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ORIGINAL PAPER



Genetic Diversity of Walnut Species

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ABSTRACT

Walnut has always been used to earn valuable foreign exchange. Being a nutty tree it's very hard to grow without seed treatment like stratification and scarification. Having an origin of Iran, the botanical name of walnut is *Juglans* sp. which having a chromosome number of $2n=32$ are very familiar by everyone. Walnut being a deciduous tree with shady canopy generally cultivated for its kernels generally called seeds. It has wide distribution in Iraq, Afghanistan, some parts of China, Turkey, Romania, United States of America, India, and the region of Mediterranean. Apart of this, China is the largest producers as well as biggest consumer of walnuts too. But it is estimated that less than 1-2% of the total population in the world have been known and familiar with the species and cultivars of walnut described very well earlier further in any literature cited.

Keywords: Walnut, Seed treatment, Stratification, Scarification, Species, Cultivars

INTRODUCTION

An American botanist, horticulturist and pioneer in agricultural sciences Luther Burbank is credited with early research in California Walnut cultivation. Luther Burbank began in making the controlled crosses between the walnut species in the late 19th century after hearing about a "Supposed Natural European Hybrid Walnut". He though then crossed between *Juglans hindsii* (Northern Californian Black Walnuts) × *Juglans regia* (Persian Walnuts) and produced a variety called 'Paradox' because of its

really fast vigorous growth and other “anomalies”. He also crossed two American species, of walnut that is *Juglans hindsii* × *Juglans nigra* (Eastern Black Walnut) producing the “Royal” walnuts progeny that were having an identification of vigorous growth and are prolific nut producers. A third inter-specific hybrid was a cross between *Juglans ailantifolia* (Japanese walnut) × *Juglans regia* that was recognised as extremely vigorous progeny but was not named. He also observed segregation in the F₂ population and described giants and dwarfs as reversions of the ancestral forms. Luther Burbank also made various selections of walnut scion cultivar and he was especially interested in the thin shelled kernels of walnuts.

Later, he collected the seeds of the *J. regia* growing in the regions of the San Francisco because it produced the regularly and have very high-quality nuts with relatively thin but poorly sealed shells. He selected one of the seedlings named “Santa Rosa Soft Shell” and identified it as a large bearing crops of nuts that were nearly white with thin shells and delicious white meat. Thus, Luther Burbank’s contribution in walnuts industries was memorised to this day, especially for the widespread use of the seedlings and clonal Paradox walnut rootstock. Thus, its history is very large running throughout the world in different centuries by different people.

SPECIES DIVERSITY IN WALNUT

There are various types of species of walnut which are having different types of origin. These walnuts are found in various countries at various locations as their native places and some of them are having names after their original place. These walnuts are mentioned with their origin, common name and according to use to understand them.

1. *Juglans regia* (Persian walnuts)

This species is also called as English walnut or Persian walnuts and their origin place is Iran (earlier called as Persia). They are actually counted to be of excellent quality walnuts ever due to their texture, aroma, and appearance. It is a large deciduous tree attaining a height of 25-35 meters and a trunk can reach up to 2 meters in diameter commonly with a shorter trunk broad crown and is taller and narrower in dense forest competition. This species is a light demanding species and requires full sun light to grow well.

2. *Juglans nigra* (Black Walnuts)

These walnuts are classified as Black Walnuts. It is also referred as Eastern American Black Walnuts. These walnuts species are not as excellent as the Persians once, but they are good for making furniture and dyes due the discharging of colours while being deshelled from the nuts. As these East American Walnuts are deciduous like other walnuts are but, the height is about 30-40 cm. Under forest competition it develops a tall and a straight trunk. When it is grown up in an open area it has short trunk and broader crown.

3. *Juglans cinerea* (Butternut Walnut)

This species is called as Butternut Walnut. It is not commonly grown as an ornamental but it is a valued Native American tree that is unfortunately becoming increasingly rare in the wild now because of a canker disease. Butternut is similar in appearance with black walnut except it is generally smaller, its bark is less fissured, it has fewer leaflets per leaf and its nuts are more oval than round. But the kernels are sweet, oily and tasty, having a buttery flavour, specified common name. Native Americans used these nuts for the food and boiled the tree sap for syrup. Butternut wood, though softer than black walnut, was once valued for a variety of uses including panelling, cabinets and furniture. Overharvesting of trees for commercial use plus losses from the canker disease has reduced native tree populations to the point where the butternut is now endangered in most parts of its range. This species is sometimes commonly called white walnut because of the light colour of the wood.

