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General Status of Leguminous Vegetable Genetic Resources in Turkey

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ABSTRACT

The legume family is of great significance because so many species are used throughout the world as sources of food and medicine. Turkey is described as a microcenter for bean (*Phaseolus vulgaris* L.), faba bean (*Vicia faba* L.), and cowpea (*Vigna unguiculata*) species. Wild, weedy and cultivated forms of *Pisum* are found in Turkey where the primary and secondary gene centres of origin overlap. The national collection of Leguminosae species at National Gene Bank of Turkey (AARI) consist of many accessions based on collection-related activities which systematically started since the early 1960s: 79.2% of these sources are beans (*P. vulgaris* L.), 12.4% is faba bean (*V. faba* L.) 5.8% is pea (*Pisum sativum* L.) and 2.6% is cowpea (*V. unguiculata*). In this review, the number of leguminous vegetable accessions of Turkish origin at different seed gene banks around the world is provided. The aim of this review is to outline some of the legume vegetable genetic resources of Turkey, their distribution, collection and characterization, and to describe cultivar breeding programmes.

Keywords: accession, cowpea, faba bean, green bean, pea, seed gene bank, Turkey

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INTRODUCTION

The Leguminosae is the third largest family of higher plants with 20,000 species classified into around 650 genera (Gepts *et al*. 2005). Many of the species are also grown for the production of their dried seeds which are frequently referred to as pulses or grain legumes; they include *P. sativum* L. (pea), *P. vulgaris* L. (common beans) and *V. faba* L. (faba bean) and *V. unguiculata* (cowpea). These crops are usually considered to be vegetables when grown for the production of their immature seeds (George 1985).

Turkey is one of significant country with its rich plant genetic resources and plant diversity. It is scientifically agreed that two of the centers of diversity and centers of origin; the near eastern and the Mediterranean overlap at Turkey. This, of course, indicates that Turkey is the one of the center of origin and/or center of diversity of several crop plants with wild weedy and cultivated forms and many plant species (Balkaya and Karaagac 2005; Tan 2009). Turkey is the meeting ground of three phytogeographical regions; Euro-Siberian, Mediterranean and Irano-Turanian. Due to its great variety in geomorphology, topography and climate, Turkey has large diversity of habitats so it is very rich in plant species and endemism (Karagöz *et al*. 2010). Turkey is a centre of origin and/or a centre of diversity for lentil, chickpea, *Pisum* spp., and a micro-centre for bean, faba bean, and cowpea (Açıkgöz 2001). According to Harlan (1951) there are five micro gene centres in which more than 100 species, including *Phaseolus vulgaris*, *Vicia faba*, *Lens culinaris* have large variability in Turkey (Demir 1990).

Species belonging to the Leguminosae family are widely grown in Turkey. The annual production of leguminous vegetable species in Turkey is 807,292 tonnes (TUIK 2010). The common bean is a crop of considerable global importance as a vegetable and as grain legume. Green bean (*P. vulgaris* L.) is the most important cultivated legume in Turkey with a 72.8% share, and garden pea has a share 11.2% with 90,191 tonnes annually (TUIK 2010) (**Table 1**).

The utilization of plant genetic resources is one key to

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Invited Mini-Review

Table 1 Leguminous vegetable production values of Turkey (tonnes) (TUIK 2010).

Green bean		Pinto bean		Garden pea		Faba bean		Cowpea	
Samsun	105,092	Muğla	15,426	Bursa	29,449	Mersin	7,197	İzmir	7,010
Bursa	44,935	Samsun	12,444	Hatay	8,321	Antalya	6,152	Muğla	3,065
Antalya	44,668	İzmir	6,696	Balıkesir	7,882	Balıkesir	4,250	Manisa	1,389
Tokat	39,061	Tokat	5,897	Adana	7,080	İzmir	4,071	Aydın	1,228
Turkey	587,967		70,614		90,191		41,929		16,591

Table 2 *Phaseolus* collections with Turkey originated at different seed gene banks of the world.

