

SELECTION OF WALNUT (*JUGLANS REGIA L.*) FOR LATERAL BEARING AND CLUSTER BEARING HABIT

K. K. PRAMANICK, A. K. SHUKLA, SANTOSH WATPADE, MADHU PATIAL AND
JITENDER KUMAR

*Indian Agricultural Research Institute, Regional Station (Cereals & Horticultural Crops)
Shimla-171004 (H.P.)*

E-mail: kallol_pramanick@yahoo.co.in and kallolpramanick@gmail.com

Abstract: Persian walnut (*Juglans regia* L.), also called the English walnut, is the only species widely cultivated for nut production which are being used for table purposes. It has various microelement and nutritious substances and is one of the important nut crops in the world. India has significant Persian walnut trees, most of which are seedling grown. Due to the extensive variability of biological material, the result of cross-pollination and generative propagation prevailed by natural dissemination in Himalayan region of India has rich phenotypic diversity in walnut germplasm. Older orchards in most traditional walnut producing countries consist of mature seedling trees characterized by a long juvenile period and poor, inconsistent bearing habits. This is due to the fact that the Persian walnut is more difficult to propagate vegetatively than any other tree nut species. A unique walnut plant, Sel-3 (Pusa Khor) is being evaluated at the ICAR-IARI Regional Station Shimla, Himachal Pradesh, India. It was collected from Chamba region of Himachal Pradesh which came into bearing in the second year of its grafting. The known varieties of walnut normally take 10 to 15 years to come into bearing. Sometimes it takes even more. The fruit appears to be borne in lateral position as well as terminally. This is a characteristic of newly evolved early, good quality and heavy bearing walnut cultivars. However, no such cultivar is reported in India so far. The leaf size and annual shoot increment is also differing from other walnut plants collected during the same survey. The nut is thin shelled, kernel colour is light yellow and good in taste. It is semi-vigorous in nature. This is also suitable for high density plantation. The unique walnut "Pusa Khor" is having Lateral bearing and Cluster bearing habit.

INTRODUCTION

Persian walnut (*Juglans regia* L.), also called the English walnut, is the most valuable commercial species in its genus belonging to the family Juglandaceae. Persian Walnut (*Juglans regia* L.) is known to be rich in oil, vitamins, minerals and proteins (Ozcan, 2009, Özcan, İman, & Arslan, 2010 and is mostly produced in orchards in temperate zones like Turkey, China, Iran and USA (Erturk & Dalkilic, 2011; FAO, 2013. Different *Juglans* species originated on several continents, while the Persian walnut is native to temperate regions in mountainous Eastern Europe and central Asia, extending from Turkey, Iran and

western China eastward to the Himalayan regions in India and Nepal (Leslie & McGranahan, 1998). All *Juglans* species are monoecious, with catkins being borne laterally on one-year-old wood, and pistillate flowers borne terminally or laterally (newer cultivars) on current season's wood. Although walnuts are genetically self-fruitful they exhibit the phenomenon of dichogamy, being either protandrous or protogynous depending on cultivar. Hence, walnuts are mostly cross-pollinated by wind (Polito, 1998). The walnut is regarded as highly valuable by an increasingly health conscious world due to various health benefits, including a great source of vitamin E

and omega-3 fatty acids, as well as the ability to lower the level of cholesterol in human bodies (Savage *et al.*, 2001).

Older orchards in most traditional walnut producing countries consist of mature seedling trees characterized by a long juvenile period and poor, inconsistent bearing habits. This is due to the fact that the Persian walnut is more difficult to propagate vegetatively than any other tree nut species (Lagerstedt, 1979; MacDonald, 1987; Reil *et al.*, 1998; Hartmann *et al.*, 2002). For a long time in the past, propagation through seed was only method available for walnut multiplication though this practice resulted into plants of great variability (Sharma *et al.*, 2003). Generally, walnut does not respond favourably to the vegetative propagation techniques under normal conditions, the way other temperate fruits do.

