Journal of Agriculture and Veterinary Science
ISSN: 2959-1198 (Print), 2959-1201 (Online)

Research Article

Multilocation Adaptability Studies of Walnut for Assessing the Scope of Walnut Cultivation in Punjab

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Article History
Received: September 29, 2023
Accepted: November 12, 2023
Published: November 14, 2023

Abstract

The walnut plant (*Juglans regia*) is a resource for food, dermatocosmetic and phytotherapeutic products, is raw material in the wood industry and a source of biomass. Walnut is highly nutritious containing polyphenols, rich in fatty acids, tocopherols and essential mineral and amino acids. In the present study a multilocation trial of two varieties of walnut "Odum Murree Selection and "Hartley" were done. The trials were conducted at three different sites i-e Tret Murree, Sandhian Murree and Koroda Khushab. Differences in flowering time were observed between the sites with Khushab site having the earlier flowering due to warm temperature. In case of yield per tree Odum Murree selection proved to be superior than Hartley at all the studied sites. Regarding the varieties performance Odum Murree selection proved superior in terms of Nut Weight (10.88 g) and Kernel weight (7.04 g) as compared to values of Nut weight (8.16 g) and kernel weight (4.75 g) in case of Hartley. In terms of number of nuts per tree Odum Murree selection produced 55 % more nuts per tree than Hartley. It has been shown that the establishment of walnut orchard at different sites is sustainable and appropriate approach for capitalizing agricultural land potential and may have social and economic prospects in future.

Keywords: *Juglans regia*, Odum Murree, Phytotherapeutic, Walnut

Introduction

Walnut belongs to genus Juglans and Family Juglandaceae. Twenty one out of sixty species in Juglandaceae family belongs to genus Juglans. However, the two most

https://doi.org/10.55627/Javs.02.3.0341

prominent are *Juglans regia* and *Juglans nigra* L. due to their valuable wood and delicious kernel taste (Manning, 1978). Juglans regia or Persian walnut is ancient species originated in central Asia, Kyrgyzstan and western Himalayan Chain (Fjellstrom and Parfitt, 1995; Fernandez-Lopez *et al.*, 2000). China is largest producer of walnut with a production of 1100 thousand metric tons as of 2022 while Pakistan was the 18th largest producer of Walnut with Rs 15090 metric tons (Shahbandeh, 2022). In Pakistan Northern Pakistan Malakand division is famous for cultivation of Walnut since long time. This area is contributing about 82 % of total walnut production of country (MINFAL, 2000).

Walnut is economically and socially very important when it come to studying the ecological impact like atmospheric purification, air current tempering (wind) and cleaning of environment (Chenevard *et al.*, 1997; Gauthier and Jacobs, 2011). The walnut is vigorous in nature in terms of growth and may grow upto 30 m tall having thick skin and smooth bark having silvery grey colour. Walnut is characterized by strong branches, wide rich crown and 5-9 elliptical leaflets in leaves and possesses glabrous margins. It flowers in April-May. The male flowers cylindrical, multiflorus and grouped in male gametes that can be solitary or in form of pairs. The female flowers are sessile, purplish in colour and solitary. The fruit shape is spherical, single seed and two oil rich cotyledons. It multiplies by seed (McGranahan and Leslie, 1991; Cociu, 1983; Ţurcanu and Comănici, 2004; Popa *et al.*, 2023).

Walnut (*Juglans regia* L.) is widely popular nut tree popular throughout the world. The cultivated or domesticated walnut is also referred as white walnut, Persian walnut and common walnut. It belongs to family Juglandaceae and known as *J. regia*. The cultivation of walnut in Europe dates back to 1000 BC. At present, walnut is cultivated in Southern Europe, USA, northern Africa, Southern America and eastern Asia (Daura-Pich *et al.*, 2020; Taha and Al-wadaan, 2011). China is leading producer of walnut followed by USA, Iran, Turkey, Romania, France and India but Chile and Argentina are new entrants into this field (Martínez *et al.*, 2010).

It is heterogamous which means depending on cultivar it can be protandrous (male flowers mature first) or it show protogynous behavior (female flowers mature first). This dichomgamy phenomenon encourages cross pollination and thus production is primarily depends on wind pollination and bloom overlap. Nuts may show a single or cluster appearance with green fleshy husk outside which irregularly splits at maturity. Walnut prefers frost free site conditions with fertile well drained soils (Kerr, 1993; Ducci *et al.*, 1997; Pua and Davey, 2007).

The leaves of walnut since ancient times considered as remedy in form of alcoholic extracts. Tea and syrup for reducing blood glucose levels, treatment of diarrhea, cosmetic products and hair loss etc (Ahmad and Harwood, 1973; Bhargava and Westfall, 1968; Taha and Al-wadaan, 2011; Liao *et al.*, 2020). The walnut endocarp is rich source saturated fat (60 %), Protein (15 %), Fiber (2.4 %) and used as remedy for cough treatment, stomach infection, respiratory and urinary tract diseases (Rather *et al.*, 2012; Zhang *et al.*, 2009; Simsek *et al.*, 2017).

