

RESEARCH ARTICLE

Estimation of variability and genetic parameters for kernel quality traits (protein and oil content) in the seedling raised natural walnut (*Juglans regia* L.) population in the Kashmir valley

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SUMMARY

The present investigation on estimation of variability and genetic parameters for kernel quality traits (protein and oil content) in the seedling raised natural walnut (*Juglans regia* L.) population in the Kashmir valley was carried out in order to document the available genetic variability in walnut germplasm and to select elite walnut genotypes possessing superior attributes and quality traits. During the survey, data were recorded on one hundred fifty two (152) walnut trees growing in different areas of Kashmir valley. Remarkable variability were observed in seedling walnut trees for different morphological, nut and kernel characters. Similarly, variations were also reported for other characters viz., tree vigour, growth habit, branching habit, leaflet shape, shoot colour, nut shape, shell texture, shell colour, shell seal, shell strength, shell integrity, kernel shrivel and kernel colour. Studies that the oil content of kernels had a population mean of 62.102 per cent with a range of 50.22-70.00 per cent. Maximum kernel oil content (70%) was found in the walnut selection WS-114 and minimum (50.22%) in the WS-150. Analysis of variance revealed a phenotypic variance of 29.027 as compared to genotypic variance of 8.546 with environmental variance being 20.48. Based on the estimation of components of variance, the phenotypic and genotypic co-efficients of variation were 8.67 and 4.70 per cent, respectively. Heritability (broad sense) was 47.43 per cent and the expected genetic gain as only 5.261 (% of the mean).

Key Words : Walnut, Kernel characteristics, Oil content, Proteins

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The Persian walnut (*Juglans regia* L.), known as the English walnut, belongs to the family Juglandaceae. English walnut has its origin in the

eastern Europe, Asia minor and points eastward to Himalayan mountains. The native habitat of walnut extends from the Carpathian mountains to Europe across Turkey, Iraq, Afghanistan, South Russia and further eastward into the foot hills of the Himalayas. In India walnuts are usually grown in the mid hill areas of Jammu and Kashmir, Himachal Pradesh, and upper hills of

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Uttarakhand and Arunachal Pradesh. The soil most suitable for its cultivation should be well-drained and deep silt loamy containing organic matter in abundance. It should not have a fluctuating water level, hard pan and/or sandy sub-soil with alkaline reaction. A soil 2.5 to 3.0 m deep gives best results because the roots can penetrate deep and utilize residual soil moisture during dry spell and also make available sufficient nutrients. Furthermore, availability of sufficient moisture in the leaves can reduce the damage due to sun burning of leaves, shoots and young fruits. Walnut is grown commercially in about 48 countries with an area of 66, 58, 966 hectares. The world walnut production is about 16, 70, 109 MT. The chief walnut producing countries are China (22%), USA (20%), Iran (12%) and Turkey (10%) (Anonymous, 2007). India accounts for about 2.0 per cent of the world production. In India, Jammu and Kashmir is leading both in area as well as in production with an area of 82.04 thousand ha and production of 146.78 thousand tonnes. However, the productivity level of 1.79 t ha⁻¹ is far below than other countries. Himachal Pradesh has an area of 6.54 thousand ha with a production of 1.24 thousand tonnes and productivity level of 0.19 t ha⁻¹; while Uttarakhand has an area of 19.26 thousand ha with a production of 8.73 thousand tonnes and productivity level of 0.45 t/ha and Arunachal Pradesh has an area of 2285 ha with a production of about 51 tonnes and productivity level of 0.022 t/ha.

In the state of Jammu and Kashmir, Anantnag is the leading district both in area as well as production corresponding to an area of 13647 ha and production of 41180 tonnes with a productivity level of 3.01 t ha⁻¹, followed by the Kupwara district that covers an area of 8175 ha with 22103 tonnes production and a productivity level of a 2.70 t ha⁻¹. Kulgam ranks 6th in area and 3rd in production in the J&K state and has the highest productivity of 3.52 t ha⁻¹, which is even higher than that of USA. This indicates that the state has the right type of agro-climatic conditions and vast potential to produce export quality walnut and kernels. The walnut in Jammu and Kashmir state, due to their origin to non-descriptive type of seedlings, has resulted in the production. The cultivar evaluation has scientific merits for a system that can ensure the release of genetically distinct elite cultivars. These in turn can promote its productivity, contribute to conservation of genetic resources and also promote breeding strategies that will support both horticulture and plant breeding (Smith and Smith, 1988).

Of a mixed crop that envisages lot of variation in the nut and kernel characteristics (Bhat *et al.*, 1999). In many cases the propagation ratio can be improved by using a stronger cytokinin or increasing its concentration. However, this can sometimes have detrimental effects in the later stages of micro propagation. Micro propagation studies have also been carried out in some other species of nuts and similar trees like hazelnut (Radojevic *et al.*, 1975; Mele and Messeguer, 1983; Perez *et al.*, 1983); chestnut (Vieter and Vieter, 1980) and almond (Mehra and Mehra, 1974). But reports on *in vitro* walnut culture are scarce.

MATERIAL AND METHODS

The present investigation on estimation of variability and genetic parameters for kernel quality traits (protein and oil content) in the seedling raised natural walnut (*Juglans regia* L.) population in the Kashmir valley was carried out during the crop seasons of 2013 and 2014. The studies comprised two clusters of germplasm extending over the main geographical distribution of cultivation in the Jammu and Kashmir state. Genetic variability studies and diversity were estimated in the natural walnut population of Kashmir valley forming two cluster populations. Two standard check cultivars (Sulaiman and Hamdaan) were used for comparison.

