History and current status of grafted vegetables in Turkey

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Introduction

Grafting herbaceous seedlings is a unique horticultural technique practiced for many years in East Asia, to solve problems associated with intensive cultivation given limited arable land for vegetable production. According to Lee and Oda (2003), a self-grafting technique to increase fruit size in bottle gourd, by increasing root volume through bunch grafting, was described in an ancient book written in China in the 5th century and in Korea in the 17th century (Mudge et al., 2009).

The first record of interspecific grafting in fruit-bearing vegetables as a strategy to manage pests/diseases and to increase yield was for watermelon [*Citrullus lanatus* (Thunb.) Matsum. & Nakai], using a squash (*Cucurbita moschata* Duch.) rootstock and *Lagenaria siceraria* (Ashita, 1927). This graft was reportedly performed by a watermelon producer in Japan (Tateishi, 1927). The success of these trials led to increased numbers of grafted vegetable species and a larger cultivation area.

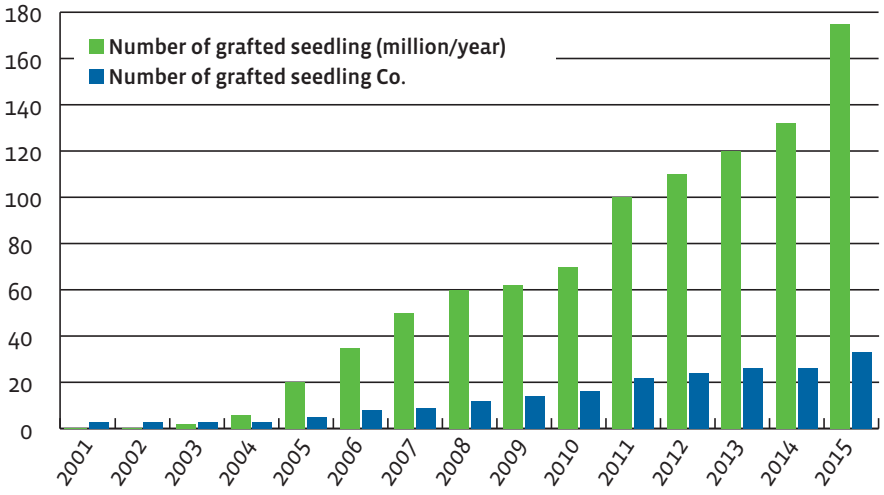


Figure 1. Total number of grafted seedlings and grafted seedling companies in Turkey from 2001 to 2015 (Young Plant Union, 2015).



Figure 2. General view of grafted watermelon seedlings from Antalya (Antalya Tarım, 2015).

Research on cucumber (*Cucumis sativus* L.) grafting also started in the late 1920s, but wider commercial applications did not occur until 1960 (Sakata et al., 2007). In the *Solanaceae* family, the first grafted crop was eggplant (*Solanum melongena* L.) on scarlet eggplant (*Solanum integrifolium* Poir.) in the 1950s (Oda, 1999). Grafting tomato (*Solanum lycopersicum* L.) was introduced as a commercial practice in the 1960s (Lee and Oda, 2003). At present, grafted plants are used for fruit production of most watermelon, tomato, eggplant, cucumber, melon and pepper. Grafting of these crops is performed for both open field and protected cultivation in Japan and Korea, as well as in China, Spain, Italy, Greece, Turkey and Israel. In short, grafting occurs wherever fruit bearing vegetables are being cultivated intensively (Ryu et al., 1973; Lee, 1994; Davis et al., 2008).

The ban of methyl bromide (MB) soil fumigation led to research on alternative control methods for soil borne pathogens in vegetable production, particularly in protected cultivation. Although alternative chemical applications and other cultural practices have

Table 1. Major advantages and disadvantages of grafting in vegetables (Lee et al., 2010).

