

Comparing the cost of cardboard box concepts that increase the productivity of tree planting machines: a case study from southern Sweden

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ABSTRACT

There is a strong need to mechanize tree planting in Nordic forestry. Today, tree planting machines plant <1% of all seedlings in Swedish forestry. The planting machines that are commercially available (mainly the crane-mounted Bracke Planter on excavators) currently plant trees with higher quality but more expensively than mechanized site preparation (mainly disc trenchers mounted on forwarders) with subsequent manual planting. Because they are designed for manual tree planting, today's seedling handling systems are one of the bottlenecks keeping tree planting machines from becoming economically competitive with manual tree planting. However, cardboard concepts that would speed up seedling reloading on the Bracke Planter 196 seedling carousel have been proposed. The question then raised was: could the time savings offered by these seedling supply concepts pay for the added packaging and investment costs?

The objectives of this study were to: 1) analyze the cost-efficiency of three conceptual seedling supply systems involving cardboard boxes of varying packing densities; and 2) compare their total costs with those of today's two most common seedling supply systems in southern Sweden.

All systems were based on cultivating seedlings in Hiko v93 cultivation trays. The first system entailed seedling handling in cultivation trays between the nursery and planting machine, while the other four systems involved transferring seedlings from cultivation trays to cardboard boxes at varying densities and dimensions for transport to the planting machine. Data (time consumption values, costs, measurements, capacities, etc.) were acquired from manufacturers, nursery personnel, contractors, transportation companies, etc. Costs were then calculated and tallied up.

The results showed that cultivation trays (Hiko) seem to be the most cost-efficient packaging system for excavator-based tree planting machines. Because of low packing densities, the three proposed cardboard box concepts did not seem to be cost-efficient. Indeed, to save on transport and packaging material costs, seedlings in boxes should be shipped lying down with intertwined stems/green parts. And as long as the hourly cost of excavator-based mechanized tree planting is relatively low (because of low-tech planting machines, i.e. Bracke Planter) and primary transport distances are short (because of few contracted planting machines), even the highest-density cardboard box

concept seemed to be cost-inefficient. However, the cost-competitiveness of the high-density cardboard box concepts would increase if we had made the analysis for continuously advancing planting machines with high hourly costs and manual seedling loading (e.g. a tree planting machine like the recently developed Plantmax).