4. *Juglans californica* (Californian Black Walnut)

Californian Black Walnut is a common name of *J. californica*. Southern California Walnut is an uncommon shrub or tree to 15-25 ft., grows along stream beds from Ventura south. This plant is important to wildlife as it provides food and nesting sites for many birds and mammals. The walnuts are one of the strongest allelopathic plants and are difficult to garden under. Lovely small tree that is becoming more-scarce as the bulldozers make their way across southern California removing the vegetation to make way for shopping malls, highways and housing sub divisions. This tree is called Southern California Black Walnut. Nuts are small but edible. This species tolerates seasonal flooding.



Juglans regia



Juglans cinerea



Juglans nigra

5. *Juglans major* (Arizona Walnut)

The woods of this species are as similar as, like that of Black Walnut, is used for furniture and gunstocks, but the supply is limited. The valuable enlarged burls and bases of the trunks make beautifully patterned tabletops and veneer. It is a deciduous

tree growing to 15 meters at a fast rate. The nut of this tree is small, thick shelled with deep grooves enclosing an oily, edible seeds. This tree in moist regions, the tree features a single stout trunk in drier situations.

6. **Juglans hindsii** (North Californian walnut)

This species is also called as Hind's Black Walnut, Paradox Hybrid Walnut. The black dye is also obtained from this species. It is a medium sized tree of short bulky proportion. It can grow up to the height of 30-60 feet's tall and has a single erect trunk. These trunks grow without branches up to 10-40 feet's and the crown of the tree is wider than the height of the tree. Trunk reaches up to the diameter of 5-6 feet near the base of the tree. This tree is heavy, hard and rather coarse grained. Apart from valuable timber, the tree is occasionally cultivated for its wood. This tree is also planted for habitat restoration projects and natural landscaping projects.

7. **Juglans ailantifolia** (Japanese Walnut)

This walnut is native to Japan and Sakhalin. It is a deciduous tree which grows up to a height of 20 meters tall. It rarely also can grow up to 30 meters and stem is 40-80 cm in diameter with light grey bark. Japanese Walnut grows on almost any type of soil, as long as fertile. It does need space to develop a good, regular crown. It is resistant to frost (WH 1 - 6) and is resistant to canker diseases and can withstand wind. The husks of nuts from this tree are also used to make a yellowish dye.

8. **Juglans hirsute**

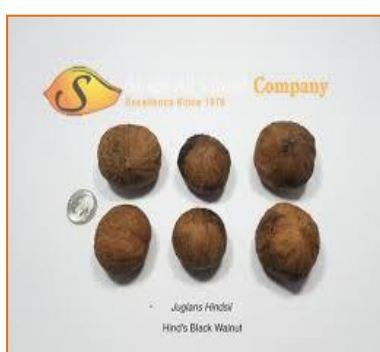
It is a very mysterious type of walnuts species having no such present popularly. But is found to have an origin of Central Mexico, North-East Mexico and South -West Mexico.

SOME OTHER SPECIES

J. sigillata, J. hopiensis, J. cathayensis, J. mandshurica, J. australis, J. neotropica, J. olanchana, J. guatemalensis, J. mollis



Juglans major



Juglans hindsii



Juglans ailantifolia

DIVERSITY OF WALNUT CULTIVARS

There are various cultivars of the walnuts which are exotic and indigenous which can help in the increase in production, area and productivity of the country. This may help the old orchard owners or thinking about establishing new orchards of walnuts which can get a rough idea for the various options to increase their income and which cultivar should they plant replacing the old ones. The walnut cultivars are divided into two categories:

- Exotic Cultivars
- Indigenous Cultivars

Exotic Cultivars

Exotic cultivars are those cultivars which are generally grown and found outside the country means which are grown and found in foreign country. There are various exotic walnut cultivars in the list but few of them are enlisted below:

Ashley

It is a precocious, moderate sized and upright tree. This variety is a lateral bearer. The shells have good strength and appearance, light in colour, good quality and easy in removal. The net weight of the nut is 12.9 grams whereas the kernel weight is 6.4 grams and kernel percent is 50 %. The variety has early harvest date, but variety is very susceptible to blight. DNA marker also indicated that Ashley and Payne are identical. Tehama, Chico and Hartley are used as pollinizers variety. This variety is susceptible to blight and codling moth. The yield of this variety is moderate yielder.

Chandler

This variety is moderately vigorous and is most common variety grown for its excellent colour and halves. This variety has fewer pest problems. It is a late harvesting variety till mid-October. The nut weight is 13.4 grams whereas the kernel weight is 6.5 grams. The kernel percentage of this variety is 49 %. The shells of chandler are oval, smooth, light in colour and is thin shelled. The shell of this variety becomes stronger in older trees. The kernels of chandler are easily removed into two halves but, the kernels are extra light in colour. The kernels are not well filled but, are late harvesting variety. It is suggested to establish chandler with its pollinizer cultivar at a spacing of 7meters×5 meters. The yield of this variety is 4.5 tons per hectare.