Advantages	Disadvantages
Disease resistance/tolerance	Additional expenses for rootstock seed
Nematode resistance/tolerance	Additional labor cost
Yield increase	Experienced labor needed
Low temperature tolerance	Selection of scion/rootstock combinations
High temperature tolerance	Different combinations for production season
High salt tolerance	Different combinations for production methods
Wet soil tolerance	Increased infection of seed borne diseases
Enhanced nutrient uptake	Increased vegetative growth
Enhanced water uptake	Delayed fruit harvesting
Shoot growth promotion	Lower fruit quality (taste, color, flavor, etc.)
Multiple and/or successive production	Physiological disorders
Heavy metal and organic pollutant tolerance	Late incompatibility
Quality changes	Requirement of different cultural practices
Convenient production of organic wastes	Higher price of grafted seedlings
Ornamental value for exhibition and education	Insufficient information about new scion/rootstock combinations
Extended harvest period	

been tested and developed, one of the best methods to control soil borne diseases is to graft susceptible cultivars onto resistant rootstocks. Furthermore, grafting onto suitable rootstocks affects plant growth parameters, including flowering, fruit maturation date, yield, and quality. After MB fumigation was phased out in Turkey, researchers and producers began to use grafting as an alternative method to avoid soil borne pests and diseases. The advantages and disadvantages of using grafted seedlings are listed (Table 1).

Grafting of fruit bearing vegetables is used to control soil borne wilt diseases caused by *Fusarium* and *Verticillium* (Lee, 1994; Yetişir et al., 2003), to increase low temperature tolerance (Tachibana, 1989), salinity tolerance (Behboudian et al., 1986), and to increase plant growth and fruit yield by enhancing water and nutrient uptake (Lee, 1994; Oda, 1995; Ruiz et al., 1996, 1997).

Cucurbit species (watermelon, melon and cucumber) are grafted onto *Cucurbita moschata, C. maxima, C. ficifolia, Benincasa hispida* or *Lagenaria siceraria*; onto interspecific (*C. maxima* and *C. moschata*) hybrids rootstocks (Lee, 1994; Oda, 1995) or onto rootstocks of the same species. Tomato is grafted onto *Solanum lycopersicum*, *S. melongena*, and *S. lycopersicum* × *S. habrochaites*. Eggplant is grafted onto *S. melongena* and *S. torvum*, and pepper onto *Capsicum annuum*. Currently, several rootstock cultivars for vegetable grafting have been bred and released by Turkish and international companies.

Grafting in fruit bearing vegetables was suggested in vegetable growing courses in Turkey in the 1980s. The first scientific research was conducted around that time on the effect of double root systems on yield and quality of tomato (Dizdaroğlu, 1985). It was followed by Vuruşkan (1989) investigating the effects of tomato rootstocks on graft compatibility and yield in eggplant. Until 2000, there were no reports published on vegetable grafting in Turkey. However, research and commercial applications of vegetable grafting in Turkey began after 2000, and was accompanied by the expansion of protected vegetable cultivation. Preliminary studies on watermelon grafting were performed but they were unpublished. In an initial study on watermelon grafting, 'Crimson Tide' was grafted onto 10 different rootstocks and all grafted plants exhibited resistance to *Fusarium oxysporum* f. sp. *niveum*. Grafted plants had significantly greater vegetative growth, fruit yield and quality, except in cases of graft incompatibility (Yetişir et al., 2003). After the first successful trial on grafted watermelon production, private companies and public research institutes carried out several experiments on grafted watermelon. Research on the effect of using rootstocks for fruit bearing vegetables on biotic stresses (Yetişir et al., 2003; Yılmaz et al., 2007; Curuk et al., 2010; Karaca et al., 2012; Karaağaç, 2013), abiotic stresses (Özmen, 2009; Yetişir and Uygur, 2009, 2010; Öztekin, 2009; Semiz and Suarez, 2015), yield and quality (Yetişir and Sari, 2003; Yarşi, 2003; Öztekin, 2009; Cansev and Ozgur, 2010; Karaca et al., 2012; Karaağaç, 2013; Özdemir et al., 2016) and rootstock breeding (Yetişir et al., 2007; Karaca et al., 2012; Balkaya et al., 2010) were conducted for different vegetable species. Currently, many Turkish researchers are examining the mechanism of stress physiology and quality in relation to grafting. Their results are published in Turkish research journals and presented at symposia and congresses. The number of articles published in indexed international journals is also gradually increasing.

