Clonal forestry in Norway – Tried it once. Could it work now?

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Abstract

Cutting propagation of Norway spruce has been used scientifically in Norway since the late fifties. Rooted cuttings from twigs of both mature and young trees were made. Interesting results from e.g. defence against pathogenic fungi has emerged, based on experiments with the clonal rows we planted at our experimental farm forty years ago. In the seventies, a wave of semi-commercial initiatives emerged in Europe, with the intention to mass propagate superior clones of conifers. Propagation cycles (cuttings from cuttings) were introduced, to maintain the juvenile vigour that was found to be essential for rooting and orthotropic growth. Our Norwegian group established such propagation cycles experimentally for Norway spruce, but concluded in 1980-1982 that problems with poor root quality and plagiotropic growth could not be solved in this way (the sad story from Norway).

Inspired by a Canadian research group, we thus tried another option; the bulk propagation of well-tested full sib families in breeding, where rooted cuttings were made from juvenile, succulent seedlings of high yielding families. Based on experimental evidences, we estimated that it could be possible to produce at least 20 – 30 cutting per seedling within a year, and establish hedges for further production of numerous twigs for rooting some years thereafter. We tested cuttings in field trials, and no major adverse effects were found. Biri nursery optimistically developed a robot prototype (together with a toothbrush company), which could be used to insert the detached twigs automatically into the root medium in multipot containers. In parallel, we tried to find the optimal photoperiod for rooting and growth, and spent quite a lot of time to refine the propagation system. We realised, however, that the nursery growers actually disliked the appearance of the cuttings, they became expensive to produce, and the customers were reluctant to buy the plants. Moreover, problems with temporary plagiotropic growth, combined with a short containerized production period, made the rooted cuttings even less appealing. Going back to a 3- or 4-years bare-root plant production cycle, was not considered an option among Norwegian plant producers and their advisors.

Clonal forestry with Norway spruce could work if somatic embryogenesis (SE) becomes an efficient plant production system. Combined with cryopreservation and clonal testing programs, our data indicate that we could deliberately use SE temperature to adjust bud phenology and growth rhythm of the propagated clones to match regional and local climates. Norwegian politicians would like to see increase forest growth to mitigate national emissions of greenhouse gases, and this has revitalized an interest for tree breeding. Nowadays, more than 60 % of the seeds used to produce Norway spruce seedlings originate from seed orchards. We may therefore use clonal forestry for the most productive areas if done at an acceptable cost. However, SE still produces erratic, unpredictable outputs, at least in our hands. SE works poorly for many of the promising genotypes we may want to propagate. So, before clonal forestry will work, we need to solve the problems with SE. This is a tall order, frankly speaking. We have tried to refine SE for quite a number of years already, without progress towards commercialization. If we succeed, we further need to convince the public, forest owners, environmentalists and decision makers, that clonal forestry will retain sustainable forests, where genetic variation maintains diverse and robust, thereby keeping the risk for unexpected calamities as low as possible.