Collection, Characterization and Evaluation of Walnut (*Juglans regia* L) Germplasm from North-Western Himalayas

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From the different agro-ecological habitats of North-Western Himalayan region of India, 422 accessions of *Juglans* landrace diversity from naturalized populations were collected. The area studied was in Uttaranchal (170), Jammu and Kashmir (150) and Himachal Pradesh (102), lying between 30°35'E latitude and 75°79' N longitude. Exploration trips were made from January 2000 onwards in forest, villages and farmer backyards which are mostly inaccessible. These *Juglans* landrace diversity were characterized for quantitative and qualitative traits in order to be utilized as variety, in respective of agro-ecological regions as well as for conservation in the field gene bank for future utilization and breeding programme. The large variation in nut weight, nut length, nut shape, nut diameter, shell texture, shell colour, shell seal, kernel percentage, kernel percentage, kernel colour, kernel filling, kernel protein and kernel oil were recorded within and between agroecological zones. The range of in shell nut weight, kernel percentage and kernel oil varied from 7.68-18.45g, 28.51-55.55%, 53.00-79.54% in Uttaranchal; 6.29-27.16g, 33.05-66.26%, 58.38-7244% in Jammu and Kashmir and 9.18-19.98g, 34.10-57.88%, 13-81-74.92% in Himachal Pradesh, respectively. The nut shape varied from ovate, round, elliptic, broad elliptical, short trapezoid and long trapezoid. Kernel colour ranged form light amber to extra light with moderate to very easy removal of kernel halves.

Key Words: Collection, Characterization, Evaluation, Germplasm, *Juglans*, Walnut.

Nut fruits have great potential for their further utilization in North-Western Himalayan region of India. Among the nut fruits, walnut (*Juglans regia* L.) occupies an important place because they are are nutritious, with long shelf-life and require less care in cultivation. It has rich land race diversity in Himalayan region due to high ecological diversity (Joshi and Pandey, 1996, Pandey, 1998). Nut fruits in general, and walnut in particular, is an excellent example of under-utilization of existing plant genetic resources.

The present paper describes the collection, characterization and evaluation of walnut germplasm from North-Western Himalayas in order to assess the variability and identify the promising accessions for future utilization.

Material and Methods

Collection

Germplasm collection missions were undertaken during the year 2000 onwards. The area of collection involved from the states of Uttaranchal, Jammu and Kashmir and Himachal Pradesh of North-Western Himalayan region of India between 30°35'E latitude and 75°79'N longitude. Climatic conditions are warm tropical to arctic/arid terperate. Topography is mostly hilly terrain along with gently undulating plains. Sampling strategy was determined through selective methods, mostly from the farmer's backyards. Sufficient nut samples of *Juglans regia* were collected and trees were market with white paint in order to acquire the bud sticks for further multiplication.

Characterization

The nut samples were characterized for different morphometric and chemical traits based on IPGRI descriptors of *Juglans regia* with slight modification IPGRI, 1997). The various characters studied were nut length (cm), nut weight (g), nut diameter (cm) kernel percentage and kernel thickness (mm).

Chemical Analysis

The kernel oil of *Juglans regia* was determined by non-destructive method using Newport NMR Analyzer (Model-4000, Oxford Analytical Instruments, Ltd. U.K.) after calibrating with pure oil extracted with hexane by conventional solvent extraction method. The kernel protein content was determined by the conventional Kjeldahl method in Kjeltec Auto 1030 Analyser (Tecator, Sweden) and multiplication factor

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6.25 was used to convert nitrogen in protein (Jayaraman, 1981).

Results and Discussion

The study was based on ecological diversity along with collection and characterization of juglans landrace diversity from the region.

Ecological Diversity

The North-Western Himalayas comprises the states of Jammu and Kashmir, Himachal Pradesh, Uttaranchal hills and Shiwalik hills having four distinct ecological zones. The vegetation is in general, drought resistant and cold tolerant. The area usually receives low rainfall, but get heavy snowfall or rain in winters.

The region has a number of land races of *Juglans*. Other characteristic vegetation consist of extensive stands of pines (*Pinus roxburghii*), deodar (*Pinus deodar*), oak (*Quercus dilatata* and *Q. incana*), *Rhododendron* sp. and *Hippophae rhmamnoides*. The soils are extermely varied. The foot and plain valley have deposits of gravel and coarse sand alluvial and red loams. On mountains the forests soils are clayey and gravely porous sandy loam rich in humus. Marshy low lying comprises peaty soils.

All the landrace diversity of *Juglans regia* show considerable variation with respect no tel to different soil, rainfall and temperature. *Juglans* can be successfully grown on wide range of soil types including rocky soils. Some of *Juglans* landrace have been found to grow even on rocky soil along with water streams in Uttaranchal hills. Generally, no serious diseases and insect were observed on the naturally occurring trees except leaf spot in *Juglans*.

Collection

The Indian Council of Agricultural Research carried out an extensive programme under the National Agricultural Technology Project (Plant Biodiversity) for the collection of indigenous *Juglans* landraces from the North-Western Himalayan region of India. This programme has been carried out in collaboration with research institutes/state agricultural universities. non-governmental organization along with farmer participations. The project has been implemented from Januany 2000 and several exploration trips were carried out in the respective states. The areas surveyed were Anmantnag, Budgam, Srinagar, Pulwama and Baramulla districts of Jammu and Kashmir (J&K), Uttarkashi, Dehradun, Tehri, Almora, Champawat and Nainital districts of Uttaranchal; Kallu, Chamba, Linnaur, Solan, Shimla and Sirmaur districts of Himachal Pradesh. A total of 422 diverse landraces of *Juglans regia* have been collected (Table 1) The diversity collected are from Uttaranchal (170), Himachal Pradesh (102) and Jammu and Kashmir (150). These materials were collected from different altitudes and include villages, forests and farmers backyards of the repective agro-ecological zones.