The high costs associated with the production of grafted seedlings, particularly the costs of



Figure 3. General view of grafted tomato seedlings from Antalya (Antalya Tarım, 2015).

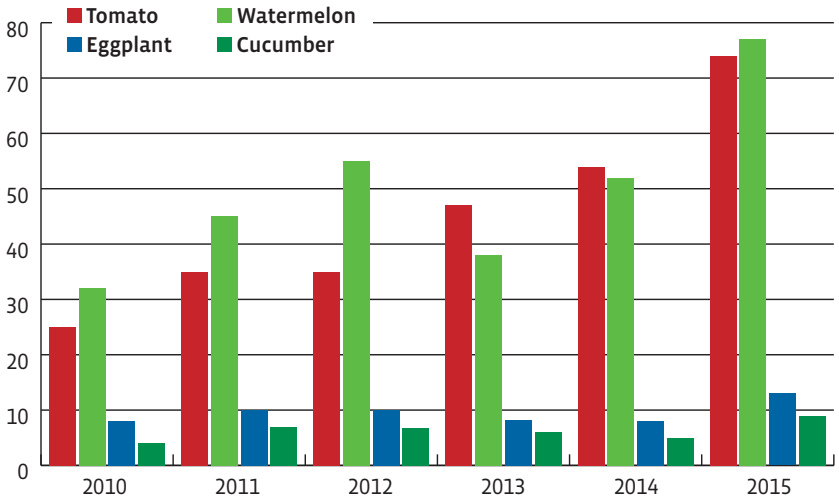


Figure 4. Number (million) of grafted seedlings for the four major vegetables from 2010 to 2015 in Turkey (Young Plant Union, 2015).

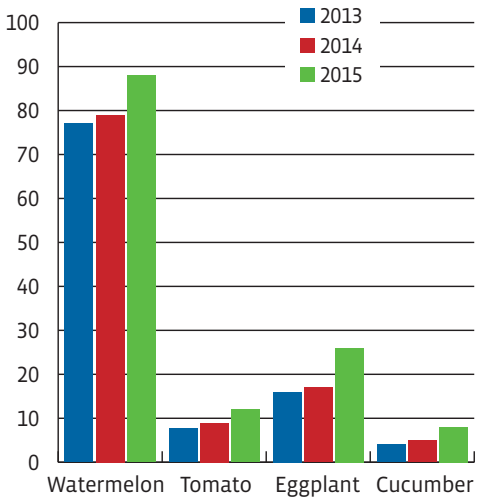


Figure 5. Proportion (%) of seedlings of watermelon, tomato, eggplant and cucumber that were grafted from 2013 to 2015 in Turkey (Young Plant Union, 2015).

Table 2. Rootstocks used in solanaceaous crops in Turkey.

Tomato			Eggplant		Pepper
61-53RZ	Force	Mecano	Ahtapot	KNLF	Gelafut
Arazi	Ground	Nirvana	Beafourt	Maxifort	Capital
Arstrong	Hamarat	Rootex	Brutus	Nirvana	DRO3413
Beufort	Heman	Resistar	Emperador	Rootex	Faundation
Big Power	Kemerit	Spirit	Endam	Sarafin	Ferrai
Body	King Kong	Tm 10043	Kemerit	Tpk-Ro	Güçlü
Brigeor	KNFL	To-Ro	King-Kong	Yedi	Harry
Buffon	Kudret	Vigomax			Kapital
Dohkko	Kyndia	Yedi			Scarface
Endam	Maxifort				Snooker
					Tresor

Table 3. Rootstocks used in cucurbitaceaous crops in Turkey.

