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**RESEARCH ARTICLE**

# Seedling age and growth rate of a gymnospermic tree species (*Pinus wallichiana*) from Ganji valley District Skardu Gilgit-Baltistan, Pakistan

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## *Abstract*

Using dendrochronological methods 15 Himalayan Pine (*Pinus wallichiana*) tree species were selected to obtain wood sample by Swedish Increment Borer device. Four size classes of mean age of various seedlings, based on two cm interval, showed that the relationship between Dbh classes and actual age was significantly correlated ($r = 0.544$, $p<0.01$). Dbh size classes showed that mean age increases with respect to Dbh, though like seedlings due to wide variance it is not prudent to predict age from Dbh. In normal circumstance, seedlings show variation in regeneration pattern in different periods, this condition may be due to the different ecological, biotic and biological situation. It indicates that the growth rate of seedlings was more or less similar to different size classes. Relationship between growth rates year/cm and actual age of seeding attained a significant relation ($r=0.571$, $p<0.01$). It is shown that the growth rate of seedlings varies in different size classes. This situation may be due to the natural and human induced disturbance or other environmental stress.



## INTRODUCTION

Although tree rings are being used in feretory to estimate the age of trees by the Pakistan forest Institute, Peshawar. Khan (1968) counting tree ring of *Pinus wallichiana* from Tarkhal forest of Azad Kashimir to estimate age of trees. Champion et al. (1965) evaluated the age of *Pinus gerardiana* using the tree rings from the forest of Zhob District. Shiekh (1985) determined the age of Juniperus exclesa from the Ziarat forest of Baluchistan. These observations were chiefly based only counting tree rings, no missing, double and missing radius were considered. In addition no allowance was made to the years when tree reached the height of the breast height. Dendrochronological techniques were used first time in Pakistan by Ahmed (1988a) who estimated ages and growth rates of a some planted tree species of Quetta, again Ahmed (1988b) also presented the problem encountered to determine the age of trees. Ahmed et al. (1991) determined age and growth rates of *Juniperus excelsa* and *Pinus gerardiana* trees from Balochistan. Recently Siddqui (2011) conducted study to estimate the growth rate and age of different coniferous tree species from the moist temperate area of Himalayan region of Pakistan. Khan (2011) also described age and growth rate of some tree from the forest of Chitral district. Wahab (2011) presented age and growth rates of tree species from District Dir. Hussain et al. (2012) evaluated age and growth rates of Picea smithiana from Stak valley, Central Karakorum National Park. Siddiqui et al (2013) estimated age and growth rates of dominant coniferous from moist temperate areas of Himalayan and Hindukhush range of Pakistan. Further more Akber et al (2010.2011,2013, 2014a,2014b,2014c) carried out extensive research work on some other aspects of forest form different forested areas of Gilgit-Baltitan. Beside the above mentioned research work no work has been conducted in Ganji valley. Therefore aim and objective of present study to estimate the age and growth rates of *Pinus wallichiana* seedling from Ganji valley of Gilgit-Baaltistan.

## Material and methods

### Field Methods

#### Site discription

Sampling site is located in Ganji which is one of a small valley of Sub-Division Rundo of District Skardu in northern areas of Pakistan at the latitude and longitude $35^0$.56 N and $74^0$ 98 E. Trees were on South East facing exposure with $15^o$ slope about 75 km from Skardu District on the upper bank of Indus river. The elevation was 3310 m a.s.l while the canopy was closed.

#### Site selection

First step was selection of site which is one of the important principles of dendrochronology. In this regard high elevation site was targeted, anticipating that rings of trees were expected to be quite sensitive there as compared to the low elevation.

#### Extraction of core

To collect the wood sample (cores) from the living *Pinus wallichiana* trees the Swedish Increment Borer was used. The criteria for the sampling from the trees were

(1) Trees should not infect due to any diseases or fire.

(2) Undisturbed and mature trees were selected.

(3) Trees growing on steep site were selected. These criteria were recommended by Ahmed (1984) and Ahmed et al. (2009).

Two cores from each tree were collected on breast height and Dbh of the trees were measured using Dbh tape. All cores were persevered in plastic straws in order to prevent damage during the field. Each cores were labeled with tree Dbh tree number, date of sampling and name of the site.

