

Seed Source Variation for Nursery Traits in *Quercus leucotrichophora* and *Quercus glauca*

RAJESH SHARMA AND SANJEEV KUMAR

Himalayan Forest Research Institute, Conifer Campus, Panthaghati, Shimla 171 009;
rajeshsolan@yahoo.com

ABSTRACT Seed source variation in *Quercus leucotrichophora* and *Q. glauca* using 13 and 8 seed sources of the two species, respectively was investigated. The study reveals significant differences for germination and survival per cent amongst the investigated seed sources of both the species but fail to differentiate significantly amongst the seed sources for growth traits at the nursery stage.

Key words: Seed source, nursery traits, *Quercus* spp.

Knowledge of magnitude and pattern of genetic differentiation among seed sources is useful for delimiting both seed collection zones for operational reforestation and breeding units for tree improvement programmes. Delimitation can be based upon knowledge of genetic differentiation of seed or seedling populations growing in controlled environments or upon genetic differentiation among seed sources in field experiments at or near harvest stage [1]. Further, the maintenance of the capacity of populations to adapt to changing environments is considered to be the most important criterion in the determination of long-term survival ability. Such adaptability should in large part be a consequence of genetic variability, which in turn is a function of the genetic variation realized in an actual population and the ability to create genetic variation in subsequent generations [2].

Tree species whose distribution extends to a large geographical area with varying climate and topography are usually known to have local populations adapted to their environment. The degree of adaptations varies with the relative rates of environment change or sometime sudden change in topography, aspect and soil, resulting in corresponding genetic variation in the species. This variation within the populations of tree species has been exploited in the selection of superior

provenance for a given site and for evolving strategies for conservation of genetic diversity within populations of tree species.

Of the five species of genus *Quercus* found in the country the two species of oak i.e., *Quercus leucotrichophora* (Ban Oak) and *Q. glauca* (Bani Oak) are the much valued multipurpose tree species distributed throughout western Himalayan region between 1000m to 2400m [3]. These are found typically in moist situations in valleys, on the sides of ravines and along streams. Both of these play subsistence role in the economy of rural population in hilly areas of Himachal Pradesh, Uttaranchal and Jammu and Kashmir states. In these states, they are extensively used as fuel wood, fodder and small timber (mainly agricultural) implements. Ban oak is also used for making charcoal. They become main source of fodder in winter. Ban oak and Bani oak form an important component of Himalayan ecosystem from soil and water conservation point of view. Because of their multipurpose uses, extensive exploitation is leading to gradual depletion of their natural habitat and therefore, their conservation needs special attention.

For the conservation of these two species and to meet the increasing demand for fuel, fodder and

timber, natural sources need to be exploited for the genetic variation through selection, to identify populations or stands with potential to realize the gains of selection through increase in productivity.

Keeping in view, the wide utility of these species and less attention paid to exploit the genetic potential of these two species and arrest gradual depletion in their habitat, present study forms a part of long term improvement programme with objectives to identify seed sources with maximum variability for nursery traits.

MATERIAL AND METHODS

The source material for this study were derived by collecting acorns of *Quercus leucotrichophora* and *Q. glauca* from 13 and 8 different seed sources respectively, (Table 1) from the distribution zones

Table 1. Geographical variation of different seed sources of *Quercus leucotrichophora* and *Q. glauca*

S.No.	Seed Source	Altitude	District
1.	Kandaghat	1500	Solan
2.	Junga	1480	Solan
3.	Ghanahatti	1800	Shimla
4.	Naina Tikker	1350	Sirmaur
5.	Sarahan	1500	Sirmaur
6.	Patta	1190	Shimla
7.	Kufri	2632	Shimla
8.	Kasauli	1890	Solan
9.	Mushibir	1350	Solan
10.	Chail	2100	Solan
11.	Shilli	1500	Solan
12.	Palampur	1300	Kangra
13.	Rajgarh	1440	Sirmaur

(Fig. 1) of the species in the state of Himachal Pradesh during September 1999. Acorns collected from 15 trees distantly located from each other within the seed source were bulked to make a homogenous sample. Acorns of the two species were sown at Shilly nursery, 3 km North-East of Solan (30° 55' latitude, 77° 09' longitude), at an altitude of about 1500 m. Boiling hot water

treatment was given to the acorns of both the species before sowing. Sowing was done to raise seedlings for field experiments in beds of 1 m² in a Randomized Block Design with three replications and 25 acorns in each replication for both the species. The seeds were dibbled 2cm deep and 5cm apart, in lines spaced 25cm apart. The germination in both species started after 8 days of sowing and completed in 45 days. The observations were recorded on germination, survival, seedling height and collar diameter. The observations with regard to survival and growth parameters were recorded after one year of sowing. Data of growth parameters was further recorded in subsequent two years. Sixteen seedlings per replication for both the species were taken for statistical analysis. Data recorded were subjected to statistical analysis to examine the significance of differences if any, amongst the seed sources (ANOVA). The replication effects were considered to be random and seed source differences were tested by F-test (0.5 % level of significance).