Watermelon			Cucumber		Melon
Ayfer Port	Dinamo	Obez	64-10 RZ	Harry	Azman
All Star	Ferro	Parlatan	Affyne RZ	Maximus	Cobalt
Argentario	Flexiport	RS841	AS3507	Mendoza	Ferro
Avar	Jumbo	Shintoza	Cobalt RZ	Nun 9075	Flexiport
Azman	Macis	Strong Tosa	Delfin	Obez	Jumbo
Carnivor	Maximus	Vitally	Desousa	Parlatan	Nun 9075
Cobalt RZ	Macis	Zorba	Ferro	RS841	RS841
CSQ1371	Nun 9075		GS20002	TZ148	Spinx RZ
			GS2005	Zorba	Strong Tosa

intensive labor, rootstock seed and after-graft care, have prevented this technology from being widely adopted in Turkey. However, in the early 21st century, mass production techniques for grafted vegetable transplants were improved, and new rootstocks with desirable traits and compatibility with selected scion cultivars and grafting technology were introduced from Europe. This was achieved through the marketing efforts of local and international seed companies and through information exchange among research communities. Grafted vegetable seedling production has increased markedly during the last decade (Young Plant Union, 2015). The purpose of this article is to briefly describe the scientific and commercial status of the grafted vegetable seedling sector in Turkey.

Present status of vegetable grafting in Turkey

Vegetable seedling production has exhibited remarkable development during the last 20 years. More than 100 vegetable nursery companies produce more than 4 billion vegetable seedlings annually. Since 2001, Turkish companies have introduced and developed grafting methods suitable for commercial vegetable production. Grafted seedlings of watermelon, tomato, eggplant, cucumber, melon and pepper are produced by 33 seedling companies in Turkey. In 2015, they produced 175 million seedlings. The total number of grafted seedlings in Turkey has increased more than tenfold in the last decade (Figure 1).

The grafted seedling industry in Turkey is located mainly in Antalya Province, where a significant amount of protected vegetable cultivation occurs. In addition, about 2 million grafted watermelon seedlings have been exported to neighboring countries, such as Bulgaria and Hungary. Turkish companies have made considerable investments in vegetable transplant (grafted/ungrafted) production areas, particularly in infrastructure and human resources. The sector has gained significant experience and knowledge within this period. Many companies have been established that can produce healthy and high quality grafted/ungrafted seedlings (Figures 1-3). The number of grafted seedlings based on species and year, from 2010 to 2015, is shown in Figure 4. As in other countries, tomato (with 74 million transplants per year), and watermelon (with 77 million per year), were the most grafted vegetable species. Eggplant and cucumber followed. Recently, production of grafted melon and pepper has begun. In 2015, 260,000 seedlings of melon and 70,000 seedlings of pepper were grafted. Producers are looking for melon and pepper scion/rootstock combinations that will result in higher yields and quality under common biotic (soil borne pests and diseases) and abiotic (low soil temperature, salinity, and high pH) stresses.

The proportion of seedlings that were grafted, for the four major grafted vegetables, has

