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Research Article

Multilocation Adaptability Studies of Pecannut for Assessing the Scope of Pecanut Cultivation in Punjab

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Abstract

Pecans (*Carya illinoinensis*) belong to Juglandaceae family. It is large tree and may go upto the height of 20-30 meters and sometime upto 40 meters. The productivity period spread over the span of several hundred years producing nuts of great commercial value. Pecan is enriched source of fatty acid (mono and poly unsaturated) and bioactive substances attributing various health benefits. Several researchers have observed that fruit quality is affected by various Preharvest and postharvest factors. The main problem associated with pecans storage is lipid oxidation which may cause noticeable off-flavor. In the present study a multilocation trial of two varieties of Pecannut "DMA-2 and "DMA-1" were done. DMA-2 selection proved superior in terms of Nut Weight (9 g) and Kernel weight (5 g) as compared to values of Nut weight (5 g) and kernel weight (3 g) in case of DMA-1. In terms of number of nuts per tree DMA-2 selection produced 20 % more nuts per tree than DMA-1.

Keywords: *Adaptability; Kernel weight; Pecannut.*

Introduction

Pecans (*Carya illinoinensis*), a hickory species is native to northern Mexico and southern United states along Mississippi River region (Barstow, 2018). It has great socioeconomic importance and popular worldwide owing to its profitability (Ojeda-Barrios *et al.*, 2016). USA is top producer of pecans and along with Mexico it account for more than 90 % of total pecans produced in the world. The total production stands at 124000 metric tons in 2017-18 (Misachi, 2018). Pecans take almost ten years to develop into nut producing trees (Randall *et al.*, 2015). The productivity period spread over the span of several hundred

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years producing nuts of great commercial value. The pecan is large tree deciduous in nature, growing to height of 20-40 meters and a spread around 15-20 m and trunk diameter around 2 meters. The leaves are 30-45 cm long, alternate and pinnate (Randall *et al.*, 2015).

Nowadays, people focus on natural food consumption owing to increase in population per capita income and neutraceuticals effects of fruits. Among these foods, pecans due to its beneficial health effects, phenolic compounds and micronutrients help in reducing heart diseases risk. Pecan is enriched source of fatty acid (mono and poly unsaturated) and bioactive substances attributing various health benefits (Domínguez-Avila *et al.*, 2015). A regular consumption of nuts is related to various health benefits like shielding from oxidative stress, reducing bad cholesterol, and have anti-inflammatory, anticancer, and antidiabetic benefits (Eagappan and Sasikumar, 2014).

Fruit plants in contrast to annual crops require greater initial investment and give long term return. This is quite noticeable in case of pecans in which production starts between 4th to 10th years however full production potential is attained between 12th to 15th years after plantation (Wells, 2013). The pecan plant is monoecious, having male and female inflorescence on same plant however it possesses dichomgamy mechanism. Dichomgamy is mechanism developed by plant to prevent self-pollination which can result in endogamy producing smaller nuts and less kernel yield(Wood, 2009). It is recommended that in case of commercial orchard, about 15% of the plants must be of pollinator's nature (Wells, 2013).

Pecans need well drained fertile soils having good water holding capacity and organic matter facilitating the root system development (Call *et al.*, 2006; Wells, 2013). Pecans are sensitive to soils with poor drainage as it restricts their growth and development so these must be avoided when establishing commercial pecan orchards. Moreover such soils dues to lack of oxygen cause stress condition to the soil ultimately leading to productivity reduction and death. In addition to that they are also sensitive to saline soils (Grageda-Grageda *et al.*, 2011). Moreover adult pecan trees require proper light for optimal yield and quality (Ávila *et al.*, 2010). When crown of adjacent trees come near to each other, the light incidents for lower branches decreases resulting in low yield (Wood and Stahmann, 2004).

