- *Thinning will improve the quality of final crop.*
- *Thinning will increase overall timber revenue by increasing the volume of sawlog produced and provide a source of early revenue to the owner.*
- *Thinning is more profitable than no thinning for yield classes 14 and greater.*
- *It is better to thin early rather than late, and to gain the full advantage of thinning, crops must be capable of reaching their financial rotation.*
- *Not all crops will be suitable for thinning due to access and stability. As a general rule, only crops capable of attaining a top height of 20 m should be thinned.*
- *First thinning can incur a loss, especially when access is difficult, sales size is small, the average tree size is small, and where site conditions are difficult for harvesting and extraction.*

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Thinning to improve stand quality

Henry Phillips[1]

Thinning involves the removal of part of the crop in order to concentrate future volume growth on fewer and better quality stems. The main aim of thinning is to improve stem quality through the removal of deformed/unthrifty trees and to reduce the time taken for trees to reach valuable sawlog size. Thinning is the most powerful tool the grower possesses to manipulate the development of the plantation and the quality and log size of the final crop (Hibberd 1991).

Thinning will increase overall timber revenue by increasing the volume of sawlog produced. This is due to the fact that larger trees attract significantly higher prices (Figure 1), as they are less expensive to harvest (on a €/m^3 basis) and yield more valuable end products.

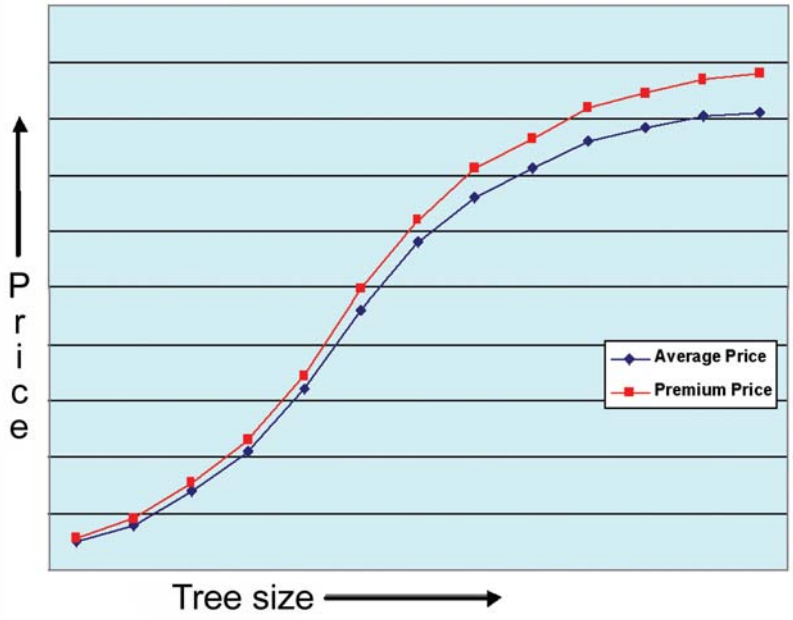

FIGURE 1: Price size curve for conifers 1985-2001.

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There are many advantages to thinning (Price 1989) including:

- it allows easier access into the crop for management inspection;
- waste can be avoided by removing suppressed trees before they decay;
- promotion of stand hygiene by removing dying trees and allowing freer air circulation;
- provision of revenues early in the rotation;
- promotion of opportunities for natural regeneration;
- improved genetic quality for subsequent rotations;
- improved the saleability of the plantation should the owner wish to dispose of the asset;
- enhancement of flora and fauna.

Types of thinning

The two main types of thinning practiced in Ireland are **rack and selection** and **selection**. In a rack and selection thinning (normally done at time of first thinning), a line of trees, usually every seventh line, is removed and the intervening trees are selectively thinned. Selection thinning involves the removal of deformed, unthrifty and weaker trees throughout the crop and preferably should involve the marking of these trees in advance of harvesting.

Thinning can be either mechanised or motor manual. In mechanised thinning, a harvester fells, delimbs and crosscuts the stem into various product assortments, e.g. pulpwood, pallet wood, stake wood and sawlog (usually based on the top diameter and length of the log). The material is then extracted to roadside by a forwarder. This is the most common system used in Ireland and accounts for approximately 90% of thinnings undertaken. In motor manual thinning, the felling, delimbing and crosscutting operations are done by chainsaw and extraction to roadside is by skidder, cable crane, horse or forwarder.

Timing of thinning

The timing of first and subsequent thinnings depends on the productivity of the site. Yield class is used to identify the potential growth rate of plantations. Yield classes vary from 4 to 30 for conifers depending on species and site productivity. A yield class of 20 means that the crop has the potential to produce 20 m^3 per ha per year over a full rotation. For grant-aided forestry, a site must be capable of supporting yield class 14 Sitka spruce or yield class 4 oak/beech, or their equivalents. The higher the yield class, the greater the growth rate, the shorter the rotation and the earlier the age of first thinning.

