Diallel Crossing in *Pinus cembra*: V. Age Trends in Genetic Parameters and Genetic Gain for Total and Annual Height Growth across 16 Years of Testing

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A full diallel mating design (p=10 parents) was carried out in a natural population of Swiss stone pine (*Pinus cembra* L.) from the southern Carpathian Mountains. At age six, after nursery testing, the material was field planted in one site, using a completely randomized block design with 100 families, four replicates and 15 tree row-plots per replication, spaced 2.5 x 2.5 m. Total and annual height growth were assessed at successive ages across a 16 year testing period (i. e. nursery test between ages one to six and field test between ages seven and 16). Plot means of the measured traits were analyzed using the general least-squares method by means of the computer DIALL programme prepared by SCHAFFER and USANIS (1969).

Across the testing period, significant ($p<0.05$) and highly significant ($p<0.01$; $p<0.001$) differences occurred in total height growth for general and specific combining ability effects. These results suggest that the two traits were controlled by nuclear additive and non-additive genes. In an ascendant trend, the additive variance, as a percent of the total genetic variance, ranged between 5 % at age six to 67 % at age 16 for total height growth while that for annual height growth ranged between 33 % at age four to 78 % at age 16. In a descendent trend, the dominance ratios σ^2SCA / σ^2GCA for total height growth ranged between 8.2 at age two to 0.3 at age 16, suggesting that the additive variance could be used in a breeding programme. Parents with significant general combining ability effects for the two traits were found. For total height growth, the narrow-sense family mean heritability estimates varied in an ascendant trend between 0.06 at age two and 0.65 at age 16 while the narrow-sense individual tree heritability varied between 0.02 and 0.37. Age-age additive genetic correlations for total height growth rose from 0.85 at age two to 0.95 at age six and then leveled off across the field test indicating that if the goal is to improve 16-year height, early selection can be considered at age six. By selecting the best 20 families and the best 20 % of individuals within families, a genetic gain in total height growth of 8.8 % and 9.9 %, respectively, could be achieved at age 16. The improvement of growth using both family and individual selections could be applied. The very high age-age and trait-trait genetic correlations suggest that both early and indirect selection could be applied effectively.