

## INTRODUCTION

Walnut is one of the Iranian traditional nut crops, found in 29-39° latitude and 45-64° longitudes, from lowlands up to 2500 meters height. Dominant walnut species is *Juglans regia*. Wild and natural sites of this species are scattered in north, west and centre of the country. Many scientists know Iran as the origin of *J. regia* and call it Persian walnut. *J. regia* is native to wetter areas in the mountains of Iran. Walnut stands are found in the Kopet Dagh Mountains, the low land along the southern shore of Caspian Sea and in sporadic locations throughout the ranges of western and southern Iran. The Kopet Dagh Mountains along the northern border of Iran are quite dry, especially on the northern slope and do not support forests. Native *J. regia* is found here only in a few of the wetter gorges and deep valleys.

Walnuts are grown to a great extent on Elburz, Zagros, Lalezar and Jabal Barez mountain feet (Fig 1). Most of these trees are seedlings and show a wide variation in their characteristics. Therefore it can be easily found precociously, lateral bearing, big kernel and other valuable characters in these genotypes. In some districts, plantings expanded along the rivers, around the orchards or mixed with other fruit trees. There are many old and huge trees of this species in Iran. The age of the oldest is estimated to be about 1400 years. This tree is situated in "Oregon", a village of Shahre Kord city. There are also many other old walnut trees in Khansar, Isfahan, Qazvin, Taleghan and Tooserkan regions with the age ranging from 300 to 700 years (Fig 1). These trees produce about 50-100 thousand nuts each. Unfortunately, many of these trees have been destroyed by English, Italian and Russian timber buyers after second world war (1951-1961).

In recent years, with the government encouragement, identification of superior genotypes and establishing grafted orchards using these genotypes have been started. In addition, walnut price increment in domestic markets has promoted growers to establish new walnut orchards. Thus, planted area of non-bearing orchards increased to five folds during last decade (Fig 2). At the present time, number of walnut growers is estimated around 30,000.

Islamic Republic of Iran occupies an important niche among the world's leading producers. With its 45 thousand hectares of walnut crops which produce an average of 145 thousand MT annually, or 10%

Years	Planted area (ha)		Production (t)
	Fruit bearing	Non-fruit bearing	
1988	11644	5196	37821
1989	13243	5395	46009
1990	15025	9027	44482
1991	17973	12067	64486
1992	22696	10089	71237
1993	25976	12460	110819
1994	28975	14563	117218
1995	32290	14978	119218
1996	35783	17889	113187
1997	41766	20837	124872
1998	45152	27373	145820
1999	50161	32698	142906

of world production, Iran ranks third among leading producers (Tab 1). Strong demand and good price of walnut in domestic markets has decreased tends to export this crop. Walnut kernel is a valuable snack in Iran, sometimes eaten with cheese for breakfast. It is also a suitable ingredient for sweets. This is a very valuable tree for Iranian growers because of its nuts as well as its timber.

## TECHNICAL INFORMATION

## Distribution

All over Iran but particularly in northern, western and central district on mountain feet of Alborz, Zagros, Lalezar and Jabal Barez in Kerman, Hamedan, Qazvin, Azarbaijan, Kermanshah, Khorasan and Fars provinces (Fig 3).

## Cultivars

There are important populations of Persian walnut in Iran and most of them are seedlings. These populations have shown relatively stable characteristics for long time. The biggest walnut populations are situated in Tooserkan, Kerman, Qazvin and Shahmirzad district. These populations have not been much studied. Many of these trees are very old, indicative of resistance to much stress during hundreds of years.

## Germplasm

In northern Iran, *J. regia* is found in the Caspian lowlands and Elburz Mountain region of Mazandaran, Gorgan and Gillan provinces at elevations of 60-2400 m. Collections are noted here from the Mazandaran Mountains, the Haraz valley and the mountains around Gorgan. These wetter mountain regions of Iran exhibit a typical holarctic deciduous forest. Also, there are scattered *J. regia* collections in the mountain ranges extending from eastern Turkey to southern Pakistan through the Iranian provinces of Azarbaijan-e Bakhtari, Kordestan, Kermanshah, Lorestan, Bakhtiari, Kerman and Khorasan. In the south Caspian lowlands, north face of

Elburz Mountains, the mountains of Khorasan and Zagros ranges densely forested areas have been severely degraded and the natural vegetation has been reduced to mere remnants as a result of agricultural activity and cutting.

