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Characterization of walnut seedling selection on the bases of non-metric characters

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Abstract
Seedling selections based on non-metric characters after catogerization of 90 walnut seedlings evaluated at two districts, Solan and Sirmour (H.P), revealed substantial variation for selection of better types to add to the prevailing walnut diversity. The entire seedling population at the studied sties, Jauna Ji and Dharo ki Dhar (Solan) and Wasni (Sirmour) were characterized in three different girth classes (C-I, C-II, C-III). For brevity the districts were represented as So (Solan) and Si (Sirmour). The non-metric traits recorded are highlighted, plant growth was usually either erect or semi- erect with varying number and percentage, both dominated spreading growth habit. Leaf and leaflet shape was mostly elliptic or broad elliptic in most genotypes at both the sides. Among the entire population narrow leaf apex dominated oblong shape. Leaf colour was predominately green least was dark green. Shoot pubescence was slightly glabrous/ glabrous few were pubescent, most frequent shoot colour was green brown in most seedlings at both sides. Among the nut features broad elliptical and ovate outscored other shapes studied. Nut base was rounded in nature least observed was cuneate type. Trait pistil point prominence was categorized, position of pad on suture varied usually was evident on upper half of the nut. Shell surface was moderately smooth, least possessed rough surface, adherence of two halves and shell strength were intermediate type. Commercially important features- kernel colour was mostly amber very few had extra light colour. After tasting kernel flavor was rated as satisfactory. Plumpness was moderate was most seedlings with no shrivelage, kernel removal was moderate. These characters were highly significant to select desirable types.

Keywords: Characterization, Walnut, Non metric, Selection

Introduction
Among nut fruit crops, walnut cultivation has been rated as one of the best material for diversifying fruit due to high adaptability especially to both soil and agroecological conditions. Nut has been in cultivation from very an ancient time. Paleontology studies have shown that crop was grown in abundance vast regions extending from Carpathian Mountains in Eastern Europe, across Turkey, Iraq, Iran, Afghanistan and southern USSR to north western Himalayas. Name Persian walnut is most appropriate, reflects place of origin, multipurpose crop, kernel is a rich source of proteins (15-20%), fats (60-75%), good quantum of carbohydrates, phosphoric acid and vitamins, consumed fresh or in confectionery, bakery, yield high valuable edible oil. Its timber is suitable for high class carving, furniture, making of gun butts, bark has medicinal value, nut husk for dying etc.
Crop is extensively grown in Jammu and Kashmir, Himachal Pradesh, Uttarakhand and Arunachal Pradesh are of seedling origin through number of exploration in the Himalayan region has resulted in identification and isolation of several promising types and has formed the genetic base of germplasm which has been used to extend its cultivation in several suitable places. The total area under walnut in India is about 109 thousand hectare with annual production of 300 thousand MT (NHB 2017-2018). Jammu and Kashmir is the leader in walnut production as climatic condition suits its cultivation followed by Uttarakhand, Himachal Pradesh and Arunachal Pradesh.
The present investigation to select and characterize superior seedling genotypes Solan and Sirmour with objective to characterize selected type for growth flower and nut characters, establish a database of selected types and to develop appropriate descriptor of selected types.

Material and method
Seedling selections of trees was made from natural population from Solan and Sirmour districts. Through personal interaction with the owners of 150 walnut trees 90 were finally selected on the bases of their previous record as indicated by the owners for study purpose. At each location non metric data was recorded 45 seedling trees. In all 48 characters pertaining to

foliage, nut and kernel characters. For recording of data UPOV (1988) [33] guidelines was followed for various foliage, nut and kernel characters.

Review of literature

Foliage character

Walnut seedling and cultivars have shown marked degree of variation in pomological characters, juvenile period being long care be taken to evaluate types which are in flowering and fruiting to ensure stability of the phenotypic traits. English walnut cultivars were systematically analyzed in southern Italy, observed variation in trunk girth which was maximum in cv. Tehma and ranged from 3.80 to 47.54 m^2 while studying variability in walnut recorded plants which were several centuries old originated as seedling trees, with huge girth of 11m. and height of more than 45 meters.

Barone *et al*., (1990) [3], Peter (1990) [22] and Dewan *et al.* (1992) [7] systematically analyzed morphological features found remarkable variation in seedling and hybrid population. Lansari *et al*. (2001) [19] identified better performing types to widen the genetic base of collections resulted in 55 seedlings with significant variability in shoot length and diameter.