Seedling trees of walnut (*Juglans regia* L) are found growing in all parts of North Western Himalayan Region at 1200-2200 meters elevation and trees exhibit considerable variation in respect of vegetative growth and fruit characters. Use of this variability in the selection of superior seedlings with desirable traits will be of paramount importance in the expansion of walnut cultivation in this country. These seedling selections will not only produce nuts of desirable quality, but are also well adapted to the local climatic and soil conditions. Persian walnut is one of the most important nut crop grown in temperate region and produces edible nuts having higher nutritional value. In India there is no systematic orchards of walnut and trees of seedling origin are grown which exhibit wide intra specific diversity for tree, foliage, floral, nut and kernel characters. The variation provides better opportunity for selection of unique walnut tree (s). The multiplication of these elite trees through vegetative propagation will play an important role in broadening the genetic base of nut crops. unique walnut plant (Pusa Khor) is being evaluated at the ICAR-IARI Regional Station Shimla, Himachal Pradesh, India for its lateral bearing and cluster bearing habit.

MATERIALS AND METHODS

Survey of the walnut germplasm was carried out in different districts of Himachal Pradesh, India.

Out of the total population of seedling trees, Ten genotypes viz. Soghi Selection, Kullu Selection, Chamba Selection, Lahul & Spiti Selection, Kinnaur Selection, Kotkhai Selection, Shimla Selection, Rohru Selection, Jubbal Selection and Theog Selection were identified on the basis of nut and kernel characteristics and yield potential. Trees were selected after evaluation on the basis of regular fruit production according to interviews with orchard owners and observed phenotypic diversity. The selected trees were healthy, mature and had a full crop. Diverse horticultural practices, fertilizer application, irrigation and other cultural practices were applied at regular intervals each year.

Observations on various vegetative and nut characters were recorded following the standard guidelines (UPOV,1988). Thirty nuts were selected randomly from the tree after these were sun dried to edible stage. Fat content was estimated by the method as suggested by Folch *et al.* (1957).

Different characteristics were used to assess the range of variation among the accessions during two successive years (Table 1). Measurements of each nut and kernel trait were based on 30 replicates and the mean values were used. Some variables were measured by laboratory equipment. Nut dimensions (length and width) were measured using a digital Vernier caliper. The weight for nut and kernel was measured using electronic balance with 0.01 g precision. Also, some characteristics such as nut shape, kernel traits (filled, plumpness, shriveling and color), shell traits (color, seal, texture and hardness), kernel removal from nuts were determined based on rating.

RESULTS AND DISCUSSION

The nut characteristics of the walnut selections from different districts of Himachal Pradesh represented in Table 1. Nut size varied from 33.3mm to 57.1mm. Maximum recorded in Sel. 10 where as minimum exhibited in Sel-4. Moderate nut size recorded in Sel-5, Sel-6 and Sel-3. Dry nut weight ranged from 10.2g to 20.1g. Sel-10 recorded maximum followed by Sel-3(12.3g) where as minimum was observed in Sel-1. Kernel ratio (%) also varied 41.3 % in Sel-7 to 53.2% in

Sel-10 followed by Sel-3(51.1%).Fruit weight varied from 97.19g to 31.24g. Maximum Fruit weight recorded in Sel-10 where as minimum was exhibited in Sel-8.Moderate Fruit weight recorded in Sel-6,Sel-5,Sel-4 and Sel-3. Nut Shell Thickness (mm) ranged from 1.15mm to 1.39mm. Maximum recorded in Sel-6 and Sel-4 where as minimum in Sel-1 followed by Sel-3(1.20mm). Both Lateral and Terminal bearing habit recorded in Sel-3 only (Plate 2 and Plate 3). Also Cluster bearing habit observed in Sel-3 only (Plate-1).



Plate 1: Cluster Bearing habit in Sel-3



Plate 2: Lateral Bearing habit in Sel-3

A unique walnut plant is being evaluated at the IARI Regional Station, Shimla. It was collected from the Chamba region of Himachal Pradesh. This plant came into bearing in the second year of its grafting. The known varieties of walnut normally take 10 to 12 years to come into bearing. The fruit is borne in lateral position as well as terminally. Terminal bearing is associated with initiation of new growth early in the season which culminates in a mixed bud



