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Effect of stratification on height of seedlings per month of spruce (*Picea smithiana*) under nursery conditions in North Kashmir Himalayas (India)

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Abstract
The seeds collected from different altitudes were exposed to moist chilling ranging from 0-60 days at 4±1 °C and 8±1 °C. Seed samples were drawn for studies after subjecting the seeds to chilling duration of 0,15,30,45, and 60 days and evaluated for germination in nursery. Different altitudes, chilling temperatures and chilling durations significantly influenced the germination characteristics of *Picea smithiana*. Nursery performance of seeds was also affected due to altitude, chilling temperature and chilling duration. Maximum cumulative height after one growing season was recorded in seeds subjected to chilling at 4±1 °C for 60 days at lower altitude (4.67cm) and it decreased with increasing altitude.

Keywords: seeds, nursery, altitudes, chilling temperatures and chilling durations

1. Introduction
In Himalayas, the three conifer species especially *Pinus*, *Cedrus* and *Picea* are distributed on an altitudinal line one above the other in tires, in pure or in mixed species combination. Four genera *Abies*, *Cedrus*, *Picea* and *Pinus* form extensive forest of great economic value in the Himalayas. Spruce (*Picea smithiana* Wall. Boiss) commonly referred as high level conifer, it produce good seeds at an interval of 4-6 years (Singh and Singh, 1984) [17]. The *P. smithina* occurs throughout the western Himalayas from Afghanistan eastwards at least as far as Kumaun, Uttrakhand in India chiefly at elevation of 2,100-3,350 m amsl, though occasionally descending lower on northern aspects and ascending higher on southern aspects.

Coniferous seeds are generally characterized by physiological, morphological or morpho-physiological dormancy, often complicated by the inhibitory effect of hard seed coat (Nikolaeva, 1990) [12]. This type of dormancy is primarily due to undeveloped embryo or decreased metabolic activities of the embryo and requires cold stratification treatment to produce sufficient level of enzymes, hormones, soluble metabolites and other compounds needed by the embryo for germination). Moist chilling or cold stratification has been widely used as a pre-sowing treatment for breaking dormancy and enhancing the maximum rate and percentage germination of dormant seeds of many tree species (Schopmeyer, 1974; AOSA, 1992; ISTA, 1993) [16, 1, 9]. The technique is simple, inexpensive and effective in overcoming seed dormancy, although the phenomenon is not yet fully explained. However, the effects of moist chilling in establishing hormonal levels that favour germination have been suggested to result from cold-stimulation of appropriate enzyme activity (Nikolaeva, 1977) [11]. Conifer seeds can withstand extreme cold, but once water is imbibed, they become less tolerant of low temperature (Coursolle *et al.* 1998; Sakai and Larcher, 1987) [6, 15].

2. Materials and Methods
2.1 Description of experimental site
Three altitudes (each having 2 sites) situated in North Kashmir were selected for seed collection for the study having altitudinal range of 2,200-2,600 m (Langate Forest Division), 2,600-3,000 m (Jhelum valley Forest Division) and 3,000-3,400 m (Kamraj Forest Division).
The seeds were subjected to moist chilling for a period ranging from 0-60 days. For the purpose, three sets of seeds were formed from six sites after bulking the seeds from each division. The seeds were kept in cold water for 48 hours and after draining excess water were stored in sealed air tight containers in refrigerator at 4±1 and 8±1ºC for chilling

treatment which ranged from 0 to 60 days. After chilling treatment seeds were tried for germination in nursery

2.2 Nursery conditions
Design = RBD
Observation was recorded on following parameter.

2.2.1 Growth height per month
The length of the elongating shoot was measured at an interval of one month with a measuring scale up to the end of growing season.

2.3 Data analysis
The entire data generated from the present investigation were subjected to statistical analysis as per methods described by Gomez and Gomez (1984) [8]. The least significant difference at 0.05 per cent level was used for testing the significant differences among treatments. The data for both the years of investigation were pooled after performing homogeneity test. The heterogeneous data were pooled by the weighed means method as described by Nigam and Gupta (1979) [10]. Stastical package used was SAS software licenced to (SAS incorporation USA) licenced to Division of Agri-statistics Shalimar Srinagar

3. Results
Height of seedlings per month
Height of seedlings raised from seed samples collected from different altitudes was recorded monthly from April to November. The results are described separately for 4±1 °C and 8±1 °C of chilling temperature.

