

## ROOTSTOCKS USED FOR TEMPERATE FRUIT TREES IN TURKEY: AN OVERVIEW

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Most of the fruit tree orchards in Turkey are grafted onto rootstocks, except chestnuts and cornelian cherries, which are generally propagated by seeds. The main rootstocks used by Turkish growers for temperate fruit trees nowadays are: wild apple seedlings, M.9 and MM.106 for apples; wild pear, in particular *Pyrus eleagrifolia* L. seedlings for pears; wild peach seedlings for peaches; wild plum seedlings for plums; seedlings of *Mazzard* and *Mahaleb*, very recently clonally propagated Gisela 5 and Gisela 6 rootstocks for cherries; *Juglans regia* L. seedlings for walnut; wild almond seedlings for almond; wild apricot seedlings for apricot. The level of clonal rootstock use for temperate fruit tree species is not satisfactory in Turkey. However, in recent years the number of orchards established with clonal rootstocks, in particular for apples and cherries, has been increased in the country. In this paper the current status of rootstock use for temperate fruit trees in Turkey is reported.

**Key words:** temperate fruit trees, rootstock use, Turkey.

**Introduction.** Agriculture traditionally has been a pillar of Turkey's economy. Although the industrial and service sectors increased their dominance in recent years, Turkey remained the largest producer and exporter of agricultural products in the Middle East and North African region. Turkey's fertile soil and hard-working farmers make the country one of the few in the world that is self-sufficient in terms of food. The total land area of Turkey is about 78.3 million ha supporting 26.4 million ha of agricultural and 20.7 million ha of forest land (Ayyildiz et al., 1997; Anonymous, 2005).

Turkey's natural environment is very diverse, ranging from subtropical to cold temperate. This ecological diversity has contributed not only to a high genetic diversity, but has also allowed the successful introduction and cultivation of a great number of fruit tree species. Thus, over 85 fruit tree species including almost all the deciduous species such as apples, pears, cherries, quinces, almonds, pistachios etc. are grown successfully in the country (Ercisli, 2004).

The country dominates in the world by hazelnut, apricot, sweet cherry, fig and quince production (FAO, 2005). Fruit production is conducted throughout the country, although it is less common in the mountainous Eastern regions, where

animal husbandry is the principal activity.

The development of the Turkey's fruit industry has been remarkable in the last decade. Currently planted fruit tree area is more than 240.000 ha, mainly central area of the country. Previously, Turkey's fruit industry was based mainly on dried fruit export, but recently fresh fruit export gained importance. Hazelnut, sweet cherry, citrus, fig and dried apricot export have an important place in Turkish economy (FAO, 2005). One of the important factors, which affect this improvement in Turkey, is the use of rootstocks for different fruit tree species.

As well known, the use of rootstocks is very important in fruit tree growing not only for yield efficiency, mineral uptake, hardiness etc., but also to meet specific cultural needs, aside from vigor management, with adaptability to climatic and edaphic conditions having a high priority requirement (Ercisli et al., 2000).

During the last two decades, the use of clonal rootstocks for temperate fruit tree crops such as apples, cherries, and nectarines, particularly increased in Turkey. The aim of this study was to give latest information on the use of rootstocks in Turkey for temperate fruit tree crops.

**Materials and methods.** The data used in this study was obtained from Ministry of Agriculture of Turkey ([www.tarim.gov.tr](http://www.tarim.gov.tr)).

**Results.** *Stone Fruit Rootstocks.* The seedling and clonal rootstocks, their percentage and number of rootstocks produced in Turkey in 2005 for stone fruits are listed in Table 1.

It can be seen in Table 1 that the great majority of rootstocks used for apricot cultivars in Turkey were still wild apricot seedlings (95.99%). Apricot culture was practiced in Turkey more than 1000 years ago and the use of plantations of systematically grafted trees was started from 1960's. In some parts of Turkey, for example, in Erzincan plain, the majority of apricot trees come from ungrafted seedling material. However, in modern orchards of Turkey, the cultivars are grafted in general on wild apricot seedling rootstocks using T-budding method. The use of other *Prunus* species such as *Prunus cerasifera*, *Prunus persica* and *Prunus armeniaca* L. seedlings is restricted by problems of graft incompatibility (Unal, 1992).

