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Pre-sowing Treatments and Germination Behavior of *Pinus gerardiana* Wall- An Endangered Bio-resource of Dry Temperate Region

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ABSTRACT

The objective of study was to ascertain the appropriate and effective physical and chemical pre-sowing treatments given to chilgoza (*Pinus girardiana*) seeds to have better seed seedling ratio with quality attributes. Eleven pre-sowing treatments including six stratification periods of 15 days intervals were tested in completely randomized block design. The study revealed that significantly higher germination per centage (88.46%), capacity (85.00%) and energy (70.00%) was reported under outdoor stratification done for 45 days with 19-24°C temperate regime. The hierarchical order of the effect of pre-sowing treatments reported to be as stratification > BAP (2000ppm) > gibberlic acid (2000ppm) > gibberlic acid (2000ppm) + dilute H_2SO_4 > perchloric acid > gibberlic acid (1000ppm) + dilute H_2SO_4 > gibberlic acid (1000ppm) > hydrogen sulphide > hydrogen peroxide > hot water > cold water. Application of 2000 ppm BAP proved best among the growth and chemical treatments with higher value of germination per centage (72.00%) over rest of the tested similar pre-sowing treatment. The study also revealed that the chemical pre-sowing treatment namely hydrogen peroxide gave minimum (60.00%) germination percent value among all the tested chemical treatments. The present study recommends that the physical pre-sowing treatment as stratification done for 45 days (OD) and BAP (2000ppm) are the only treatments which proven best for getting the higher germination in stipulated period besides getting quality planting material of such economical and threatened bio-resource of dry temperate region of the North Western Himalayas.

INTRODUCTION

Neoza has aptly been described as the Champion of the Species of Rocky Mountains as it grows under difficult and harsh conditions prevailing in the inner Himalayas. It is the pioneer tree species for its inhabiting region (cold and arid conditions) and also gains significance in checking soil erosion. Its distribution is quite sparse in the world and is confined to mountainous regions of eastern Afganistan, parts of Pakistan and with scattered occurance in the valleys of Northern

Himalayas. In India, it is restricted to the dry temperate region of North Western Himalayas lying at an elevation varying from 1600 to 3300 m amsl. Chilgoza forests with good yield occur only in Kinnaur and some parts of Chamba district of Himachal Pradesh. It extends westward to Kishtwar and Astor in Jammu & Kashmir. The pine is known for its edible seeds (chilgoza) and holds pivtol role in the economy of the most of the families living in the areas of its distribution. In the past, the traditional harvesting rules made it possible to respect trees and allow a small portion of seeds to reach the ground and the trees were able to regenerate. Now, opening of roads and involvement of private contractors for seed collection has reversed the situation and making the condition more miserable with respect to the natural regeneration. As a consequence, virtually there is no natural regeneration of this species except in very small fraction of its range (5.0%) where the species is inaccessible to significant human exploitation (Richardson and Rundel 1998). Even the seeds left after extraction couldn't germinate due to one or the other reasons. The impediments in the way of natural regeneration are unrestricted collection, uncontrolled grazing and extremely inhospitable climatic and edaphic factors. Even in certain situations birds, rodents and reptiles, etc. also destroy the seeds. So, there is no regeneration of the species in practical sense. If the similar conditions prevail then the poorest inhabitants can't have the access to this valuable resource for their sustenance in the times to come. It is rarest pine under cultivation because of its limited pockets due to very low adaptability to new conditions. Therefore, considerable scope exists for increasing its availability with yield through proper care and management of the forests existing in its natural zone. The conifer seeds in general have high degree of dormancy which prevents their germination even when provided with favorable environmental conditions (Jull and Blazich 2000 and Sharma 2005). It is well documented that only 50 per cent area is used for direct seed sowing and rest is taken up for planting nursery raised quality stock. The regeneration problem associated with neoza pine needs an immediate attention for saving such valuable resource of inner dry temperate Himalayas. Therefore, the present investigation was taken to establish the best pre-sowing treatment for mass production of quality planting material to the tune of available plantation area.