3.1 Chilling temperature 4±1 ºC
The maximum mean cumulative height of 4.150 cm was recorded in the seedlings raised from seed samples collected from lower altitude (2,200-2,600 m), which was significantly higher than 3.860 and 3.570 cm recorded in the seedlings raised from seed samples collected from middle (2,600-3,000 m) and upper altitudes (3,000-3,400 m) respectively (Table 1). Regarding effect of chilling duration the maximum cumulative height was found in lower altitude (2,200-2,600 m) which was 4.670 cm in seedlings where seeds were subjected to 60 days chilling duration respectively. Similarly at middle altitude the maximum cumulative growth height was 4.280 cm after 60 days of chilling duration. At higher altitude maximum height was 3.830 cm after 60 days of chilling.

Table 1: Altitudinal variation in cumulative height (cm) recorded monthly in Spruce (*Picea smithiana*) seedlings under nursery conditions as influenced by different chilling durations at (4± 1 ºC) chilling temperature

Altitude (m)	Months	Chilling duration (Days)					
		Control	15	30	45	60	Mean
2,200-2,600	April	2.870	3.250	3.460	3.690	3.800	3.410
	May	3.000	3.400	3.630	3.820	4.000	3.570
	June	3.190	3.630	3.820	4.050	4.220	3.780
	July	3.400	3.920	4.070	4.250	4.540	4.030
	August	3.740	4.250	4.430	4.620	4.930	4.390
	September	3.850	4.380	4.750	4.950	5.250	4.630
	October	3.890	4.410	4.870	5.050	5.320	4.700
	November	3.890	4.430	4.870	5.110	5.340	4.720
Mean		3.470	3.950	4.230	4.440	4.670	4.150
2,600-3,000	April	2.750	2.870	3.340	3.540	3.600	3.220
	May	2.820	2.930	3.400	3.630	3.730	3.300
	June	2.920	3.180	3.630	3.810	3.900	3.480
	July	3.100	3.520	3.870	4.160	4.230	3.770
	August	3.420	3.940	4.320	4.550	4.590	4.160
	September	3.490	4.140	4.460	4.690	4.720	4.300
	October	3.520	4.190	4.470	4.720	4.740	4.320
	November	3.550	4.210	4.480	4.730	4.760	4.340
Mean		3.190	3.620	3.990	4.220	4.280	3.860
3,000-3,400	April	2.640	2.850	3.210	3.290	3.360	3.070
	May	2.700	2.930	3.300	3.350	3.440	3.140
	June	2.890	3.100	3.490	3.510	3.540	3.300
	July	3.120	3.320	3.670	3.690	3.700	3.500
	August	3.350	3.570	3.970	4.000	4.090	3.790
	September	3.430	3.710	4.120	4.140	4.170	3.910
	October	3.460	3.750	4.170	4.180	4.200	3.950
	November	3.490	3.770	4.180	4.200	4.210	3.970
Mean		3.130	3.370	3.760	3.790	3.830	3.570

CD ($P \leq 0.05$)
Months (M): 0.008 M×A: 0.014
Altitudes (A): 0.005 M×D: 0.019
Durations (D): 0.007 A×D: 0.011
M×A×D: 0.032

3.2 Chilling temperature (8±1 ºC)
The maximum mean cumulative height of 3.930 cm was recorded in the seedlings raised from seed samples collected from lower altitude (2,200-2,600 m), which was significantly higher than 3.640 and 3.390 cm recorded in the seedlings raised from seed samples collected from middle (2,600-3,000 m) and upper altitudes (3,000-3,400 m) respectively (Table 2). Regarding effect of chilling duration the maximum cumulative height was found in lower altitude (2,200-2,600 m) which was 4.380 cm in seedlings where seeds were

subjected to 60 days chilling duration respectively. Similarly at middle altitude the maximum cumulative growth height was 4.100 cm after 60 days of chilling duration. At higher altitude maximum height was 3.760 cm after 60 days of chilling.