According to the latest data, Turkey occupy 1<sup>st</sup> place both by sweet cherry production and export levels in the world (FAO, 2005). Primary sweet cherry rootstocks used in Turkey are wild *Prunus avium* L. (*Mazzard*) seedlings (40.12%) and followed by *Prunus mahaleb* L. seedlings (28.75%), Gisela 6 (*Prunus cerasus* x *Prunus canescens*) (14.84%) and Gisela 5 (*Prunus canescens* x *Prunus cerasus*) (10.01%) rootstocks, respectively (Table 1). Turkish growers mainly prefer to use *Mazzard* seedlings for sweet cherries because of its good soil adaptability. In general, *Prunus mahaleb* L. seedlings were used for sweet cherries only on calcareous droughty soils in Turkey. In latest years the use of Gisela 5 and Gisela 6 rootstocks has been widespread very quickly. On the other hand, *Prunus mahaleb* L. seedlings (92.22%) still remain the main choice for Turkish sour cherry producers because of its high compatibility with sour cherry cultivars, tolerance to drought, smaller tree size, good precocity, and high productivity. In Turkey, the trees of *Prunus mahaleb* L. with yellow fruited and light-colored trunks are generally preferred for rootstock for both sweet and sour cherry cultivars. It is believed that these types do not show incompatibility with scion cultivars (Misirli et al., 1996).

**Table 1. Stone fruit rootstocks propagated, percentage and quantity of grafted plants produced in Turkey nurseries in 2005**

**1 lentelė. Kaulavaisių poskiepai, Turkijos medelynuose 2005 metais įskiepytų augalų procentas ir kiekis**

Fruit tree crops Augalo rūšis	Rootstocks Poskiepai	Number of grafted plants Įskiepytų augalų skaičius	
		%	units/vnt.
Apricots / Abrikosai	Nemaguard	3.70	30 000
	Wild plum seedlings / Laukinių slyvų sėjinukai	0.31	2550
	Wild apricot seedlings / Laukinių abrikosų sėjinukai	95.99	810 822
Sweet cherries Trešnės	Mahaleb seedlings / Mahaleb sėjinukai	28.70	583 368
	Mazzard seedlings / Mazzard sėjinukai	40.12	813 912
	SL 64	6.33	128 400
	Gisela 5	10.01	203 120
	Gisela 6	14.84	301 000
Sour cherries Vyšnios	Mahaleb seedlings / Mahaleb sėjinukai	92.22	296 163
	Wild sour cherry seedlings / Laukinių vyšnių sėjinukai	6.53	20 985
	Wild sweet cherry seedlings / Laukinių trešnių sėjinukai	1.25	4 000
Peaches / Persikai	Nemaguard	1.24	10 000
	Almond seedlings / Migdolų sėjinukai	0.20	2 000
	GF 677	2.29	18 500
	Marianna GF8-1	1.24	1 000
	Wild peach seedlings / Laukinių persikų sėjinukai	94.51	764 629
	Wild apricot seedlings / Laukinių abrikosų sėjinukai	0.50	4 315
	GF 305	0.02	143
Nectarines/Nektarinai	GF 677	59.96	35 500
	Marianna GF8-1	16.89	10 000
	Wild peach seedlings / Laukinių persikų sėjinukai	6.26	3 705
	Nemaguard	16.89	10 000
Plums / Slyvos	Marianna GF8-1	4.42	20 000
	Wild plum seedlings / Laukinių slyvų sėjinukai	80.78	367 768
	Wild apricot seedlings / Laukinių abrikosų sėjinukai	0.30	1 380
	Myrobalan B	14.00	63 400
Almonds / Migdolai	GF 677	3.00	4 000
	Wild almond seedlings / Laukinių migdolų sėjinukai	97.00	115 343

Wild peach seedlings still are the principal rootstock source for peach cultivars in Turkey with the percentage of use – 94.51% (Table 1). The wild peach types are usually obtained from peach trees that have escaped cultivation and are found growing wild or in a nearly wild state. A major problem with wild peaches is their genetic variability and general lack of uniformity in the nursery and the orchard (Guleryuz, 1998).

