



Research Article

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Screening and Evaluation of Exotic and Indigenous Walnut Genotype and Varieties



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Abstract

A trail to investigate the “screening and evaluation of exotic and indigenous walnut genotype and varieties” was conducted at Agriculture Research Institute (ARI) Swat during 2015. Thirteen genotypes such as G-04, G-09, G-10, G-12, G-13, G-15, G-16, G-17, G-19, G-20, G-26, G-29, G-33 and varieties such as Paynee and Serr. The parameters studied were picking dates, nuts with husk weight, nuts fresh weight, dried nuts weight, kernel percentage, nuts size, kernel color, kernel test, fruit color, yield per plant, number of nuts per kg. Regarding genotypes (G-10, G-13, G-26 and G-33) were observed as early picking, (G-17, G-20, G-29) as mid picking and (G-04, G-09, G-12, G-15, G-16, G-19) as late picking. (G-15, G-16) showed light, (G-17) Amber, while (G-04, G-09, G-12, G-13, G-19, G-20, G-26, G-29, G-33) showed light Amber, and (G-10) was dark Amber in color. Very good, good and fair, kernel taste was noted in (G-19, G-20), (G-10, G-12, G-13, G-15, G-16, G-26, G-29, G-33) and (G-04, G-09, G-17) respectively. Maximum nut with husk weight (80.0g) fresh weight (29g) and dried weight (21.1g) was recorded in G-15.

On the other hand maximum kernel percentage (55%), number of nuts [1-3] per kg were recorded for G-13, and nuts size (1840.4mm²) for G-12, while yield (15.200kg) per plant was noted for G-10, whereas the minimum nut size (937.9mm²), nut fresh weight (11.5g) and nut dried weight (8.1g) was noted in G-13. Minimum number of nuts (50) per kg was recorded in G-15, minimum nut with husk weight was noted in G-4 (29.0g) and minimum yield (10.250kg) was recorded in G-12, while minimum kernel percentage (38%) was noted in G-15. In case of varieties Paynee and Serr were noted as late picking varieties having good kernel test with light and extra light kernel color. Maximum nut with husk weight (22.9g) fresh weight (17.3g) dried weight (12.8g) kernel percentage (50%) nut size (1356.6mm²) was observed in Serr. On the other hand Paynee showed maximum kernel percentage (54%), yield (15kg) per tree and number of nuts (105) per kg, whereas minimum number of nuts (101) per kg was observed in Serr.

Keywords: Germplasm; Walnut; Varieties; Genotypes

Introduction

Walnut belongs to the family *Juglandaceae* and genus *Juglans*. The family consists of about 60 species, 21 of which are placed in the genus *Juglans*. However, the most important among them are *Juglans regia* L and *Juglans nigra* L. [4] that are famous for their delicious kernel and valuable wood. Persian walnut (*Juglans regia* L) is an ancient species [5] originated in Central Asia, the West Himalayan chain and 4 Kyrgyzstan [6]. Walnuts are the most widely distributed of all nut species and have been appreciated by human beings since ancient times. It has been cultivated in southern Europe since 1000 BC [7]. Walnuts are growing in the Northern Pakistan since time immemorial and are one of the most important nut crops grown in Malakand division. Malakand division contributes about 82% of the total walnut production of

the country [8]. The walnut trees in Malakand division are mostly of seedling origin and exhibit considerable variability in nuts size, shape, shell thickness and color, quality and color of kernel and in other morphological attributes. There are no regular orchards of walnut in the area; however, significant numbers of trees are grown on marginal lands in diffused plantations and thus are a source of additional income of the farming community.

In Malakand division, due to the extensive local use of walnut bark and timber, the specie is being aggressively harvested. Swat valley is the best place for walnut production and account around 35 percent of the country's walnut population. In Swat walnut occupies 500ha out of the total 1,497ha. Mostly, Swat walnut is exported due to its high quality and demand. Kernels of good

quality have good price and there is especially a high demand for thin-shelled walnut (*Kaghzi akhrot*) in market [9]. Walnut has a number of medicinal and non-food uses. Traditionally, since time immemorial, walnut bark has been used for teeth cleaning and curing gum diseases. Walnut consists of mostly omega-3 and omega-6 polyunsaturated fatty acids, which are essential dietary fatty acids and helps in the prevention of coronary heart diseases [10]. Nut consumption is associated with a protective effect against coronary heart disease, partly due to its high antioxidant content [11].