## Orchard features

Walnut trees traditionally planted along the rivers, around the orchards, interplanted with the other fruits or exclusively at distances of 10-15 m. In new specialised orchards, 9-10 x 10-11 m spaces are used.

## Propagation

Mainly by seed. Recently, grafting used for propagation of superior genotypes. Some research projects on micro-propagation are underway.

## Training and pruning systems

Common training system is modified central leader. Pruning is not common in traditional orchards and some growers believe that pruning is not necessary for walnut trees, but in new orchards pruning is done.

## Fertilization

Scarcely used. In specialised orchards, manure (40-60 t/ha), 400 kg/ha KCl and 250 kg/ha P<sub>2</sub>O<sub>5</sub> used at planting and 100 g of N unit for each year of the age of the tree is necessary.

## Irrigation

Walnut trees require about 10,000 to 12,000 m<sup>3</sup>/ha during growing season. In north of Iran, near the Caspian Sea, in which there is more than 700 mm raining, irrigation is not necessary but in other parts of Iran orchards are irrigated every 10-15 days during summer. The irrigation system in traditional orchards is furrow or basin but in new plantings there is drip irrigation.

## Diseases and pests

In spite of rarely application of pesticides against pests and diseases, most of wal-

nut trees are healthy in appearance. Blight and anthracnose are observed in some regions with the high rainfall during spring and summer, especially around the Caspian Sea. Black line disease has not been reported yet, maybe because all walnut trees are grafted on *J. regia* rootstock. Aphids, codling moth, bark and tree borers, scales and mites are seen in some districts. Birds, especially crow, attack the nuts during harvest. Its damage is more severe in orchards, which harvesting is delayed.

#### Physiological disorders

Walnut kernel browning is a major problem some years when summer is dry and hot. Some of the growers try to decrease this disorder by making holes on the tree trunk using an axe or long nail. They claim that walnut bleeding is effective on kernel colour.

#### Harvest

From 5-10 September to mid October depending on variety and climate. Because of the variation of walnut seedlings, harvesting is manually done.

#### Post-harvest systems

Hulling is done traditionally by hand. Recently some hullers and dryers have been imported or were made by local experts.

#### Import and export

As far as we know, there is no import of walnut. Export of in-shell dried walnut is not so much due to high demand of domestic markets. Top export destinations for Iranian walnut kernel are: the United Arab Emirates, Germany, Turkey, Saudi Arabia, Qatar, Liban, Kuwait, Ukraine, Sweden and Syria.

#### Research

Main institution	Area
Ministry of Agriculture Agricultural Research Centrein Karaj, Shahrood, Mashhad, Ormieh, Azar Shahr	Genotype evaluation, germplasm, breeding, irrigation, grafting, apomixis
Department of Horticulture Faculty of Agriculture University of Tehran Karaj	Tissue culture, stooling, grafting

#### Prospective

1. Identification and evaluation of superior genotypes using IPGRI walnut descriptors into the rich walnut populations of Iran.
2. Estimating mathematical models between qualitative and quantitative characters of walnut trees and environmental conditions of their growing district.

3. Improvement of grafting methods for asexual propagation of superior genotypes and releasing new cultivars.

4. Research on other propagation methods (ex: micropropagation, stooling, apomixis, etc.).

5. Establishing modern orchards using superior cultivars.

6. Mechanisation of harvest and post-harvest systems.

#### ACKNOWLEDGEMENT

The author wishes to acknowledge Dr. Eric Germain, Director of UREFV, INRA for his kindness in scientific editing of this paper.

#### REFERENCES

Agricultural Statistics and Information Department, 1999. Dried fruits, figures and views. Ministry of Agriculture. Iran.