### Laboratory Method

#### Preparation of sample

Second step is laboratory work: in this step the cores were air dried for two to three days for further processing. Then the dried cores were mounted on grooved wooden strips with the help of water soluble glue and were fixed with masking tape and again left for drying for two days. Each core at the time of mounting was given an ID, sample collection date, species name, trees number, site name , core number and Dbh of trees.

#### Sanding

Using different grade of sand papers each core was sanded until suitable polished surface was obtained.

#### Crossdating

Cross dating is one of the basic principal and most essential methods in dendrocronological study (Fritts, 1976).

After sanding, the next important step was to compare rings of one tree to another tree from bark to pith and to assign calendar years for each rings under powerful microscope using skeleton plot method followed by Stokes and Smiley (1968). First those cores were selected whose outside ring was known means that year of collection were dated from outside to pith. Narrow and wide rings were marked on the skeleton plot and most narrow rings in the whole stand were circled as pointer years. One point was marked after every ten years, two points after every fifty years and three points after every century using lead pencil. Pointer rings memorizing method (Speer, 2010) was used during the crossdating.

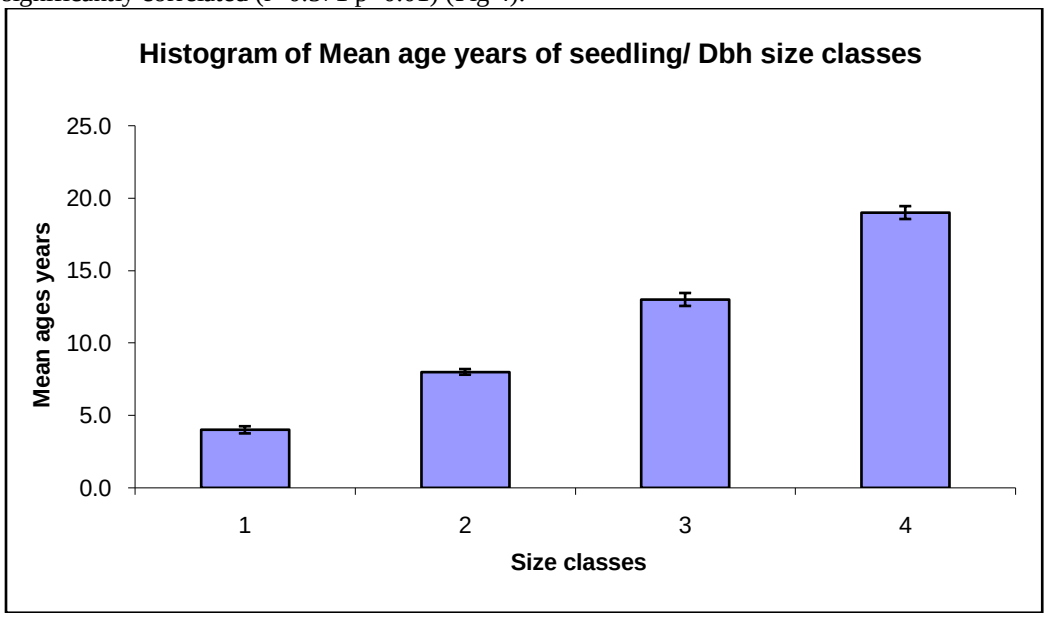
#### Age and Growth rate estimation

Age and growth rates of seedling were calculated following Ahmed (1984), and Ahmed et al. (1990a, 1990b, 1991 and 2009) to determine the relationship between Dbh/age and age/growth rates of seedling as well as trees Linear Regression was used whereas Dbh size classes Histogram were plotted using MS excel 2003-2007. Dbh size classes interval of each seedling is based on two cm Dbh and each trees seedling were divided into four classes.

## Results

### Age and Growth rate of seedlings

Histogram of Dbh/age of seedlings is presented in Fig 1. Each size class based on 2 cm interval which showoed that mean age is increasing with respect to the Dbh increment. Relationship between actual age and Dbh size classes is shown in Fig 2. Dbh showed significantly correlation ($r=0.544$, $p<0.01$) with actual age of the seedlings. Histogram of mean growth rates and Dbh size classes of *Pinus wallichiana* seedlings is presented in Fig 3 which indicated that growth rate of seedlings in 2 cm classes attained slow growth while 4cm, 6cm and 8cm classes appeared with more or less similar growth. The regression analysis between Dbh and growth rates showed significantly correlated ($r=0.571$ $p<0.01$) (Fig 4).




