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Seedling parameters of *Quercus leucotrichophora* under natural conditions along altitudinal gradient at different locations of North West Himalayas

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Abstract
The present investigation entitled "Seedling parameters of *Quercus leucotrichophora* under natural conditions along altitudinal gradient at different locations of North west Himalayas" was carried out during the year 2018-19 to know the status of growth of ban oak seedlings under natural regeneration in Chail forests of district Solan, Kufri forests of district Shimla, Sarahan and Churdhar forests in Sirmaur district of Himachal Pradesh with three elevations i.e., E1 (<1500 m), E2 (1500-1800 m) and E3 (>1800 m) in each. The natural regeneration of ban oak in North West Himalayas is poor due to various reasons. Therefore, this study was conducted to know the growth of ban oak seedlings in natural conditions i.e., in Forests. Under this study, the seedlings were marked in the forests and next year, its growth parameters were evaluated. The results from the present study showed that there was no significant effect of elevation on the growth of seedlings of ban oak was observed. Among locations, seedlings collected from Churdhar forests showed best results for all seedling parameters. As the seedlings selected in the forests were young due to which no such variation in the growth was recorded.

Keywords: Seedling parameters, ban oak, elevations, locations etc.

Introduction
Quercus leucotrichophora belonging to fagaceae family is among important hardwood species of the world occupying a sizable area in Himalayan ecosystem. It flowers from April to May and fruits in the month of December. The seeds/acorns are eaten by monkeys, squirrels, and flying foxes whereas the seedlings are affected by grazing and browsing, as the leaves are an excellent fodder for the animals. Plant regeneration is a complex and dynamic process which includes many factors (e.g. flowers, pollination, seed maturity stage, emergence and establishment, planting practices, vegetation management and silvicultural system etc.) that depend upon abiotic environment. Seedling establishment is the earliest and critical life history stage, most sensitive to micro environment and available resources particularly soil moisture. The regeneration of degraded ecosystems is extremely difficult due to the physical instability and environmental characteristics of the area (Silori and Mishra 2001) [11]. The causes of regeneration failure include: lack of viable seeds due to insect or animal predation, unfavorable micro sites and grazing of seedlings by domesticated animals. Under *Quercus*, leaf litter is thick which poses a problem for the seeds to germinate. Sometimes stand characteristics such as stand height, diameter, crown and light penetrance etc. also affect the regeneration of the species. Keeping in view the ecological importance of the species and regeneration problems the present investigation was carried out to study the growth of young seedlings along altitudinal gradient in different locations of North West Himalayas.

Material and Methods
The present investigation entitled "Seedling parameters of *Quercus leucotrichophora* under natural conditions along altitudinal gradient at different locations of North west Himalayas" was conducted during the year 2018-19 to find the growth parameters of regeneration of ban oak in Chail forests of district Solan, Kufri forests of district Shimla, Sarahan and Churdhar forests in Sirmaur district of Himachal Pradesh. The aim of the study was to assess the seedling growth parameters from natural regeneration of *Quercus leucotrichophora* in different locations along elevations. The elevations chosen were E1 (<1500 m), E2 (1500-1800 m) and E3 (>1800 m).

In each location and at each elevation, three quadrats of size of 2m × 2m were laid out with three replications at each elevation and the seedlings were marked. The seedlings of ban oak were plucked next year from the quadrat and brought to laboratory for measurement of seedling parameters and dried for measuring biomass.

Results and Discussion

The marked seedlings in the ban oak forests were collected next year from all the locations and elevations, after which the growth parameters were evaluated. Some marked seedlings were absent which were eaten by browsing animals and some were covered by the leaves and needles of neighbouring associates of ban Oak. The seedling parameters collected (Table 1-3) are described as under:

Collar diameter (mm)

The seedlings of ban oak in different locations exhibited significant difference for collar diameter of seedlings with maximum value of 2.48 mm in Churdhar forests followed by Chail and Kufri forests with same value of 1.82 mm and minimum 1.69 mm in Sarahan forests, whereas elevations and locations x elevations interaction (L x E) was recorded with non significant effect on collar diameter of seedlings.

Seedling Height (cm)

The mean seedling height was affected significantly for different locations with highest seedling height 11.86 cm in Churdhar forests followed by Kufri forests (9.22 cm) and lowest (8.28 cm) in Sarahan forests while the effect of elevations and locations x elevation interaction (L x E) was recorded non significant.

Number of leaves

It is evident from data in Table 1 that locations, elevations and locations x elevations interaction (L x E) had no significant effect on number of leaves. However, the maximum number of leaves (7.44) was observed in Churdhar forests followed by Kufri forests (6.22) and lowest (5.67) in Sarahan forests. The elevations showed an increasing trend for number of leaves as: E1 (6.08) > E2 (6.17) > E3 (6.75).