According to evaluation work on seedling walnut population (Sharma and Sharma 2000a) [26], observed significant variation in trunk girth based on varying age of the trees. Joolka *et al*. (2005) [14] identified twenty superior strains. Solar and Stamper (2006) [30] through extensive evaluation work on 1215 seedlings trees identified selection 'Z-62' for its erect growth, 'C-6/7' with very spreading growth. Eskandari *et al*. (2006) [8] after surveyed 81 different walnut orchards from different places found variation in morphological and nut characters. Bayazit *et al.* (2009) [4] and Gandev, (2011) [9]. through evaluation observed comparative study of nut and tree a characters of different species and interspecific hybrids recorded high vigorous growth in *J. regia* (avg. 5.05 m) and less than 37 percent less than of Paradox (Mosivand *et al*., 2013) [20].

Nut and kernel character

Nut and kernel characters determine quality of produce most are, quantitative in nature affected by prevailing environmental conditions where they growing over years. Most evaluation studies on above parameters revolve around nut width, nut height and thickness of pad suture, kernel characters, average kernel weight, its percentage are of prime economic importance both for local and international market. From various studies nut features indicated variation from very thin to thick kernel like 'Sunland'. Further good kernel fill easily removed from cavity, light and loose in the endocarp extracted intact from the nuts.

In a selection from Kinnaur district (Himachal Pradesh) nut weight was 15.5 g rated very highly differed from commercial types 'Wilson Wonder' and Kashmir budded. Shell thickness ranged from 0.8- 4.3 mm with 4.33, kernel percentage. (highest) but less than Chinese selection (80.0%). In seedling '16' shell was very thin as observed by Chauhan and Sharma, (1979) [5] in genetic material from Kinnaur. Tamponi *et al.* (1997) [31] and Zhang and Zhang (1997) [35] identified noticeable variation in nut size, weight, shell thickness hardiness and productive nature, shelling percentage all showed substantial variation provided a platform for selection of desired genotypes.

Sharma and Sharma (2000a b) [26] through non hierarchial Euclidean cluster analysis from four districts of Himachal Pradesh, recorded high variation for nut and kernel characters. Further from 342 trees, 57 were identified as regular bearer with better nut and kernel features (Sharma and Sharma, 2005) [28]. Joolka *et al.* (2005) [14] also recorded variation in nut and kernel characters and selected 10 superior types of which 4-5 recommended as cultivation.

According to Kong *et al.* (2008) [18] in ' Xiangling' and Luguo-2 a new cultivar bred by Zhang *et al.* (2008) [36], from their evaluation studies isolated genotypes with vigour nuts that ranged from 10.1- 14.5 g. Guo *et al.* (2009) [12] developed early maturity cv. Longman-15 at Longman area of Gansu province, nut matured in late August, large sized, weight as 16.8g, shell smooth, thickness 1.3 mm, kernel easily shelled as whole or semi-whole. Ghasemi *et al*. (2012) [10], Cosmulescu (2013) [6] and Attar *et al.* (2014) [2] screened Persian walnut trees from different places selected superior genotypes/cultivars from indigenous types. Keles *et al.* (2014) [16], Shamlu *et al.* (2018) [25] and Khadivi *et al.* (2019) [17] recorded remarkable variation from Inner Anatolia, Azadsashar and Markazi province, identified genotypes superior to control for nut and kernel features.

Result and discussion

To accomplish the referred objectives 48 characters pertaining to plant, foliage flowering, nut and kernel characters were recorded. On the bases of non-metric characters of nut and kernel traits are highlighted in Table (1-16) and are briefly described as per UPOV guidelines *(Solan distt- So, Sirmour distt- Si).

Foliage characters

Growth habit: Variation observed under Jaunaji and Dharo ki Dhar in district Solan (So). (Table 1, 9), growth habit was either erect or semi erect in 18 plant each from 45 selected seedling (40.0%), spreading growth habit was least in nine plants (20.0%). At Wasni (Si) growth habit was characterized as erect, semi erect and spreading, with frequency of 11, 20 and 14 in sequence, semi erect character dominated other categories.

Shape of leaf: Most frequent shape observed was broad elliptic (19/45 out of 45 plants) with of 42.0 and 22.2 per cent (narrow elliptic) least shape was seen in 10 plants (So), whereas shape was of two types elliptic (28, 62.2%) and broad elliptic (17, 37.8%) was recorded in Si seedling (Table 1, 9).