In Turkey, most of plum trees are found in wild or semi-wild conditions. Plant characteristics of plum species naturally grown in Turkey are very diverse, ranging from shrubs to large trees, spreading to upright and early to late blooming (Ercisli, 2004). Wild seed propagated rootstocks (80.78%) mainly from *Prunus cerasifera* L. species have been used. Turkish growers believe that less incompatibility is seen when European plums are put on this species (Gonulsen et al., 1985). Myrobalan B is the second widely used seedling rootstock in Turkey with sharing of 14% (Table 1).

Until 1980's almond trees originally were grown ungrafted as seedlings in Turkey. Now grafting, mainly onto almond seedlings (97%), is common way for almond production in Turkey. Field budding practices onto seedlings in main almond growing regions in Turkey is desirable because of deeper and longer tap-rooted characteristics of seedlings. Field budded trees in these regions are considered to be more resistant to dry conditions. On the other hand, seeds from bitter almond trees have been characteristically used by nurserymen as sources of seeds. Trees from such sources are thought to be more vigorous and generally superior to trees from sweet-kernelled seeds. It is possible that such seeds are less often eaten by rodents and thus survive better in field planting (Akca and Ceylan, 1996).

**P o m e R o o t s t o c k s.** The main rootstocks used for apple cultivars in Turkey were wild apple seedlings (37.07%), M.9 (35.96%) and MM.106 (22.60%) (Table 2).

The center of genetic diversity of apple (*Malus*) is in Asia Minor (Turkey), likewise the cradle of human civilization. *M. pumila* L. and *M. trilobata* L. are native Anatolia (Way et al., 1990). A large number of wild apple populations' originated from the Black Sea and Northeast regions of Turkey. These wild germplasm are critical in maintaining diversity in the gene pool. A research project on genes controlling economic traits of *Malus* species found in Turkey is being carried out by apple breeders, plant pathologists and germplasm curators (McCandless, 1999). Though the fruit quality of these wild species is very poor, the possible frost and drought tolerance and dwarf growth habit might be valuable genetic traits for apple rootstocks breeding. If these wild plants came true-to-type from seed, this could be a source of apomixes for use in breeding rootstocks.

Throughout Turkey, the most common rootstock used for pear cultivars still is wild pear seedlings, in particular *Pyrus elaeagrifolia* with 97.0% (Table 2). *Pyrus elaeagrifolia* L. originated in Crimea, Anatolia, East Bulgaria, Romania, and European Turkey. The species shows high drought and cold resistance and therefore provides one of the most commonly used rootstocks for pear cultivars in Turkey (Guleryuz, 1998).

Table 2. Pome rootstocks propagated, percentage and quantity of grafted plants produced in Turkey nurseries in 2005

2 lentelė. Sėklavaisių poskiepai, Turkijos medelynuose 2005 metais įskiepytų augalų procentas ir kiekis

Fruit tree crops Vaismedžiai	Rootstocks Poskiepai	Number of grafted plants Įskiepytų augalų skaičius	
		%	units / vnt.
Apples / Obelys	M.9	35.96	950 936
	M.26	1.06	28 108
	MM.106	22.60	598 176
	MM.109	0.02	5670
	MM.111	3.31	87 915
	Wild apple seedlings / Laukinių obelų sėjinukai	37.07	984 118
Pears / Kriaušės	Quince A / Svarainis A	2.99	13 512
	Wild quince seedlings / Laukinių svarainių sėjinukai	0.01	210
	Wild pear seedlings / Laukinių kriaušių sėjinukai	97.0	488 037
Quinces / Svarainiai	Quince A / Svarainis A	19.0	21 790
	Wild quince seedlings / Laukinių svarainių sėjinukai	81.0	90 475

**Nut Crop Rootstocks. Pistachios.** In Turkey, there are wild pistachio populations including *Pistacia vera*, *Pistacia khinjuk* and *Pistacia terebinthus* trees or shrubs. These wild plants are being grafted *in situ* conditions by standard pistachio cultivars. However, in modern pistachio orchards, pistachios are commercially propagated by budding the chosen scion cultivar onto seedling rootstocks (100 percent *Pistacia vera* L. seedlings used). Therefore, the rootstocks for used pistachios cultivars in Turkey, however, are genetically variable, since the seed from which it grew was the progeny of a heterozygous female parent and unknown heterozygous pollen parent (Guleryuz, 1998).