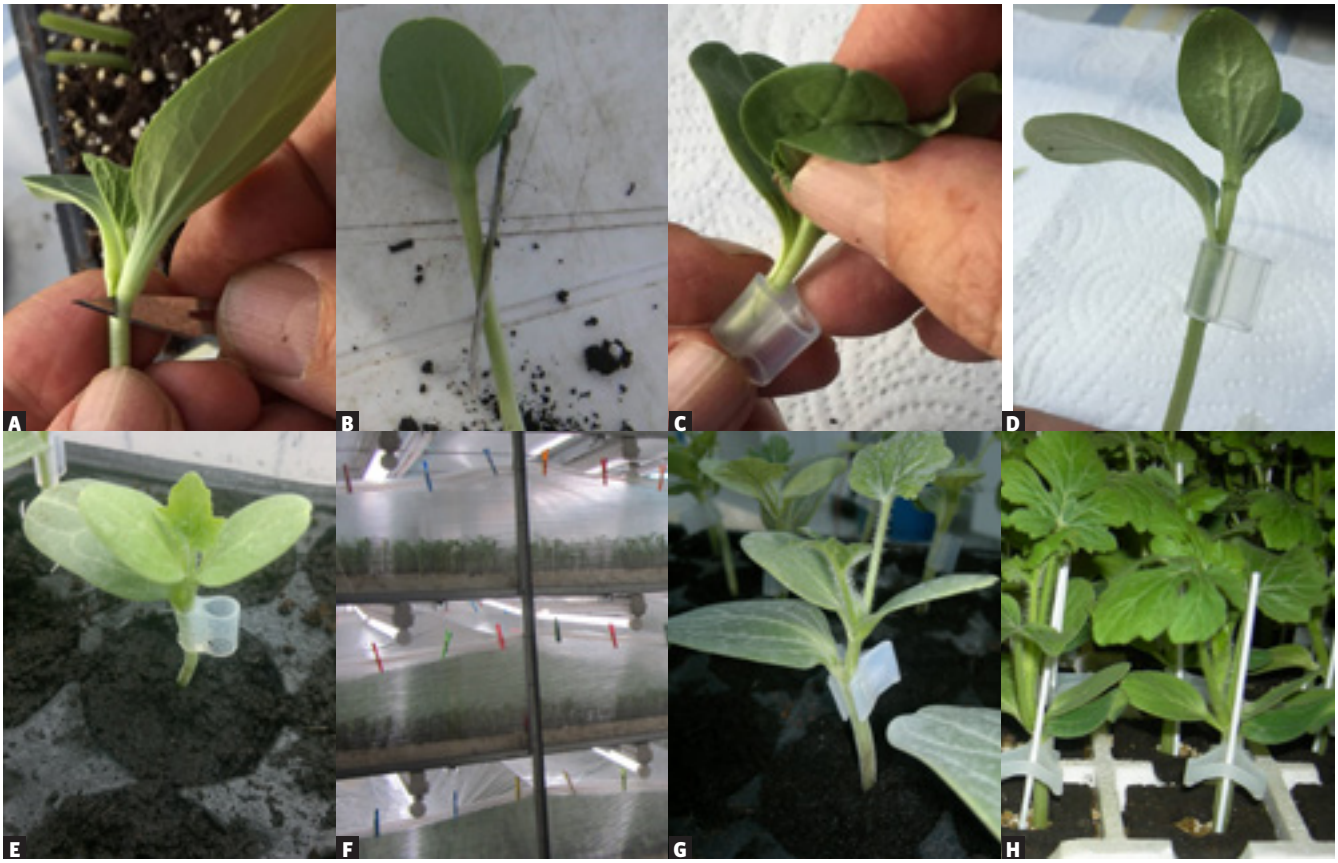


Figure 6. Splice/cut grafting method in cucurbits. A. rootstock preparation; B. prepared scion; C. insertion of tube and scion; D. grafted watermelon seedling; E. replanted grafted watermelon seedling; F. seedling in post graft care unit; G, H. grafted seedling ready to transplant.

increased over the last 10 years and the trend from 2013-2015 is shown in Figure 5. In 2015, the proportion of watermelon, tomato, eggplant and cucumber that were grafted was 88, 12, 26 and 8%, respectively. Most of the grafted seedlings are used in protected cultivation (lower plastic tunnels and greenhouses) in the Mediterranean and Aegean regions of Turkey.

Grafting methods and rootstocks

Different grafting methods have been applied to the cucurbitaceous family in Turkey. Approach, cleft, hole insertion, splice grafting (cut or single cotyledon), and root removal with splice, are just a few of the techniques employed.

Splice/cut grafting (Figure 6) is the most popular technique used by Turkish producers because it is suitable for use with interspecific squash seedlings as rootstocks. The root removed splice/cut grafting method is another common procedure used by Turkish seedling companies.

Tube, approach and cleft grafting methods are used for solanaceous vegetables. Tube grafting (Figure 7) is commonly used by nursery houses. Detailed information about vegetable grafting techniques has been previously described (Davis et al., 2008; Lee et al., 2010). At present, manual grafting is still the primary form of grafting for vegetables in Turkey. However, semi or fully automated grafting robots have been developed by several agricultural machine companies. Some models are available from the Far East and some from European countries. Vegetable species are grafted onto intra- or inter-specific hybrid rootstocks bred from species mentioned above. There are many rootstocks used in Turkey for solanaceous (Table 2) and cucurbitaceaous (Table 3) crops.

