

STUDY ON NATURAL REGENERATION OF CHIR PINE  
(PINUS ROXBURGHII ROXB.)

by

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Abstract

It is commonly known that factors like grazing and fire are the main causes for slow and unsatisfactory establishment of natural regeneration in many Chir pine forests, especially in those located near highly populated villages. In order to study the effect of proper protection on the growth of Chir pine, a long term experiment was started in the forests of Research and Training Field Station, Shinkiari. This paper presents interim results of the first two year's observations, which give the progress of chir pine seedling growth. About 10,000 plants per hectare, which are more than 20 cm tall, and sufficient to constitute future stands of desirable densities, are the result of two years of protection from fire and biotic factors. Strong indications could be found for a substantial reduction of the regeneration period which would lead to an increased productivity of these forests.

INTRODUCTION

As one of the most important commercial conifer species of Pakistan, Chir pine grows in the subtropical zone of the Himalayan foothills between about 900 and 1800m elevation. The species covers extensive areas mainly in Swat, Hazara, Murree Hills and Azad Kashmir. These forests are presently managed under the shelterwood system aiming at natural regeneration. For this purpose the canopy is opened gradually in a series of three felling operations (CHAMPION, et al., 1965), these are preparatory felling, seeding felling and final felling of the remaining seed bearers.

Currently, the regeneration period is 25 years on good sites and 30 years on poor site conditions but practically very often it takes even longer to get the regeneration well established. This leads to an undesirable extension of the rotation period because

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the regeneration area (Periodic Block IV) cannot be transferred to the next older age class (Periodic Block III) immediately after the completion of the prescribed regeneration period. In the absence of natural regeneration, bushy weed growth invades the forest thus hindering its future establishment.

Additionally, a long regeneration period results in unevenaged structures of the forest which is an undesirable situation under the uniform shelterwood system.

Fire and biotic factors (grazing, grass cutting) are commonly considered to be responsible for the total failure or poor regeneration of Chir pine forests by natural means. In view of the these considerations, a long-term study on the undisturbed growth of natural chir regeneration was started in the forests of Research and Training Field Station of Pakistan Forest Institute at Shinkiari/Siran Forest Division in 1987. The main objective of the research project is to study the growth of natural regeneration of Chir pine which is fully protected from fire and biotic factors.

Other specific objectives include:

- to quantify the chir pine seedling growth in terms of density (plants/ha), percentage of survival, height growth/year
- to assess the effect of competing ground vegetation on the survival and growth of chir pine seedlings and
- to determine the optimum length of the regeneration period required for full establishment of the regeneration

## MATERIAL AND METHOD

### Experimental Site

For this study a mature stand was selected in Compartment Massar 8(ii). This compartment was allotted to the Periodic Block (PB) IV already in 1923 and kept in the same block for 55 years until 1978 because of slow and unsatisfactory establishment of natural regeneration (IQBAL, 1978). Although the compartment was shifted to PB III in 1978 it still contained some areas which were without established regeneration and with mature trees serving as seed bearers.

For the purpose of this study an area of 0.4 ha on a ridge with south-west aspect was selected and fenced. It was surrounded

by a strip to provide full fire protection. The regeneration study was laid out within this protected plot in a completely randomised design with four treatments replicated 7 times.

The treatments in plot size of 10x10m each consist of removals of ground vegetation of the following intensities:

- A: Control (no removal of ground vegetation)
- B: Removal of ground vegetation once a year
- C: Removal of ground vegetation every third month
- D: Removal of ground vegetation every month

In order to avoid time consuming counting of all seedlings on the 100m<sup>2</sup> plots, 9 circular sub-plots of 1m diameter were selected on a systematic grid in each plot.

### Data Collection and Analysis

A crown map was prepared for the whole experimental area showing the position of each mature tree with diameter larger than 40cm (seed-bearer) and its crown projection. The study required long-term observations of natural regeneration for conclusive results. So far data has been recorded for three times only. The number of chir pine plants by height classes in all plots were recorded once a year in January 1988, 1989 and 1990. In this way information during two complete growing seasons was obtained. Additionally 101 saplings of different heights, which are distributed over all 4 treatments were permanently marked. In order to quantify the progress of growth, the heights of the saplings were measured every year.

All computations of the data were carried out with the help of an IBM Personal Computer (AT) using a word processor (Word Star) for creating the data bank and SPSS PC + (NORUSIS, 1986), a statistical package, for the analysis of the data.