MATERIAL AND METHODS

The study was conducted under laboratory conditions in the Faculty of Forestry, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir after getting the freshly collected seeds from Padar range of Kishtwar Forest Division of Jammu province in Jammu & Kashmir state. Seeds were subjected to eleven pre-sowing treatments including stratification. Stratification treatment at 15 days interval viz. P_1 (0 day), P_2 (15 days), P_3 (30 days), P_4 (45 days), P_5 (60 days) and P_6 (75 days) under four temperature regimes viz. T_1 (room temperature: 19-24°C), T_2 (out-door pit:16.5°C/04.50°C), T_3 (4$\pm$1°C) and T_4 (-4$\pm$1°C) in moist sand were tested. The rest of the treatments were cold and hot water, gibberlic acid (GA_3)1000 and 2000 ppm, perchloric acid (4 hrs.), BAP (2000 ppm), gibberlic acid (1000 ppm) + dilute H_2SO_4, gibberlic acid (2000 ppm) + dilute H_2SO_4, hydrogen sulphide (H_2S) and hydrogen peroxide (H_2O_2). The experiment comprised of 90 seeds per lot and each treatment replicated thrice in Completely Randomized Block Design (CRBD) in seed germinator at 25$\pm$1°C. The observation on germination parameters were recorded daily upto 28 days to accomplish the experiment. The germination parameters were calculated as per the following standard formulae:

Germination Percent: Germination percent was calculated as the per centage number of seeds germinated at the final count.

$$\text{Germination (\%)} = \frac{\text{Number of germinated seeds}}{\text{Total number of seeds kept}} \text{X100}$$

Germination Capacity (GC):

$$GC = \frac{\text{Number of seeds germinated at the end of test period} + \text{Number of un-germinatedviable seed}}{\text{Total number of sown seeds}} \times 100$$

Germination Energy (GE): Percentage of the total number of seeds that had gerrminated when the germination reached its peak.

$$GE = \frac{\frac{\text{Number of seeds germinated upto peak}}{\text{Time of germination}}}{\text{Number of seeds kept for test}} \times 100$$

The germination test was done in trays lined with double fold germination blotter paper. The seeds were placed sparsely and moistened as and when required. The trays were monitored regularly. The seeds were considered to be germinated as soon as radical emerged out. The data with respect to the germination parameters were analyzed with standard statistical procedures and discussed in the results and discussion head.

RESULTS AND DISCUSSION

The data presented in Fig. and 2 revealed that the tested pre-sowing treatments gave statistical significant effect on the germination parameters namely germination per centage, capacity and energy among all the treatments given to neoza pine seeds.

Effect of stratification periods on germination behavior

It is clearly indicate from the fig 1.0 that the germination per centage found to increase consistently with the increase in the period of stratification from 0 to 45 days and thereafter decreased in the rest of the two stratified periods of 60 and 75 days in room temperature (RT) and outdoor (OD) stratification treatment. But, the story is not similar as far as refrigerated conditions for the same stratified periods. The highest germination of 88.46 per cent obtained when seeds were stratified for 45 days (P_3:Out-door; 19-24°C) and this value behaved statistically at par with P_4 (60 days, outdoor; 19-24°C) and (45 days, refrigerated condition, 4$\pm$1°C) treatments. It is further observed that the stratification done for 45 days outdoor gave 67.32 per cent more germination percentage over the non-stratified seeds (control) where it gave only 28.90 per cent germination. The results are in congruous with the earlier findings of Singh (1989) in Spruce whereas Malik and Shamet (2008) worked on neoza pine seeds and supported the present outcome of the investigation. The stratification done for 45 days (4$\pm$1°C) in refrigerated conditions also gave 82.17 per cent germination which was at par with stratification (60 days, outdoor; 19-24°C) treatment. The higher germination under cold stratification entails due to the increased endogenous levels of gibberlin which stimulated the enzyme activities at faster rate (Gasper et. al. 1975). Seeds stratified for 75 days (-4 $\pm$1°C) gave only 32.00 per cent germination which was next to the control (no pre-sowing treatment) as far as germination values are concerned. But overall, it is observed that outdoor and/or warm stratification gave higher germination as compared to the cold stratification. This may be ascribed to the physiological reason that germination needs warmer conditions. Germination capacity and energy behaved invariably as that of germination per centage with stratification treatment. The enhancement in the germination per centage of neoza pine seeds with the pre-sowing treatments is due to the fact that the biochemical constituents are found to change during the stratification. The findings are equally advocated by Ching (1973) and Dogra (2003). It is also observed from the Fig. 1 that stratification temperature exerts significant effect on germination parameters of neoza pine seeds. The present findings are in line with earlier reported by Schineider and Gifford (1994) and Kao and Rowan (1970).