Table 2: Altitudinal variation in cumulative height (cm) recorded monthly in Spruce (*Picea smithiana*) seedlings under nursery conditions as influenced by different chilling durations at (8±1 °C) chilling temperature

Altitude (m)	Months	Chilling duration (Days)					
		Control	15	30	45	60	Mean
2,200-2,600	April	2.800	3.130	3.290	3.420	3.610	3.250
	May	2.900	3.260	3.420	3.530	3.780	3.370
	June	3.090	3.450	3.590	3.730	3.990	3.570
	July	3.390	3.720	3.910	3.930	4.280	3.840
	August	3.470	4.030	4.260	4.300	4.620	4.190
	September	3.830	4.140	4.480	4.550	4.960	4.390
	October	3.860	4.170	4.550	4.640	4.920	4.420
	November	3.860	4.180	4.590	4.640	4.950	4.440
Mean		3.430	3.760	4.010	4.090	4.380	3.930
2,600-3,000	April	2.540	2.700	3.130	3.410	3.480	3.050
	May	2.700	2.750	3.220	3.510	3.600	3.150
	June	2.790	2.950	3.420	3.680	3.750	3.310
	July	2.950	3.240	3.640	3.990	4.040	3.570
	August	3.230	3.610	4.030	4.350	4.380	3.920
	September	3.290	3.790	4.140	4.480	4.510	4.040
	October	3.320	3.830	4.150	4.500	4.520	4.060
	November	3.340	3.870	4.160	4.520	4.540	4.080
Mean		3.020	3.340	3.730	4.050	4.100	3.640
3,000-3,400	April	2.550	2.680	3.000	3.090	3.310	2.920
	May	2.590	2.740	3.070	3.140	3.370	2.980
	June	2.750	2.910	3.260	3.270	3.450	3.120
	July	2.950	3.120	3.470	3.500	3.640	3.330
	August	3.170	3.340	3.730	3.800	4.010	3.610
	September	3.230	3.450	3.860	3.910	4.070	3.700
	October	3.260	3.500	3.900	3.940	4.110	3.740
	November	3.280	3.530	3.920	3.970	4.120	3.760
Mean		2.970	3.150	3.520	3.570	3.760	3.390

CD ($P \leq 0.05$)
Months (M): 0.014 M×A: 0.024
Altitudes (A):0.008 M×D: 0.030
Durations (D):0.011 A×D: 0.019
M×A×D: 0.053

4. Discussion

4.1 Height per month

Height which is the change in actual growth over time and is an important index of productivity. In the present study different altitudes, chilling temperatures as well as duration of chilling had an effect on height of seedlings. During one growing season the maximum growth of 4.72 cm was recorded in the seedlings raised from seed samples that were exposed to 4±1 °C and collected from lower altitude, which was significantly higher than 4.34 and 3.97 cm recorded in the samples of middle and upper altitudes respectively. Similarly at 8±1 °C chilling temperature the maximum growth of 4.44 cm was also recorded in the seed samples of lower altitude that was also significantly higher than 4.08 and 3.76 cm recorded in the seed samples of middle and upper altitudes respectively. Chilling period also influenced growth rate significantly. At 4±1 °C the height of 3.64 cm in control increased significantly to 4.13, 4.51, 4.680 and 4.77 cm, while as at 8±1 °C the height of 3.49 cm in control increased significantly to 3.86, 4.22, 4.37, and 4.53 cm corresponding to 15,30,45, and 60 days of chilling respectively. Height rate determines which seedling is efficient, more efficient the seedling more is the growth rate (Causton, 1983, Brand, 1991) [3, 2]. Growth rate is the most important index of productivity (Radosevich and Osteryoung, 1987) [14]. Growth rate gives the change in actual growth over time (Wareing and Philips, 1981) [20]. Thus it was observed that best result for height was recorded in lower altitude (4.670) after 60 days of chilling at 4±1 °C. Parvin *et al*. (2015) [13] documented that seeds of *Juglans nigra* subjected to 2 months stratification and treated with 400 ppm GA_3 showed the maximum increment in growth.

In the present investigation seed germination parameters showed strong positive correlations with growth parameters. Seed germination and seedling growth parameters are interdependent and are governed by genetic makeup, environmental influences and seed traits (Dunlap and Barnett, 1983) [7]. Growth parameters have strong positive relationship with seed size and weight (Chauhan and Raina, 1980) [4] and these seed traits regulate germination and subsequent plant growth. Similar variation among the seed size categories in the growth characteristics has also been reported by several researchers, Singh and Saxena (2009) [18] in *Jatropha Curcus*, Uniyal *et al*. (2007) [19] in *Azadirachra indica* and Cicek and Tilki (2007) [5] in *Castanea sativa*.