Present problems of vegetable grafting in Turkey

Turkey is an important vegetable-producing country. One key component for successful high quality and high yielding vegetable production is to begin with high quality transplants. Seedling quality is one of the primary concerns among farmers. High quality transplants can be produced through grafting and more farmers are purchasing grafted seedlings from professional nurseries. There remains considerable potential to increase the use of grafted seedlings using suitable scion/rootstock combinations in Turkey. However, the following issues should be addressed to overcome limitations of grafted vegetables.

The high cost of grafted seedlings

Grafted seedlings are expensive. This high cost is the result of extra labor and investment. Investment is needed for propagation and grafting, the long production period, and rootstock costs. With the rapid increase in Turkish labor costs, the increasing expense of producing grafted seedlings often discourages potential growers. Therefore, investigation into easy grafting methods, mechanization of grafting and improved acclimatization systems will assist in the mass production of grafted seedlings at a lower cost.

Sanitation problems in grafted seedling production

Seed borne diseases (bacterial fruit blotch, bacterial canker, and cucumber green mottle mosaic virus) are a serious problem in both grafted and ungrafted seedling production. Seed testing and disinfection are neglected in some seedling nurseries. However, transmission of diseases in the production process of grafted seedlings occurs more easily than in regular seedling production. This is probably because some diseases can be transmitted easily by cutting tools from seedling to seedling. In addition, the cut surfaces of both the rootstock and the scion may be easy entry points for pathogens, and high relative humidity and ambient temperature in the healing chambers promote the spread of diseases.

Lack of compatible multi-disease resistant rootstocks

Appropriate rootstocks can provide disease resistance, better abiotic stress tolerance,



Figure 7. Tube grafting method in tomato. A, B. rootstock preparation; C. rootstock, cut and tube inserted; D. prepared scion; E. grafted tomato seedling; F. replanted grafted tomato seedlings in post graft care unit; G. grafted seedling with double shoot (Altın Fide, 2015).

and higher yield and product quality. Unfortunately, commercial rootstocks with desired traits and high graft compatibility are limited. Hence, breeding and identification of compatible multi-disease resistant/tolerant rootstocks with tolerance to abiotic stresses is a basic requirement for continued success. In addition, breeding rootstocks tolerant to high temperature for long season cultivation, and cucurbit rootstocks that have small cotyledons, will be high priorities in future research.

Limitation of available rootstock information

Most seedlings are currently grafted onto a limited number of common rootstocks. There is only limited information on the use of other rootstocks, compatibility to other cultivars, and performance of grafted seedlings in various climatic and cultural conditions. Information about cultural practices for each rootstock (grafting through to harvest) and for every growing condition should be provided to nursery house owners and producers.

Some negative effects of grafting on fruit quality

Fruit quality of watermelon and melon can be negatively affected by rootstocks. For instance, a reduction in fruit soluble solids content was reported in some studies (Yetişir and Sari, 2003). There are several conflicting reports on the effect of grafting on fruit quality. The differences observed in the various studies may be the result of different growing conditions and agricultural practices, types of rootstock/scion combinations used, and harvest dates. Thus, it is very important to breed rootstocks that produce high quality vegetables.

The small scale of grafted seedling production

Small scale systems to produce grafted seedlings cannot ensure the quality (physiological and pathological) of the seedlings. Proper acclimatization and sanitation are critical for grafted seedlings to survive. The failure of small scale producers to control and maintain suitable conditions during the healing and hardening processes can result in lower quality grafted seedlings.