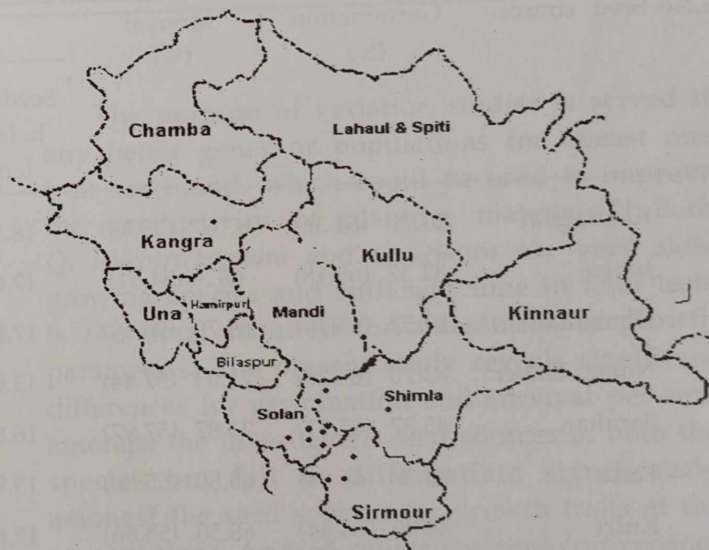


Fig. 1. Distribution of seed sources in HP

RESULTS AND DISCUSSION

Genetic variation is considered the most important determinant of the ability of forest tree populations to survive in temporarily and spatially heterogeneous environmental conditions. The presence and maintenance of genetic variation of forest tree populations play a significant role in the long-term stability of forest ecosystems. The amount of genetic variation is generally accepted

as an important determinant for the adaptive potential of populations and hence, estimates of genetic variation are made to differentiate populations of a species.

Quercus leucotrichophora

Significant differences among different seed sources of *Q. leucotrichophora* were found for germination and survival per cent (Table 2). The germination was found to vary from 81.27 to 85.50 per cent for Kandaghat and Palampur seed sources, respectively. The mean germination per cent was 83.37. The survival per cent among the 13 seed sources was found maximum for Sarahan (71.87) and minimum (66.30) for Junga seed source. Significant differences for germination and survival per cent have also been reported in case of *Cedrus libani* [4] and in *Acacia catechu* [5]. No further mortality was observed after the end of third year.

Non-significant differences among the seed sources for the three-year growth data were observed for *Q. leucotrichophora*. However, Kandaghat seed source was found to excel with regard to growth data of all the three years except for collar diameter of 2001 and seedling height of 2002 for which Junga seed source recorded the maximum values for the traits. Minimum values for these traits were recorded for different seed sources. Similar investigations to record variation in germination, survival and growth traits (seedling height and collar diameter) have also been observed by many authors for *Pinus roxburghii* [6].

Quercus glauca

The seed sources of *Q. glauca* differed significantly amongst themselves for germination and survival per cent (Table 3). The germination per cent varied from 71.60 for Shilli seed source to 75.70 per cent

Table 2. Variation in nursery traits of different seed sources of *Quercus leucotrichophora*

S.No.	Seed source	Germination (%)	Survival (%)	2001		2002		2003	
				Seedling height (cm)	Collar diameter (cm)	Seedling height (cm)	Collar diameter (cm)	Seedling height (cm)	Collar diameter (cm)
1	Kandaghat	81.27 (64.36)	67.67 (55.36)	18.56	0.45	44.86	0.70	89.17	1.27
2	Junga	82.37 (65.18)	66.30(54.51)	17.60	0.46	50.81	0.68	88.51	0.99
3	Ghanahatti	82.53 (65.30)	69.70 (56.60)	17.81	0.40	45.41	0.65	88.30	0.92
4	Naina Tikker	83.70 (66.20)	71.03 (57.44)	13.96	0.44	38.08	0.69	80.95	1.01
5	Sarahan	85.37 (67.51)	71.87 (57.97)	16.88	0.41	42.66	0.65	87.70	0.96
6	Patta	83.37 (65.94)	68.50 (55.86)	13.96	0.43	39.07	0.67	70.65	1.04
7	Kufri	84.00 (66.44)	68.50 (55.86)	15.83	0.44	41.84	0.68	88.69	1.0
8	Kasauli	83.53 (66.06)	69.00 (56.17)	13.90	0.42	43.99	0.67	88.90	1.06
9	Mushibir	83.53 (66.06)	70.10 (56.85)	14.17	0.40	40.86	0.67	84.65	1.0
10	Chail	82.40 (65.20)	68.97 (56.15)	15.42	0.39	40.88	0.68	86.57	0.97
11	Shilli	82.53 (65.30)	70.37 (57.02)	14.90	0.38	43.89	0.68	85.86	0.99
12	Palampur	85.50 (67.63)	71.63 (57.82)	15.11	0.42	42.45	0.68	83.79	1.0
13	Rajgarh	83.70 (66.20)	70.93 (57.38)	15.94	0.39	38.34	0.59	77.84	0.93
Mean		83.37	69.58	15.69	0.41	42.55	0.67	84.74	1.01
CD _{0.05}		1.29	1.06	NS	NS	NS	NS	NS	NS

() Values in the parenthesis are transformed values.