## RESULTS AND DISCUSSION

### Mature Stand

The present condition of the mature stand is the result of past cutting operations under the shelterwood system. Details of the growing stock on the experimental area are as follows:

|               |                     |               |                      |
|---------------|---------------------|---------------|----------------------|
| Tree No./ha   | : 68                | Basal area/ha | : 21.7m <sup>2</sup> |
| Volume/ha     | : 215m <sup>3</sup> | Mean diameter | : 64cm               |
| Crown density | : 29%               |               |                      |

Under the uniform shelterwood system usually 25-40 trees per hectare (10-15 trees per acre) are retained as seed bearers (CHAMPION, *et al*, 1965). Although the tree number in the experimental area is higher, no felling was done after the establishment of the experiment.

About 30% of the area is covered by the crowns and its distribution is shown in the crown map (Figure 1):

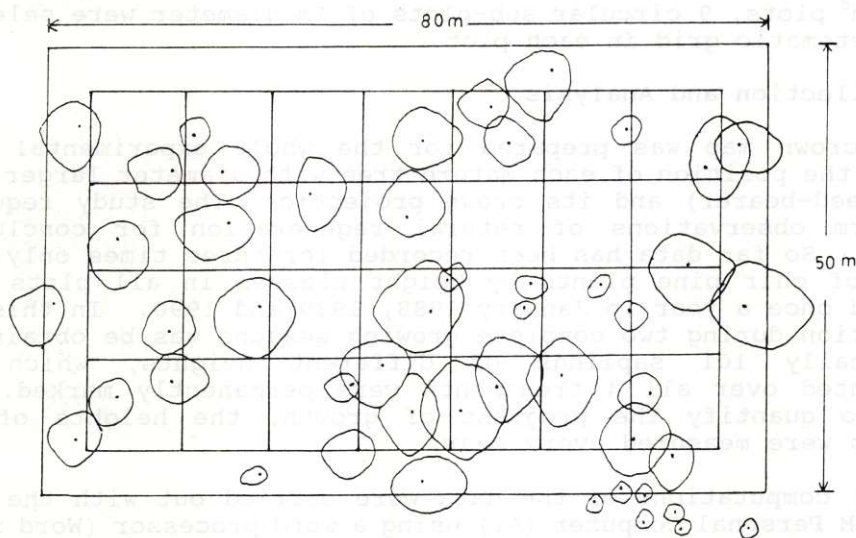


Figure 1: Crown map of the experiment area

## Regeneration

### Total number of plants per hectare

Table 1 shows the number of plants per hectare and by height classes which were found at the time of three data recordings.

Table 1: Chir pine seedlings/ha by height classes

| Date of<br>data<br>recording | Height Classes   |                      |                        |                       |                    | Total<br>N/ha   |
|------------------------------|------------------|----------------------|------------------------|-----------------------|--------------------|-----------------|
|                              | I<br>5cm<br>N/ha | II<br>6-10cm<br>N/ha | III<br>11-15cm<br>N/ha | IV<br>16-20cm<br>N/ha | V<br>>20cm<br>N/ha |                 |
| Jan.1988                     | 2730<br>(15%)    | 5915<br>(33%)        | 5156<br>(30%)          | 2326<br>(13%)         | 1597<br>(26%)      | 17724<br>(100%) |
| Jan.1989                     | 7229<br>(25%)    | 10009<br>(34%)       | 1466<br>(5%)           | 2780<br>(10%)         | 7583<br>(26%)      | 29067<br>(164%) |
| Jan.1990                     | 2983<br>(13%)    | 3387<br>(15%)        | 3994<br>(18%)          | 2022<br>(9%)          | 9908<br>(45%)      | 22294<br>(126%) |

In the first year after complete protection of the area, the number of seedlings increased from 17724 to 29067 (64%). It came down to 22294 during the second year which means an increase of 26% over two years period (1988-90).

### Pattern of Regeneration

The distribution of natural regeneration from 1988-1990 by height classes shows the variation in the number of plants in different height classes (Figure 2). This is due to germination of seeds, recruitment of seedlings into higher classes and their mortality.

