Half-Sib Progeny Evaluation in Chir Pine

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Summary

Some growth and wood characteristics were analysed in an half-sib progeny test of chir pine (*Pinus roxburghii* SARGENT) located at Solan comprising of 58 families from the State of Himachal Pradesh (western Himalaya). Observations were recorded on 5 year old progenies. Significant family and within-family differences were observed for all the traits studied. Heritabilities (within-family, half-sib family and individual tree basis) and genetic gains (family selection and within-family selection) were also determined. Within-family selection gain was effective as compared to family selection genetic gain because of the high selection intensity (90%) of family selection.

Key words: Pinus roxburghii, chir pine, heritability, genetic gain.

FDC: 232.11; 174.7 *Pinus roxburghii.*

Introduction

Pinus roxburghii SARGENT is one of the indigenous species of high commercial importance and is well known for its timber, paper pulp and resin yield. This species is confined to the monsoon belt of the outer Himalaya from Bhutan to north eastern parts of west Pakistan. In India, chir pine is widely spread in sub-tropical pine forests in the Himalaya and Shivalik hills at elevations of 450 m to 2300 m, but grows best between an altitudinal range of 600 m to 1800 m. Its commercial value is enhanced by the fact that it is adapted to a wide range of soil and climatic conditions.

There is immence scope for genetic improvement in chir pine with its wide range of distribution in the western and central Himalaya and a high range of natural variation. Out of the original 118 candidate trees selected from the whole distributional range of chir pine in Himachal Pradesh (India), only 58 plus trees were selected and their progenies raised for evaluation. The aim was to study the "within" and "between" family variation and to compute the heritabilities on the basis of the performance of 5 year old progenies.

Materials and Methods

The chir pine half-sib progeny test plantation sampled for analysis of growth and wood quality traits is located at Nauni (Solan). The plantation site is situated approximately at an elevation of 1150 m above mean sea level on the southern aspect and lies at 30° 51'N latitude and 76° 11'E longitude. The test plantation has been raised in a randomised complete block design with 3 replications using 10 trees per row plot at 3 m x 3 m spacing. All the observations were made on the basis of 3 plants per plot when the plantation was 5 years old (including nursery period). The data were analysed statistically for the assessment of analysis of variance components, heritability, and genetic gains as given by ZOBEL and TALBERT (1984).

Results

The growth and wood quality traits were not only statistically examined but their heritability components and genetic

Table 1. – Estimates of heritability and genetic gain.

Parameter	Height (m)	Collar diameter (cm)	Current year growth(cm)	Tracheid length (mm)	Specific gravity	Surface area of spur(cm^2)
x_p	0.9170	4.6500	13.410	1.7200	0.3980	7.1040
$C_{0.95}$	0.79-1.05	4.10-5.2	9.41-17.4	1.4-2.04	0.18-0.61	6.4-7.8
h^2f	0.5429	0.5042	0.4720	0.5233	0.6050	0.4004
h^2w	0.8769	0.4818	0.4258	0.9747	0.6290	0.3249
h^2i	0.6909	0.4940	0.4420	0.6915	0.6512	0.3430
Gf	0.0440	0.1300	0.8260	0.1100	0.0074	0.1070
Gw	0.2580	0.6070	3.8800	0.7040	0.0330	0.5180
Gt	0.3020	0.7370	4.7060	0.8140	0.0400	0.6250

x_p = Plantation mean: 58 families, 3 replications, 3 trees per plot
$C_{0.95}$ = Confidence limit (95%)
h^2f = Heritability on a half-sib family basis
h^2w = Heritability on a within-family basis
h^2i = Heritability on an individual basis
Gf = Genetic gain of family selection (90%)
Gw = Genetic gain of within-family selection (30%)
Gt = Total genetic gain (Gf + Gw)

gains were also computed. There were significant differences between and within families with respect to all characters under study at 1% level of significance.

Narrow sense heritability (half-sib family, within-family and individual tree basis) was worked out for all the characters. Maximum heritability on half-sib family basis was observed for height, whereas tracheid length exhibited maximum heritability on within-family as well as individual tree basis. Minimum heritability on half-sib family, within-family and individual tree basis was noticed in the surface area of the spur (*Table 1*).

Genetic gain at family and within-family level was also computed (*Table 1*). Maximum genetic gain of family (Gf) and within family (Gw) selection was exhibited by the current year growth whereas the minimum total genetic gain (Gt) was noted in the case of specific gravity of wood. Genetic gain of family selection contributed less to the total genetic gain because of the high selection intensity (90%).

Discussion

In the massive afforestation drive in the Himalaya, chir pine well known for its timber and resin production, has outnumbered all other species because of its high commercial value and its wide range of adaptability to soil and climatic conditions. The present investigations were carried out to evaluate the half-sib progenies of 58 trees of chir pine selected from the state of Himachal Pradesh, India.

All the characters under study exhibited significant differences (between-families and within-families) at 1% level of significance. In general, most economic characteristics of special value in forest trees have a large amount of individual tree variability that will be available to the tree breeder. This is true even for the characteristics that are complex. An occassional tree species, such as *Pinus resinosa* (red pine) will show only a small amount of tree to tree genetic variation (FOWLER and MORRIS, 1977) but these cases are exception rather than the rule. Specific gravity of the branch wood exhibited highest heritability on a half-sib family basis (60.5%) whereas tracheid length exhibited highest heritability on a within-family and individual tree basis followed by height of the plant. It has been reported that specific gravity and tracheid length in conifers are under strong genetic control (JACKSON and GREENE, 1958; ZOBEL, 1961, 1964; BYRAM and LOWE, 1988), therefore such variation and a high estimated value of heritability indicated that genetic improvement can be made by selection for specific gravity, tracheid length and height of the plant. The heritability estimates, however, indicate only the effectiveness with which selection of genotype can be based on the phenotypic performance, but fails to indicate the real genetic progress (JOHNSON et al., 1955). Therefore, high heritability need not always be accompanied by greater genetic progress. Specific gravity, tracheid length and height of the plant recorded high heritability estimates but showed only moderate genetic gain (*Table 1*), whereas the current year growth recorded moderate heritabilities but high genetic gain. Therefore, the current year growth with moderate heritabilities along with high genetic gain (Gt) can be considered for selection purposes.

Literature

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Genetic Structure of *Picea abies* Trees Tolerant and Sensitive to Industrial Pollution

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Summary

Comparison of the genetic structure of 2 groups of trees of *Picea abies* tolerant and sensitive to industrial pollution, has shown that there are differences in frequencies of some alleles and genotypes and also in the level of genetic variation. In average, for 10 loci in the tolerant group of trees a higher heterozygosity (Ho) and higher genotypic polymorphism index (Pg) (ca. 25%) were observed. The greatest differences in heterozygosity level are noted at G6PDH, Fest, ShDH and GOTC loci.

Key words: Picea abies, genetic structure, industrial pollution.
FDC: 165.3; 425.1; 174.7 *Picea abies.*

Introduction

In south-western Poland a progressing decline of the coniferous forest is observed especially dramatically so in the Sudety Mts..This is caused by heavy industrial emission, mainly of SO_2 and NOx from Germany and the Czech Republic as well as from local emitors. In the area of Beskid Śląski Mts., individual trees of *Picea abies* with different extent of injuries