Several researchers have observed that fruit quality is affected by various Pre-harvest and postharvest factors. The main problem associated with pecans storage is lipid oxidation which may cause noticeable off-flavor (Siebeneichler *et al.*, 2022). Pecan does not tolerate humid soils for prolonged time period (Madero *et al.*, 2016). Pecan being perennial trees produces abundant crop in one season and being nutrient exhaustive it depletes nutrient storages resulting in reduction of new shoots production leading to low yield in following season (Orozco-Meléndez *et al.*, 2021) Recently, cultivation techniques (Luo *et al.*, 2016), quality of nut (Atanasov *et al.*, 2018) the plants fruits chemical constituents (Fernandes *et al.*, 2017) and utilization of components and fruits shells (Martínez-Casillas *et al.*, 2019) were studied to determine pecan economy. Pecan trees owing to their huge size require large areas for cultivation and extended growing periods (Zhang *et al.*, 2015). The present study was designed to conduct a multilocation trial of two PecanNut accessions DMA-2 and DMA-1 for their suitability for cultivation in Punjab.

Methodology

Site Selection

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The experimental site consists of three locations: Tret and Baglian in Murree and one in Sargodha.

Duration

The PecanNut 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 DMA-1 and DMA-2 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.

1. An experiment was designed to compare the two accessions at one location (Tret Murree). The parameters studied were Plant height (ft), blooming period (days), maturity (days), shell thickness (Atanasov *et al.*), Nut length (Atanasov *et al.*), Nut Weight (g), shell weight (g), Nut Diameter (Atanasov *et al.*), Kernel weight (g), Kernel Percentage (%) and number of nuts per tree
2. In the second studies these two varieties were checked for adaptability at three different locations i-e Tret Murree, Baglian Murree and 92-Morr Khushab. The parameters studied were Flowering Time, Flowering duration (day), Nut 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% (d Steel and Torrie, 1986).

Results and Discussion

Performance Comparison of DMA-2 with DMA-1 (Check Variety) at Tret Murree

The experiment consists of comparison of two accessions of DMA-2 and DMA-1 at Tret Murree during the year 2019-20. It is clearly visible from Table 1 that DMA-2 Selection proved superior to DMA-1 in terms of early and prolonged blooming resulting in more nut length and diameter. In terms of kernel percentage and weight DMA-2 selection showed 66 % and 21 % increase respectively (Table 1).

The weight of a Pecannut is an indicator pecan tree quality (Ojeda-Barrios *et al.*, 2021). There is an increase of 20 % in number of nuts in DMA-2 selection as compared to the DMA-1. The kernel percentage serves as important quality parameter, associated with the market price of pecans (Ojeda-Barrios *et al.*, 2016). Well formed and large kernel are desirable character demanded by consumers and it specific to pecan cultivars however orchard management practices also influence this character (Wells, 2017b; Madero *et al.*, 2016).

Table 1: Performance comparison of pecannut DMA-2 Selection with DMA-1 (check variety) in field.

Parameters Studied	DMA-2	DMA-1 (Check)	% Increase or decrease
Plant Height (ft)	28 b	32 a	-14 %
Blooming Period	End march to 2nd week of April	End march to Ist week of April	late

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Maturity	Oct-Nov	October-Nov	-
Shell Thickness	5.14 a	4.85 b	+ 5 %
Nut Length (Atanasov *et al.*)	33.33 b	40.29 a	-20 %
Nut Diameter	24.83 a	21.26 b	+ 11.3
Nut Weight (g)	9 a	8 b	+11.25
Kernel Weight (g)	5 a	3 b	66 %
Shell weight	4 b	5 a	+25 %
Kernel Percentage (%)	80 a	66 b	+ 21.21 %
Number of Nuts/Tree	1000 a	800 b	+ 20 %

The kernel yield or kernel percentage with respect to total nut weight is important criteria considered while choosing a cultivar. However, Intra cultivar variation may also affect the kernel percentage depending on use of different management practices (Wells, 2017b). Consumer acceptance of Pecannut quality is normally driven by interior quality, flavor and sometimes emotional responses. In this perception, pecan can bring economic investment and can provide medium term good income return as compared to traditional crops (Du *et al.*, 2022; Ferrara *et al.*, 2023).