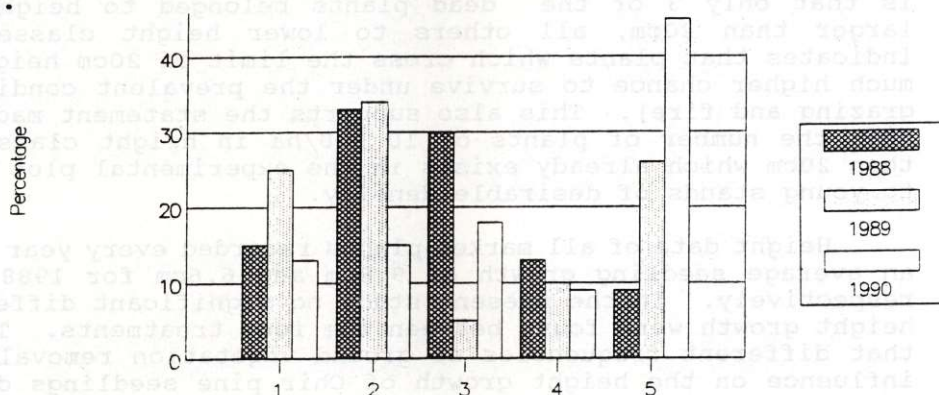


Figure 2: Pattern of natural regeneration by height classes

The most important effect of protection can be seen in the height class V in which saplings larger than 20cm height are increased in number from 1597 (9%) in 1988 to 9908 (45%) in 1990. This number also roughly corresponds with the initial stocking of 10 000 plants/ha recommended for *Pinus nigra* afforestations in Europe for production of constructional timber (MAYER, 1977). TROUP (1921) suggested a spacing of 1.5 x 1.5 m (4500 plants/ha) for chir pine plantations in India. At present Chir pine plantations are established at a spacing of 2.4 x 2.4m (1740 plants/ha) in the Himalayan Region of Pakistan and Nepal (World Bank, 1989; APPLGATE, *et al* 1987). Although the regeneration in the experimental plot is not yet established, one can expect a much higher crop density in the naturally regenerated stands than that in artificial plantations.

### Effect of Treatments

The analysis of variance indicates that there are no significant differences in the total number of plants/ha as a result of different treatments of removal of ground vegetation. This shows that the existing ground vegetation has obviously no effect on the germination and subsequent survival of the plants on this particular site.

### Survival and Height Growth

Out of 101 plants which were permanently marked in 1988, 14 plants (14%) died after 2 years. 10 plants died during the first and 4 plants during the second year. An interesting observation is that only 3 of the dead plants belonged to height classes larger than 20cm, all others to lower height classes. This indicates that plants which cross the limit of 20cm height have a much higher chance to survive under the prevalent conditions (no grazing and fire). This also supports the statement made earlier that the number of plants of 10 000/ha in height classes larger than 20cm which already exists in the experimental plot will lead to young stands of desirable density.

Height data of all marked plants recorded every year indicated an average seedling growth of 9.8cm and 6.6cm for 1988 and 1989 respectively. In the present study no significant differences in height growth were found between the four treatments. This means that different frequencies of ground vegetation removals have no influence on the height growth of Chir pine seedlings during the period of observation.

### Natural Regeneration of Chir pine outside the Experimental Area

The natural regeneration of Chir pine is also being monitored in 5 blank areas which were created by felling of trees in Massar 8(ii) during the year 1987. The sizes of the area ranges between 530 to 6600 m<sup>2</sup>. In order to regenerate these areas by natural means, a Chowkidar has been appointed to control grazing and protect the regeneration from fire. The regeneration was examined annually in permanently marked circles at regular intervals in the areas. The number of seedlings larger than 20cm height for different areas are given in Table 2 below:

Table 2: Number of seedlings/ha larger than 20cm of height

| Area No. | Year of data recording |       |       |
|----------|------------------------|-------|-------|
|          | 1988                   | 1989  | 1990  |
| 1        | 606                    | 12132 | 3032  |
| 2        | 0                      | 6033  | 10727 |
| 3        | 0                      | 4632  | 11580 |
| 5        | 0                      | 10918 | 10919 |
| 6        | 0                      | 1819  | 18198 |

A substantial increase in the number of plants larger than 20cm of height is seen in most of the above areas. Two years of watch-and ward protection has resulted in 10 000 and more plants/ha in these areas. This number is sufficient to establish future stands of desirable density.

### CONCLUSION

The interim results of this study are summarised as follows:

- A two years period of protection from grazing, uncontrolled grasscutting and fire resulted in a substantial increase (26%) in the number of seedlings in the area. The increase in the number of plants which are taller than 20 cm also reached a level of about 10 000 plants/ha after two years which is sufficient to build up future stands of suitable stocking. The same could be proved on areas outside the experimental plot where less protection could be given to the regeneration.
- A detailed study on the seedling mortality revealed that a height of 20 cm is sufficient for the survival of the seedlings. Once a plant has reached this height, it is very likely to survive under these protected conditions.

- The existing density of the ground vegetation as a result of site conditions and shade provided by the mature seed bearers as well as different frequencies of ground vegetation removal have no significant influence on the number of plants and their height growth.
- At present no final results concerning the most suitable regeneration period can be given. However, observation of two years show already an enormous progress (plant number/ha and height growth) in the establishment of the regeneration. This allows the assumption that the regeneration period could become much shorter than the present standard of 25 and/or 30 years, if control of fire and grazing/grass cutting is ensured.

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