ASID, 2000. Agricultural statistics year-book. Ministry of Agriculture. Iran.

Atefi J., 1990. Preliminary research on Persian walnut and correlation between pair characters. 1<sup>st</sup> Intl. Symp. on Walnut Production, 25-29 Sep. 1989, Budapest (Hungary). Acta Hort. 284: 97-104.

Atefi J., 1997. Study on phenological and pomological characters on walnut promising clones in Iran. 3<sup>rd</sup> Intl. Walnut Congress, 13-16 June 1995, Alcobaca (Portugal). Acta Hort. 442: 101-108.

Dehlavi A., 1994. Walnut growing. Baghdar. No. 1: 40-42.

Farshi AA, 1997. An estimate of water requirement of main field crops and orchards in Iran. Soil and Water Research Institute. Ministry of Agriculture. Iran.

Germain E., 1993. The Persian walnut in Iran. Nucis. No. 1: 5 - 6.

Grassi G., 1998. Walnut. In: Grassi et al. (eds.) Italian horticulture. Societa Orticola Italiana. Italy.

INC, 2000. World consumption and production trends. The cracker. No. 1: 33-49.

Leslie Ch. and McGranahan G., 1988. Native populations of *Juglans regia* - a draft. Intl. Conference on Walnuts. Sep.19-23. Yalova, Turkey.

Pourbabaee H. et al., 1999. Diversity of woody species of common walnut (*Juglans regia* L.) sites in Guilan forests. Iranian Journal of Natural Resources. 52 (1): 35-45.

Visan consulting engineers, 1995. Study of Iran horticulture project report. Vol. 7. Ministry of Agriculture. Iran.

K. Vahdati

Department of Horticulture, Faculty of Agriculture  
University of Tehran - Karaj-Iran  
Email: kvahdati@chamran.ut.ac.ir  
Tel: ++98 21 7811963 - Fax: ++98 21 8078611

## HEDGEROW WALNUT PLANTING SYSTEM: EXPERIENCES IN SPAIN

### INTRODUCTION

Walnut orchards using grafted trees started to be planted in Spain around 1976 when Californian and French cultivars were introduced. Walnut orchard management was unknown and technologies applied in California and France were assessed.

At present the surface of grafted walnut orchards is around 3500 ha, and the Spanish walnut production from regular plantations is about 4000 t, considering that most orchards are still young. Main cultivars in adult orchards are: 'Franquette', in areas having late spring frosts, and 'Hartley' and 'Serr' in warm areas. Since 1990 the most favourite cultivar is 'Chandler'.

So far Spanish technology to produce walnuts has been developed and orchards are well managed. Pests and diseases are detected and treated in time. *Xanthomonas arboricola* pv. *juglandis* (Blight) and *Cydia pomonella* are the main phytosanitary affections. In some places, spray orchard programme should include *Gnomonia leptostyla* control.

The Extensive and semi-intensive plantations are still the most common planting systems in Spain although some farmers started planting cultivars like 'Chico', 'Vina' or 'Chandler' in hedgerow. Experimental hedgerow orchards are being controlled by IRTA (Figure 1), some useful results of these trials are reported in this paper. Mechanical pruning is also evaluated.

### Description of IRTA's experimental walnut hedgerow plot

In 1988, an intensive walnut orchard was planted in the Northeast of Spain, at Bitem, near Tortosa, Tarragona, as a hedgerow. Two cultivars were chosen, 'Chico' and 'Vina' both had shown a high and precocious productivity in Mediterranean environment (Aletà and Ninot, 1993). Two planting distances were considered 7 m x 5 m and 7 m x 3.5 m, trees were trained in central leader but their primary branches were selected on the row direction. Two assays were established, the first to compare the cited planting distances using 'Chico' and the second to compare cultivar behaviour of 'Chico' and 'Vina' at 7 m x 5 m. Two pollinators were also included 'Serr' and 'Amigo' in parallel rows to those of main cultivars. Both trials were planned as complete blocks with 3 replications. The number of observations per treatment varied from 5, at 7 m x 5 m, to 8, at 7 m x 3.5 m. Experimental plots are