Table 1. Areas explored and *Juglans* diversity collected from North-Western Himalayan region of India

Areas surveyed and explored	Diversity Collected
Anantnag, Budgam. Srinagar, Kupwara, Pulwama, and Baramulla districts of Jammu & Kashmir	150
Dehradun, Uttarkashi, Tehri, Almora, Champawat, and Nainital districts of Uttaranchal	170
Kallu, Chamba, Kinnaur, Solan, Shimla and Srimaur	102
Total diversity collected	**422**

Characterization

Uniform descriptors were followed by all the institutions involved in the collection, evaluation, documentation and conservation of *Juglans*. Considerable variability exists for nut fruits size sape, kernel percentage, kernel colour, kernel protein and kernel oil content. The *Juglans* fruits posses thin shell, papery shell, semi-hard and hard shell along with creamy white kernel colur. The kernel oil and protein in some of landraces are quite high, from >70% and 20% respectively. Apart from use as dry fruits, the walnut oil is commercially used for making soap, oil and other cosmetic pruducts.

Net Characteristics

A large variation in nut weight, nut length, nut shape and nut diameter were recorded within and between the different agro-ecological zones. The range of nut weight was varied from 7.68-18-45 g in Uttaranchal, 6.29-27.16g in J&K and 9.18-19-98g in Himachal Pradesh (Table 2). Aslam (1993) reported that average in shell, nut weight varied between 9.37 to 12.96 g in case of indigenous selection and 8.45 to 10.46g in case of exotic cultivars. In the present study the high nut weight was recorded in some of the accessions, and similar nut weight was observed by Paunovic (1990), and higher than found in Himachal Pradesh and Uttaranchal by Gautam (2000) and Lal and Singh

Table 2. Characterization of *Juglans* diversity based on nut and kernel characters

Characters	Range of variation for important traits.		
	Uttaranchal	Jammu & Kashmir	Himachal Pradesh
Nut Characters			
Nut length (cm)	3.22-5.06	2.22-5.10	3.01-4.90
Nut diameter (cm)	2.60-3.75	2.68-4.55	2.98-3.77
Nut weight (g)	7.68-18.45	6.29-27.16	9.18-19.98
Nut shape	*R, O, LT, BE	*R,O, ST, BE. LT, T	*BO, ST, BE, O,LT
Shell thickness (mm)	1.30-3.23	1.0-3.0	1.40-2.36
Shell texture	Smooth to Rough	V. Smooth to Rough	Smooth to Rough
Shell colour	Light to Dark	Light to dark	Light to V. dark
Shell seal	V. weak to Strong	V. weak to strong	Weak to very strong
Kernel characteristics			
Kernel (%)	28.51-55.55	33.05-66.26	34.10-57.88
Kernel oil (%)	53.00-79.54	58.38-66.66	13.81-74.92
Kernel protein (%)	11.15-28.80	14.38-21.16	11.81-26.89
Kernel colour	*ET to LA	*ET to LA	*ET to LA
Kernel filling	Poor to V. Good	Poor to Excellent	Poor to Good

*R=Round, O=Ovate, LT=Long Trapezoid, BE=Broad Elliptic, ST=Short Trapezoid,
T=Triangular, BV=Broad Ovate, C=Circular, ET=Extra Light, LA=Light Amber

(1978), respectively. Similarly the nut length and nut diameter ranged from 3.22-5.06 and 2.60-3.75cm in Uttaranchal; 2.22-5.10 and 2.68-4.55cm in and 3.01-4.94 and 2.98-3.77 cm in Himachal Pradesh respectively and a sizeable number of accessions have either at par or more than that suggested by Serr and Ford (1954) in all .the three states. The nut shape varied from round, ovate, long trapezoid, short trapezoid, broad elliptic, elliptic, broad ovate and triangular amongst the different region. Shell texture and shell colour were smooth to rough and light to dark in Uttaaranchal (1.30-3.23mm) and Himachal Pradesh (1.11-2.36mm). Similar observations have been reported by other workers (Rue and Yang, 1990; Lal and Singh 1978; Paunovic, 1990 and Gautam, 2000).

Kernel Characterstics

Considerable variability exists in kernel characteristics amongst the hill regions of India. There is large variation in kernel percentage, which varied 28.51-55.55% in Uttaranchal, 33.05-66.26% in and 34.10-57.88% in Himachal Pradesh. Thus there is great scope for selection of walnut variety on the basis of kernel recovery as suggested by Serr and Ford (1954). Similar results were also reported by Bhat *et al.* (1992) that high kernel percentage from 54.20 to 63.20 in whereas contrary to this Qureshi & Dalal (1985) reported 30-35 percent kernel in seedlings from Kinnaur district of Himachal Pradesh but nut size of this selection was very small. Pieklo and Czynczyk (1990) reported 37.60 to 53.10 per cent in Italy (Radicarti *et al.* 1990). Wang *et al.* (1990) and China and Armenia repectively,

Amongst the *Juglans* land race diversityfew important accessions collected from North-Western Himalayas could be used as a potential lines in breeding for imcorporation of various traits viz; bearing habit, nut quality, kernel percentage, high percentage of kernel protein, kernel oil and precocity as well as resistance to various diseases and insects.

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