6.4 Simulating concepts for fully mechanized stand regeneration

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Abstract

Boom-tip mounted planting devices are currently the only fully mechanized systems available commercially for reforestation in the Nordic countries. These devices prepare the soil (generally via spot mounding) and plant a seedling, both during the same work cycle. Bracke p11 and M-planter are the most common devices on the market. When mounted on excavators, these systems provide excellent silvicultural results, but their productivity is poor. Consequently, today's tree planting machines generally cannot compete economically with today's most common regeneration system, i.e. mechanized scarification followed by manual planting.

The objective of the present study was to investigate novel conceptual systems for fully mechanized stand regeneration that could possibly compete with mechanized scarification and manual planting. We created four alternative systems using discrete-event simulation. The systems were as follows:

1) Mechanized scarification (disc trenching, continuously advancing) and manual planting.

2) M-planter or Bracke p11, i.e. mounding with planting (fully mechanized, intermittently advancing).

3) SilvaNova 2.0 (fully mechanized, continuously advancing).

4) SilvaSuperNova (fully mechanized, continuously advancing).

Hence, systems 1 and 2 already exist, whereas systems 3 and 4 are purely conceptual. SilvaNova 2.0 and SilvaSuperNova are upgraded versions of the old Silva Nova planting machine (which was large, expensive and mounted on a forwarder's load-space). The original Silva Nova was operated by two operators, one drove the base machine while the other operated the planting unit. Moreover, later versions of the Silva Nova were equipped with MIDAS trenching units (which were mounted in front of the rear bogie so that it immediately compacted the berm, effectively inverting the soil and humus). To improve competitiveness, we assumed the SilvaNova 2.0 planting unit to be fully automated and the whole machine to be operated by a single person. Meanwhile, the SilvaSuperNova is assumed to be completely autonomous, it follows a beforehand programmed path.

The simulation results confirmed current knowledge: mechanized scarification can efficiently create many planting spots per hectare making *System 1* the most cost-efficient, non-autonomous alternative. Meanwhile, mounding with planting (*System 2*) was the most expensive alternative. SilvaNova 2.0 was slightly more expensive than *System 1*, but cheaper than *System 2*. And finally, the autonomous SilvaSuperNova was slightly cheaper than *System 1*. Thus, the simulations showed that SilvaNova 2.0 and SilvaSuperNova (*Systems 3* and *4*) probably have some development potential. But equally important, the simulation showed that the silvicultural results (in terms of occurrence of empty areas lacking seedlings) are a relative weakness of *Systems 3* and *4*.