Table 1: Collar Diameter (mm), Seedling Height (cm) and No. of leaves per plant of ban oak in different locations along increasing elevations

	Collar Diameter (mm)				Seedling Height (cm)				No. of Leaves			
Elevations (E) / Locations (L)	E1 <1500m	E2 1500-1800m	E3 >1800m	Mean	E1 <1500m	E2 1500-1800m	E3 >1800m	Mean	E1 <1500m	E2 1500-1800m	E3 >1800m	Mean
Chail forests	1.67	2.00	1.78	1.82	10.00	7.17	7.67	8.28	5.33	5.33	7.33	6.00
Kufri forests	1.94	1.70	1.82	1.82	9.27	10.40	8.00	9.22	5.00	7.67	6.00	6.22
Churdhar forests	2.33	2.47	2.62	2.48	9.17	12.60	13.80	11.86	6.33	7.33	8.67	7.44
Sarahan forests	1.66	1.77	1.64	1.69	9.40	7.23	9.90	8.84	7.67	4.33	5.00	5.67
Mean	1.90	1.99	1.97		9.46	9.35	9.84		6.08	6.17	6.75	
$CD_{0.05}$ (L)	0.56	2.49	NS									
(E)	NS	NS	NS									
(L X E)	NS	NS	NS									

Shoot length (g)

Data in Table 2 showed that locations, elevations and location x elevation interaction (L x E) had no significant effect on mean shoot length. However, it was recorded highest (11.81 cm) in Churdhar forests followed by Kufri forests (10.11 cm) and lowest (8.44 cm) in Chail forests. The length of the seedlings can be affected by the accumulation of dry matter (Leaves and needles) which suppressed the shoot growth.

Fig 1: Seedlings collected from ban oak forests

Root length (g)

The mean root length was not affected significantly by locations, elevations and locations x elevations interaction (L x E). The mean root length of ban oak seedlings was recorded highest (13.29 cm) in Kufri forests and smallest (11.99 cm) in Sarahan forests whereas with elevation, the root length was found to decrease as: E3 > E2 > E1, respectively. The root length can be affected by the forest floor which varies with elevation.

Table 2: Shoot Length (cm) and Root Length (cm) of ban oak seedlings in different locations along increasing elevations

Elevations (E) / Locations (L)	Shoot Length (cm)				Root Length (cm)			
	E1 <1500m	E2 1500-1800m	E3 >1800m	Mean	E1 <1500m	E2 1500-1800m	E3 >1800m	Mean
Chail forests	10.50	8.02	8.02	8.84	12.53	12.67	12.17	12.46
Kufri forests	9.62	10.75	9.97	10.11	13.55	9.67	16.67	13.29
Churdhar forests	9.67	14.15	11.60	11.81	12.33	13.83	13.33	13.17
Sarahan forests	9.75	10.25	10.25	10.08	11.00	13.70	11.27	11.99
Mean	9.88	10.79	9.96		12.35	12.47	13.36	
$CD_{0.05}$ (L)	NS	NS						
(E)	NS	NS						
(L X E)	NS	NS						

Dry Shoot Weight (g)

The dry shoot weight was also not affected significantly by locations, elevations and locations x elevations interaction (L x E). However, maximum dry weight of shoots of ban oak seedlings was highest (1.12 g) in Churdhar forests followed by Chail forests (0.66 g), Sarahan forests (0.63 g) and lowest (0.55 g) in Kufri forests. Among elevations, the shoot weight was found to increase from lower to higher elevation as: E1 < E2 < E3.

Dry Root weight (g)

The dry root weight of ban Oak seedlings was affected significantly by locations with highest value (1.31 g) in Churdhar forests followed by Chail forests (0.99 g), Kufri forests (0.80 g) and lowest (0.48 g) in Sarahan forests whereas elevations and interaction between locations and elevations (L x E) was recorded non significant.

Total dry Biomass (g)

The total dry biomass of ban oak seedlings was observed significant for locations with maximum (2.43 g) in Churdhar forests followed by Chail forests (1.64 g), Kufri forests (1.35 g) and least (1.12 g) in Sarahan forests. However, the interaction effect of locations and elevations (L x E) and elevations was recorded non significant for total dry biomass of ban oak seedlings.