Shape of leaflets: In the present study leaflet shape (Table 1, 9) was elliptic followed by broad elliptic 19/45 (42.20%), least was narrow elliptic (11/45, 24.4%) in So seedlings, whereas it was either narrow elliptic, elliptic or broad elliptic in 14, 23 and 8 in Si seedlings, elliptic (51.1%) followed by narrow elliptic (31.1%) registered higher percentage, least was broad elliptic (17.7%).

Shape of leaf apex: Character ranged from narrow to oblong (So), highest was narrow leaf apex, 38/45 (84.5%), oblong apex was only in seven plants (15.5%). Si seedlings depicted narrow and oblong shape with frequency of 32 and 13 plants (Table 2, 10). Maximum was of narrow leaf apex (71.1%).

Leaf colour: Trait (Table 2, 10) varied from light green to dark green (So). Green color (137 AB) was dominant in 23 plants (51.1%), least was dark green (7/ 45 plants) with overall percentage of 15.6. Light green colour was observed in 15 plants. Seedlings (Si) depicted light green, green, dark

green in 11, 28 and 6 trees. Green colour (137AB) was commonly, light green, dark green was least observed (6/45 trees)

Rachis colour: was either green, yellow or red, green and yellow colour was significant present in 40 and 5 trees, red rachis colour was not seen in any So seedling (Table 2, 10). In Si seedlings green and yellow colour was dominant in 34 and 11 plants (75.6, 24.4%).

Shoot pubescence: Shoots were either glabrous, slightly glabrous or pubescent. Maximum was slightly glabrous pubescence (20), glabrous (19) and least (6) as pubescent (So). In Si seedlings glabrous was maximum (24/45), slightly glabrous (14/ 45) and least pubescent (7/45) with 53.3, 31.11 and 15.5 percentage (Table 3, 11).

Shoot colour: Ranged as green brown, pale brown or blackish, 41, 2, 2 in So trees (Table 3, 11), dominant colour was green brown (91.11%) and least was pale brown and blackish (4.44% each). In Si seedling, green brown colour was most frequent (82.2%), least was blackish (6.7%).

Nut and kernel characters

Nut shape was either (longitudinal of suture and cross section perpendicular in suture) circular, trapezoid, ovate, elliptic, triangular, broad elliptic, ovate and cordate. In the present study broad elliptic, ovate, circular broad ovate was seen in 17, 11, 7, 10 trees, shape in section perpendicular to suture was in 7, 15, 13 and 10 trees, base perpendicular to suture was either truncate, rounded or cuneate in 16, 20 and 9 trees with average of 35.6, 44.4 and 20.0 per cent (Table 4, 12). Rounded base was most frequent (So). Under the present study nut shape (longitudinal selection through suture) was broad elliptic, ovate, circular, broad ovate in 22, 8, 12, 3 trees (Si), when trait was seen in cross section perpendicular to suture was 15, 10, 11 and 9 trees in sequence (Table 4, 12). Under both cases broad elliptical nut shape was highest (48.9, 33.3%). Nut base shape (perpendicular of suture) was truncate, rounded and cuneate in 12, 20, 13 seedling trees, round base was observed as highest (44.4%), cuneate in (28.9%) and lowest as truncate (26.7%).

Apex shape perpendicular to suture matched with the above character (So), additional shape was obtuse, emarginated in 8, 13, 18 and 6 trees. Maximum, obtuse in 18 trees (40%), rounded, 13 trees (28.9%), least emarginated in 6 trees (13.3%). Provenance of pistil point was short, medium or long, maximum as medium in 22, short in 14, long in 9 trees. Position of suture was on upper half, on upper 2/3 or on whole length was in 25, 16 and 4 trees (Table 5, 13).

Same apex shape as recorded for So was recorded for Si seedlings i.e., truncate, rounded, obtuse and emerginate in 8, 14, 14, 9 trees (Table 5, 13). Round and obtuse shape appeared frequent with percentage of (31.1% each), truncate shape was least (17.8%). Prominence of pistil point varied as short, medium and long with frequency of 14, 21, 10 trees. Medium pistil provenance registered highest (46.7%). Position of pad on suture (as for So) was in 23, 15, 7 tree. Pad suture on upper half registered highest percentage (51.1%).