Walnut is cherished owing to its excellent taste, highly nutritional and medicinal importance. The walnut wood is used for high grade furniture making and is regarded as most profitable and valuable woods of the world. The common methods of propagating

https://doi.org/10.55627/Javs.02.3.0341

walnut include cleft and tongue grafting. In addition to that chip and patch budding are other methods used for propagation. The present study was designed to conduct a multilocation trial of two walnut accessions Odum Murree Selection and Hartley for their suitability for cultivation in Punjab.

Methodology

Site Selection

The experimental site consists of three locations: Tret and Sandhian in Murree and one in Korada Khushab.

Duration

The walnut trees 15 years of age were used in the study. The trials were conducted for three consecutive years from 2018-2020.

Varieties

Two Walnut varieties i-e Odum Murree Selection and Hartley were studied in the experiment.

Layout of the experiment

The experiment was conducted according to Randomized complete block design (RCBD). The experiment was divided into two different studies.

An experiment was designed to compare the two accessions at one location (Tret Murree). The parameters studied were Plant height (m), blooming period (days), maturity (Days), shell thickness (mm), Nut length (mm), Nut Weight (g), Nut Diameter (mm), Kernel weight (g), Kernel Percentage (%) and number of nuts per tree.

In the second studies these two varieties were checked for adaptability at three different locations i-e Tret Murree, Sandhian Murree and Korada Khushab. The parameters studied were Flowering Time, Flowering duration (day), Fruit weight (g) and yield per tree (kg). The data was collected from 2018-20. The results were pooled and presented.

Statistical analysis

The experiment was laid out in Randomized complete block design with three treatments and three replication and total nine plants per treatment. The data was analyzed using the Statistic Software and means were compared using LSD (Least Square Difference) test at probability level of 5% (Steel et al., 1997).

Results and Discussion

Performance comparison of Odum murree selection with Hartley (check variety) at Tret Murree

The experiment consists of comparison of two accessions of Walnut Odum Murree Selection and Hartley at Tret Murree during the year 2019-20. Researchers suggested that while evaluating new walnut accession, phenotypic characteristics are of prime importance. Traits like bud break date; lateral fruiting, blooming and harvest as well as nut weight (g), kernel weight (g) and percentage (%) have been identified as selection criteria (Manthos *et al.*, 2023).

It is clearly visible from Table 1 that Odum Murree Selection proved superior to Hartley in terms of plant height (m), early blooming and late maturity resulting in more nut length and diameter. In terms of kernel percentage and weight Odum Murree selection showed 43 % and 48 % increase respectively. Regarding the number of nuts per tree Odum produced 55 % more nuts than Hartley. Researchers found that kernel ration was

https://doi.org/10.55627/Javs.02.3.0341

around 40-60 % (Balci *et al.*, 2001) and 46-67 % (Baojun *et al.*, 2009) in walnut genotypes in Turkey. Yarilgac *et al.* (2001) reported a kernel percentage of 49-59 %. There is an increase of 55 % in number of nuts in Odum Murree selection as compared to the Hartley variety. According to Arzani *et al.* (2008) the most essential traits while accessing walnut genotype are kernel weight, nut weight, kernel percentage and easy removal of kernel halves.

Table 1: Performance comparison of Odum Murree selection with Hartley (check variety) in field.

Parameters Studied	Odum Murree Selection	Hartley (Check Variety)	% Increase or Decrease
Plant Height (m)	3.40 ± 0.149 a	3.17 ± 128 a	+ 13 %
Blooming Period	April , 2nd Week	April , 3rd Week	Early
Maturity	October, 2nd Week	October, Ist Week	Late
Shell Thickness	Thin	Thin	-
Nut Length (mm)	36.50 ± 1.49 a	29.71 ± 1.06 b	+ 22 %
Nut Diameter	32.25 ± 1.78 a	25.32 ± 0.57 b	+ 27 %
Nut Weight (g)	10.88 ± 0.63 a	8.16 + 0.44b	+ 33 %
Kernel Weight (g)	7.04 ± 0.66 a	4.75 ± 0.24 b	+ 48 %
Kernel Percentage	64.45 ± 2.63 a	44.81 ± 2.64 b	+ 43 %
Number of Nuts/Tree	211 ± 2.42 a	136 ± 2.23 b	+ 55 %

*Means sharing a different letter are significantly different at 5 % level of probability

Adaptability studies of walnut at three different locations

Adaptability studies were conducted by Hill fruit Research station Sunny Bank Murree at Tret Murree, Sandhian Murree and Korada Khushab (Table 2, 3 and Figure 1, 2).

Data regarding the flowering time shows that Odum Murree selection is early flowering in nature as compared to Hartley (Table 2). Moreover the flowering duration is more in case of Odum Murree selection (20 days) as compared to Hartley (17 days) (Table 3). The flowering in Odum Murree selection is almost one week earlier than Hartley. Moreover the flower duration is 15-20 % more in case of Odum Murree selection as compared to Hartley. The year to year variation in climatic condition may alter the number of days for flowering partiulcarly influencing the male flowers. (Mariana and Sina Niculina, 2017).