Species	Seed gene banks*												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
Phaseoulus vulgaris	2161	1108	1075		285	40						1	4670
Phaseoulus vulgaris var. *ellipticus*								2					2
Phaseoulus vulgaris var *nanus*				257					1				258
Phaseoulus vulgaris var. *oblongus*								1			1		2
Phaseoulus vulgaris var. *spaericum*								1					1
Phaseoulus vulgaris var. *vulgaris*				82					2	1			85
Phaseolus coccineus	14	1	10							1			26
Phaseolus sp.							6						6
Total	2175	1109	1085	339	285	40	6	4	3	2	1	1	5050

*[1] AARI: Aegean Agricultural Research Institute, Menemen/İzmir, Turkey
[2] USDA: National Germplasm Resources Laboratory, Beltsville Maryland, USA
[3] CIAT: International Center for Tropical Agriculture, Cali, Colombia
[4] DEU146: Gene bank, Leibniz Institute of Plant Genetics and Crop Plant Research, Gatersleben, Germany
[5] BGR001: Institute for Plant Genetic Resources "K. Malkov", Sadovo, Bulgaria
[6] RUS001: N.I. Vavilov All-Russian Scientific Research Institute, St. Petersburg, Russia
[7] POL030: Research Institute of Vegetable Crops, Skierniewice, Poland
[8] UKR001: Institute of Plant Production n.a. V.Y. Yurjev, Kharkiv, Ukraine
[9] AUT001: AGES-Austrian Agency for Health and Food Safety, Linz, Austria
[10] BEL014: National Botanical Garden of Belgium, Meise, Belgium
[11] ROM007: Banca de Resurse Genetice Vegetale, Suceava, Romania
[12] UKR008:Ustymivka Experimental Station of Plant Production, Globyns'kyi, Ukraine

improving agricultural productivity and sustainability. Organized collection, evaluation and conservation of crop genetic resources have gone on for two hundred years (Brush and Meng 1998). The need for the conservation of plant genetic resources is now widely accepted globally. Currently, projects are being conducted in many countries to conserve genetic resources. Intensive genetic improvement, together with the development of agricultural inputs, has led to the replacement of many local varieties by a few uniform modern cultivars in developing countries. For this reason, preservation of populations and landraces is very important (Balkaya 2009).

The aim of this review is to document the leguminous vegetable genetic resources of Turkey, including the distribution of species, their collection and characterization, present and ongoing cultivar breeding programs, and the utilization of documented species.

GREEN BEAN

The common bean is a crop of considerable importance in the world as a vegetable and as a grain legume. Its use as a vegetable can involve fresh pods (French bean) but also fresh grain in developed countries, used fresh in developing nations (Escribano *et al.* 1997). In Turkey, green bean is the most economically important member of the Leguminosae family. According to FAO records from 2010, Turkey's total green bean production was 587,967 tonnes and was ranked third in the world (FAOSTAT 2010). Samsun province has a big share (17.8%) in green bean production with 105,092 tonnes (**Table 1**). Beans are cultivated throughout Turkey for fresh vegetable and dry use. Because of better adaptation of beans to various climatic regions, the most important variations observed are in fruiting characters, pod and seed size, and testa colour (Balkaya and Ergün 2007).

Common bean (*P. vulgaris* L.) is a species of American origin whose two principal areas of domestication are South and Central America (Gepts *et al.* 1986). Approximately 200 years ago, it began to be grown in Turkey (Bayraktar 1976; Günay 1992). In Turkey, common bean landraces still represent important genetic resources used directly by farmers on a small scale (Balkaya *et al.* 1999). Turkish farmers have grown common bean landraces due to their adaptation ability to local environmental conditions and suitability and preference by the local population. Consequently, common bean populations show an appreciable diversity to the range of ecological and human influences and old bean landraces have progressively been replaced with improved new cultivars, which ensure higher yields and incomes, and meet the processors' and consumers' requirements (Balkaya and Ergün 2008).

Over 5,000 *Phaseolus* spp. accessions of Turkish origin were collected from different seed gene banks around the world. Detailed information about these accessions is provided in **Table 2**. In the AARI collection, 2,175 accessions were collected from different sites in Turkey and seed material is preserved in cold storage (**Table 2**).