Walnut husk yields valuable oil and yellowish dye when pressed. The oil is used in soaps, paints, and making dye. Walnut has high nutritional value. It is rich in proteins (14-24%), fats (52-70%) and vitamins; especially vitamins B group and E, while in minerals; K and Mg are worth mentioning. Important amino acids are glutamic acid, arginine and leucine. Taurine (2-amino ethyl sulfonic acid), an organic acid and a derivative of the sulfur-containing amino acid cystine is found in variable quantities between 0.2 and 0.6mg %. It is an important compound and involved in many functions; homeostatic regulation, thermoregulation, nervous conduction, protection against oxidative stress [12]. Walnut tree is medium to large with spreading crown. The leaf is compound consisting of 7-11 leaflets. Walnut tree is perennial, monoecious and mostly cross-pollinated. It shows high variability in both pomological and phenological traits. Male (catkins) and female (pistillate) flowers are borne on the same tree. Catkins are borne laterally on one-year old shoots while pistillate flowers borne terminally or laterally on current season's growth in spikes of typically 2-3 flowers (some times more than three).

It is heterogamous, either protoandrous (male flowers mature first) or protogynous (female flowers mature first) depending upon the cultivars. This dichogamy encourages cross pollination and thus production mainly depends on wind pollination and bloom overlap [13]. Nuts are borne singly or in clusters and a green, fleshy husk surrounds it, which splits irregularly at maturity. Walnut is extremely sensitive to site conditions and should only be planted on the most suitable frost free, fertile, well drained and deeply root able sites [14]. The wood of walnut is regarded to be as one of the most valuable woods in the world for high grade furniture [15]. Common methods of propagation are tongue, cleft and hypocotyle grafting. However, chip and patch budding can also be used as propagation methods.

There are up to 50 different genotypes of *Juglatis regia* cultivated in different areas of Pakistan that is in the KPK province including Malakand division (districts of Swat, Dir, Bunir, Chitral, Shangla and Malakand Agency), Kaghan (district Mansehra), in Gilgit-Baltistan province have a number of walnut clusters, and Leepa in Neelum valley and Muffazarabad in Azad Jammu & Kashmir Ali et al. [9] while Murree Hills in Punjab have sparse plantations. Approximately, 35,000 families cultivate walnut for their livelihood. This production is consumed locally

and also exported to some countries. Individual walnut trees are grown along boundaries of fields, channels, and backyards, etc. Mostly Pakistan seedlings are commercially grown, however some exotic cultivars have also been tried from time to time at research stations such as 'Chandler', 'Hartley', 'Lam', 'Germisara', 'lupanesti', 'Valerie', 'Odum', 'Sere' and 'Sulemani' [16] and many local selections like 'MS-1', 'MS-2', 'MS-18' from Malakand, 'SW-1', 'SW-3' from Swat, 'Dir-2' and 'Chitral-1', 'Chitral-2', 'Chitral-3', 'Kurram-1', 'Kurram-2', 'Kurram-3', 'Kurram-4' [17].

Good research work has been going on with characterization of 226 genotypes collected from various locations of Malakand [18]. Genotypes present in Dir, Chitral, Swat and Leepa (Neelum, AJ & K) are superior in various qualitative and quantitative traits to the adopted exotic varieties i.e., 'Serr' and 'Paynee'. Pakistan has a tremendous population of indigenous walnut germplasm, but multiplication by seeds give variation in the orchards. Therefore nursery men need to use vegetative means of propagation to provide true types plants with better production capability. Keeping in view the best agro climatic conditions of Swat for walnut production this study was designed to screen and evaluate indigenous walnut varieties in Agriculture Research Institute Mingora Swat to determine the fruit size, quality and yield of walnut [19-30].

Materials and Methods

The study of Screening and evaluation of exotic and indigenous walnut germ plasm was conducted at Agriculture Research Institute Mingora Swat during 2015. The focal objective was to identify high yielding genotypes in Agriculture Research Institute Mingora Swat for better fruit size, fruit quality and yield of walnut.

Experimental design

There were thirteen different genotypes and two varieties of walnut and each having two trees, thus sixty trees were cultivated in the field. The distance between plant to plant and row to row was 20x20 feet. Experiment was based on the following genotypes and varieties

Genotypes

G-04, G-09, G-10, G-12, G-13, G-15, G-16, G-17, G-19, G-20, G-26, G-29, G-33

Varieties

Paynee and Serr.

Result and Discussion

The research work on screening and evaluation of exotic and indigenous walnut germplasm was conducted at Agriculture research institute Mingora swat during 2015. Data recorded the following parameter are presented in Table 1-10, while the original replicated data is placed in Table 1a-10a. The result are briefly describe as under:

Picking date

Frequency distribution analysis of picking dates is presented in Table 1 while the original data is presented in Table 1a.