Plate 3: Lateral Bearing habit in Sel-3

(with both floral and vegetative primordial). This is a characteristic of newly evolved early, good quality and heavy bearing walnut cultivars. However, no such cultivar is reported in India so far. The nut is thin shelled. Kernel colour is light yellow and good in taste. The oil per cent as well as shelling per cent recorded 55 and 50, respectively (Table 1). An ideal nut should weigh between 12-18 g has a clean, strong and thin shell with tight seal and easily removable light kernel, clean and plump kernel weighing at least 50 per cent of the in-shell-nut (McGranahan and Leslie,1990). According to Ramos *et al.* (1984) selection of clones that produce pistillate flowers on lateral buds has resulted in significant yield increases in Persian walnut, *Juglans regia*. Lateral bearing Persian walnut cultivars tend to be more precocious and are better suited to high yielding, high density plantings. Some eastern black walnut cultivars possess a characteristic known as lateral bud bearing (Sparks,1982). These cultivars produce pistillate flowers on a profusion of short, spur type branches distributed along main scaffold limbs. With this growth pattern, both leaves and nuts are born throughout the tree canopy resulting in increased yield potential (Reid, 1996). The heritability of the lateral bearing characteristic is unknown for black walnut but Hansche *et al.* (1972) found this trait to have a moderate level of heritability in Persian walnut. An ideal walnut cultivar must have late leafing, both terminal and lateral bearing, Cluster bearing, low incidence of pistillate flower abscission, high yielding nuts with large size, relatively smooth,

Table 1: Nut and Bearing characteristics of the walnut selections from Himachal Pradesh, India

No.	Selection	Nut Size Index(mm)	Dry Nut weight (g)	Kernel ratio (%)	Fruit wt. (g)	Nut Shell Thickness (mm)	Both Lateral and Terminal Bearing	Cluster Bearing
1	Sel-1	34.6	10.2	48.2	42.07	1.15	No	No
2	Sel-2	34.4	10.6	45.4	42.17	1.28	No	No
3	Sel-3	36.5	12.3	51.2	43.71	1.20	Yes	Yes
4	Sel-4	33.3	10.9	48.6	51.24	1.39	No	No
5	Sel-5	40.2	10.6	47.2	54.03	1.29	No	No
6	Sel-6	39.6	11.2	46.0	56.25	1.39	No	No
7	Sel-7	34.4	11.5	41.3	37.63	1.38	No	No
8	Sel-8	35.3	10.3	46.2	31.24	1.37	No	No
9	Sel-9	34.6	10.4	48.2	39.92	1.36	No	No
10	Sel-10	57.1	20.1	53.2	97.19	1.25	No	No

50% kernel recovery, plump and light colored kernel and at least moderately resistant to pest and diseases (Cosmulescu *et al.* 2010; Botu *et al.* 2010; McGranahan and Leslie 2012).

CONCLUSION

Several factors are important to consider when selecting a walnut cultivar including local climate and pest conditions. Walnut requires a period of winter chill to break dormancy and initiate leaf and flower production. Because pollination is required to set a crop, growers should select a cultivar with overlapping male and female flower maturity or, if a suitable pollen source is not nearby, plant a few trees of a pollinizer variety. Early leafing and flowering varieties are more exposed to spring rains that contribute to bacterial blight.

High development costs for establishing a walnut orchard demand the planting of cultivars that bear large crops at an early age. Cultivars displaying lateral bud fruitfulness generally come into production well in advance of non-lateral bearing cultivars. Shell thickness and structure are the most important determinant of percent kernel and nut crack-ability. The highest quality walnuts have a thin outer shell with no internal convolutions protruding into the nut meat. The inner shell partition between kernel halves should be very thin to allow easy removal of kernel pieces. An ideal walnut cultivar must have late leafing, both terminal and lateral bearing, Cluster bearing, low incidence of pistillate flower abscission, high yielding nuts

with large size, relatively smooth, 50% kernel recovery, plump and light colored kernel and at least moderately resistant to pest and diseases. The nuts of the tree collected by scientists of ICAR-IARI, Regional Station, Shimla from Chamba District of Himachal Pradesh, India appear to meet this standard.