Table 3: Dry root weight (g), dry shoot weight (g) and total biomass (g) of ban oak seedlings in different locations along increasing elevations

Elevations (E) / Locations (L)	Dry Shoot Weight (g)				Dry Root Weight (g)				Total Biomass (g)			
	E1 <1500m	E2 1500-1800m	E3 >1800m	Mean	E1 <1500m	E2 1500-1800m	E3 >1800m	Mean	E1 <1500m	E2 1500-1800m	E3 >1800m	Mean
Chail forests	0.42	0.74	0.81	0.66	1.03	1.06	0.87	0.99	1.44	1.79	1.68	1.64
Kufri forests	0.51	0.67	0.48	0.55	0.79	0.72	0.87	0.80	1.30	1.39	1.35	1.35
Churdhar forests	1.00	1.07	1.29	1.12	0.89	1.16	1.87	1.31	1.89	2.23	3.16	2.43
Sarahan forests	0.71	0.61	0.58	0.63	0.50	0.48	0.46	0.48	1.21	1.10	1.04	1.12
Mean	0.66	0.77	0.79		0.80	0.86	1.02		1.46	1.63	1.81	
$CD_{0.05}$ (L)	NS	0.55	0.93									
(E)	NS	NS	NS									
(L X E)	NS	NS	NS									

It the present study, altitude had no significant effect on the different parameters of ban oak seedlings. The reason for no significant variation may be due to collection period because the seedlings from the forests were one year old seedlings which still had to face competition for light and space. As the seeds have enough food material which is utilized in early growth of the seedlings after which the seedlings were subjected to be lost due to competition and human/ animal interferences next year. Due to all these reasons there was no variation among the seedlings along altitude. The growth of the seedlings in initial stage or first year is also affected by the deposition of thick leaf litter on the forest floor in ban oak forests which delays germination. The shoot length in the present study varied from 8.02 cm (E3 of Chail forests) to 14.15 cm (E2 of Churdhar forests), whereas root length varied from 9.67 (E2 of Kufri forests) to 16.67 cm (E3 of Kufri forests) which also signifies the above ground stress by which the root length increased by shoot length. Among locations, seedlings collected from Churdhar forests showed maximum values for all the parameters. This may be due to the suitable site conditions and fewer animals' interferences which lead to good growth of seedlings in Churdhar forests. No such study has been carried out by any researchers.

Pandit *et al.* (1999) [7] carried out a study in a high-altitude chir pine (*Pinus roxburghii*)-mixed oak (*Quercus leucotrichophora*) at 5 sites between 1800 and 2100 m altitude in the Gwaldam area in Uttar Pradesh. They found the low density of seedlings and saplings in almost all the species in the forest indicated a poor regeneration pattern. Due to severe lopping pressure *Q. leucotrichophora* fails to produce seeds. Quazi (2001) [8] studied the regeneration and the formation of pure stands of banj oak on abandoned terraces in the central Himalayas. Results showed that the species and regeneration microsite interaction was significant for variables measured (density, height and root collar diameter). In another experiment, Rajwar *et al.* (1991) [9] studied the regeneration status of an oak forest of Garhwal Himalaya in which he found only 88 per cent of the tree species were recorded at the seedling stage and the percentage was still further reduced at the sapling stage. Seeds wastage due to frugivory, inadequate regeneration, low establishment of seedlings and trampling driven damages to seedlings caused by browsing animals are attributed as key reasons for degradation of oaks forest (Thadani and Ashton 1995) [13].

Significant results for seedlings parameters of ban oak were obtained by many researchers in nursery conditions. A study done by Saklani *et al.* 2012, in one year old seedlings of *Q. leucotrichophora* whose seeds were collected from 18

provenances showed that the shoot length was the highest in Budashu (39.55 cm) and the lowest (31.81 cm) in Dovsrikot provenance. Likewise, root length was maximum (41.86 cm) in Bankura and minimum (15.43 cm) in Bersuri among various provenances. Root/shoot ratio was recorded maximum (1.14) in Bankura and minimum (0.47) in Solan provenance. Collar diameter of seedlings was recorded maximum (3.80 mm) in Bersuri provenance and minimum (2.76 mm) in Solan provenance. Maximum (12.44) number of leaves per plant was recorded in Kandoliya provenance. Among various components of seedlings, roots contributed the highest biomass followed by leaves and shoot, irrespective of provenances. On average, there were 4.62, 1.97 and 2.86-fold a variation between minimum and a maximum value of biomass partitioned by roots, shoots and leaves, respectively, irrespective of provenances. Seedling growth traits, however, did not exhibit any positive or negative trend with altitude except collar diameter.