Characterization studies for green bean breeding programs

Kıpçak *et al.* (1951) stated that bean populations collected in Turkey are divided on the basis of seed shape. Round seed varieties have been found in the East Black Sea region. Varieties with kidney- and elliptic-shaped beans have been found in Kastamonu province. Flat kidney beans are widespread through Central Anatolia. Cultivar breeding studies have been conducted on common bean populations in various parts of Turkey since 1960. Türkes (1990) identified four candidate cultivars of the Trakya region bean population through pedigree selection based on earliness, pod shape, and quality and yield traits. Bas *et al.* (1991) characterized and bred new cultivars from green bean populations in the Aegean region. 360 populations were collected during 1984-1985. 'Zondra 86' was registered as a green bean cultivar. Research was carried out with bean seeds having characteristics of the population collected from areas of Içel province in the Mediterranean region during 1990-1996. Lines 14 of the climbing Ayse population and dwarf line 21 were the most favourable lines for yield and quality. These lines were recommended as cultivar candidates for early spring (Tunar and Kesici 1998). From 1995-1998, a study

was undertaken to determine plant characteristics and to select suitable green bean cultivars for fresh consumption from populations of the Black Sea region. In this study, 166 climbing and 34 dwarf types were collected and identified (Balkaya and Yanmaz 1999). Besides this, 15 selected lines and 5 commercial cultivars were identified by SDS-PAGE and field tests by Balkaya and Yanmaz (2003).

Artvin province, located in north-east region of Turkey, is a small province but has rich plant diversity due to its different geographical and ecological formations. Landraces of common bean were collected from 279 locations in 74 villages in 7 districts of the province (Bozoğlu and Sözen 2007). Landraces were sorted into 400 samples according to their growth habit, seed colour, colour pattern and shape. Eleven monocolored and 21 dicolored or polycolored seed groups were determined. The majority of seed were subcompressus type. The samples in the first group were ranked first in terms of size index. According to 100-seed weight, 64.68% of the population was between 25 to 40 g; 30.69% of the population was > 40 g (Bozoğlu and Sözen 2011).

28 green bean genotypes collected from eastern Turkey were characterized using simple sequence repeat (SSR) markers and morphological traits (Sarıkamış *et al.* 2009). The UPGMA dendrogram constructed based on the SSR data yielded two major clusters. The overall genetic distance was around 98%, among the genotypes. This information can be used to help select Turkish green bean lines.

Seeds from 51 bean genotypes obtained from the Aegean Agricultural Research Institute were multiplied under ecological conditions of the Samsun province in 2006 by Madakbas and Ergin (2010). Similarities and differences in terms of morphological variation were identified for all genotypes. In the principle component analysis (PCA), the two initial PC axes explained 53.9% of total variation and cluster analysis was based on 19 parameters resulting in 5 clusters.

PINTO BEAN

Pinto bean (*P. vulgaris* L var. 'Pinto') has an important role in human nutrition in Turkey. It can be consumed as fresh pod, fresh grain and grain legume. In addition, it can be consumed as canned and dried pod. Pinto bean has an 8.7% share with 70,614 tonnes annually (**Table 1**). In Turkey, the pinto bean crop is important and the major producing province in the south is Muğla (15,426 tonnes) and Samsun (12,444 tonnes) in the north (Balkaya and Ergün 2008).

Pinto bean and their varieties are still traditionally grown by farmers and this activity is commonly associated with other crops such as the maize (Balkaya and Odabaş 2005). For this reason, a high degree of diversity is still maintained within this species; therefore, it is possible to collect valuable bean germplasm in this region. Pinto bean landraces usually have local names. They have certain particular properties such as earliness, seed coat color and shape, reputation for adaptation to local climatic conditions and cultural practices, resistance or tolerance against pest and diseases (Balkaya *et al.* 1999).

Characterization studies for pinto bean breeding programs

The collection, evaluation, and characterisation of Turkish Pinto bean germplasm are a field of interest and are of economical and ecological importance. Forty four pinto bean populations were collected and evaluated according to morphological, earliness and yield traits under Samsun ecological conditions in 2003 and 2004 (Balkaya and Ergün 2007). Results showed that populations displayed significant differences in pod length, width, and pod shape in longitudinal section, pod shell thickness, pod color, stringiness and pod curvature. PCA showed that the first four PC axes explained 83.3% of the total multivariate variation. Data were subjected to cluster analysis and several groups were identified, with most of the populations clustered into six groups. A dendrogram was prepared to evaluate morphological differences among populations, revealing high variation. The results provided information on the diversity and breeding potential of Turkish Pinto bean germplasm (Balkaya and Ergün 2008). Another study was conducted to identify and select valuable genetic resources of the Pinto bean populations. From observations, 10 genotypes were determined to be superior after using a weighting-based ranking method for fresh pod and fresh grain pod in the first year. In the second year, from these superior genotypes; 4 genotypes (55ÇA07, 55ÇA15, 55TE15 and 55TE20) for fresh pods and 5 genotypes (55ÇA01, 55ÇA05, 55ÇA15, 55ÇA24 and 55TE15) for fresh grain pods were selected as promising genotypes. These selected genotypes will be developed into new Pinto bean varieties in the future (Balkaya and Ergün 2007).