Table 2: Multi location flowering time data of walnut "Odum Murree selection" Vs "Hartley".

Location of Trial	2018		2019		2020	
	Odum	Hartley (Check Variety)	Odum	Hartley (Check Variety)	Odum	Hartley (Check Variety)
Tret Murree	April , 2nd Week	April , 3rd Week	April , 2nd Week	April , 3rd Week	April , 3rd Week	April , 4th Week
Sandhian Murree	April. Ist week	April , 2nd Week	March 4th Week	April Ist Week	April. Ist week	April , 2nd Week
Mian Farm Karoda Khushab	March. Ist week	March , 2nd Week	March. 2nd week	March , 3rd Week	March. 3rd week	March , 4th Week

As discussed earlier early flowering and more flower duration give Odum Murree selection increased growth period resulting in improved quality parameters like nut weight and yield (Table 3). Similarly regarding the yield Odum Murree selection

https://doi.org/10.55627/Javs.02.3.0341

performed better than Hartley at all the tree studied location. On an average Odum Murree selection has 14- 17 percent more yield as compared to Hartley. The nut production is largely dependent on climatic conditions especially at critical stages like pollination and fruit growth (Prentović *et al.*, 2014).

Figure 1. Pictorial view of different stages of walnut.

Figure 2. Walnut tree at Tret Murree.

Table 3: Performance Comparison of Odum Murree Selection with Hartley (Check Variety) at different location.

Location	Flowering Duration (Days)		Nut Weight (g)		Yield (kg/tree)	
	Odum	Hartley	Odum	Hartley	Odum	Hartley
Tret Murree	20.0 ± 0.58 a	17.0 ± 0.88 b	9.32 ± 0.36	7.6 ± 0.29	21.0 ± 0.36 a	18.4 ± 0.29 b
Sandhian Murree	19.2 ± 0.44 a	18.3 ± 0.73 b	9.2 ± 0.17 a	8.6 ± 0.12 b	20.5 ± 0.17 a	18 ± 0.12 b
Mian Farm Korada Khushab	19.0 ± 0.58 a	17.0 ± 0.58 b	9.5 ± 0.16 a	8.2 ± 0.16 b	20.5 ± 0.29 a	17.6 ± 0.41 b

*Means sharing a different letter are statistically different at 5 % level of probability

Arzani *et al.* (2008) observed variation values in weight of walnut, weight of kernel, shell thickness as 6.0-15.2 grams 2.6-9.1 grams and 0.4-1.44 mm. Researchers observed that fruit size and weight of shell directly decrease the percentage of kernel while kernel weight have found to increase the percentage of kernel (Bayazit, 2012). The findings of this study are in line with other researchers who found negative correlation between the shell thickness and kernel percentage of walnut (Eskandari *et al.*, 2004; Amiri *et al.*, 2010). Li *et al.* (2009) found that the strongest affect on walnut shell thickness occurred due to characteristics of genotype. Moreover, less shell thickness resulted in increases of percentage of kernel. The noticeable features affecting yield were fruit number per tree and the kernel percentage. It has been observed that kernel percentage showed negative correlation with fruit length and width, fruit weight, fruit height, thickness of shell. Shoot

https://doi.org/10.55627/Javs.02.3.0341

length and kernel weight while the volume of tree canopy and number of nuts per tree have positive influence on the kernel percentage (Bayazit, 2012).

The varieties showed better performance in terms of yield and nut quality. Walnut owing to its monoecious nature is highly cross pollinated therefore the progenies provide a better opportunity for selection of superior genotype as compared to their ancestors. The species indigenous to a existing environment possess stable genes, better quality fruit, more yield, disease and insect resistant and better cope with adverse environment as compared to exotic species (Khattak *et al.*, 2007). There is a vast potential for introduction of improved walnut varieties through selection and hybridization. Another approach can be replacing wild type with cultivated or grafting walnut with superior genotypes. This approach has been successfully practice in Turkey (Şen, 2011; Karadeniz and Şişman, 2015; Sameeullah and Karadeniz, 2017).

Conclusion

Breeding work on walnut tend to develop new genotype having high kernel percentage, thin shell and high yield. Based on the above observation it can be concluded that Odum Murree selection is the superior variety as compared to Hartley and can be adopted for cultivation at selected pockets in Punjab. The quality parameters like storage life and taste make it more suitable for cultivation. Odum Murree selection is early flowering, have extended flowering time and more nuts per tree making it superior as compared to check variety Hartley and provide the scope of cultivation in wide area. The integrated approaches should be followed to improve the production and yield of walnut in Pakistan. Training of research workers and progressive farmers involved in walnut improvement program and subsequently introduction and adaptability studies of walnut may be conducted.

Conflict of Interest

The authors have not declared any conflict of interest.

Authors Contributions

All the authors contributed equally in the manuscript.

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