Parameters shell surface (So) was either moderately smooth, smooth or rough in 22 (48.9%), 16 (35.6%) and 7 trees (15.6%), most nuts were moderately smooth and only 15.6% had rough shell surface. Parameters, grooves along pad on suture was in 14, 27 and 4 trees in sequence as shallow, medium or deep. Traits adherence of two halves and shell strength in the studied population was weak, intermediate and strong, present in 5, 27 and 13 trees, intermediate, strong and weak in sequences were 60.0, 28.9 and 11.1 per cent adherence (Table 6, 14).

Same characters in Si seedlings were characterized as moderately smooth, smooth and rough in 15, 19, 11 tree. Smooth shell surface, moderately smooth and rough in sequence registered 42.2, 33.3 and 24.4 percentage., trait grooves along pod on suture was in 17, 20, 8 trees. Class medium shallow and deep registered overall percentage of 44.4, 38.8 and 17.8. Adherence of two halves and shell strength was as weak, intermediate and strong 8, 17 and 20 trees, highest as strong (44.4%), intermediate (37.8%) and least as weak (17.8%).

Parameter shell strength assessed at So and Si were characterization as weak, intermediate and strong, in 9, 27 and 9 trees (So), shell strength was maximum in intermediate (90.9%). Kernel colour was observed to be extra light, light, amber or dark brown in 2, 16, 17 and 9 trees in sequence. Amber and light colour were predominant and extra light kernel colour was observed in only two trees (4.4%). Kernel flavour was characterized either satisfactory or unsatisfactory. Kernel flavour was satisfactory in all the 45 seedling trees from district Solan (Table 7, 15).

Shell strength (Si) was weak in 11, intermediate in 18 and strong in 16 trees, intermediate and strong registered maximum (40.0%), strong (35.6%). Kernel colour as extra light, light, amber or dark amber was in 4, 8, 18, 15 tree, amber color superseded all other types with percentage (40.0%), 33.3 (dark amber) and least 8.9 (extra light). Kernel flavor was rated as satisfactory in all 45 samples studied (Table 7, 16).

Parameter kernel plumpness (So) was observed to be- thin, moderate or plumpy in 7, 22 and 16 trees (Table 8, 16), moderate plumpness was maximum in 27 trees, least thin was in 7 trees (15.6%), kernel shrivelness, shrivel number was maximum in 37 trees (82.2%) and kernel top shrivel was seen only in 8 trees (17.8%). Ease of kernel removal was judged as difficult moderate or easy, was in 7, 31 and 7 trees. Moderate kernel removal was found maximum in 31 trees (68.9%).

For Si seedlings characters assessed were similar to those of So seedlings, moderate and plumpy class had maximum percentage of 42.2 and least thin had 15.6 per cent. Further kernel shrivelness expressed in 5 types (UPOV descriptor), in present study kernels with tip shrivel and no shrivel were in 3 and 42 tree, (93.3%) were without any shrivelness. Ease of kernel removal in sequence was classed as difficult, moderate or easy in 17, 22 and 6 tree. Most genotypes showed moderately kernel removal (48.9%).

In India, Thakur (1993) [32], through appropriate identification and characterization some cultivars have been recommended for cultivation. Vasilescu and Botu (1997) [34], Rouskas *et al.* (1997) [24] on growth habit, colour of one year old shoot (pale brown, green brown and blackish) lateral leaflet shape their categories were by said researcher in their evaluation work. Variation in nut base shape, apex shape, pistil point, location of pad on suture, shell character i.e. colour, seal its strength, texture, grooves along suture etc. in the present study with minor to substantial variation, on phenologiacal pomological characterization are in agreement with the findings of different researcher. (UPOV 1988, Atefi 1997 and Sharma and Sharma 1998) [33, 1, 29]. variation in kernel features (indicated above) are in line with the observation of Pramanick (2006) [23], Gong *et al.* (2006) [11], Zhao *et al.*

(2007) [37], Guo *et al*. (2009) [12], Hou *et al.* (2010) and Joolka *et al.* (2008) [15].

Non metric trait comprised of nut shape (Ovate, broad ovate, broad elliptic and circular, some short round types were identified in the studied seedling trees, nut base shape (truncate, rounded, cuneate), apex shape (obtuse, round, truncate), pistil prominence (short, medium, long), pad position on suture (upper half, upper 2/3, on entire length), shell surface (smooth moderate, rough), grooves on suture (Shallow, medium, deep), adherence of two halves (weak, intermediate, strong), shell strength (weak, intermediate, strong). Kernel parameters included colour (light amber, amber, dark amber, extra light), kernel flavor (satisfactory and unsatisfactory), kernel plumpness (thin, moderate plumpy), kernel shrivel (shriveled, non-shriveled), ease of kernel removal (easy, moderate, difficult). Trait growth habit both of seedling selection, cultivars grown (at some places the growth was either spreading, semi spreading, semi erect or erect).

