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Review Article

# NEW APPROACHES TO PROTECT WILD ALMOND GENETIC SOURCES: A REVIEW

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**ABSTRACT.** Turkey has rich local and wild fruit varieties which grown at poor soils and hard climatic conditions. One of them is wild almonds which spreads almost everywhere at Anatolia. Cultivated almonds became differentiated into two ecotypes during evolution and later domestication processes: Mediterranean and Central Asia. Numerous related wild species are also found growing in the mountains and deserts of Central Asia from western China through Iran and Turkey. These native almond species are utilized for oil extraction, soil erosion control, reforestation, rootstocks, and as a source of novel genes in breeding programs. But important wild almonds have lost because of road construction and new residential regions in recent years. To prevent this, it needs new strategies such as genetic material collection, genetic characterization and the use of biotechnology to breed new cultivars. In this study, we discussed new approaches to protect wild almond genetic sources.

**Keywords:** *Wild almond, genetic approaches*

## INTRODUCTION

Almond (*Prunus dulcis*), in Turkish, this species is called 'Badem', is a species of genus *Prunus* and subgenus *Amygdalus* that is commercially grown worldwide. Almond is one of the most important nut crops worldwide and it produces fruits of high commercial value. USA is the leading producer with about 1 million tonnes production [1]. In the year 2018, the world production of almond was about 3,2 million tonnes out of which Turkey produced 100,000 tonnes [2]. Almond species grow in regions of the world that are characterized as having a subtropical Mediterranean climate, with mild wet winters and warm, dry summers. These species originated in central Asia and represent divergent evolution under xerophytic environments [3]. Its production is mostly based on orchards with traditional managements. These clones, local cultivars and seedlings as well as related wild species constitute a valuable source of genetic diversity and an excellent potential for improvement. Owing to the responsibility of rootstock for a wide range of fruit tree properties, they have an important role in modern horticulture and commercial orchards [4-7].

The *Prunus* species *P. fenzliana* (Fritsch) Lipsky, *P. bucharica* Korschinsky and *P. kuramica* Korschinsky (of the Section Euamygdalus) from its origin regions are described as the wild species most closely related to almond [8,9], and may be the ancestral species of the modern cultivated almond [1]. There are more than thirty wild or partially cultivated almond species in the world. Ladizinsky [10], however, identified only *P. fenzliana* as the wild ancestor of almond. *P. webbii* (Spach) Vieh, thought to have originated on the Balkan peninsula, is also described as closely related to almond [8,9]. The evolution and distribution of almonds, both in cultivation and in the associated semi wild state, has been divided into three stages: Asiatic, Mediterranean, and Californian, corresponding to the geographical areas where is grown [8, 1, 11, 12].

The fruit of almond, as with other *Prunus* species, is a drupe where the mature, stony endocarp together with the seed forms a propagation unit comparable to a botanical seed surrounded by its protective testa. The almond is the earliest deciduous fruit and nut tree to bloom in spring due to its low winter chilling requirements and quick growth response to warm temperatures [1,11,12].

***Almond Breeding Objectives***

The limited gene pool in cultivated almond limits the cultivation of specific areas with Mediterranean climate. Related almond species demonstrate a higher resistance to abiotic and biotic stresses and so represent valuable germplasm sources for breeding [13]. Crosses between almond and related species have been successful [14,8,15,11,16] and numerous spontaneous interspecific hybrids have been reported [17,18,9]. Interspecific hybrids between these related species, including peach [*P. persica* (L.) Batsch] 9 almond and *P. webbii* Spach 9 peach have been previously used long time for almond rootstock breeding in France [14], USA [19], Spain [20] or Yugoslavia [21]. In addition, many of these species have been used directly as a rootstocks for almond usually for non-irrigated conditions, including *P. spartioides* Spach [22] in Iran; *P. bucharica* (Korsh.) Hand.-Mazz. [23,24] and *P. fenzliana* Fritsch [25] in Russia; *P. webbii* [26] in Turkey; and *P. fenzliana, P. bucharica, P. kuramica* Korsh. and *P. argentea* Lam. [8] or *P. dehiscens* Koehne and *P. kotschyi* (Boiss. et Hohen.) Nab. [27] in France.

***Why Plant Gene Resources to Be Reduced and Lose Rapidly?***

The rapid increase in the world's population, unconsciously utilizing herbal resources for human needs, land trenches, traditional varieties have been replaced with hybrids, use of herbicides, consuming from nature instead of production, natural disasters, urbanization and industrialization cause plant gene resources to be reduced and lost rapidly [28].

