



Harvesting / Transportation No. 3

- ▶ *Harvesting first thinnings for energy takes place earlier than traditional first thinning.*
- ▶ *Benefits of early thinning include improved stand stability and revenue generation at an earlier stage of the rotation.*
- ▶ *Trees are harvested as whole stems in the spring, left to dry over the summer to reduce moisture content and to allow needles to drop off.*
- ▶ *Chipping takes place in the autumn when the moisture content of the felled trees is reduced.*
- ▶ *Whole tree chips produce slightly more ash than chips made from stem wood only.*
- ▶ *Thinning is carried out in two stages: line thinning, followed by a selection thinning a year later.*
- ▶ *Chipping can be done using a purpose-built machine or a tractor-mounted chipper with parallel crane infeed.*

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Harvesting wood for energy from early first thinnings

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Background

Wood for energy is a fairly new concept in Ireland, but one that has great potential. Ireland has a large number of young conifer plantations that are approaching first thinning. Harvesting these small trees is not always cost effective and wood for energy may offer a solution in certain situations.

In Denmark more than 90% of all first thinnings are harvested for energy. The methods and machines for this operation have been developed over the past 20 years. Several methods have been developed for particular situations but no one method exists that is suitable for all circumstances. The methods described in this note are valid for sites with a reasonable to good ground bearing capacity. The whole tree method prevents the use of a brush mat because all of the branches and tops are chipped, so extra wide tyres or bandtracks should be used on all machines to reduce their ground impact.

Silviculture

Harvesting first thinnings for energy generally allows felling to be done earlier than usual. Normally thinning takes place when trees have grown large enough to provide a proportion amount of small sawlog (previously known as boxwood) and stakewood. Benefits of early thinning include the improvement of stand stability and the generation of revenue to the grower at an earlier stage of the rotation.

Thinning for energy also allows the removal of poorly formed trees, and better spacing of the future crop. When felling to produce energy wood it does not matter if the trees are double stemmed, crooked, diseased, damaged or even of an undesired species. After a first thinning for energy, the subsequent thinning will give a better yield of higher value products and the harvesting of those trees will be cheaper.

The most important point about harvesting first thinnings for energy is that the trees are harvested as whole trees, felled at least half a year in advance of the chipping, so that the felled trees can benefit from summer drying. The summer

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drying not only allows the moisture content of the chips to fall, but also permits most of the needles to drop off. Needles contain 70-80% of all the nutrients in the tree and it is important that they remain in the forest to reduce nutrient depletion by biomass removal.

Chipping the tops and branches, and all small undesired trees, can increase the amount of wood harvested per hectare by as much as 30-40%. This means that although the energy assortment might command a lower price than other assortments, the relatively low cost of the harvesting operation, together with the increased volume harvested can outweigh the lower price.

Wood ash

Whole tree chips produce slightly more ash than chips originating from stem wood only. This is because bark and branches have higher nutrient contents, and soil can become embedded in the bark. Needles in the fuel will increase the amount of fly ash and increase the risk of corrosion of the boiler. Normally the ash content is in the order of 1-2% on dry weight basis, and might increase to 1.5 to 2.5% if the needles are burned as well.

Fly ash is the light fraction of the ash that has to be filtered from the flue gasses. By burning needles, the