A study conducted by Kuhne and Bartsch (2007) [5] on *Quercus robur* seedlings in which they gave flooding and non flooding treatments for 24 weeks. The non-flooded seeds (C) after 24 weeks of growth of seedlings recorded the number of plants (48), shoot length (389.4 mm), root collar diameter (3.08mm), number of leaves (9.9), total leaf area (162.7cm^2), root weight (0.77g), shoot weight (0.49 g) and leaf weight (0.55g). Due to increased competition for resources and space in forests among understorey vegetation inhibit the growth of seedlings. Crow (1988) [2] also found that shrubs and herbaceous vegetation inhibit growth of seedlings and saplings of trees. According to Moktan *et al*. (2009) [6], the presence of abundant shrubs and herbs impedes seedling establishment of both shade-tolerant and intolerant species. The seedlings are more prone to competition from herb and shrubs than saplings (Gairola *et al.* 2012) [4].

Several studies have been carried out to examine the variation in seedling traits among the seed sources in different species in Garhwal Himalaya *viz*. *Terminalia tomentosa*, *T. bellerica*, *T. chebula* (Chauhan *et al*. 2007) [1], *Grewia optiva* (Uniyal *et al*. 2002) [14], *Albizia chenensis* (Dhanai *et al.* 2003) [3], *Celtis australis* (Singh and Bhatt 2008) [12].

Conclusion

From the present study, it can be concluded that seedling parameters did not show a significant variation with altitude which may be due to the reason that the seedlings collected from the forests were one year old seedlings which still had to face competition for light and space. The seedlings were also subjected to be lost due to human and animal interference next year, as some seedling under study was affected by the browsing animals. Due to all these reasons there was no variation among the seedlings along altitude was seen. Among locations, Churdhar forests showed good results for seedling parameters due to good site conditions and less animal interference. In natural conditions, seedlings are subjected to stress, competition, browsing and trampling damage due to which the survival rate becomes lesser and the growth also slows down. Transplanting of nursery stock is best option to fully stock the forests. Early protection to the ban oak seedlings is desired to ensure good regeneration in the forests and more research is required to be carried out to study the variation in growth of ban oak seedlings.

References

1. Chauhan S, Singh B, Bhatt BP, Todaria NP. Effects of the altitude of seed origin and storage on germination of three *Terminalia* species, Garhwal Himalaya, India. Forests Trees and Livelihoods. 2007;17:339-344.
2. Crow TR. Reproductive mode and mechanisms for self-replacement of northern red oak (*Quercusrubra*) - a review. Forest Science. 1988;34:19-40.
3. Dhanai CS, Uniyal AK, Todaria NP. Source Variation in *Albizia chinensis* (OSBECK) MER. Seed and seedling characteristics. Silvae Genetica. 2003;52(5–6):259-266.
4. Gairola S, Sharma CM, Ghildiyal SK, Suyal S. Regeneration dynamics of dominant tree species along an altitudinal gradient in moist temperate valley slopes of the Garhwal Himalaya. Journal of Forestry Research. 2012;23(1):53-63.
5. Kuhne C, Bartsch N. Germination of acorns and development of oak seedlings (*Quercus robur* L.) following flooding. Journal of Forest Science. 2007;53(9):391-399.
6. Moktan MR, Gratzer G, Richards WH, Rai TB, Dukpa D. Regeneration and structure of mixed conifer forests under single-tree harvest management in the western Bhutan Himalayas. Forest Ecology and Management. 2009;258:243-255.
7. Pandit A, Tewari A, Ram J. Tree layer analysis and regeneration in a mixed conifer-oak forest in central Himalaya. Indian Journal of Forestry. 1999;21:290-297.
8. Quazi S. Regeneration and the formation of pure stands of banj oak (*Quercus leucotrichophora* A. Camus) on abandoned terraces in the central Himalayas. TRI News. 2001;20:29-32.
9. Rajwar GS, Dhaulakhandi M, Kumar P. Regeneration status of an oak forest of Garhwal Himalaya. Indian Forester. 1991;125:623-630.
10. Saklani KP, Singh B, Bhatt BP. Influence of altitude on seed and seedling characteristics in *Quercus leucotrichophora* A. Camus. ex. Bahadur. Silvae Genetica. 2012;61(1-2):36-43.
11. Silori C, Mishra BK. Assessment of livestock grazing pressure in and around the elephant corridors in Mudumalai Wildlife Sanctuary, South India. Biodiversity and Conservation. 2001;10(12):2181-2195.
12. Singh B, Bhatt BP. Variability in seed and seedling traits of *Celtis australis* in Central Himalaya, India. Plant Genetic Resources News Letters. 2008;156:56-61.
13. Thandani R, Ashton PMS. Regeneration of banj oak (*Quercus leucotrichophora* A Camus) in the Central Himalaya. Forest Ecology and management. 1995;78:217-224.
14. Uniyal AK, Bhatt BP, Todaria NP. Provenance variation in seed characteristics of *Grewia oppositifolia* Roxb. – A Promising agroforestry tree-crop of Central Himalaya. India. Indian Journal of Forestry. 2002;25(2):209-214.