Eureka

Eureka is a vigorous tree. This cultivar is early to mid-season variety with distinctive elongated nut shape. The bearing habit of this tree is terminal bearing and is a fair yielder. Shells are elongated, round at both ends and shells are solid and sealed. The kernels have poor kernel colour. The kernel weight is 7.4 grams and percentage of kernel is 49%. The net weight of the nut is about 15.2 grams. The yield of this variety is fair.

Fernette

This variety is developed in France. It is a moderately vigorous tree. It is a lateral bearer with good yield. Fernette is an abundant pollen producer and more precocious than Franquette. The shells of this cultivar are having good strength. The kernels are light to extra light in colour. This variety is generally used as a pollinizer variety for chandler. The net weight of the nut is 14.9 grams, kernel weight is 7.5 grams and kernel percent is about 50%. The yield of this variety is 1.84 tons per hectare.

Fernor

Fernor is a cold resistant, late leafing, productive and precocious French walnut variety. It is a hybrid of Franquette × Lara. Fernor produces thin shelled nuts. Its kernels are light coloured and are tasty. Its kernels are easy to remove shells and are easy to crack out into two halves. As this tree grows in an upright manner so Fernor is suitable for High Density Planting (HDP) with a spacing of 6meters×5meters and its pollinizer variety is Fernette and is recommended planting 1 Fernette tree for every 10 Fernor trees. It can yield up to 8 tons per hectare when reaches to maturity.

Franquette/Franquette

Franquette is also known as Franquette and is also a French variety as similar to the Fernette. It is a late leafing, vigorous large tree, terminal bearer with self-fertile and late harvesting cultivar of walnut. Shells are medium sized, thin with good seal having good quality with light to extra light in colour. The nut size is 11 grams, kernel weight is 5.5 grams and kernel percent is 50%. This variety is also primarily used for the pollinization of chandler and Hartley. The yield of this variety is a fair.

Serr

Serr is a very vigorous, moderately fruitful on laterals. Shells are thin, having good seal and well filled. The kernels are light coloured with excellent quality. Pollinizers are not recommended for this cultivar but are pollinized by Chico and Tehama. It is of high quality and potential high productivity but susceptible to flower drop if exposed to pollen. The high kernel yield of this variety is 57%, average weight of kernel per nut is about 8.3 grams and per nut weight is about 14.6 grams. The yield of this variety is variable.

OTHER EXOTIC CULTIVARS

Howard, Tulare, Ivanhoe, Solano, Durham, Robert Livermore, Sexton, Lara, Placentia, Paradox, Royal, Payne, Hartley *etc.*

Local Cultivars

Local cultivars are those cultivars which are developed in the particular country by the breeders and are as promising as the exotic ones. Some local walnut cultivars are as follows:

Govind/Gobind

Govind is also called as Gobind in some parts of India especially in Uttarakhand. Himachal Pradesh is the major state of this exotic local cultivar cultivation. The kernels of this cultivar are flavourful, excellent and are easy to break with soft shells.

Karan

This cultivar of walnut is extra thin shelled having high shelling percentage.

Bulbul

This cultivar has very thin shell with high shelling percentage and is sought for export purpose.

Chakrata No:14

This walnut cultivar has very thin shell, good filling and attractive light amber colour of the kernels.

Chakrata Selection

Chakrata Selection is the Pride of Uttarakhand state. This variety bears medium sized nuts with plumpy kernels. This variety is only cultivated in the Chakrata regions of district Dehradun and hence earned its name.

CITH Walnut-1

This variety of nut is suitable for export as well as for domestic market. The tree is of medium vigour growth. Kernels are light in colour having bold nut 28 g in weight, and large kernel size is about 14.21 g. The good kernel recovery is 50.75%. The shells are light in colour, having intermediate shell seal, intermediate shell strength, having long trapezoidal shape and are very easy to remove kernel halves.

CITH Walnut-2

This promising walnut genotype has vigorous plant growth, having a medium size nut of 16.0 g and kernel weight 8.0 g. The shells are soft with shelling percentage 50% with light kernel colour. Nuts are large in size, ovate in shape with medium shell texture. With medium shell colour, strong shell seal and intermediate shell strength, there is complete shell integrity, with satisfactory kernel flavour, and well filled kernel, which is plummy and easy to remove kernels into halves.

CITH Walnut-3

A medium tree vigour, nuts are large with long trapezoidal in shape, rough in shell texture and having medium shell colour. The nuts have strong shell seal and shell strength. They have complete shell integrity with satisfactory kernel flavour. The kernels are well filled and are plummy which is difficult to remove kernel halves and the kernels are light in colour. The net nut weight is 19.3 g and kernel weight 9.8 g with kernel recovery 50.7%.

Other local cultivars

Roopa, Hamdan, Sulaiman etc.

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