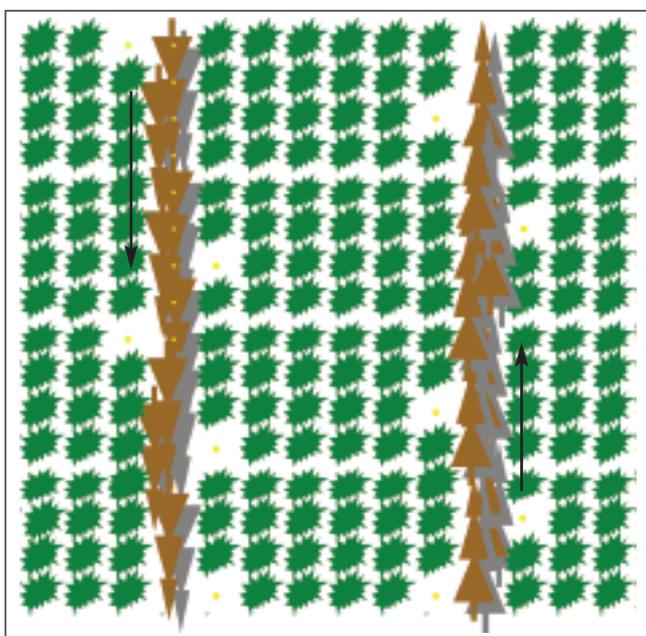


Figure 1: The layout of the stand after the rack has been felled. Arrows indicate direction of travel.

amount of fly ash will increase and place strain on the filtering system. Needles are very light compared to wood particles and are blown up from the bed of burning wood by the primary air, which is blown through the bed.

Wood ash has to be deposited until further notice in a controlled landfill, which can be very expensive. In most cases the landfill will not accept dry ash, which means that water has to be added, increasing the weight. Costs of up to €150 per tonne and more to deposit ash are not uncommon.

Thinning method

First thinning is usually carried out in two stages:

- a line thinning, where the whole trees are felled by chainsaw and chipped after summer drying by a terrain-chipper, every sixth or seventh line is removed (Figure 1);
- a selection thinning one year later, where the trees are felled by a feller-buncher, taken into the skidrow and dropped there for summer drying. Later the whole trees are chipped with a terrain-chipper (Figure 2).

Three important reasons why first thinning is carried out in two stages are:

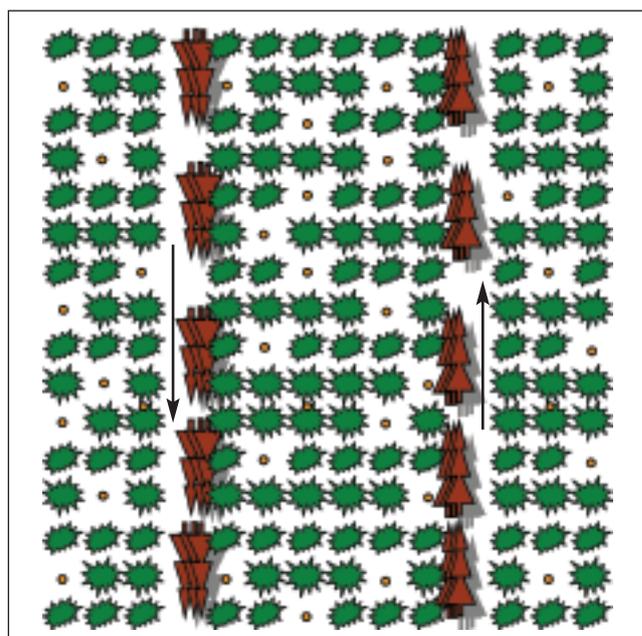


Figure 2: The layout of the stand after selective thinning by feller-buncher. Arrows indicate direction of travel.

- Silvicultural: the stand has one growing season to adapt to the missing rows, and the lines next to those removed can stabilise;
- The feller-buncher cannot fell the line and do a selection thinning, as it has to push the trees down into the unthinned part of the stand while creating an obstacle for itself;
- If a combined line and selection thinning was carried out, the pile of trees in the rack would dry extremely slowly, and would decay rather than dry.

During the line thinning and the subsequent selection thinning, stems are left close to the stump in a roof-tile fashion in the rack for summer drying. It is vital, however, that trees are fully felled off the stump.

Types of machines

Trees can be chipped using a purpose-built machine or by a tractor-mounted chipper with parallel infeed by crane.