Table 1: Frequency distribution analysis of thirteen walnut genotypes and varieties based on picking date.

Picking date	Frequency	Percentage
Early picking (01 th -09 th September)	4	26.66%
Mid picking (10 th -18 th September)	3	20%
Late picking (19 th -27 th September)	8	53.33%

Table 1a: Original data for picking dates of different genotypes and varieties.

Genotype/Variety	Picking Date
PAYNEE	25-sep-2015
SERR	20-sep-2015
G-04	21-sep-2015
G-09	21-sep-2015
G-10	03-sep-2015
G-12	24-sep-2015
G-13	07-sep-2015
G-15	21-sep-2015
G-16	21-sep-2015
G-17	15-sep-2015
G-19	22-sep-2015
G-20	14-sep-2015
G-26	07-sep-2015
G-29	17-sep-2015
G-33	01sep-2015

Data for genotype and varieties showed that out of thirteen walnut genotypes and two varieties 26.66% (G-10, G-13, G-26, G-33) were the early picking (1st-9th Sept) followed by 20% (G-17, G-20, G-29) as the mid picking (10th-18th Sept) while 53.33% (Paynee, Serr, G-04, G-09, G-12, G-15, G16, G19), where the late picking (19th -27th Sept) genotype and varieties. (G-33) was the early picking (01th-09th Sept) genotype while paynee the late picking (27th Sept) genotype and variety.

With husk weight (g)

Frequency distribution of nut with husk weight is presented in Table 2 while the original data is present in Table 2a.

Table 2: Frequency distribution analysis of thirteen walnut genotypes and two varieties for nut with husk weight (g).

Nut With Husk Weight (G)	Frequency	Percentage
(22.9-41.9)	5	33.33%
(42.0-61.0)	6	40%
(61.1-80.0)	4	26.66%

Table 2a: Original data for nut with husk weight (g) of different genotypes and varieties.

Genotype/variety	Nuts with husk weight(g)
PAYNEE	38.3
SERR	22.9
G-04	29.0
G-09	58.2
G-10	52.0
G-12	56.6
G-13	29.5
G-15	80.0
G-16	60.5
G-17	68.0
G-19	34.2
G-20	80.0
G-26	66.0
G-29	59.0
G-33	53.0

Data showed that out of thirteen walnut genotypes and two varieties 33.33% (Paynee, Serr, G-04, G-13,G-19) ranged between 22.9-41.9(g) nut with husk weight, followed by 40% (G-09,G-10,G-12,G-16,G-29,G-33) ranged between 42-61(g), while 26.66% (G-15, G-17, G-20, G-26) ranged between 61.1-80.0(g) Maximum nut with husk weight was shown by G-20 and G-15 (80.0g), while the minimum was noted in Serr (22.9g).

Nut fresh weight (g)

Table 3: Frequency distribution analysis of thirteen walnut genotypes and two varieties for nut fresh weight (g).

Nut Fresh Weight (G)	Frequency	Percentage
(11.5-17.3)	4	26.66%
(17.4-23.2)	8	53.33%
(23.3-29.1)	3	20.00%

Frequency distribution analysis of nut fresh weight is presented in Table 3 while the original data is presented in Table 3a. Data of nut fresh weight showed that out of total thirteen walnut genotypes and two varieties 26.66% (Paynee, Serr, G-04, G-13) ranged between 11.5-17.3(g) followed by 53.33% (G-9, G-10, G-12, G-16, G-17, G-19, G-29, G-33) ranged between 17.4-23.2(g) while 20% (G-15,G-20,G-26) ranged between 23.3-29.1(g). Maximum nut fresh weight was showed by G-15 (29g), while the minimum was noted in G-13(11.5g).

Table 3a: Original data for nut fresh weight (g) of different genotypes and varieties.

Genotype/Variety	Nut Fresh Weight(G)
PAYNEE	16
SERR	17
G-04	13.5
G-09	22.3
G-10	20.5
G-12	20.6
G-13	11.5
G-15	29
G-16	20.5
G-17	22
-G-19	18.7
G-20	23.5
G-26	26
G-29	23
G-33	20.5

Dried nut weight (g)

Frequency distribution analysis of dried nut weight is presented in Table 4 while the original data is presented in Table 4a.

Table 4: Frequency distribution analysis of thirteen walnut genotypes and two varieties for dried nut weight (g).

Dried Nut Weight (G)	Frequency	Percentage
(8.1-12.43)	5	33.33%
(12.5-16.83)	9	60%
(16.9-21.23)	1	6.66%

Table 4a: Original data for dried nut weight (g) of different genotypes and varieties.

