

THE IMPLICATIONS OF AFTER EFFECTS FOR BREEDING AND CONSERVATION OF GENETIC RESOURCES OF NORWAY SPRUCE

TORE SKRØPPA AND ØYSTEIN JOHNSEN

Norwegian Forest Research institute

1432 Ås Norway

In *Picea abies*, several independent tests have shown that the climate and weather conditions during sexual reproduction influence the adaptive properties of the progenies. The phenomenon is expressed in Norway spruce seed orchards established by moving parent trees, propagated as grafts, from north to south, from

high to low elevation, or from outdoor to indoor greenhouse conditions. The progenies exhibit a changed phenology and delayed development of frost hardiness in autumn compared to their siblings reproduced in a colder environment. Similar results are observed in tests of seedlings from the seed collected in Norwegian stands planted

with spruce provenances of Central European origin; one-year-old seedlings from such stands perform similar to the local Norwegian provenances.

The observed effect is one of the factors that have importance for the evolutionary process in Norway spruce. It contributes to maintain the genetic variation in natural populations as a broader array of genotypes is kept after selection based on the phenotypic values, and also because offspring in different seed years from the same mother trees may differ in their phenotypes. The effect may also be one reason why trait relationships are different at the provenance and family level.

The after effect should be taken into account when seed orchards are located on sites with warmer climatic conditions than the intended planting zones. It is in particular critical for the use of indoor seed orchards as results show that seedlings from seeds produced in a greenhouse have a reduced autumn frost hardiness compared to their siblings derived from seeds produced outside the greenhouse. This effect may also influence breeding operations, in particular the production of breeding populations and families for progeny

testing, and restrict the use of seed lots produced in different seed years.

Legal regulations, such as those by EU and OECD, are based on a stable performance of seedlings from provenances and seed orchards. However, the observed results demonstrate that it may not always be realistic to require such stability. In extreme cases and until more information becomes available, it may be necessary to give different recommendations for the use of seed produced in the same seed orchard in different years.

A consequence of the after effect may be a reduced need for specific gene conservation activities in Norway spruce. The effect makes this species a highly adaptable one in the boreal forest. Earlier provenance transfers from Central Europe to Scandinavia have in some cases resulted in maladapted plantations with reduced timber quality. It seems that the after effect is a factor that reduces possible negative consequences of these provenance transfers for the next generations. Combined with this increased genetic variability, the after effect seems to be beneficial for the genetic resources of the species also under changing climatic conditions.