: 2 |

As seen in Table 4, while the purple color in the main color criterion of the seeds is not found in genotypes collected from Antalya province, the genotypes with red, purple and pinkish orange colors are not found in Burdur. In addition, black color, one of the second main colors, is not found in the genotypes collected from Burdur. Bozoğlu and Sözen (2013) collected 400 bean genotypes according to seed color and shape, in order to prevent the loss of landrace bean variety from Artvin province. They notified that the genotypes were collected; 180 (45.0%) white seed color, 113 (28.3%) unicolor seed color, and the remaining 107 (26.7%) had multicolored seed color. The most common seed color in the Western Mediterranean region is white, which accounts corresponds to 33.0% of the total genotypes. This is followed by genotypes with yellow seed (23.0%). Similarly, white seed color (63.9%) was dominant in the landrace bean genotypes collected from Central Blacksea Region (Sözen et al., 2014).

Compared with this study, it can be said that seed color variability (white, gray, brown, black) detected in the Middle Black Sea Region is less than in the Western Mediterranean Region. Rana et al. (2015) characterized 4274 accessions in the Gene Bank of India and similar to this study, white (31.0%) and red (29.0 were dominant and 66.0% had single seed color. The researchers have noted that they have detected many seed colors and that this color diversity is also found elsewhere in the world. This shows that the genes that managed the seed color have been moved through introgress between gene pools and hybridization. Okii et al. (2014) have studied 284 bean accessions, 268 of which are landrace accessions and they reported that the

Figure 2. Diversity of seed morphology of collected from Antalya, Isparta and Burdur province

dominant color was maroon (18.0%) in these seed coat. In a study comparing landrace varieties of beans from Bulgaria and Portugal, the regional differences in seed characteristics were clearly demonstrated. While the Portuguese landrace beans have many seed colors (red, white, brown, brownish, bicolor), it has a dominant white color in the Bulgarian landrace beans (Stoilova et al., 2013). As can be understood from the results, the use of seed characteristics during the collection of local varieties is extremely important. In the last 100 years, significant losses have occurred in diversity and this situation continues uninterruptedly. These irreversible losses, including landrace varieties, worry about gene banks and plant breeders. Polymorphism is the primary source of change in the morphological and physiological appearance of plants. It is the basis for plants and animals to be adaptable to various environmental conditions. Diversity ensures that living beings are resistant to the challenges of the future (Hammer et al., 2003). Since landrace varieties are important genetic resources, the priority is to collect and record these varieties.

## 4. Conclusion

Landrace cultivars are one of the plant genetic resources and are included in the group to be given priority as genetic material. Due to the diversity and distinctiveness of plant growth habit and seed color, these characteristics come to the fore in the collection of landrace beans. In this study, we have concluded that the landrace green bean material we collected is very rich when considering the seed visual properties. Finally, we suggest that the data obtained from this study will be able to support future breeding programs and provide significant contributions to the conservation of landrace bean gene resources in Mediterranean Region.

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