Development of new varieties to increase agricultural production and transposing to the wild plant species in the state of raw material to future generations without erosion will be possible with the preservation and protection of the existing plant variety.

Although the gene resources in the world are protected by the gene banks, the reasons for the fact that the gene banks have limited opportunities and the number of gene sources to be protected is high; new techniques for collecting, evaluating and reproducing gene resources are used [29].

***New Approaches to Protect Wild Almond Genetic Sources***

*Biochemical and Molecular Techniques*

In order to supplement the morphology-based results, several molecular techniques, including isoenzyme [30] and DNA-based markers such as ISSRs [31,32], SSRs [33,12,34-38] and AFLPs [39,40] have been used for describing diversity and genetic characterization of wild type almond germplasm throughout the world. These techniques are not affected by environmental changes and have a short time like a day.

*In Vitro* Techniques

Tissue culture techniques used for vegetative replication are used to store problematic gene sources for many years, but embriyonic suspension techniques ensure that the protecting is at the cell level.

The preservation of genetic material in the form of DNA has provided new possibilities for the conservation of plant genetic resources [41-44].

*Slow Growth Technique Using Enclosure*

The main of this technique is to minimize the growth rate of cultures *in vitro* storage. For this purpose, successful results can be obtained by
•using immature zygotic embryos,
•reducing storage temperature,
•reducing oxygen pressure in the culture media,
•modification the media composition,
•pouring leaves of shoots.

*Cryopreservation*

The principle of this method, which is developed for long-term storage, is that the genetic material is frozen at very low temperatures [29].

The cultures are frozen with liquid (-196 °C) or gas (-150 °C) nitrogen. At the end of storage, the temperature is increased and cell proliferation studies can be carried out when the material is ready. [45,46].

*Artificial Seed Storage*

This method is mostly used for preserving the species that are resistant to drying and storing seeds. In this method, shoot tips or somatic embryos are encapsulated with the help of a half-fold material that serves as seed coats and endosperm (Fig. 1) [29, 47].

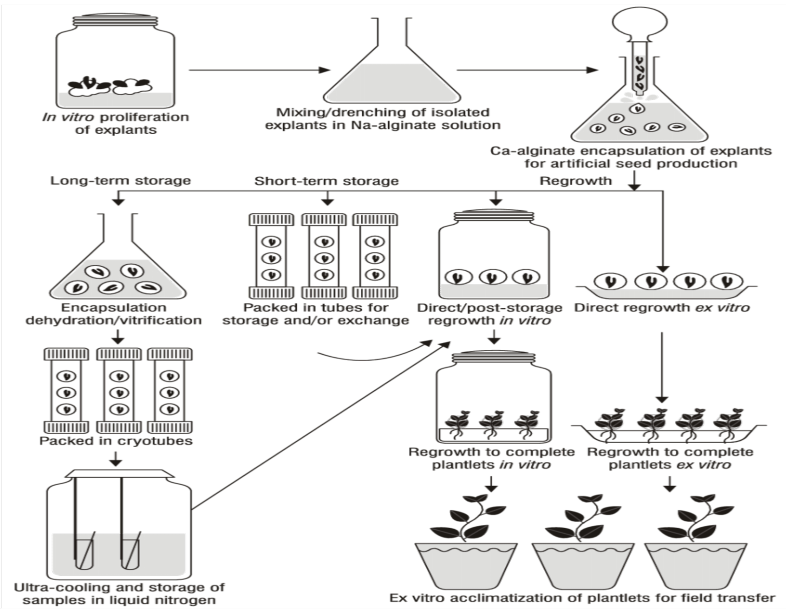


***Fig. 1.*** *Artificial seed storage*

## CONCLUSION

These wild species provide an enlarged pool of available germplasm and suitable characteristics such as late bloom and self-fertility and resistance to drought, salinity and low winter temperatures. Moreover, wild almond species demonstrate higher resistance to abiotic and biotic stresses, and so represent valuable germplasm sources for breeding.

These native almond species are utilized for; oil extraction, soil erosion control, reforestation, rootstocks and as a source of novel genes in breeding programs. But important wild almonds have lost because of road construction and new residential regions in recent years. To prevent this, it needs new strategies such as genetic material collection, genetic characterization and the use of biotechnology to breed new cultivars.

In this study, we discussed wild almond cultivars and new approaches to protect these genetic sources.

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