Conclusions and future prospects

Vegetable grafting has been successful in many Asian countries since the 1950s, and is becoming increasingly popular worldwide. New rootstocks have been developed and distributed by several multinational breeding companies through their commercial activities. Breeding and identification of suitable rootstocks for each species with tolerance/resistance to biotic and abiotic stresses is a basic requirement for successful ongoing application of this technique. The development and introduction of mechanization and automation technology will promote large-scale production, which will reduce costs. Efficient labor management has been recognized as a key to success in mass production of grafted seedlings. Vegetable producers in Turkey can now purchase grafted seedlings of any specific combination from many commercial nursery houses rather than doing the tedious grafting themselves. Although the advantages of grafted seedlings are now well known around the world, production of uniform, healthy grafted seedlings at a feasible cost is the crucial factor limiting wider use, especially for those growers with limited experience and knowledge. The Young Plant Union has established an open access database, which will provide information about rootstocks, scion/combination, and cultural practices of grafted material. This database will benefit from the participation of all stakeholders and will help to improve the success of this technology. Researchers from universities, research institutes and industries should work together to develop the use of this technology as a critical tool for sustainable vegetable production in Turkey.

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› References

Ashita, E. (1927). Grafting of watermelons (in Japanese). Korea (Chosun) Agr. Nwsl. *1*, 9.

Behboudian, N.M., Walker, R.R., and Torokfalvy, E. (1986). Effects of water stress and salinity on photosynthesis of pistachio. Sci. Hortic. *29*, 251–61.

Balkaya, A., Özbakir, M., and Kurtar, E.S. (2010). The phenotypic diversity and fruit characterization of winter squash (*Cucurbita maxima*) populations from the Black Sea region of Turkey. African Journal of Biotechnology *9*, 152–162.

Cansev, A., and Ozgur, M. (2010). Grafting cucumber seedlings on *Cucurbita* spp.: comparison of different grafting methods, scions and their performance. J.F.A.E. *8* (*3-4*), 804–809.

Curuk, S., Dasgan, H.Y., Mansuroglu, S., Kurt, S., Mazmanoglu, M., Tarla, G., and Durgac, C. (2010). Leaf mineral composition of grafted eggplant grown in soil infested with Verticillium and root-knot nematodes. Pesquisa Agropecuaria Brasileira *45* (*8*), 879–885.

Davis, A.R., Perkins-Veazie, P., Hassell, R., King, S.R., and Zhang, X. (2008). Grafting effects on vegetable quality. HortScience *43*, 1670–1672.

Dizdaroğlu, A. (1985). Sera domates üretiminde aşı uygulaması ile elde edilen çift kök sistemine sahip domateslerin verim ve kalite yönünden üstünlükleri üzerine bir araştırma. Yüksek Lisans Tezi (Bornova, İzmir, Turkey: Ege Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Bölümü).

Karaca, F., Yetişir, H., Solmaz, İ., Çandır, E., Kurt, Ş., Sarı, N., and Güler, Z. (2012). Rootstock potential of Turkish *Lagenaria siceraria* germplasm for watermelon: plant growth yield and quality. Turk J Agric For *36*, 1–11.

Karaağaç, O. (2013). Determination of rootstock potential of winter squash (*C. maxima* Duchesne) and pumpkin (*C. moschata* Duchesne) genotypes selected from Black Sea region for watermelon. Ph.D thesis (Samsun, Turkey: Institute of Natural and Applied Science of Ondkuz Mayıs University).

Lee, J.M. (1994). Cultivation of grafted vegetables I. Current status, grafting methods and benefits. HortScience *29*, 235–239.

Lee, J.M., Kubota, C., Tsao, S.J., Bie, Z.L., Hoyos, E.P., Morra, L., and Oda, M. (2010). Current status of vegetable grafting: diffusion, grafting techniques, automation. Scientia Hort. *127*, 93–105.

Lee, J.M., and Oda, M. (2003). Grafting of herbaceous vegetable and ornamental crops. Hortic. Rev. *28*, 61–124.

Oda, M. (1995). New grafting methods for fruit-bearing vegetables in Japan. JARQ *29*, 187–198.

Oda, M. (1999). Grafting of vegetables to improve greenhouse production. Food & Fertilizer Technology Center Ext. Bull. *480*, 1–11.

Özmen, S. (2009). Effect of different irrigation levels on plant development, yield and quality of grafted and no grafted watermelons under Cukurova conditions. PhD. Thesis (Adana, Turkey: Department of Agricultural Building and Irrigation, Cukurova University), pp.115.