Table 3. Variation in nursery traits of different seed sources of *Quercus glauca*

S.No.	Seed source	Germination (%)	Survival (%)	2001		2002		2003	
				Seedling height (cm)	Collar diameter (cm)	Seedling height (cm)	Collar diameter (cm)	Seedling height (cm)	Collar diameter (cm)
1	Junga	74.33(59.57)	65.13(54.29)	13.92	0.35	32.74	0.53	62.87	0.70
2	Patta	71.93(58.01)	67.03(54.96)	13.40	0.37	29.52	0.52	60.14	0.71
3	Chail	73.13(58.78)	62.10(52.00)	12.88	0.34	32.19	0.49	59.65	0.68
4	Kandaghat	74.60(59.74)	67.50(55.25)	13.42	0.35	28.72	0.53	49.95	0.68
5	Ghanahatti	74.37(59.59)	66.63(54.72)	15.17	0.39	31.01	0.54	60.54	0.71
6	Shilli	71.60(57.80)	67.93(55.51)	14.58	0.38	30.03	0.56	49.20	0.76
7	Naina Tikker	73.87(59.26)	66.37(54.55)	14.04	0.35	29.10	0.52	56.34	0.66
8	Kufri	75.70(60.47)	68.23(55.69)	14.90	0.38	32.70	0.56	59.81	0.76
Mean		73.69	66.47	14.04	0.36	30.75	0.53	57.31	0.71
CDo.o5		0.95	1.07	NS	NS	NS	NS	NS	NS

Values in the parenthesis are transformed values.

for Kufri seed source. The mean germination per cent was 73.69 per cent. The survival per cent was found to vary from 62.10 per cent in case of Chail seed source to a maximum of 68.23 per cent recorded for Kufri seed source. The mean for survival per cent was 66.47. The survival per cent remained the same after third year of sowing.

Like *Quercus leucotrichophora* non-significant differences were observed for growth characters. For the growth data recorded during the year 2001, the maximum seedling height (15.17 cm) as well as collar diameter (0.39 cm) were recorded for Ghanahatti seed source (Table 3) whereas Chail seed source was found to have minimum seedling height and collar diameter of 12.88 cm and 0.34 cm, respectively. Junga seed source for the trait seedling height and Shilli and Kufri seed sources for collar diameter recorded maximum values for the years 2002 and 2003. Kandaghat (28.72) and Shilli (49.20) recorded the minimum values for seedling height for the year 2002 and 2003, respectively and Chail seed source for collar diameter for both the years.

The purpose of variation studies is served if any better genes or populations for atleast one trait are found, which could be used to improve the productivity of planting material [7]. Both *Q. leucotrichophora* and *Q. glauca* are very slow growing species and sufficient time in field tests is therefore, required for assessment of growth parameters. The present study reveals significant differences for germination and survival per cent amongst the investigated seed sources of both the species but fail to differentiate significantly amongst the seed sources for growth traits at the nursery stage. As seed source variation/provenance studies in these species have not been carried out hence, long term field tests are essentially required to screen out the best performing populations/ seed sources for growth traits for their subsequent exploitation in future improvement programmes.

REFERENCES

1. ADAMS, W.T & R.K. CAMPBELL (1981). Genetic adaptation and seed source specificity. In *Proc. Workshop: Reforestation of skeletal soils*. (S.D. Hobbs and O.T. Helgeson Eds). Medford, Oregon, 78-85.

2. GREGORIUS, H.R., H.H. HATTEMER, F. BERGMANN & G. MULLER-STARK (1985). *Umweltbelastung und Anpassungsfähigkeit von Baumpopulationen*. (Environmental stress and adaptability of forest tree populations). *Silvae Genetica*, 34: 230-241.
3. CHAMPION, H.G. & S.K. SETH (1968). *A revised survey of the forest types of India*. GOI Publication, New Delhi.
4. DAGDAS, S. (1995). Variation in growth of six-year old provenances of cedar (*Cedrus libani*) established in central Anatolia. *IC-Anadolu-Drmançilik-Arastırma-Fostitusu-Dergisi.*, 79: 117-136.
5. SELVAN, T. (1999). Progeny testing and *in-vitro* propagation, of *Acacia catechu* Willd. Ph.D. Thesis submitted to Dr. Y.S. Parmar, UHF, Nauni, Solan (H.P.) 135p.
6. SHARMA, RAJESHI, SURINDER KUMAR & K.S. THAKUR (2006). Genetic improvement of chir pine (*Pinus roxburghii* Sargent) in India — A Review. *Indian Forester*, 132(3): 314-328.
7. NAMKOONG, G., E.B. SNYDER & R.W. STONECYPHER (1966). Heritability and gain concepts for evaluating breeding systems such as seedling seed orchards. *Silvae Genet.*, 15: 76-84.