The timing of first thinning is especially important in Ireland due to our windy climate and the wet mineral soils that so often typify plantations. If delayed, the crop trees can get drawn up and once opened up through thinning could render the crop liable to windthrow. The recommended ages of thinning for Sitka spruce are shown in Figure 2. These should be treated as maximum ages for Irish conditions.

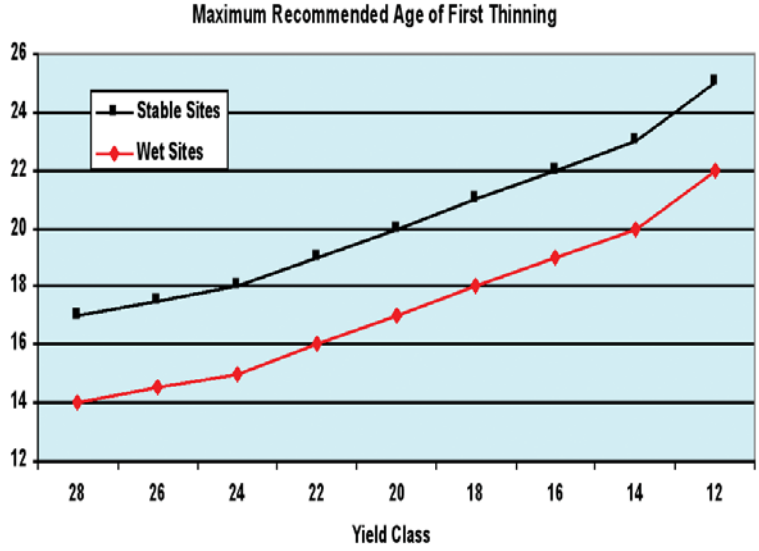

FIGURE 2: Maximum age of first thinning.

Following a first thinning, crops should be thinned on a regular basis, normally every four to six years depending on the yield class, with higher yield classes having more frequent thinnings.

Site suitability

Not all crops will be suitable for thinning. On unstable sites, typically gley and peat soils, maximum height growth may be limited before the onset of windblow (Figure 3) (Ní Dhubháin *et al.* 2002). On such sites, it may be more prudent to either thin early and carry out a limited number of thinnings or leave the crop unthinned. As a general rule, crops on wet sites, especially if they are exposed, should not be thinned.

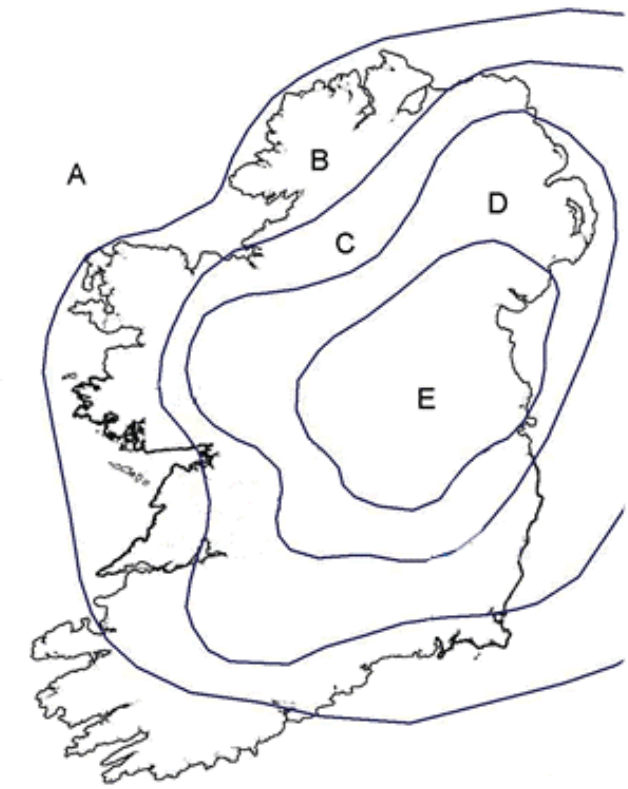

FIGURE 3: The five wind zones of Ireland. Wind zones separate the country into areas of homogeneous wind strength. They are represented alphabetically from A to E (A = strongest winds, E = weakest winds) (Ní Dhubháin *et* al. 2002). In terms of wind risk, A = most susceptible, while E = least susceptible.

Harvesting costs

Although thinning represents a source of much needed revenue, it incurs a number of costs. These include harvesting, marking of thinnings, road and drain repair following thinning and possibly roading required to provide access to the plantation. Typical harvesting and extraction costs based on 2001 rates are shown in Table 1.