GARDEN PEA

Pea (*P. sativum* L.) is an important legume grown and consumed extensively worldwide. It is an old world cool season annual legume crop whose origins traces back to the primary center of origin in the Near and Middle East (Ambrose 2008). The wild, weedy and cultivated forms of *Pisum* are found in Turkey where the primary and secondary gene centres of origin overlap (Açıkgöz 2001). Wild species of *Pisum* have been conserved in isolated areas, primarily in the eastern Mediterranean region. The variability of garden pea and the variety of forms in which it is consumed are a testimony to its long history of cultivation, adaptability and popularity as a crop in countries around the world (Ambrose 2008).

Pea is the second most important legume after common bean (*P. vulgaris* L.) in Turkey with a total production of 90,191 tonnes (**Table 1**). Bursa province has a big share (32.7%) in production with 29,449 tonnes, followed by Hatay province (8,321 tonnes).

Table 3 *Pisum spp.* collections with Turkey originated at different seed gene banks of the world.

Species	Seed gene banks*							
	1	**2**	**4**	**6**	**13**	**15**	**16**	**Total**
Pisum sativum		101		100	47	115	46	409
Pisum sativum var. *arvense*		4				5		9
Pisum sativum L. subsp. *elatius*		21	2		19	34		76
Pisum sativum var. *pumili*		4				1		5
Pisum sativum var. *sativum*		46	10			50		106
Pisum sp.			19					19
Pisum spp.	160							160
Total	160	176	31	100	66	205	46	784

*[1] AARI: Aegean Agricultural Research Institute, Menemen/İzmir, Turkey
[2] USDA: National Germplasm Resources Laboratory, Beltsville Maryland, USA
[4] DEU146: Genebank, Leibniz Institute of Plant Genetics and Crop Plant Research, Gatersleben, Germany
[6] RUS001: N.I. Vavilov All-Russian Scientific Research Institute, St. Petersburg, Russia
[13] GBR011: Mike Ambrose John Innes Centre, Norwich Research Park Colney Lane, Norwich, UK
[15] ICARDA: International Center for Agricultural Research in the Dry Areas, Syrian Arab Republic
[16] CGN: Centre for Genetic Resources, Wageningen, The Netherlands

Table 4 *V. faba* collections with Turkey originated at different seed gene banks of the world.

Species	Seed gene banks*						
	1	2	4	6	15	16	Total
Vicia faba	341	30		31	132	12	546
Vicia faba L. subsp. *faba* var. *faba* subvar. *clausa*			6				6
Vicia faba L. subsp. *faba* var. *faba* subvar. *faba*			1				1
Total	341	30	7	31	132	12	553

[1] AARI: Aegean Agricultural Research Institute, Menemen/İzmir, Turkey
[2] USDA: National Germplasm Resources Laboratory, Beltsville Maryland, USA
[4] DEU146: Genebank, Leibniz Institute of Plant Genetics and Crop Plant Research, Gatersleben, Germany
[6] RUS001: N.I. Vavilov All-Russian Scientific Research Institute, St. Petersburg, Russia
[15] ICARDA: International Center for Agricultural Research in the Dry Areas, Syrian Arab Republic
[16] CGN: Centre for Genetic Resources, Wageningen, The Netherlands

Totally, 784 accessions were collected with Turkey as the origin of different seed gene banks around the world (**Table 3**). AARI has 160 *Pisum* spp. genetic resources, otherwise USDA and ICARDA have the most *Pisum* genetic resources of Turkish origin, other than AARI.

Characterization studies for garden pea breeding programs

Genetic characterization of 30 pea genotypes collected from different regions of Turkey and 10 commercial pea cultivars was performed using the criteria of the International Union for the Protection of New Varieties of Plants (UPOV) (TG 7/9 *Pisum sativum*), and with 10 SSR markers (Sarıkamış *et al.* 2010). Within the collection studied, variation was observed in terms of seed, plant, pod, stipule, flower characteristics, and flowering time, which are important traits for the identification, characterization and grouping of genotypes. These findings can be used to guide future breeding studies and germplasm management of these pea genotypes.