Adaptability studies of pecannut at three different locations

Adaptability studies were conducted by Hill fruit Research station Sunny Bank Murree at Tret Murree, Baglian Murree and 92-Morr Jhang Road Sargodha (Table 2 and Figure 1, 2, 3).

Table 2: Multi location flowering time pecannut DMA-2 (candidate variety) Vs DMA-1 (Check variety).

Location of Trial	2019		2020		2021	
	DMA-2	DMA-1 (Check)	DMA-2	DMA-1 (Check)	DMA-2	DMA-1 (Check)
Tret Murree	Ist week of April	End march	Ist week of April	End march	Ist week of April	End march
Baglian New Murree	2nd week of April	Ist week of April	2nd week of April	Ist week of April	2nd week of April	Ist week of April
92- more Jhang Road Sargodha	End March	Mid March	End March	Mid March	End March	Mid March

Data regarding the flowering time shows that DMA-2 selection is early flowering in nature as compared to DMA-1 (Table 2). Moreover the flowering duration is more in case of DMA-2 as compared to DMA-1 (Figure 1). As discussed earlier early flowering and late maturity give DMA-2 increased growth period resulting in improved quality parameters like nut weight and yield (Figure 2 and 3).

The size and shape of kernel in pecan is largely influenced by factors like sunlight exposure, damage by rodents or insects and cultivar (Sparks, 1993; Prabhakar *et al.*, 2023). Breeder work is to identify causes of yield variation in given environment. A complex relationship chain is formed as components contributing to yield are interrelated. A positive relationship shows that selections done for improvement of variety will equally contribute to the variety yield traits like increase in kernel weight could increase the total yield per tree (Usha *et al.*, 2018).

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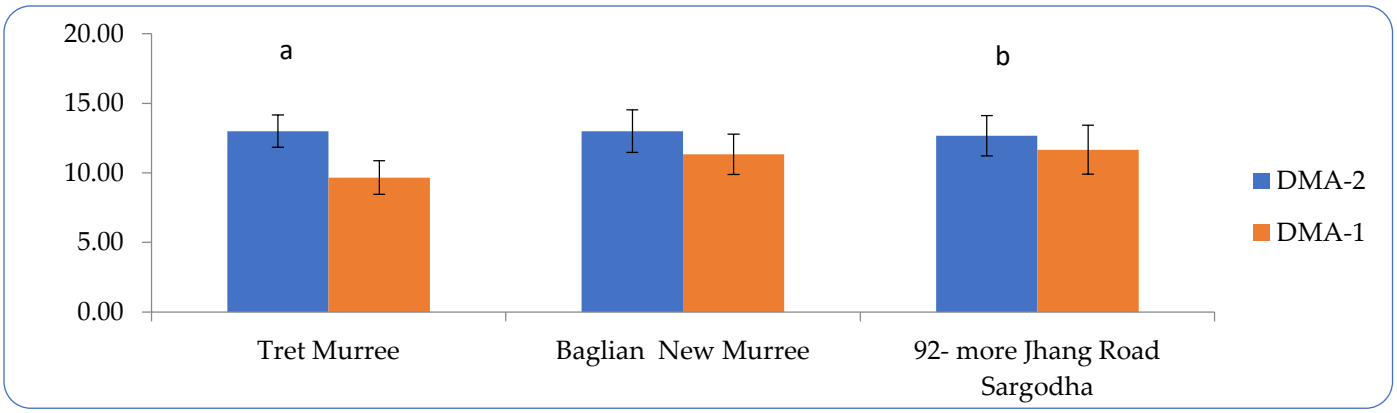

Figure 1: Multi Location Flowering Duration (Days) of Pecan nut DMA-2 (candidate variety) Vs DMA-1 (Check variety).