Table 1: Foliage character of different walnut genotype selected from district Solan.

Character	Growth habit			Shape of leaves			Shape of leaflets		
Extent of variation	Erect	Semi-erect	Spreading	Narrow elliptic	Elliptic	Broad Elliptic	Narrow elliptic	Elliptic	Broad elliptic
Frequncey (Number of tree- 45)	18	18	9	10	16	19	11	19	15
Percentage (%)	40	40	20	22.20	35.60	42.20	24.40	42.20	33.30

Table 2: Foliage character of different walnut genotype selected from district Solan

Character	Shape of leaf apex		Leaf Colour			Rachis colour		
Extent of variation	Narrow	Oblong	Light Green	Green	Dark Green	Green	Yellow	Red
Frequncey (Number of tree- 45)	38	7	15	23	7	40	5	0
Percentage (%)	84.50	(15.50	(33.3)	(51.1)	(15.6)	88.90	11.10	0

Table 3: Foliage character of different walnut genotype selected from district Solan

Character	Shoot pubescence			Shoot colour		
Extent of variation	Glabrous	Slightly glabrous	Pubescent	Green Brown	Pale Brown	Blackish
Frequncey (Number of tree- 45)	19	20	6	41	2	2
Percentage (%)	42.22	44.44	13.30	91.11	4.44	4.44

Table 4: Nut and kernel character of different walnut genotype selected from district Solan

Character	Shape of nut Longitudinal section through suture				Shape of nut in cross section perpendicular in suture				Shape of base Perpendicular to Suture		
Extent of variation	Broad Elliptical	Ovate	Circular	Broad Ovate	Broad elliptical	Ovate	Circular	Broad Ovate	Truncate	Rounded	Cuneate
Frequncey (Number of tree- 45)	17	11	7	10	7	15	13	10	16	20	9
Percentage (%)	37.80	24.40	15.60	22.20	15.60	33.30	28.80	22.20	35.60	(44.40	20

Table 5: Nut and kernel character of different walnut genotype selected from district Solan

Character	Shape of apex perpendicular to Suture				Prominence of pistil point			Position of pad on suture		
Extent of variation	Truncate	Rounded	Obtuse	Emarginated	Short	Medium	Long	On upper half	On upper 2/3	On whole Length
Frequncey (Number of tree- 45)	8	13	18	6	14	22	9	25	16	4
Percentage (%)	17.8	28.9	40	13.3	31.1	48.8	20	55.6	35.6	8.9

Table 6: Nut and kernel character of different walnut genotype selected from district Solan

Character	Structure of shell surface			Grooves along pad on sturue			Adherence of two halves		
Extent of variation	Moderately smooth	Smooth	Rough	Shallow	Medium	Deep	Week	Inter-mediate	Strong
Frequncey (Number of tree- 45)	22	16	7	14	27	4	5	27	13
Percentage (%)	48.90	35.60	15.60	31.10	60	8.90	11.10	60	28.90

Table 7: Nut and kernel character of different walnut genotype selected from district Solan

Character	Shell Strength			Kernel colour				Kernel flavor	
Extent of variation	Week	Intermediate	Strong	Extra light	Light	Amber	Dark amber	Satisfactory	Unsatisfactory
Frequncey (Number of tree- 45)	9	27	9	1	16	18	10	45	0
Percentage (%)	20	60	20	2.22	35.60	40	22.22	100	**0**

Table 8: Nut and kernel character of different walnut genotype selected from district Solan

Character	Kernel plumpness			Kernel shrivel					Ease of removal of kernel		
Extent of variation	Thin	Moderate	Plumpy	Kernels exhibiting tip shrivel	No shrivel	Kernels exhibiting <50% shrivels	Kernels exhibiting 50% shrivel	Kernels exhibiting 50% or more shrivel	Difficult	Mode-rate	Easy
Frequncey (Number of tree- 45)	7	22	16	8	37	0	0	0	7	31	7
Percentage (%)	15.6	48.9	35.6	17.8	82.2	0	0	0	(15.6)	(68.9)	(15.6)

Table 9: Foliage character of different swalnut genotype selected from district Sirmour.