Cluster I :

Plant materials in this cluster comprised 75 *in situ* earmarked seedling raised plants that were identified after detailed survey of the areas having large concentration of the crop in the districts of Kupwara and Baramulla.

Cluster II :

In this cluster plant materials also comprised 75 *in situ* earmarked seedling raised plants that were identified after extensive survey of promising materials in the Pulwama and Shopian districts of South Kashmir and Budgam district of central Kashmir. The data of both the clusters (over 2 years) were pooled together for statistical analyses. Morphological characters were recorded as per the standard descriptor of walnut recommended by IBPGRs. Colour of the kernels was scored as for nut and kernel characters a random sample of 20 nuts was selected from the harvested lot of each earmarked tree in both the years and data recorded after proper drying of the nuts. Following characters were

studied as per the descriptor.

Protein content :

The total nitrogen content was estimated by Micro-Kjeldahl's method and nitrogen content so observed was converted into protein (Nx6.25) as crude protein content, which also included non-protein nitrogen. However, to get true protein content the method given by Sadasivam and Manickam (1992) was followed.

Kernel oil content :

The oil content was extracted as per the method suggested by Sadasivam and Manickam (1992).

RESULTS AND DISCUSSION

The population mean of kernel protein content was 17.967 per cent which ranged from 14.15 to 24.25 per cent. Maximum protein content (24.25%) was recorded in kernels of WS-112 and minimum (14.15%) in the WS-149. Analysis of variance revealed a phenotypic variance of 4.315, genotypic variance 1.985 and the environmental variance of 2.329. Based on the components of variance, phenotypic and genotypic co-efficients of variation worked out to be 11.56 and 7.84 per cent, respectively. Heritability (broad sense) was 46.02 per cent and expected genetic gain (as % of the mean) was 10.960. Perusal of the revealed that the oil content of kernels had a population mean of 62.102 per cent with a range of 50.22-70.00 per cent. Maximum kernel oil content (70%) was found in the walnut selection WS-114 and minimum (50.22%) in the WS-150. Analysis of variance revealed a phenotypic variance of 29.027 as compared to genotypic variance of 8.546 with environmental variance being 20.48. Based on the estimation of components of variance, the phenotypic and genotypic co-efficients of variation were 8.67 and 4.70 per cent,

respectively. Heritability (broad sense) was 47.43 per cent and the expected genetic gain as only 5.261 (% of the mean) (Table 1).

Average kernel protein content of 13.2 per cent was recorded by Furuchi *et al.* (1981) and about 15.0 per cent by Easayan and Bessegean (1984) in the walnuts. However, Bugaria and Orgus (1985) reported a range of 10.0-19.5 per cent.

Bhat and Mir (1992) reported a range of 51.5 to 59.0 per cent oil content in the kernels of some exotic walnut genotypes. Similarly, Bugaria and Orgus (1985) reported a range of 61.0 to 72.5 per cent kernel oil content in 48 specimens of walnuts.

In Jammu and Kashmir walnut cultivation is mainly based upon conventional methods, with the result all the plantations own their origin to non-descript seedling and therefore, are extremely heterozygous in tree behaviour and quality attributes like nut size, colour and protein contents of kernels (Bhat *et al.*, 1999). The importance of nut and kernel traits of walnut in the international market has promoted the search for attributes such as nut size, nut thickness, nut colour and its smoothness, shelling percentage and other qualitative traits like kernel colour, fat content and protein percentage (Bhat and Mir, 1992). The improved nut and kernel characters could be utilised for a hybridization programme as well as for introgressing their useful traits in the commercial walnut cultivars/selection (Sharma and Sharma, 2001).

Bhat *et al.* (2002) studied the genetic variability in natural seedling originated walnut population of Kashmir valley. Most of the nuts were round in shape, had smooth shell surface, light shell colour, intermediate shell seal and intermediate shell strength with light kernel colour. They observed that the natural walnut population of Kashmir valley has great variability in nut shape, shell strength and kernel colour.

Table 1 : Estimation of variability and genetic parameters for kernel quality traits (protein and oil content) in the seedling raised natural walnut (*Juglans regia* L.) population in the Kashmir valley (Pooled values over 2 years)

Parameters estimated	Protein (%)	Oil content (%)
Population mean	17.967 ±1.075	62.102 ±3.989
Range	14.15-24.25	50.22-70.00
Phenotypic variance (σ^2_p)	4.315	29.027
Genotypic variance (σ^2_g)	1.985	8.546
Environmental variance (σ^2_e)	2.329	20.48
Phenotypic co-efficient of variation (PCV)	11.56 %	8.67 %
Genotypic co-efficient of variation (GCV)	7.84 %	4.70 %
Heritability broad sense (h^2)	46.02 %	47.43 %
Expected genetic gain (% of mean) at 5% selection intensity ($k = 2.06$)	10.960	5.261

Conclusion :

Two quality traits *viz.*, protein and oil content exhibited a mean of 17.97 and 62.10 per cent with a magnitude of variability as 14.15-24.3 and 50.2-70.0 per cent, respectively. The phenotypic co-efficient of variation was nearly 11.6 and 8.7, genotypic co-efficient of variation nearly 7.8 and 4.7, and heritability (broad sense) was 46.0 and 47.4 per cent, respectively

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