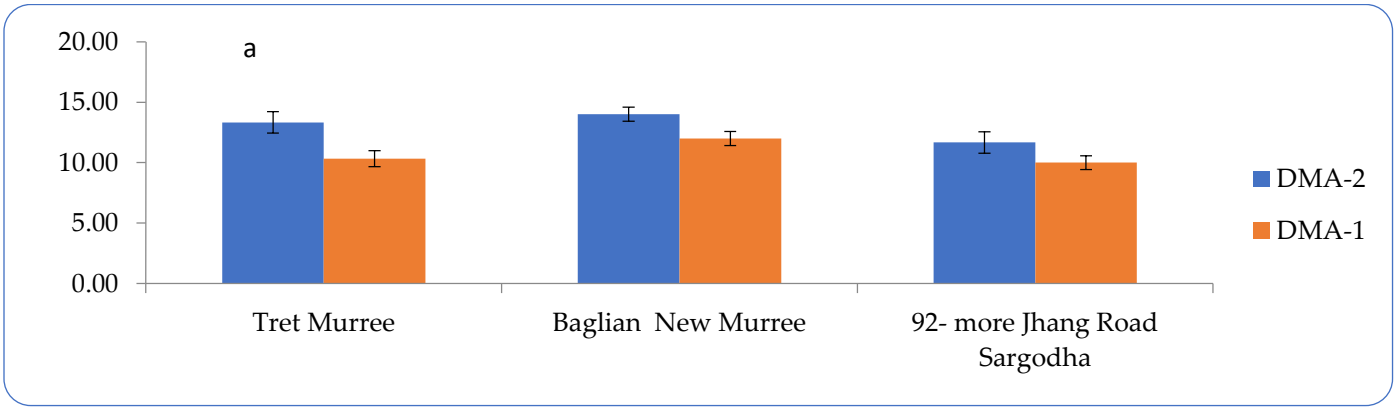

Figure 2: Multi Location Nut Weight (g) of Pecannut DMA-2(candidate variety) Vs DMA-1 (Check variety).

Figure 3: Multi location Yield/tree (kg) of Pecan nut DMA-2 (candidate variety) Vs DMA-1 (Check variety).

The yield of nut per tree showed significant and positive correlation with weight of kernel, diameter of nut , thickness of kernel , nut per cluster, cluster length, volume of nut and weight of shell and genotypic and phenotypic level. The association between these characteristics in desirable way may improve yield and quality. Similar finding are observed by (Ghasemi *et al.*, 2012), (Cosmulescu and Botu, 2012) and (Eskandari *et al.*, 2004) in case of walnut. (Thompson and Grauke, 2003) observed that shell thickness per nut volume proved to be good predictor of shelling performance though it showed variation over narrow range.

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Pecan Nut does not tolerate soils with excess humidity for prolonged period of time (Madero *et al.*, 2016) however, it is also sensitive to water deficiency, especially during the reproduction phase therefore enough water availability ensures productivity, increased nut size and quality (Wells, 2013; Ibraimo *et al.*, 2016; Madero *et al.*, 2016). Another aspect which is crucial for nut yield and quality is stage called kernel filling. When no irrigation is available, Almost half of the nuts are partially filled (Marco *et al.*, 2021). It is of prime importance that superior varieties should be selected through selection and hybridization and planted to get maximum benefits.

Conclusion

Based on the above observation it can be concluded that DMA-2 selection is the superior variety as compared to DMA-1 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. DMA-2 selection is early flowering, have extended flowering time and more nuts per tree making it superior as compared to check variety DMA-1 and provide the scope of cultivation in wide area. Pecan cultivation can serve a significant role in farmer's poverty alleviation especially of those belonging to hilly areas owing to its high demand, less postharvest losses and benefit of being cash crop.

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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