Character	Growth habit			Shape of leaves			Shape of leaflets		
Extent of variation	Erect	Semi-erect	Spreading	Narrow elliptic	Elliptic	Broad elliptic	Narrow elliptic	Elliptic	Broad elliptic
Frequncey (Number of tree- 45)	11	20	14	0	28	17	14	23	8
Percentage (%)	(24.4)	(44.4)	(31.1)	0	(62.2)	(37.8)	(31.1)	(51.1)	(17.7)

Table 10: Foliage character of different walnut genotype selected from district Sirmour

Character	Shape of leaf apex		Leaf Colour			Rachis colour		
Extent of variation	Narrow	Oblong	Light Green	Green	Dark Green	Green	Yellow	Red
Frequncey (Number of tree- 45)	32	13	11	28	6	34	11	0
Percentage (%)	(71.1)	(28.9)	(24.4)	(62.2)	(13.3)	(75.6)	(24.4)	0

Table 11: Foliage character of different walnut genotype selected from district Sirmour

Character	Shoot pubescence			Shoot colour		
Extent of variation	Glabrous	Slightly glabrous	Pubescent	Green Brown	Pale Brown	Blackish
Frequncey (Number of tree- 45)	24	14	7	37	5	3
Percentage (%)	(53.3)	(58.3)	(15.5)	(82.2)	(11.1)	(6.7)

Table 12: Nut and kernel character of different walnut genotype selected from district Sirmour

Character	Shape of nut Longitudinal section through suture				Shape of nut in cross section perpendicular in suture				Shape of base Perpendicular to Suture		
Extent of variation	Broad elliptical	Ovate	Circular	Broad Ovate	Broad elliptical	Ovate	Circular	Broad Ovate	Truncate	Rounded	Cuneate
Frequncey (Number of tree- 45)	22	8	12	3	15	10	11	9	12	20	13
Percentage (%)	(48.9)	(17.8)	(26.7)	(6.7)	(33.3)	(22.3)	(24.4)	20	(26.7)	(44.4)	(28.9)

Table 13: Nut and kernel character of different walnut genotype selected from district Sirmour

Character	Shape of apex perpendicular to Suture				Prominence of pistil point			Position of pad on suture		
Extent of variation	Truncate	Rounded	Obtuse	Emarginated	Short	Medium	Long	On upper Half	On upper 2/3	On whole length
Frequncey (Number of tree- 45)	8	14	14	9	14	21	10	23	15	7
Percentage (%)	(17.8)	(31.1)	(31.1)	(20)	(31.1)	(46.7)	(22.2)	(51.1)	(33.3)	(15.6)

Table 14: Nut and kernel character of different walnut genotype selected from district Sirmour

Character	Structure of shell surface			Grooves along pad on sturue			Adherence of two halves		
Extent of variation	Moderately smooth	Smooth	Rough	Shallow	Medium	Deep	Week	Intermediate	Strong
Frequncey (Number of tree- 45)	15	19	11	17	20	8	8	17	20
Percentage (%)	(33.3)	(42.2)	(24.4)	(37.8)	(44.4)	(17.8)	(17.8)	(37.8)	(44.4)

Table 15: Nut and kernel character of different walnut genotype selected from district Sirmour

Character	Shell Strength			Kernel colour				Kernel flavor	
Extent of variation	Week	Intermediate	Strong	Extra light	Light	Amber	Dark amber	Satisfactory	Unsatisfactory
Frequncey (Number of tree- 45)	11	18	16	4	8	18	15	45	0
Percentage (%)	(24.4)	(40)	(35.6)	(8.9)	(17.8)	(40)	(33.3)	(100)	0

Table 16: Nut and kernel character of different walnut genotype selected from district Sirmour

Character	Kernel plumpness			Kernel shrivel					Ease of removal of kernel		
Extent of variation	Thin	Moderate	Difficult	Moderate	Easy	Kernels exhibiting <50% shrivels	Kernels exhibiting 50% shrivel	Kernels exhibiting 50% or more shrivel	Difficult	Moderate	Easy
Frequncey (Number of tree- 45)	7	19	19	3	42	0	0	0	17	22	6
Percentage (%)	(15.6)	(42.2)	(42.2)	(6.7)	(93.3)	0	0	0	(37.8)	(48.9)	(13.3)

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