27 populations were collected (18 from Samsun, 3 from Giresun and Sakarya, 2 from Artvin and 1 from Tokat). Wide variation in agronomic characteristics was observed between genotypes (Karayel and Bozoğlu 2008). Seed yield per plant varied between 5.3 and 30.0 g. The largest group with 26.08% was plants having yields between 14 and 16 g. One hundred seed weight in the study population varied between 10.26 and 36.36 g. The seed weight of 2.17% of the population was between 35.8 and 38.9 g, the highest group among populations. Pods per plant varied between 7 and 87 in this population. These populations could be used in cultivar improvement programs and breeding studies for both fresh consumption and forage varieties.

FABA BEAN

Faba bean (*Vicia faba* L.) originates from the Mediterranean region and south west Asia (George 1985). It is one of the earliest domesticated food legumes in the world. The close relatives of *V. faba* are restricted to the Near East, including Anatolia, a possible gene centre of *Vicia narbonensis*, presumed wild ancestor of *V. faba*. All three types of *V. faba* (major, minor and equina) are cultivated in Turkey, but most of these have pods capable of shattering and can be assumed to be primitive populations (Açıkgöz *et al*. 1997).

Faba beans are used as a fresh vegetable in Turkey; they are also an important vegetable in canning and freezing industries. Its production in Turkey is relatively less than other food legumes. It is mainly grown in the Aegean region followed by the Marmara, Central North, Black Sea, Mediterranean and Central East regions. Annual faba bean production in Turkey is 41,929 tonnes according to 2010 records (**Table 1**).

There are 341 accessions collected from different sites of Turkey at AARI (**Table 4**). In addition, ICARDA has 132 faba bean genetic resources with origin in Turkey. The others have a smaller capacity than AARI and ICARDA.

Characterization studies for faba bean breeding programs

Characterization studies on faba bean have also been conducted in other institutes and organizations in Turkey in recent years. Some of them are presented below.

In AARI, genetic resources were used in breeding programs to widen the genetic base. Therefore, 100 faba bean accessions obtained from National Faba Bean Collection from Aegean and Marmara Regions were observed for various characters in a faba bean breeding program in 2004. The characters observed in the nursery were seed yield (g/plot), seed yield per plant (g), 100-seed weight (g), plant height (cm), first pod height (cm), branches per plant, pods per plant, seeds per plant and seeds per pod. Wide variation was found in the collection in terms of all characters (Atikyılmaz 2007).

Ten faba bean populations were collected from districts and villages of Samsun, Amasya, Sinop and Tokat provinces in the north of Turkey (Peksen *et al.* 2006). There was no significant difference among faba bean populations for green pod yield. Green pod yield per plant was positively and significantly correlated with the number of pods per plant, and pod length and thickness. Seed length, seed width, seed thickness and 100-seed weight ranged between 18.04-23.56 mm, 13.24-17.10 mm, 7.93-8.94 mm and 119.07 and 162.61 g for faba bean populations, respectively (Pekşen *et al.* 2007).

A study was conducted to determine plant characteristics and seed yields of some local faba bean populations in comparison with registered faba bean cultivars/lines between 2003 and 2005 in Samsun province (Peksen and Artık 2006). Totally 15 genotypes, three faba bean cultivars ('Eresen-87', 'Filiz-99' and 'Lara'), two lines (FLIP85-172FB and FLIP86-116FB) from ICARDA, 10 local populations collected from some districts and villages of Samsun, Amasya, Sinop and Tokat provinces, were used in the study. Seed yield ranged from 1654.3 to 3914.8 kg/ha and from 2779.9 to 5892.3 kg/ha in 2003-2004 and 2004-2005 growth season, respectively. On average, over two years, the highest and the lowest seed yields were obtained from 'Eresen-87' (4790.2 kg/ha) and G14 population (2217.1 kg/ha), respectively. G3, G4, G5, G6 and G7 populations were among the first 10 high-yielding genotypes, which were not statistically different from each other. G3 was in the second rank for seed yield (3950.9 kg/ha) among all faba bean genotypes. The highest harvest index was determined in 'Eresen-87' (57.73%), which was also superior for seed yield.

