Universitatea Transilvania din Brașov

HABILITATION THESIS

SUMMARY

Title: Evaluation of genetic diversity in coniferous tree species in Romania

Domain: Forestry

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Genetic diversity determines tree populations adaptability, evolution, and long-term survival. Historical processes, environmental conditions, past management practices, and forest reproductive material influence the distribution of genetic diversity within and among populations. This research aimed to evaluate the population structure and genetic diversity of coniferous species in Romania using nuclear and chloroplast microsatellites markers.

The analysis of genetic diversity in Norway spruce, Romania's most widespread conifer species, revealed slightly lower genetic diversity in clonal seed orchards compared to natural populations. In the first stage, the genetic identity of ramets within a clone was tested using three nSSR genetic markers. A small number of divergences were identified among ramets, attributed to the growth of the rootstock to the detriment of scion or sampling errors. In the second stage, Bayesian analysis results indicated a genetic structure consisting of two groups: one corresponding to seed orchards and the other to natural stands. The pattern of genetic variation was influenced by both adaptive divergences within seed orchards and the limited number of clones used for their establishment.

The analysis of Carpathians silver fir populations, conducted using nuclear EST-SSR markers, revealed high levels of genetic diversity across the 36 populations sampled across Romanian Carpathians. However, the silver fir populations from the Eastern Carpathians showed higher levels of genetic diversity, reflected in greater allelic richness and expected heterozygosity, as well as greater genetic differentiation compared to populations from the Southern Carpathians. Additionally, genetic differentiation was observed among the regions of origin. Although overall genetic differentiation among the analyzed populations was low, the genetic structure was less homogeneous, particularly in the North-Eastern Carpathians.

Nuclear DNA analyses of natural Scots pine populations showed that the populations from the Eastern and Southern Carpathians still maintain high genetic diversity within populations despite the fragmentation and relatively recent reduction of the species' natural range. Moreover, lower genetic diversity was observed in populations from peatland compared to those growing on rocky slopes with acidic, nutrient-poor soils. The statistically significant spatial genetic structure has been detected in nearly all studied Scots pine populations. At the chloroplast level, the analysis based on 10 microsatellite markers identified three common chlopalst DNA haplotypes shared among populations from two geographically distant regions (the Carpathians and Central Siberia), suggesting the existence of long-distance pollen-mediated gene flow or common ancestry.

Nine nSSR genetic markers were used to examine the differences among four subspecies of black pine: *banatica*, *nigra*, *pallasiana*, and *laricio*. The analyses revealed low genetic differentiation, which cannot dismiss the possibility of stratification within intraspecific taxonomic units. However, a distinct genetic structure was identified for the subspecies *banatica*, suggesting a unique origin for the Banat black pine populations and supporting the hypothesis of a Pleistocene refugium in Southwestern Carpathians region.

Genetic diversity analyses of Douglas-fir plantations in Romania revealed a high level of gene diversity and limited genetic differentiation, suggesting that the forest reproductive materials used to establish these plantations originated from a narrow range of provenances.

In conclusion, as shown by variaous arrays of molecular markers, conifer species in Romania are characterized by a high level of genetic diversity, which suggests a considerable degree of adaptability and stability of the populations, thus conferring resilience against anticipated forseen climatic pressures and environmental changes. These research findings may help develop sustainable management practices and formulate strategies and programs for the conservation and improvement of forest genetic resources of conifer species in Romania.