**Walnuts.** In Turkey, both seedling and grafted walnut (*Juglans regia* L.) trees are grown throughout the country. The cultivars mainly grafted onto wild walnut seedlings (*Juglans regia* L.). Currently all seed propagated rootstocks in Turkey are derived from open pollinated seeds. Breeding and selection programs in Turkey are focused on cultivar rather than rootstock development because of the greater potential gains by cultivar selection in native seedling populations. Rootstock development is expected to be emphasized more when improved cultivars are released. There is general agreement that the development of true-to type rootstocks for walnuts would open a whole new realm of possibilities for the walnut growers. Dwarfing, greater yields, precocity of production, and a reduction in variability of orchard trees have been among the most often mentioned attributes (Balci et al., 2001).

Table 3. Nut crop rootstocks propagated, percentage and quantity of grafted plants produced in Turkey nurseries in 2005

3 lentelė. Riešutų poskiepai, Turkijos medelynuose 2005 metais įskiepytų augalų procentas ir kiekis

Fruit tree crops Vaismedžiai	Rootstocks Poskiepai	Number of grafted plants Įskiepytų augalų skaičius	
		%	units / vnt.
Pistachios / Pistacijos	<i>P. vera</i> , <i>P. khinjuk</i> <i>P. terebinthus</i> seedlings / <i>P. terebinthus</i> sėjinukai	100	19 100
Walnuts / Graikiniai riešutai	Wild walnut seedlings / Laukinių graikinių riešutų sėjinukai	100	206 621

**Conclusion.** It may be stated that during the last decade, fruit growers in Turkey improve their use of rootstocks in order to achieve better growth of temperate fruit tree crops, better tolerance to unfavorable soil and phytosanitary problems, improved dwarfing, and reduced management costs. The most recent crop to be grafted on rootstocks in Turkey were walnut and almond, which always were grown on their own roots until the end of the 1980s. It is expected that the next decade the use of clonal rootstocks will be increased.

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## VIDUTINIO KLIMATO SĄLYGOMIS AUGANČIŲ VAISMEDŽIŲ POSKIEPIAI TURKIJOJE: APŽVALGA

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*Santrauka*

Daugelis sodo vaismedžių Turkijoje yra skiepijami, išskyrus graikinius riešutmedžius ir sedulas, kurie paprastai dauginami sėklomis. Pagrindiniai poskiepai, į kuriuos turkų augintojai mūsų laikais skiepija vidutinio klimato sąlygomis augančius vaismedžius, yra šie: laukinių obelių sėjinukai, M.9 ir MM.106 – obelims; laukinių kriaušių, ypač *Pyrus eleagrifolia* L., sėjinukai – kriaušėms; laukinių persikų sėjinukai – persikams; laukinių slyvų sėjinukai – slyvoms; Mazzard ir Mahaleb sėjinukai, visai neseniai vegetatyviniu būdu pradėti dauginti poskiepai Gisela 5 ir Gisela 6 – trešnėms; *Juglans regia* L. sėjinukai – graikiniams riešutmedžiams; laukinių migdolų sėjinukai – migdolams; laukinių abrikosų sėjinukai – abrikosams. Vegetatyviniu būdu dauginti poskiepai vidutinio klimato sąlygomis augančių vaismedžių rūšims įskiepyti Turkijoje naudojami nepakankamai. Tačiau pastaruoju metu šalyje vis daugėja su vegetatyviniais poskiepais įveistų sodų, ypač obelių ir vyšnių. Šiame straipsnyje aptartas poskiepių naudojimas vidutinio klimato vaismedžiams įskiepyti Turkijoje.

**Reikšminiai žodžiai:** vidutinio klimato vaismedžiai, poskiepių naudojimas, Turkija.