**Note:** 1=2cm, 2=4cm, 3=6cm and 4=8 cm Dbh

**Fig 1** Showing the Histogram of Dbh size classes in (cm) Vs mean age of *Pinus wallichiana* seedlings.

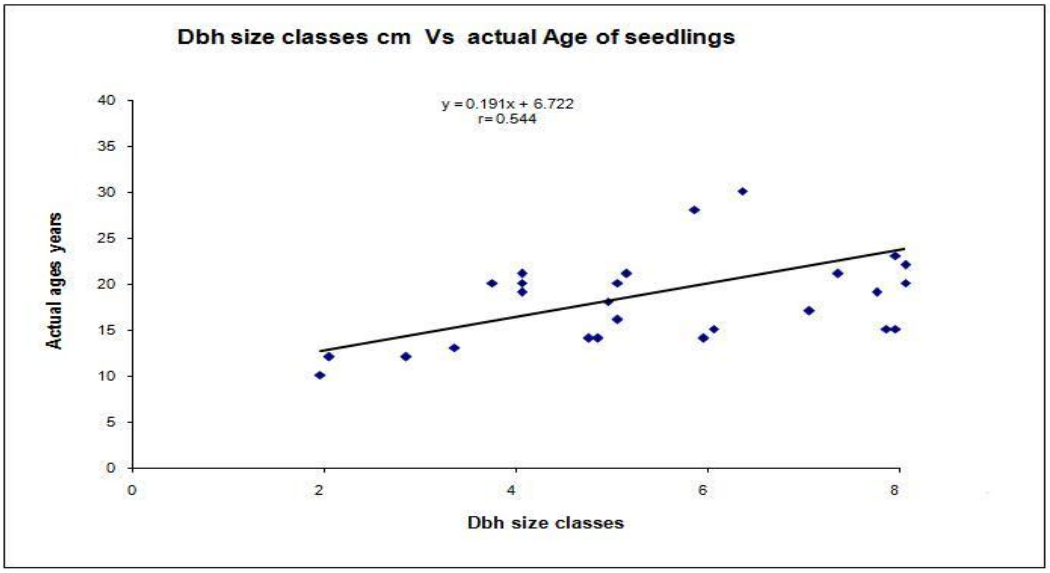
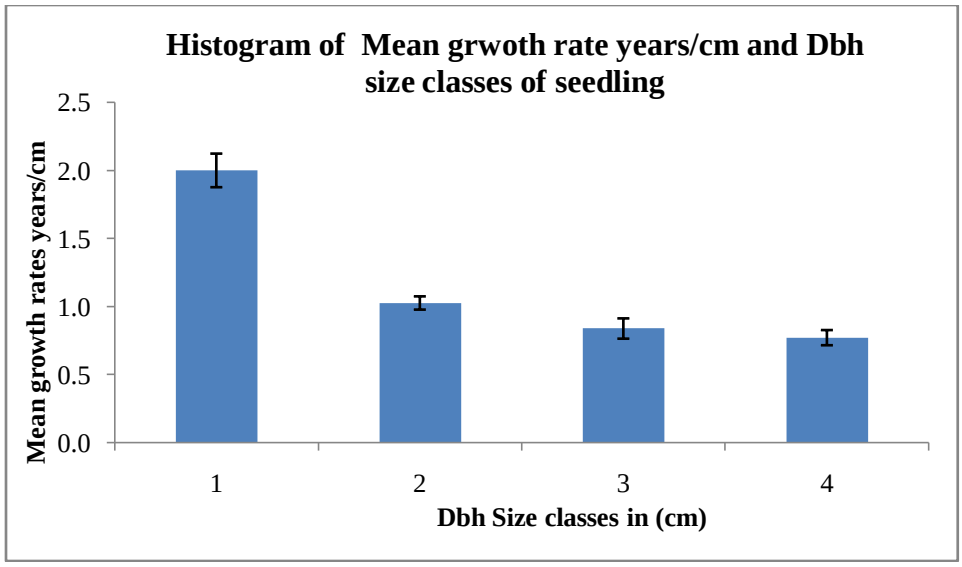