COWPEA

Cowpea (*Vigna unguiculata* L.) is an important crop, especially in some developing and less developed countries. Cowpea is widely grown in the Aegean and Mediterranean regions of Turkey. In the Black sea region, cowpea is also cultivated in some provinces to supply only family requirements (Gülümser *et al.* 1989). Izmir province has a big share (42.3%) in cowpea production with 7,010 tonnes, followed by Muğla (3,065 tonnes) (**Table 1**).

Table 5 *Vigna* spp. collections with Turkey originated at different seed gene banks of the world.

Species	Seed gene banks*						
	1	**2**	**6**	**14**	**17**	**18**	**Total**
Vigna unguiculata subsp. *unguiculata*		40					40
Vigna unguiculata	59	4	15		48		126
Vigna unguiculata subsp. *sesquipedalis*		1					1
Vigna radiata var. *radiata*	12	12	1	6		24	55
Total	71	57	16	6	48	24	222

[1] AARI: Aegean Agricultural Research Institute, Menemen/İzmir, Turkey
[2] USDA: National Germplasm Resources Laboratory, Beltsville Maryland, USA
[6] RUS001: N.I. Vavilov All-Russian Scientific Research Institute, St. Petersburg, Russia
[14] NIAS: National Institute of Agrobiological Sciences, Tsukuba, Ibaraki, Japan
[17] IITA: International Institute of Tropical Agriculture, Nigeria
[18] AVRDC: The World Vegetable Center, Shanhua, Taiwan

71 accessions were collected from different provinces of Turkey; these genetic resources are preserved in AARI (**Table 5**). There are 222 cowpea accessions that originated in Turkey.

Characterization studies for cowpea breeding programs

In Turkey, some researchers conducted studies on cowpea breeding (Ceylan and Sepetoğlu 1983; Altinbaş and Sepetoğlu 1993) aimed at developing cowpea quality factors and crop yield. In recent years, several studies have evaluated the performance of cowpea genotypes in the Black Sea region of Turkey. Pekşen (2004) evaluated the fresh pod yield, some plant and pod characteristics of eight local cowpea genotypes and two registered cowpea cultivars as the controls during 2001-2002 and 2002-2003 plant growth seasons in Samsun province. The highest fresh pod yield per plant was found in G10 genotype (110.23 g plant^{-1}). Positive and highly significant ($P < 0.01$) correlations were found between fresh pod yield per plant and fresh pod harvest period, number of pods per plant, average pod weight, length and width.

In another study, 9 cowpea genotypes (2 released cultivars and 7 lines) were evaluated for grain yield and agronomic parameters at two locations within the Middle Black Sea region of Turkey for two years (2005 to 2006). Results indicate that the effect of genotype, year and location were significant ($P < 0.05$) for many of the traits studied. Line G1 had the highest plant height (122.4 cm). Seed number per pod was higher in line G1 (9.9) than in other genotypes (Başaran *et al*. 2011).

CONCLUSION

In recent decades the awareness of a high degree of genetic erosion led to the establishment of seed and field gene bank located both in developed countries (poor in genetic resources) and in developing countries (rich in genetic resources). Around the world, only a small portion of the vegetable landraces has been collected and evaluated. The conservation and maintenance of these valuable local genetic resources is essential because they are an important source of diversity which can be used in future breeding programs. The Turkish National System for conservation and utilization of genetic resources is well organized. Since the 1960s the conservation of plant diversity has become government policy. *Ex situ* conservation activities have been undertaken since 1964. Collection activities are systematically planned, survey collections are conserved as genetic resources at the Turkey Seed Gene Bank in Izmir, and evaluation results are well documented (Tan 2009). In order to preserve these legume vegetable genetic resources, several crop species from different geographical regions of Turkey are collected and preserved. These activities are carried out in conjunction with breeding programmes, as is the introduction of the collection to breeders. In Turkey, legume vegetable improvement programs were started in the 1990s. The variation and diversity of legume vegetable genetic resources of the Turkey has greatly contributed to the genetic improvement of many vegetables. In conclusion, selected promising genotypes can be used both fresh pod and fresh grain pod production for future breeding work. The other remaining genetic materials also were some valuable traits, and their genetic content should be conserved.

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