Özdemir, A.E., Çandır, E., Yetişir, H., Aras, V., Arslan, Ö., Baltaer, Ö., Üstün, D., and Ünlü, M. (2016). Effects of rootstocks on storage and shelf life of grafted watermelons. Journal of Applied Botany and Food Quality *89*, 191–201.

Öztekin G.B. (2009). Response of tomato rootstocks to salinity stress. Ph.D thesis (Izmir, Turkey: Institute of Natural and Applied Science of Ege University).

Mudge, K., Janick, J., Scofield, S., and Goldschmidt, E.E. (2009). A history of grafting. Hortic. Rev. *35*, 437–493.

Ruiz, J.M., Belakbir, A., and Romero, L. (1996). Foliar level of phosphorus as its bioindicators in *Cucumis melo* grafted plants. A possible effect of rootstock. J. Plant Physiol. *149*, 400–404.

Ruiz, J.M., Belakbir, A., Lopez-Cantarero, A., and Romero, L. (1997). Leaf macronutrient content and yield in grafted melon plants: a model to evaluate the influence of rootstocks to genotype. Sci. Hortic. *71*, 113–123.

Ryu, J.S., Choi, K.S., and Lee, S.J. (1973). Effects of grafting stocks on growth, quality and yield of watermelon (in Korean with English summary). J. Kor. Soc. Hort. Sci. *13*, 45–49.

Sakata, Y., Ohara, T., and Sugiyama, M. (2007). The history and present state of the grafting of cucurbitaceous vegetables in Japan. Acta Hortic. *731*, 159–170. https://doi.org/10.17660/ActaHortic.2007.731.22

Semiz, G.D., and Suarez, D.L. (2015). Tomato salt tolerance: impact of grafting and water composition on yield and ion relations. Turkish Journal of Agriculture and Forestry *39* (*6*), 876–886.

Tachibana, S. (1989). Respiratory response of detached roots to lower temperatures in cucumber and figleaf gourd grown at 20°C root temperature. J. Jpn. Soc. Hort. Sci. *58* (*2*), 333–337.

Tateishi, K. (1927). Grafting watermelon on squash. Japan. J. Hort. *39*, 5–8.

Vuruşkan, M.A. (1989). Effect of different grafting methods on graft success and yield in eggplant/tomato graft combinations. Master Thesis (Ankara, Turkey: Institute of Natural and Applied Science of Ankara University).

Yarşi, G. (2003). Investigation on effect of grafted seedling on yield, quality and plant nutrient uptake in melon. Ph.D thesis (Adana, Turkey: Institute of Natural and Applied Science of Çukurova University).

Yetişir, H., and Sari, N. (2003). Effect of different rootstocks on plant growth, yield and quality of watermelon. Aust. J. Exp. Agric. *43*, 1269–1274.

Yetişir, H., and Uygur, V. (2009). Plant growth and mineral element content of different gourd species and watermelon under salinity stress. Turk. J. Agric. For. *33*, 65–77.

Yetişir, H., and Uygur, V. (2010). Responses of grafted watermelon onto different gourd species to salinity stress. J. Plant Nutr. *33*, 315–327.

Yetişir, S., Sarı, N., and Yücel, S. (2003). Rootstock resistance to Fusarium wilt and effect on watermelon fruit yield and quality. Phytoparasitica *31* (*2*), 163–169.

Yetişir, H., Kurt, S., Sari, N., and Tok, M.F. (2007). Rootstock potential of Turkish *Lagenaria siceraria* germplasm for watermelon: plant growth, graft compatibility and resistance to Fusarium. Turk. J. Agric. For. *31*, 381–388.

Yılmaz, S., Gocmen, M., Ünlü, A., Aydinsakir, K., Baysal, O., Kuzgun, M., Celikyurt, M.A., Sayın, B., and Çelik, İ. (2007). Phase out of methyl bromide for soil fumigation in protected horticulture and cut flower production in Turkey. 1st Prog. Rp. (Antalya, Turkey).

Young Plant Union. (2015). http://www.fidebirlik.org.tr/