Comparison of seed orchard and stand seed of Scots pine in direct seeding

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Background

Direct seeding of Scots pine is an important forest regeneration method in Finland. Annually some 30 000 ha of forest is regenerated by sowing. This comprises more than half of Scots pine cultivation and about 1/4 of all artificial regeneration. In total Scots pine has been sown on an area of 2.1 million hectares.

Direct seeding is mechanised to a high degree. In 2005 sowing by machine in connection to soil scarification was done on 69 % of all sowing area. The easiness in mechanisation and lower costs (< 50 %) compared to planting have helped to maintain the amount of direct seeding at a rather constant level.

Sowing consumes great amounts of seed. In 2005 about 8500 kg Scots pine seed was used for direct seeding, when at the same time the nurseries used only 475 kg's. About 1/3 of the Scots pine seed used in direct seeding is produced in seed orchards. There has been discussion whether this proportion should be increased. In order to find out the usability of the seed orchard seed in direct seeding a research project was initiated at Finnish Forest Research Institute in 2002.

Study methods

The study was accomplished by establishing field experiments where seed lots from several seed orchards were compared to stand seed lots in three years (2002 – 2004) at four localities in southern and central Finland (in the first year only at two localities).

The experimental material consisted of 4 stand and 7 seed orchard seed lots. However, only 2 (stand) and 5 (seed orchard) of them were representative to their respective groups and were therefore used for the comparison between the types. The other seed lots were used to study the relationship between seed characteristics and seedling establishment and growth. Sowing was done on scarified mineral soil on shallow holes made by a special tool. 16 seeds were sown on each sowing spot and covered with a thin layer of mineral soil. The experimental design was randomised blocks with one sowing spot of each entry in each of the 30 blocks.

The seedling establishment was monitored and the height of the tallest seedling in each sowing spot was measured at the end of each growing season. As the germination rate was high (55 % on the average in the first autumn) it was difficult to count the exact number of the closely

spaced seedlings, when they grew bigger. Therefore the success of seedling establishment was expressed as the proportion of sowing spots with at least 4 seedlings. Here the results of inventories after three growing seasons are reported.

Three year results

There was great variability between seed lots within each seed type as regards seedling establishment rate, so no general conclusions can be drawn from single seed lots. Due to mortality the proportion of sowing spots with at least four seedlings decreased between the years, especially from first to second autumn.

Seedling establishment did not differ statistically significantly between seed orchard and stand seed lots, although the proportion of sowing spots with at least four seedlings was slightly higher with seed orchard than stand seeds (75 and 72 %, respectively). However, when comparison was done on the basis of germinable seeds or equal weight of seeds, the stand seed was better than orchard seed (neither these differences were statistically significant). In two experiments there was a pronounced tendency for seed orchard seed lots to improve their relative seedling establishment from year to year. It is possible, that this development was caused by frost heaving, as the climatic and/or soil conditions in these experiments were favourable for it.

The seed orchard seed lots had on the average 20 % greater height (height of the tallest seedling in the sowing spot) than the stand seed lots (the difference was statistically significant) (Fig. 1). This relative difference remained rather stable from year to year. In one experiment there was a deviating development, which led in third autumn to inferior height of seed orchard seed lots. This experiment suffered from heavy early summer frost in the second growing season.

There was a clear tendency for those seed lots with smallest seedlings to have greatest decrease in number of seedlings between 2nd and 3rd autumn.

Conclusions

No general superiority of seed orchard seed lots in seedling establishment could be observed in these experiments, but the seed types were approximately equal. It is possible, that the conditions for germination and early development were rather favourable in these experiments, and therefore differences in seedling establishment were not present, as in many earlier studies in Sweden. However, the observed dependence between seedling size and decrease in seedling number can be an indication of selection favouring bigger seedlings, which can lead to better plant establishment of seed orchard seed lots at a higher age.

In height growth the seed orchard seed lots were superior to the stand seed lots as has been shown also in earlier studies. This height superiority was greater than commonly obtained with planted material.

The results show that seed orchard seed can be used in direct seeding and its genetic and physiological superiority in height growth is visible in the field. Measurements in the coming years are needed to confirm the long term constancy of the obtained results.

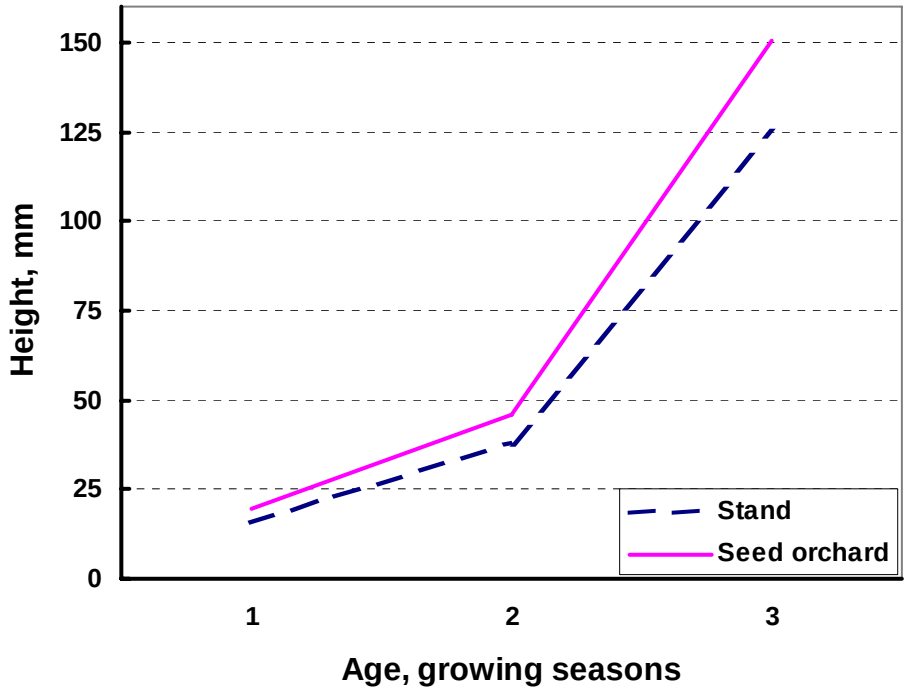

Figure 1. The average height of the tallest seedling in the sowing spot of seed orchard and stand seed lots in the first three growing seasons