Genotype/Variety	Dried Nut Weight(G)
PAYNEE	10
SERR	12.8
G-04	10.1
G-09	14.2
G-10	11.3
G-12	15.2
G-13	8.1
G-15	21.1
G-16	13.4
G-17	14
G-19	11.7
G-20	14.5
G-26	16.8
G-29	13.3
G-33	15.2

Data pertaining dried nut weight of Genotypes and varieties showed that out of thirteen genotypes and two varieties of walnut 33.33 % (Paynee, G-04,G-10,G-13, G-19) range between 8.1-12.43 (g) 60% followed by (Serr, G-09, G-12, G-16, G-17, G-20, G-26, G-29 G-33) range between 12.5-16.83 (g) while 6.66%(G-15) ranged between 16.9-21.23(g). Maximum dried nut weight was shown by G-15 (21.1g), while the minimum was noted in G-13 (8.1g).

Kernel percentage

Frequency distribution analysis regarding Kernel percentage of kernel presented in Table 5 while the original data is presented in Table 5a.

Table 5: Frequency distribution analysis of thirteen walnut genotypes and two varieties for kernel percentage.

Kernel percentage	Frequency	Percentage
(38-43.6)	3	20%
(43.7-49.3)	5	33.33%
(49.4-55)	7	46.66%

Table 5a: Original data for kernel percentage of different genotypes and varieties.

Genotype/Variety	Kernel Percentage
PAYNEE	54
SERR	50
G-04	48
G-09	51
G-10	54
G-12	51
G-13	43
G-15	38
G-16	55
G-17	47
G-19	46
G-20	46
G-26	49
G-29	53
G-33	43

Data regarding kernel percentage of the genotypes and varieties revealed that out of total thirteen genotypes and two varieties of walnut 20% (G-13, G-15, G-33) had a kernel percentage in the range of 38-43.6, 33.33% (G-04, G-17, G-19, G-20, G-26) were noted with a kernel percentage of 43.7-49.3 while 33.33% (Paynee, Serr, G-09, G-10, G-12, G-16, G-29) ranged between 49.4-55. Maximum kernel percentage was shown by G-16 (55) and Paynee, while minimum was noted in G-15 (38%).

Nut size: (m)

The nut size frequency distribution analysis is presented in Table 6 while the original data is presented in Table 6a.

Table 6: Frequency distribution analysis of thirteen walnut genotypes and two varieties for nut size (mm²).

Nut Size(mm ²)	Frequency	Percentage
(937.9-1238.7)	4	26.6%
(1239-1539.8)	5	33.3%
(1540-1840.8)	6	40%

Table 6a: Original data for nut size of different genotypes and varieties.

Genotype/variety	Nut size (mm ²)
PAYNEE	1109.8
SERR	1326.2
G-04	961.3
G-09	1459.6
G-10	1692
G-12	1840.4
G-13	937.9
G-15	1480.9
G-16	1505.6
G-17	1663.6
G-19	1237.0
G-20	1668.7
G-26	1797.0
G-29	1631.0
G-33	1316.5

Data regarding nut size of revealed that out of total thirteen genotypes and two varieties of walnut (26.6%), (Paynee, G-04, G-13, G-19) ranged between 937.9-1238.7mm² followed by 33.33% (Serr, G-9, G-15, G-16, G-33) ranged between 1239-1539.8 mm² while 40% (G-10, G-12, G-17, G-20, G-26 and G-29) had a nut size of 1540-1840.8 mm². The maximum nut size was recorded in G-12 (1840.4 mm²) while the minimum nut size was noted in G-13 (937.9 mm²).

Kernel color

Frequency distribution analysis of kernel color is presented in Table 7, while the original data is presented in Table 7a.

Table 7: Frequency distribution analysis of thirteen walnut genotypes and two varieties for kernel color.

Kernel Color	Frequency	Percentage
Light	3	20%
Extra light	1	6.6%
Amber	1	6.6%
Light Amber	9	60%
Dark Amber	1	60%

Table 7a: Original data for Kernel color of different genotypes and varieties.

Genotype/Variety	Kernel Color
PAYNEE	Light
SERR	Extra light
G-04	Light amber
G-09	Light amber
G-10	Dark amber
G-12	Light amber
G-13	Light amber
G-15	Light
G-16	Light
G-17	Amber
G-19	Light amber
G-20	Light amber
G-26	Light amber
G-29	Light amber
G-33	Light amber

Data showed that out of total thirteen walnut genotype and two varieties 20%. (Paynee, G-15, G-16) had light color, followed by 6.6% (Serr) as extra light color while 6.6% (G-17) showed amber color. 60% (G-4, G-9, G-12, G-13, G-19, G-20, G-26, G-29 and G-33) were light amber and 6.6% (G-10) was recorded as dark amber kernel color.