References

- Botu, M., Tudor, M., Botu, I. Cosmulescu, S. And Papachatzis, A (2010): Evaluation of walnut cultivars in the conditions of the Oltenia's hill area regarding functioning potential. *Analele Universitatii din Craiova, Biologie, Horticultura, Tehnologia prelucrarii produselor agricole, Ingineriemediului* 15: 94-103.
- Cosmulescu, S., Botu, M. And Trandafir, I. (2010): Mineral composition and physical characteristics of walnut (*Juglans regia* L.) cultivars originating in Romania. *Selçuk Tarım ve Gıda Bilimleri Dergisi* 24(4): 33-37.
- Erturk, U., & Dalkilic, Z. (2011). Determination of genetic relationship among some walnut (*Juglans regia* L.) genotypes and their early-bearing progenies using RAPD markers. *Romanian Biotechnological Letters*, 16, 5944 -5952.
- FAO. (2013). *Statistical database*. Retrieved August 17, 2016, from <http://faostat.fao.org>
- Folch, J., Lees, M. and Stanley, S. 1957. A simple method for the isolation and purification of total lipids from animal tissues. *J. Biol. Chem.* 226:497-506.
- Hansche, P.E., V. Beres, and H.I. Forde. 1972. Estimates of quantitative generic properties of walnut and their implications for cultivar improvement. *J. Amer. Soc. Hort. Sci.* 97:279-285.

- Hartmann HT, Kester DE, Davies FT and Geneve RL. 2002. Plant propagation: principles and practices, 7th edn. Prentice Hall Inc., New Jersey.
- Lagerstedt HB. 1979. Propagation - Seed, grafting, budding. In: R.A. Jaynes (ed.). Nut Tree Culture in North America. Hamden, Connecticut.
- Leslie CA and Mcgranahan G. 1998. The origin of the walnut. In: D.E. Ramos (ed.). Walnut production manual. University of California, Division of Agricultural and Natural Resources, Publication 3373.
- Macdonald B. 1987. Practical woody plant propagation for nursery growers, Vol.1. Timber Press, Portland, Oregon.
- McGranahan GH, Forde HI (1985) Relationship between clone age and selection trait expression in mature walnuts. *J Am SocHorticSci* 110:692-696
- McGranahan,G and Leslie,C. 1990. Walnuts (*Juglans*) In: Genetic Resources of Temperate Fruits and Nut crops. *Acta Hort.* 290: 907-951.
- McGranahan GH, Leslie C (2012) Walnut. In: Badenes ML, Byrne DH (eds) Fruit breeding. Springer, New York
- Ozcan, M. M. (2009). Some nutritional characteristics of fruit and oil of walnut (*Juglans regia* L.) growing in Turkey. *Iranian Journal of Chemistry and Chemical Engineering*,28, 57-62.
- Özcan, M. M., İman, C., &Arslan, D. (2010). Physicochemical properties, fatty acid and mineral content of some walnuts (*Juglans regia* L.) types. *Agricultural Sciences*,01, 62-67.
- Polito VS. 1998. Floral biology: Flower structure, development and pollination. In: D.E. Ramos (ed.). Walnut production manual. University of California, Division of Agricultural and Natural Resources, Publication 3373.
- Qureshi AS and Dalal MA 1985. Status of nut crops in Jammu and Kashmir state. *Progressive Horticulture* 17: 197-205.
- Ramos. D.E. 1984. Walnut orchard management. Publication no. 21410. UC. Davis. 178pp.
- Reil WO, Leslie CA, Forde HI and Mckenna JR. 1998. Propagation. In: D.E. Ramos (ed.). Walnut production manual. University of California, Division of Agricultural and Natural Resources, Publication 3373.
- Reid,W. 1996. Evaluation and management of black walnuts for nut production. Knowledge for the future of black walnut- USDA General Technical Report NC-191, 211-216.
- Savage GP, Mcneil DL and Dutta PC. 2001. Some nutritional advantages of walnuts. *Acta Hort.* 544, 557-563.
- Sharma AK, Das B (2003) Genetic variation study on nut and kernel characters of walnut seedlings. *ProgHort.ic* 35:11-13
- Sparks,A. 1982. Lateral bearing black walnuts. Northern Nut Growers Association Annual Report. 73: 33-34.
- UPOV.1998. General Information: International Union for the Protection of New varieties of plants / JG/125/1 (Prog.). Geneva, Switzerland.