The purpose-built machine consists of a chipper integrated with the base machine carrier, which also includes a container to hold the chips (Figure 3). Usually this machine works in tandem with a chip forwarder that backs up to the chipper in the stand and receives the load, which the chipper tips into its bin. The chips are then forwarded to the roadside for unloading, either into a road transport vehicle or as a pile. The advantage of this system is that the chipper can continue chipping and does not have to spend time transporting the chips to the roadside before returning to the forest for another load. The chipper and



Figure 3: The Silvatec chipper is a purpose-built machine including a chipper and a collection container.

chip forwarder should maintain radio contact with each other.

The alternative is a tractor-mounted chipper pulling a chip trailer. Usually this means that the chipper is attached to the three-point-linkage of a large agricultural tractor, which is permanently reversed (Figure 4). The chip trailer is attached to a special hitch mounted on the former front of the tractor. Usually the chip trailer is much larger than the container on the purpose-built machine, which allows the chipper to work longer before having to go to the roadside for unloading.

Moving between sites is easier with the tractor-mounted chipper. The purpose-built machines should be transported by low-loader if the distance between sites exceeds 4-5 km.

How to organise chipping

In order to facilitate chipping a number of factors have to be taken into consideration before and during the felling operation:

- The layout of the felling should allow the chipping machine to travel up and down racks. This means that the trees felled in one rack are felled in the opposite direction to the trees felled in the adjacent rack. However, if the racks are very short, up to 25-30 m, it is better to fell all trees in the same direction away from the road, and allow the chipper to reverse out of every rack.
- The entrance to each rack should be wide enough to accommodate the machine and allow it to enter without

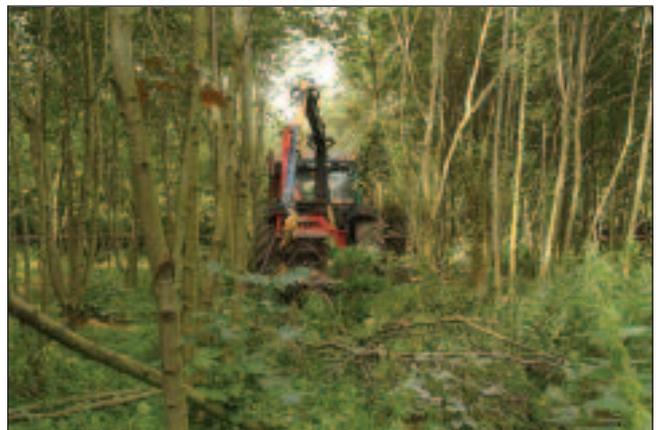


Figure 4: A TP280 tractor-mounted chipper with a trailer attached to collect the chips.

damaging the edge trees. Therefore, the corner tree of each rack next to the rack should be removed to create a type of bell mouth.

- Chipping trees from the top is difficult and chip quality is compromised.
- Very long racks should be intercepted by cross racks to offer the chipper or the chip forwarder the chance of getting to the roadside faster, without having to back out all the way and risk damaging the remaining stand.
- If obstacles are met during felling, which would hinder the chipping operation, then a diversion should be made. Obstacles might be high old stumps from a previous stand, large boulders, wet and soft spots, etc.
- If drains have to be crossed, this should be done at right angles. If the drains are deep, then some logs should be cut and placed in the drain to effect a crossing. If drains are too deep for the chipper, dirt might be forced into the infeed opening of the chipper while passing the drain, damaging the knives and anvil, and reducing production. Logs should be removed when the felling/chipping operations are completed.
- If the stand does not border on a road at both ends, a cross rack will have to be cut some metres before the end of the stand to allow an exit route for wind which would otherwise be trapped.
- If cross racks are being made, the trees from the cross rack should be felled on top of the trees from the main rack. If they are buried under the trees, then the chipper will experience difficulty processing them.

Acknowledgements

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For information and a free on-line advisory service on the wood energy supply chain, the quality of wood fuels and internal handling visit www.woodenergy.ie