**Fig 2** Showing regression between Dbh size classes Vs actual age of seedlings of *Pinus wallichiana*.




**Note:** 1=2cm, 2=4cm, 3 =6cm and 4=8 cm

**Fig 3** Showing Histogram of growth rates and Dbh size classes of *Pinus wallichiana* seedlings.

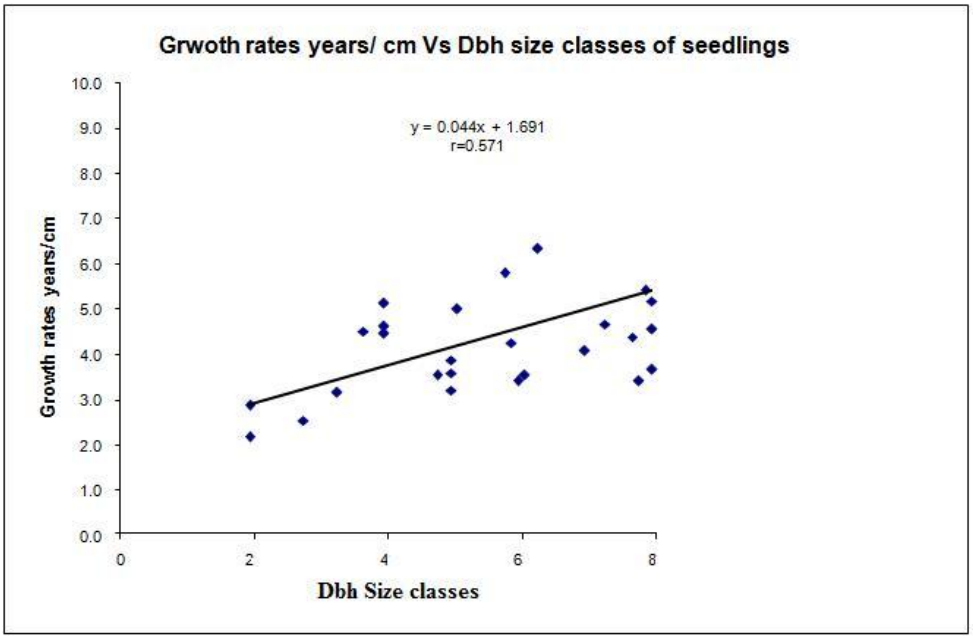



**Fig 4** Showing regression of actual growth rates Vs Dbh size classes of *Pinus wallichiana* seedlings.

## Discussions and conclusion

**Age and growth rates of seedlings**

Four size classes of mean age of various seedlings, based on two cm interval, showed that the relationship between Dbh classes and actual age was significantly correlated ($r = 0.544$, $p<0.01$). Dbh size classes showed that mean age increases with respect to Dbh, though like seedlings due to wide variance it is not prudent to forecast age from Dbh. In normal circumstance, seedlings show variation in regeneration pattern in different periods, this condition may be due to the different ecological, biotic and biological situation. It indicates that the growth rate of seedlings was more or less similar to different size classes. Relationship between growth rates year/cm and actual age of seeding attained a significant relation ($r=0.571$, $p<0.01$). It is shown that the growth rates of seedlings varies in different size classes. This situation may be due to the natural and human induced disturbance i.e. illegal cutting, grazing, burning, sliding and other environmental stress. It is recorded that the average age of *Pinus wallichiana* seedlings ranged from 10-37 years in 8 Dbh cm seedlings with 2.8 to 8.6 years/cm growth rates. Ahmed et al, (1991) in case of *Pinus gerardiana*, reported 43 years/cm growth rates in seedlings of *Pinus gerardiana* and also found strong correlation between age and growth rate with the value of $r=0.64$,$p<0.001$.Furthermore Syampungani et al.(2010) and Ahmed el al. (1988) observed strong relationship between age and growth rates of different tree species. According to Ahmed and Ogden (1987) the oldest seedling may attain a maximum of 100 years/cm while they also found significant relationship between age and growth rates. In case of *Juniperus excelsa*. Ahmed et al, (1989) described age of seedlings 66 years from 6 Dbh class and they also observed that age varies from seedling to seedling. While Hussain et al. (2012) studied seedling of *Picea smithiana* from Stak valley according to them maximum age was 126 years with the average growth rate of 2- to 15.7 year/cm. They also found strong correlation between Dbh and age of seedlings. In the present study seedling age of *Pinus wallichiana* ranged from 10 to 37. This estimation of age is within the range of the findings of above mentioned researchers. This study shows that though there is a significant relationship between Dbh and age and age and growth rate of seedlings of Pinus wallichiana, however due to wide variance, diameter is not good indicator of age.

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