GEOGRAPHICAL VARIABILITY OF THE NORWAY SPRUCE IN THE ESTONIAN SSR

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SELOSTE:

KUUSEN MAANTIETEELLINEN VAHIETELU EESTIN NEUVOSTOASAVALLASSA

The regional variations in the Estonian vegetation have resulted in the division of the republic into geobotanic districts. The productivity of the Estonian spruce stands, as well as several morphological features of the spruces (e.g. weight of the seeds, cone dimensions, the shape of the cone-scale, crown dimensions, etc.) show geographical variation. For instance, the absolute weight of spruce seeds is higher in the areas to the south of the Kunda-Paide-Virtsu alignment, which runs from the north-east to the south-west of Estonia, compared to seeds from the areas to the north of it. As this alignment coincides well with the boundaries of the Western and Eastern Baltic geobotanical sub-provinces, defined by L. Laasimer, we might term this a sub-provincial variation of the spruce stands.

The average absolute weight of the spruce seeds in the Western Baltic geobotanical sub-province (not including the islands) is 5.57 ± 0.03 g. and that in the Eastern Baltic sub-province is 6.10 ± 0.03 g. The difference is as much as 10 % (B < 0.999).

In some individual Estonian territories, one can more often find different varieties, on the basis of the shape of the cone-scale. For instance, *Picea abies var. obovata* in the surroundings of Tartu, occurs 8 times more frequently and *Picea abies var. acuminata* three times more frequently than around Rakvere (Northern Estonia). This is no doubt because of differences in the climatic, and soil conditions, which in spite of the small area of Estonia (240 km North to South and 350 km East to West) are quite large. Similarly the air temperature in different regions in Estonia can vary by more than 20° C. It may be these differences in the conditions for growth that, over an extended period, have resulted in the geographical variability of the genetic constitution of the spruce stands in Estonia. The changes may be apparent in, for instance, the frequencies of the different varieties (derived on the basis of the shape of the cone-scale), the successors of which, in their turn, differ in the genetically controlled rapid growth factor. For example, in the favourable soil conditions of Southern Estonia, the successors of *var. acuminata* are at least 20 % taller at the age of 9 year those of *var. obovata*.

In order to check the possible geographical variability of the gene pool, preliminary experiments were carried out in the spring of 1969. Seeds of 93 spruce stands originating from 14 forest enterprises were sowed in a nursery in Tartu. After 2 years the seedlings originating from the south of Tartu (south-eastern Estonia) were the tallest followed by those originating from the same northern latitude but to the West of Tartu. Seedings originating from the forest enterprises situated to the north of Tartu were smaller. These experiments no association could be established between the absolute weight of the seeds used and the height of the seedlings (Etverk 1974). Differences in the growth based on the provenance may also be observed in the later stage of growth. In the vicinity of Viljandi (south Estonia) the average height of the 9 years-old cultures of spruces (8 plus trees and 326 successors) originating from Pärnu and Rakvere forest enterprises situated to the north of Viljandi (a marine climate) was 100 ± 0.4 cm, and of those of the spruces (9 plus trees and 384 successors) originating from Võru and Kiling-Nõmme forest enterprises, situated a little to the south of Viljandi, was 122 ± 0.6 cm (i.e. 22 % higher (B > 0.99)). The differences in the growth became rather quickly evident in the vegetative successors of plus trees. At Sona seed-orchard, the height increment of the 140 grafts (4 clones) originating from Rakvere forest enterprise (north Estonia) did not differ from that of 207 grafts (5 clones) from Räpina forest enterprise (southern Estonia). By the third year, though, the height increment of Räpina grafts was 18 % greater than that of Rakvere grafts (19.9 ± 0.77 cm and 16.8 ± 0.91 cm B < 0.99 respectively).

From the above facts, however, it cannot be maintained that the southern Estonia spruces are of a better genotype than those of the north since genotypes are evaluated on the basis of ecological conditions under which the experiments are carried out. On the basis of an analysis of the rapid growth the grafts from south Estonia fare better in south Estonia. Had the experiments been carried out in the ecological conditions of the north or north-western Estonia, the results would presumably have been different.

Such a conclusion is confirmed by the experiments carried out by H. Paves in Tartu. Spruce seeds from 32 different places (from the range of 54°25' to 67°51' N and 22°19' to 60°00' E) were sown simultaneously in open ground, and in a plastic-house. From amongst those in the open ground, five provenances, originating from the territory situated a little to the south and east of Estonia (average coordinates of the territory being 56° N and 37° E) grew equally well or better than Estonian spruces (Figure 1). This denotes an average shift of 7° to the East of the territory for spruces suitable for cultivating in Estonia. The results clearly indicate the dependability of the evaluation of the genetic constitution on the ecological conditions prevailing at the place of experiment. The temperature of the plastic-house during primary stage of vegetation period resembled that of south Estonia and the continental climate of the areas to the east of Estonia.