Effect of growth regulators and chemical treatments on germination behavior

It is evident from the Fig. 2 that the germination values obtained under the influence of growth regulators and chemical treatments are somewhat low as compared to the stratification treatment. However, the highest germination per centage (72.00%) was obtained when the seeds were treated with BAP 2000ppm and lowest (60.00%) was under the influence of hydrogen peroxide (H_2O_2) among the tested growth regulators and chemical treatment. But, the overall least germination percentage was found when no treatment is given to the seeds. The Fig. 2 also shows that the water treatment as pre-sowing treatment gave low values of germination parameters while compared with stratification,

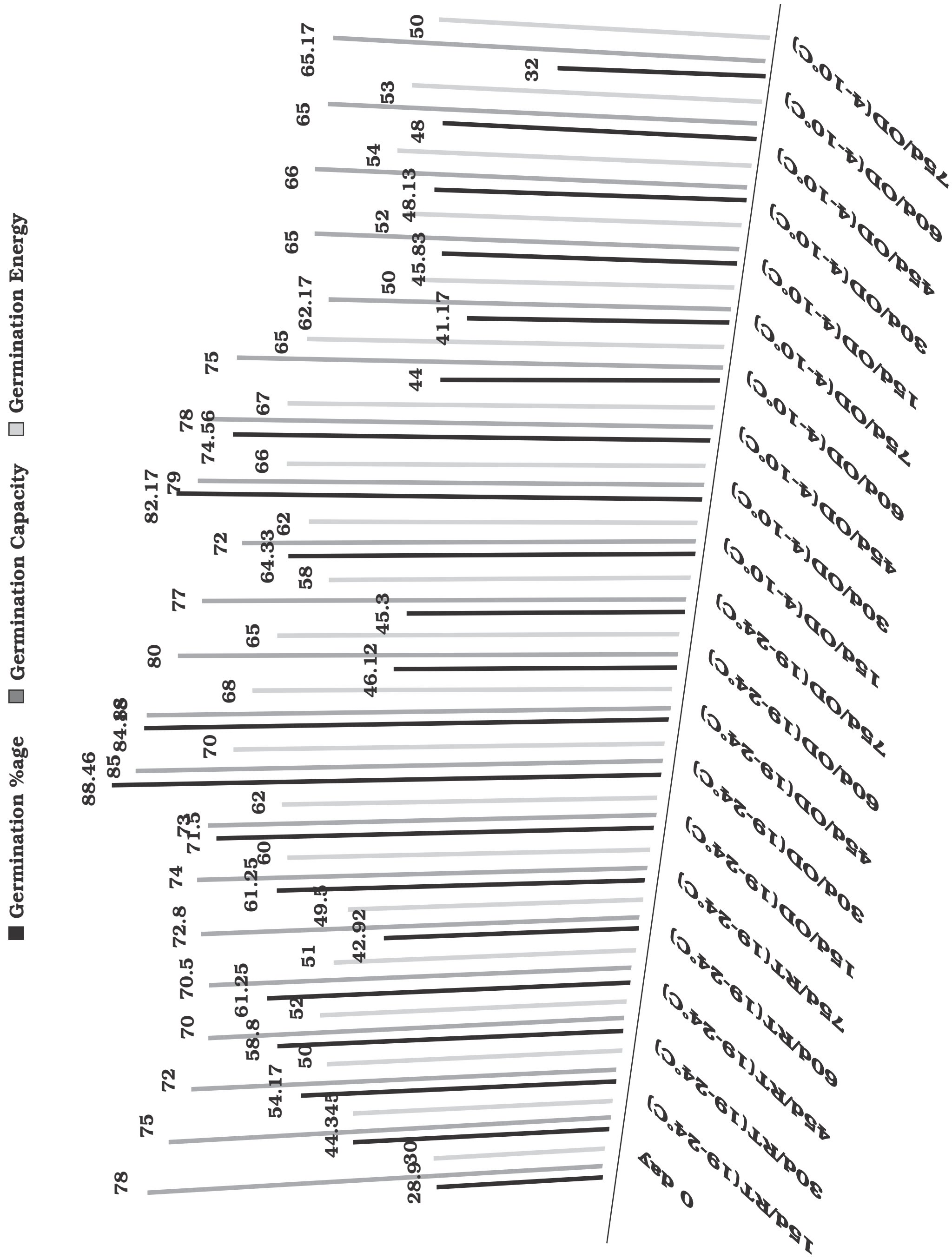
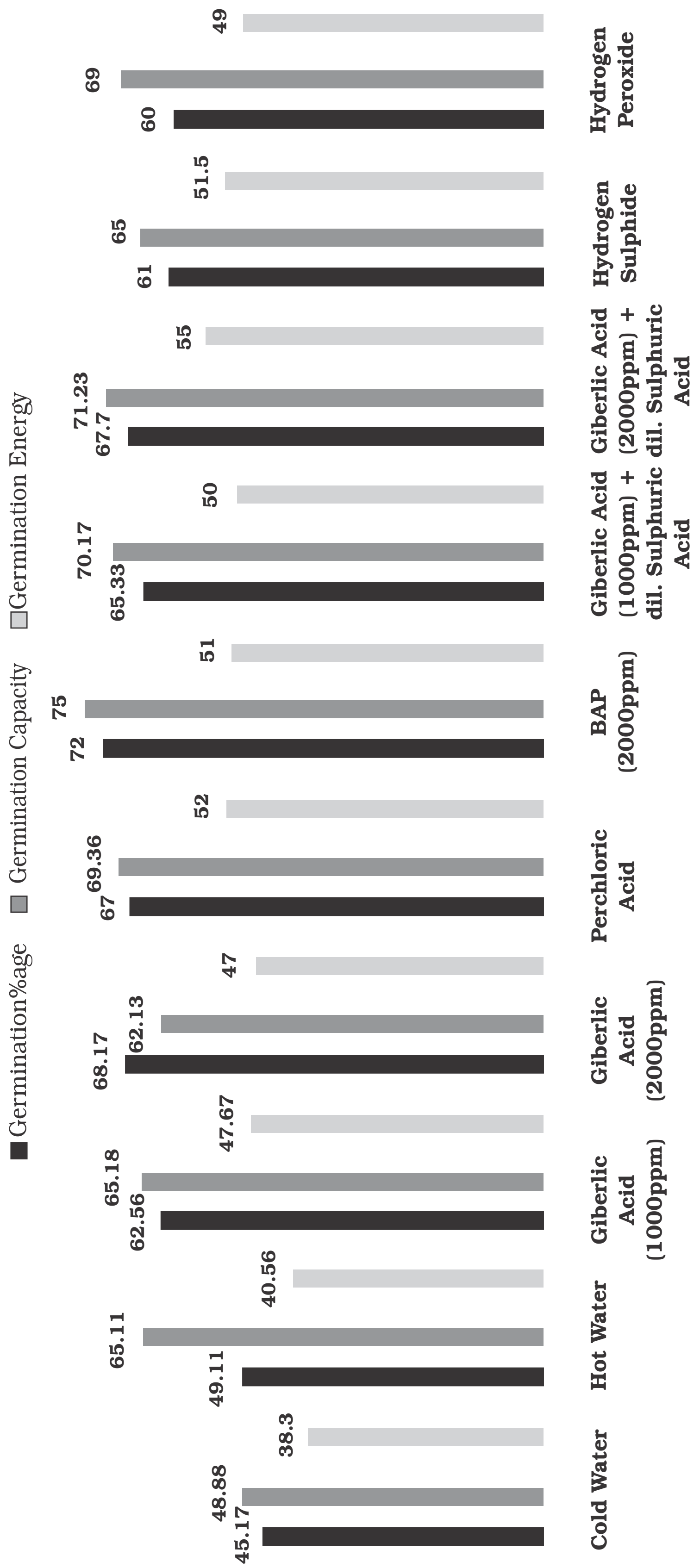


Fig. 1. Stratification and germination behaviour of *Pinus gerardiana* Wall seeds

Fig. 2 Pre-sowing treatment (chemical and growth regulators) and germination behaviour of *Pinus gerardiana* wall seeds



growth regulators and chemical treatments but higher than the control where no pre-sowing treatment was given. Further, it is also observed that the pre-sowing treatments like Gibberlic acid (2000ppm) (68.17%), Gibberlic acid (2000ppm)+dilute H_2SO_4 (67.70%) and perchloric acid (67.00%) behaved statistically at par with the BAP (2000ppm) treatment which gave highest germination among all the tested growth regulators and chemical treatments used for enhancing the germination percentage of chilgoza pine seeds. Germination capacity and energy also behaved as that of the germination per centage exerted in all the growth regulators and chemical treatments used as pre-sowing treatments. The graphical presentation (Fig. 2) of data on germination behavior with respect to cold and hot water showed that hot water is better over the cold water because hot water gave 8.00 per cent (approximately) more germination per centage over the cold water.

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