- *Improved Washington provenance Sitka spruce has been developed by selection of superior individuals in Irish plantations over the past 35 years. It is material specifically developed for Irish climatic conditions.*
- *The 1:6.3 cost/benefit ratio of planting a 50:50 mixture of improved:unimproved Washington Sitka spruce is a very attractive financial option that more than covers the additional cost of the improved planting stock.*
- *Silvicultural considerations and establishment guidelines for the planting of improved Washington Sitka spruce are presented.*

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Economic benefits and guidelines for planting improved Washington Sitka spruce

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Introduction

The combination of the high capital cost of land for afforestation and the increasing use of broadleaves in reforestation limits the opportunities for any sustainable long-term increase in volume yields in the forest estate. However, the use of improved planting stock offers a simple means to increase volume yields from Sitka spruce sites by at least one Yield Class (Yield Class [YC] is the potential maximum mean annual volume increment to 7 cm top diameter per hectare per year.). This means that it is possible to produce a greater volume of wood from the same amount of land.

The use of improved planting stock in forestry has been the subject of many studies. In almost all cases the additional costs incurred by planting improved material have been more than offset by improvements in growth, stem form and wood properties.

The improved Washington provenance Sitka spruce discussed here has been developed by Coillte and its predecessor, the Forest and Wildlife Service, over the last 35 years. It results from the selection of superior individuals in Irish plantations of Washington provenance with above average Yield Class, determining their breeding value through field testing their progeny and reselecting those individuals capable of producing progeny with superior characteristics, i.e. increased growth rate with no loss in wood density and improved stem form.

Selection of superior 'plus trees' in above average Sitka spruce plantations.

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Of the more than 500 individuals tested, 36 (about 6.5%) have been selected to produce superior progeny for commercial production. This material represents the only improved Sitka spruce developed specifically for Irish climatic conditions.

The improved Washington Sitka spruce is produced by making controlled crosses between these highly selected and tested individuals and establishing stock plants. These stock plants provide cuttings that are rooted to produce the plants to be planted in the forest. Unfortunately, the labour required to root these cuttings results in a higher cost per plant. This note demonstrates that these additional planting stock costs are more than offset by the increased productivity and timber quality provided by improved Washington Sitka spruce.

Benefits of planting improved Sitka spruce

Productivity considerations

Assumptions:

1. In order to demonstrate the economic benefits of improved Washington Sitka spruce, the level of improvement is estimated to be a 15% increase in volume, which is approximately equivalent to one Yield Class (2 m^3/hectare/year) increase in wood production on a Yield Class 14 site. On higher Yield Class sites, the 15% increase in volume would undoubtedly be in excess of one Yield Class; however, a conservative approach is used here and an increase of one Yield Class is assumed for all sites.
2. All crops will be planted as a 50:50 mixture of improved:unimproved material either as an intimate or line mixture. This is because the improved Washington Sitka spruce costs more to produce by rooted cuttings (the 2010 retail price was €395/1,000 plants) than unimproved Washington Sitka spruce (2010 retail price was €270/1,000 plants). The use of a mixture helps to minimise the effect of increased planting stock costs which would affect unit establishment costs.

In addition, although 2,500 trees are planted per hectare, only 400 to 600 trees will provide the final crop volume. Therefore it is not necessary to plant a site with 100% improved Washington Sitka spruce and the recommended option is to plant 50:50 improved: unimproved material. Planting a 50:50 mixture also permits the planting of more land with the limited number of improved plants that are available each year.

Using these assumptions, a comparison of the effect of an increase of one Yield Class across a range of Yield Classes (14 to 24) can be generated (Table 1).

The results in Table 1 clearly show that the use of improved Washington Sitka spruce will increase the current value of the crop on average by about €987 per hectare. Thus, there is significant scope for increasing the productivity of lower Yield Class sites. However, for higher Yield Class sites the increase in productivity would result in shorter rotations that will contain higher percentages of juvenile wood with poorer wood properties.

Table 1: Discounted revenue and benefit from planting a 50:50 improved:unimproved Sitka spruce mixture (€/hectare).