TABLE 1: Harvesting costs (€/m ^{3}) .

Harvesting and Extraction	Average	Range
First and second thinnings	16.00	14.50 – 20.50
Third and subsequent thinning	13.90	11.25 – 15.00
Clearfell of windblow	12.10	9.75 – 13.50
Clearfell	10.10	8.10 – 12.75
Road and drain repairs after thinning	1.00	0.25 – 2.50
Mark and measure thinnings	1.70	1.25 – 2.50

Higher costs are incurred where (a) the volumes are small, (b) tree sizes are small, (c) access is poor, (d) areas are isolated and (e) site conditions are difficult.

As the average size of private plantations is less than 10 ha, many of which are geographically isolated, the likelihood is that these plantations will be more difficult to market and more expensive to harvest than larger blocks of Coillte forests. There is the potential to improve their marketability and reduce harvesting costs and by implication, returns to the grower, by amalgamating thinning sites into larger sales packages which would be more attractive to potential purchasers. This is commonly undertaken by private owners associations/co-operatives in other countries with a more developed private sector. Given the potential volumes from the private sector, work on developing marketing co-operatives for private plantations should be developed before the end of this decade. To this end COFORD is funding a study on the development of effective market led grower co-operatives. The study is being conducted by the Western Forestry Co-operative, University of Ulster and Galway-Mayo Institute of

Technology and will examine best practice in co-operative structures throughout Europe.

Economics of thinning

The economics of thinning depend on a combination of yield class, price and site stability. Thinning increases revenues but incurs a risk in terms of windthrow on unstable sites. The results of an economic analysis using long term average standing prices (1987-2001) for conifers and costs outlined in Table 1 is shown in Figure 4. As a general rule of thumb (a) thinning is more profitable than no thinning for yield classes 14 and greater, (b) thin early rather than late and (c) to gain the full advantage of thinning, crops must be capable of reaching their financial rotation.

The financial rotation is the one which maximises the return to the grower. It is typically shorter than the traditional rotation which maximises volume production.

First thinning

First thinning represents a special case. Many private growers may decide to leave their plantations unthinned as the first thinning may incur a net cost. This, while understandable from a cash flow perspective, is not the way to maximise the overall return from the plantation. Taking the long-term view, it is possible to incur a loss on first thinnings of €3 to €6 per m^3, depending on yield class, and still achieve significantly better returns than leaving the crop unthinned. This is in addition to the increased saleability of thinned plantations, should the owner wish to sell the plantation.

Many countries recognise the cost implications of undertaking first thinning and provide financial support to ensure that (a) the grower will not incur a loss and (b) there will be a regular supply of small diameter roundwood to the market for processing. Finland, for example, in its National Forest Program 2010 has allocated significant subsidies for cleaning and first thinning to ensure the sustainability of wood production and supply to industry (Anon 1999).

The critical issue in terms of revenue from first thinning for the private owner is to maximise the volume of the higher value stake wood and pallet wood assortments (Hanrahan 2001). However, this should not occur at the expense of delaying first thinning and/or missing the optimum time for pruning.

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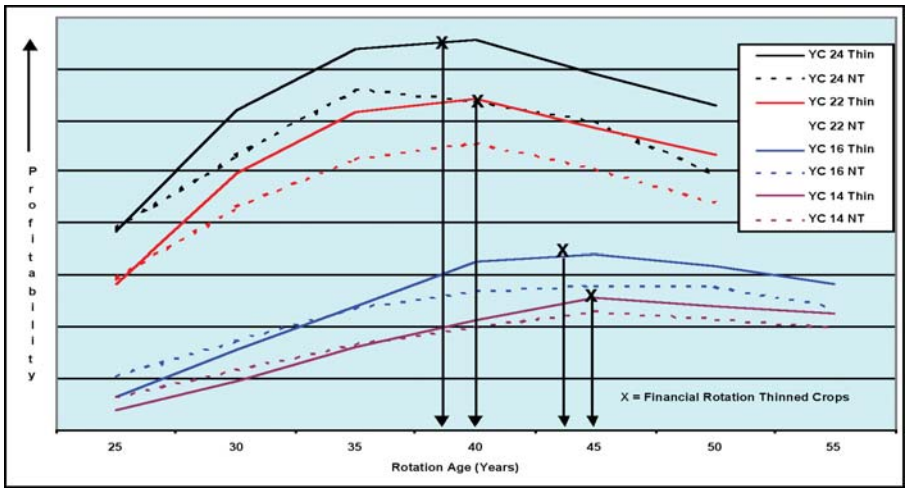

Figure 4: Comparison of profitability of thinning vs no thinning (NT) in Sitka spruce.