Because of the genetically heterogeneous nature of all the seed lots actually used in our forest enterprises, those genotypes which grow favourably in the climatic conditions of the territory, were maintained while growing the seedlings in the plastic-houses, and the largest seedlings are obtained from the seeds which are genetically unsuited to the conditions of this given area. This became apparent during planting the plastic-house seedlings of the above-
as some of the genotypes favourable to the open ground get eliminated (they have either perished in the unfavourable conditions existing in the plastic-house or having remained shorter than the others, they have been removed at the time of grading). Hence only genetically homogenous seed lots, the genetic constitution of which corresponds to the ecological conditions obtaining on the open ground, should be sowed in the plastic houses.

The speedler growth, under Estonian conditions, of the spruces originating from the south is confirmed by the successors of the Lithuanian plus trees (a total of 432 nine-year-old trees); these, in the same experimental area were the average 14 % taller than the successors (882 trees) of the Estonian plus spruce trees. This has confirmed the opinion that in order to grow Norway spruces in the northern region of the area, seeds obtained from the territories 400–600 km southwards ought to be suitable (HERKINHEIMO 1949, GUNZL 1969). Presumably this has some connection with the climate of the Northern Hemisphere becoming gradually warmer as well as the slow adaptability of the gene pool of the spruce-stands.

The variance component of the provenance has been evaluated by variance analysis (HERKINHEIMO 1967). Taking a forest enterprise as a unit of provenance (trees originating from the same forest enterprise bear the same geographical provenance), the variance component of provenance, based on 5 provenances of the 2-year-old spruce seedlings, is 6 ± 0.4 % (B > 0.999) and based on 5 provenances of the 9-year-old trees, it is 7 ± 0.5 % (B > 0.999). Of course this is considerably less than 67 ± 0.1 % (B > 0.999), the variance component of provenance in the entire Norway spruce area in the Soviet Union, based on 32 provenances. The variance component decreases as the geographical areas covered by the experiment is narrowed. If we take into account only the territory where, on the basis of 2-year-old seedlings, import of seeds in Estonia (Estonia, Latvia, Lithuania, Pihka district, and North of Byelorussia) are also considered, then the variance component of the provenance is 40 ± 0.2 % (B > 0.999). This indicates that the import of seeds from other parts of the area might be more effective than obtaining them from some selected but narrow territories of Estonia. On the other hand, it may be presumed that by the creation of an artificial population in the form of a seed-orchard, which may be obtained from the progenies of plus trees, we may be able to have seeds the genetic quality of which may not be any worse than the best quality imported seed lots. In experiments with the 9 year old successors, the influence of the parent trees (plus trees of Estonian origin) on the height of the successors was as much as 21 %, where the average height of the fastest growing successors exceeded the average height of the trees over the entire experimental area by 30–35 %.

M. GIERTYCH (1977) has divided the area of Norway spruce in Europe into 13 regions according to which Estonia belongs to the 8th (Eastern Baltic) region. It appears as if the boundaries of the 7th and 8th regions in Estonia should be included in the 7th (North East) region.

LITERATURE

ЭТВЕРК И. 1974. Разнообразие ели обыкновенной в Эстонской ССР. Таллин.

SELOSTE:


Eri alukperillä saatavat tulokset voivat kuiten
VARIATION IN THE DENSITY OF WOOD OF DIFFERENT SCOTS PINE (Pinus sylvestris L.) AND NORWAY SPRUCE (Picea abies (L.) Karst.) ORIGINS IN PROVENANCE TESTS

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SELOSTE:
MÄNTY- JA KUUSIALKUPERIEN PUUAINENEEN TIHEYDEN VAIHTELUSTA PROVENIENSISOIKEISSA

In provenance tests, different geographical races of a particular tree species are compared with each other, and with the local provenance. Climatic and disease resistance, volume growth and also the external quality of the trunk are usually established in different parts of Finland through the activities of Prof. Olli Heikinheimo in 1931. The same provenances were used in all the sub-experiments (Table 1). Only 11–12 provenances are still in existence in the sub-experiments of the Scots pine series, and 10–20 provenances of the spruce series. The variation in the number of the provenances remaining is partly due to the fact that a number of the provenances included in the experiments, especially the foreign ones, died at the seeding stage and others later on. The provenances still remaining have, in addition, suffered from wintering and fungal damage.

The study material was obtained by randomly selecting 10 sample trees from each sample block and then removing two 5 mm thick increment cores, using an increment borer, from the surface of the stems right to the pith. The increment cores were taken at breast height on the opposite sides of the stem. The mean density