	YC 14	YC 16	YC 18	YC 20	YC 22	YC 24
Rotation (years)	46	44	42	40	39	38
Discounted revenue[1] €	2,682	3,523	4,508	5,560	6,525	7,617
Yield Class increase		14 to 16	16 to 18	18 to 20	20 to 22	22 to 24
Benefit[2]	---	841	985	1,052	964	1,093

[1] *Discounted Revenue* is the value of all thinnings and the final crop net of cost of sales at 11% and a stocking reduction of 15% (based on a 2 m spacing and thinned to an intermediate thinning regime) using ten year average timber prices (1998-2007) discounted at 5% and planting a 50:50 improved to unimproved mixture.

[2] *Benefit* is the increase in the discounted revenue due to increasing the productivity of the stand by one Yield Class.

Cost considerations

Assumptions:

- Unimproved Washington Sitka spruce will cost €270.00/1,000 plants (2010 retail price).
- Improved Washington Sitka spruce cuttings will cost €395.00/1,000 plants (2010 retail price).
- Planting rates will be 2,500 plants per hectare.

The cost of planting 50% of the crop with improved Washington Sitka spruce (€156 /hectare as shown in Table 2) is more than offset by the increased benefit/hectare (on average €987) as shown in Table 1.

Combining the benefits from Table 1 with the additional costs from Table 2 allows the examination of the net impact of using improved planting stock. The cost/benefit ratio (Table 3) is an impressive 1:6.3 which, even in times of budgetary limitations, makes economic sense to invest.

Silvicultural considerations

In addition to the increased volume production there are other benefits from planting improved Washington Sitka spruce, including:

1. Faster capture of the site which can result in the elimination of a final vegetation control treatment.
2. Reduced rotation lengths (with limitations as discussed above).
3. Significant improvement in stem form.
4. Significant improvement in branching habit (fewer and smaller branches).
5. No significant reduction in wood density resulting from selection for increased growth rates.

Apart from the reduction in rotation length, it is difficult to place economic values on any of these factors which are in addition to the increases in volume production.

Guidelines for planting improved Washington Sitka spruce

1. Cuttings should be planted only on sites where Sitka spruce would normally be planted (below 300 m in elevation and in low frost risk areas) and have a low windthrow risk.
2. Although Sitka spruce rooted cuttings are not more delicate than regular Sitka spruce transplants, they should receive proper care and attention before, during and after planting.
3. Spacing of the plants should be 2 x 2 m on mounds or on the flat as with normal practice.

Table 2: Total plant costs per hectare and total additional cost above base case (planting 100% unimproved Washington Sitka spruce) of a 50:50 mixture of improved /unimproved Washington Sitka spruce.

Option	Composition	No. of plants/ha	Plant cost (€/1,000)	Total plant cost (€/ha)	Additional cost above base case (€)
Base case	100% unimproved Washington	2,500	270	675	---
Improved Sitka spruce	50% improved Washington	1,250	395	494	156
	50% unimproved Washington	1,250	270	337	
				Total 831	

Table 3: Cost/benefit ratios for planting improved Washington Sitka spruce mixtures.

	YC 14	YC 16	YC 18	YC 20	YC 22	YC 24
Rotation (years)	46	44	42	40	39	38
Benefit (€)[1]	--	841	985	1,052	964	1,093
Cost/benefit		1:5.4	1:6.3	1:6.7	1:6.2	1:7.0

[1] From Table 1.

Rooted cuttings of Sitka spruce ready for lining-out in the nursery.

4. Improved Washington plants should be planted in a 50:50 mixture with unimproved Washington Sitka spruce either as random mixtures made at the nursery or on site, or in line mixtures.
5. Fertilisation, vegetation control and weevil protection for the improved Washington plants should be the same as regular Sitka spruce transplants.

Conclusions

For an additional €156 per hectare (using 2010 retail prices) the resulting increase in volume is worth on average €987 per hectare. Thus, even under extremely conservative assumptions, the planting of improved Washington Sitka spruce in Ireland will more than cover the additional cost of the planting material. It will also increase the productivity of the national forest estate. Concerns about the higher cost of improved Washington plants should not dissuade forest owners from using this material.

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