Kernel taste

Kernel taste frequency distribution analysis is presented in Table 8, while the original data is presented in Table-8a.

Table 8: Frequency distribution analysis of thirteen walnut genotypes and two varieties for kernel taste.

Kernel Taste	Frequency	Percentage
Very Good	2	13.3%
Good	10	66.6%
Fair	3	20%

Table 8a: Original data for kernel taste of different genotypes and varieties.

Genotypes/Varieties	Kernel Taste
PAYNEE	Good
SERR	Good
G-04	Fair
G-09	Fair
G-10	Good
G-12	Good
G-13	Good
G-15	Good
G-16	Good
G-17	Fair

G-19	Very Good
G-20	Very Good
G-26	Good
G-29	Good
G-33	Good

Data shows that out of thirteen genotypes and two varieties of walnut 13.3% (G-19, G-20) showed very good kernel taste followed by 66.6% (Paynee, Serr, G-10, G-12, G-13, G-15, G-16, G-26, G-29, G-33) as good kernel taste was observed, while in 20% (G-09, G-04, and G-17) showed fair kernel taste.

Yield per plant (kg)

Frequency distribution analysis of yield potential per plant is presented in Table 9, while the original data is presented in Table 9a.

Table 9: Frequency distribution analysis of thirteen walnut genotypes and two varieties for yield per plant (kg).

Yield Per Plant (Kg)	Frequency	Percentage
(10.250-12)	10	66.6%
(12.1-13.85)	2	13.33%
(14-15.75)	3	20%

Table 9a: Original data for Yield per plant (kg) of different genotypes and varieties.

Genotypes/varieties	Yield per plant (kg)
PAYNEE	15
SERR	10.360
G-04	15.500
G-09	13.5
G-10	15.200
G-12	10.250
G-13	12.5
G-15	10.600
G-16	10.400
G-17	12.250
G-19	10.300
G-20	11
G-26	11
G-29	11.700
G-33	11

Data regarding yield potential per plant revealed that out of thirteen genotypes and two varieties of walnuts 66.6% (Serr, G-12, G-15, G-16, G-17, G-19, G-20, G-26, G-29, G-33) gives 10.250-12kg yield per plant, followed by 13.33% (G-09, G-12) as having yield, ranged between 12.1-13.85kg per plant, while 20% (Paynee, G-04, G-10) produces 14-15.75kg yield per plant. Maximum yield 15.200 was recorded the minimum is 10.250 was recorded in G-12.

Number of nuts per kg

Number of nuts per kg frequency distribution analysis is presented in Table 10, while the original data is presented in Table 10a.

Table 10: Frequency distribution analysis of thirteen walnut genotypes and two varieties for number of nuts per (kg).

Number of nuts per (kg)	Frequency	Percentage
(50-74.33)	8	53.3%
(75-99.33)	4	26.6%
(100-124.33)	3	20%

Table 10a: Original data for number of nuts per kg of different genotypes and varieties.

Genotypes/varieties	Number of nuts per kg
PAYNEE	105
SERR	101
G-04	93
G-09	76
G-10	89
G-12	73
G-13	123
G-15	50
G-16	72
G-17	66
G-19	83
G-20	53
G-26	63
G-29	70
G-33	66

Data for number of nuts per kg revealed that in thirteen genotypes and two varieties of walnut 53.3% (G-12, G-15, G-16, G-17, G-20, G-26, G-29, G-33) ranged between 50 -74.33 nuts per kg followed by 26.6% (G-04, G-09, G-10, G-19) having 75-99.33 nuts per kg, while 20% (Paynee, Serr, G-13) had 100 -124.33 nuts per kg. The maximum nuts per kg was recorded in G-13 is 123 while the minimum nuts per kg was recorded in G-15 is 50.

Conclusion and Recommendations

Based on the above observation following conclusion are made. For G-04 gave maximum yield per tree, G-15 nut with husk weight, nut fresh weight and dried nut weight while G-16 have high kernel percentage, number of nuts per kg was recorded in G-13. In case of varieties maximum yield per tree, kernel percentage and number of nuts per kg was recorded in Paynee, while maximum nut size, nut with husk weight, nut fresh weight and dried nut weigh was noted in variety Serr. Based on the above conclusion, the following recommendations are made.

For maximum yield per tree G-04, number of nuts per kg G-13 and maximum nuts size G-12 is recommended. For better yield, maximum number of nuts per kg Paynee variety is recommended, whereas for maximum nut size variety Serr is recommended.

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