5. Conclusion

The seeds of *Picea smithiana* are dormant and thus need stratification for dormancy release.

The stratification at 4±1 °C chilling temperature proved better than 8±1 °C.

Higher chilling duration of 60 days improved seed germination characteristics and seedling performance in Spruce seeds. Significant improvement in seedling was achieved when seeds were subjected to higher chilling durations. The altitudes that produced heavy seeds improved the seed germ inability and seedling performance.

6. References

1. AOSA. Association of Official Seed Analysts. Rules for testing seeds. Journal of Seed Technology. 1992; 6:1-125.
2. Brand DG. The establishment of boreal and sub-boreal conifer plantations: an integrated analysis of environmental conditions and seedling growth. Society of American Foresters. 1991; 33:68-100
3. Causton DR. A Biologist's Basic Mathematics. Edward Arnold, London, 1983, 216.
4. Chauhan PS, Raina V. Effect of seed weight on germination and growth of chir pine (*Pinus roxburghii* sergeant). Indian Forester. 1980; 16(1):53-59.
5. Cicek E, Tilki F. Seed size effect on germination, survival and seedling growth of *Castanea sativa* Mill. Journal of Biological Sciences. 2007; **7**(2):438-441.
6. Coursolle C, Bigras FJ, Margolis HA. Frost tolerance and hardening capacity during the germination and early developmental stages of four white spruce (*Picea glauca*) provenances. Canadian Journal of Botany. 1998; 76:122-1 29.
7. Dunlap JR, Barnett JP. Influence of seed size on germination and early development of loblolly pine (*Pinus taeda* L.) germinants-Canadian Journal of Forest Research. 1983; 13:40-44.
8. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research (2nd Ed.). John Wiley and Sons, Inc. New York, 1984, 680.
9. ISTA. International Rules for Seed Testing. International Seed Testing Association. Seed Science and Technology, 1993, 21.
10. Nigam AK, Gupta UK. Handbook on Analysis of Agriculture Experiments. IARI Library Avenue, New Delhi, 1979, 307.
11. Nikolaeva MG. Factors controlling the seed dormancy pattern. In: The Physiology and Biochemistry of Seed Dormancy and Germination (Ed. A.A. Khan) North-Holland, Amsterdam, 1977.
12. Nikoleava MG. Characteristics of seed germination in gymnosperms. Botanichekii Zhurnal. 1990; 75(12):1648-1656.
13. Parvin P, Khezri M, Tavasolian I, Hosseini H. The effect of gibberellic acid and chilling stratification on seed germination of Eastern black walnut (*Juglans nigra* L.). Journal of Nuts. 2015; 6(1):67-76.
14. Radosevich SR, Osteryoung K. Principles governing plant-environment interactions pp. In: *Forest Vegetation Management for Conifer Production* (Eds. JD. Walstad and PJ. Kuch). John Wiley and Sons. New York. 1987; 523:105-156.
15. Sakai A, Larcher W. Frost survival of plants. Responses and adaptation to freezing stress. Springer Verlag, Berlin, 1987, 321.
16. Schopmeyer CS. Seeds of woody plants in the United States. USDA, Forest Service, Agriculture Handbook No. 450. Washington, DC: US Government Printing Office, 1974.
17. Singh V, Singh RV. Seed dispersal, seed germination and seedling establishment in natural forests of silver fir and spruce. Indian Forester. 1984; 110:632-639.
18. Singh N, Saxena AK. Seed size variation and its effect on germination and seedling growth of Jatropha Curcas L. Indian Forester. 2009; 135(8):135-1142.
19. Uniyal AK, Singh B, Todaria NP. Effect of seed size, sowing orientation and depth on germination and seedling growth in neem (*Azadirachta indica*). Seed Technology. 2007; 29(1):68-75.
20. Wareing PF, Phillips IDJ. Growth and differentiation in Plants, 3rd Edition Pergamon Press, Oxford, 1981, 189-200.