

IT'S A FAMILY AFFAIR

'Full-sib' families are a new generation of improved Sitka spruce planting stock. **Steve J Lee**, Programme Leader for Conifer Breeding, Forest Research, explains.

The genetic improvement of Sitka spruce has been progressing steadily over the last 40 years from the selection of plus trees and progeny testing, to the establishment of seed orchards and the annual production of cuttings from family mixtures. The use of vegetatively-propagated trees (VP planting stock) from half-sibling family mixtures has become common place and VP is now a popular choice for restocking and new planting.

Predicted gains from existing family mixtures vary according to the requirements of the original customer. Normal gains are a 20% increase in stem diameter and around 15% to 20% improvement in stem straightness at 15-years old with 21% to 29% volume gains predicted at final rotation (Lee and Matthews, 2004). Over six million VP Sitka spruce trees are now planted annually in British forests with much of the balance consisting of stock derived from tested seed orchards.

There is now a new addition to the suite of improved Sitka spruce planting stock. The new stock are known as full-sibling families and they will further add to the forest managers' bottom line by continuing gains in quality and quantity and also improving stand uniformity as the variation between the size and shape of each tree is reduced.

WHAT ARE FULL-SIBLING FAMILIES?

Seeds making up a full-sibling family have just one known mother and one known father (Fig. 1) and have been produced through controlled pollination carried out by breeders (Fig. 2). This parentage contrasts with the usual 20 mothers and further 20 unrelated fathers that make up a typical half-sib family



FIGURE 1.

mixture which have been commonly available since the mid-1990s.

It follows that the variation in characters such as stem diameter, stem straightness and timber strength between say 1000 trees raised from a single full-sib family will be less than 1000 trees raised from a half-sib family mixture; the former have two parents, the latter have a mix of 40. In addition, progeny tests have provided breeders with data on the mean performance of the trees raised from these two-parent combinations allowing them to further select the best and reject the rest.

This is a potentially exciting development in the deployment of improved Sitka spruce planting stock. The selection and breeding work started in the mid-1980s when conifer breeders at Forest Research established the first trials to investigate the gains available from crosses between the best of tested parents (original plus trees).

The first of these full-sibling trials are now 20-years old and have been measured for stem diameter, stem straightness, wood density and branching quality. We have analysed the

data obtained from these early full-sibling trials, identified the families which best combine vigour and quality traits and started a programme of repeat production of preferred families through controlled pollination (Fig. 3).

It is the seed from these repeat productions of superior full-sib families which are now available to the forest industry. Forest Research has experienced considerable demand for the full-sib seed from commercial nurseries which then produce rooted cuttings in the usual way for the forest manager.

IMPROVEMENTS IN UNIFORMITY

When half-sibling family mixtures are planted in the form of vegetatively propagated trees (rooted cuttings), the mean performance of the stand is improved according to the gains predicted for the planting stock; normally 20% for stem diameter. The genetic variation within the crop however, is still very large as illustrated in Fig. 4.

When full-sib families are planted, the

genetic variation is lower. This means that more trees perform according to the predicted mean. There will be fewer very large trees, and conversely there will be fewer very small trees (Fig. 5). The amount of utilisable volume, and also that proportion of the crop making a saw-log grade will increase.

By selecting a full-sib family with good gain predictions for stem straightness and fine branches, the proportion of green logs should improve at the expense of red logs. Figures 6 and 7 illustrate the uniformity differences between eight-tree lines of unimproved Queen Charlotte Islands planting stock and a selected full-

sib family growing in a 20-year old progeny test in Spadeadam Forest, Kielder. Data from elsewhere suggest that the volume of green logs in some of the better progeny in test can be up to 40% more than the unimproved Queen Charlotte Islands (QC) control, and is commonly 20% more (Gardiner, pers com).



FIGURE 2.



FIGURE 3.

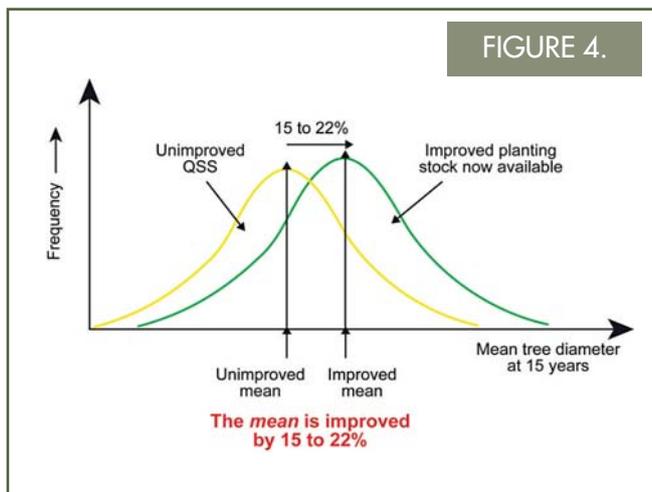


Fig. 4. The variation between trees in a stand of unimproved QCI and a half-sibling family mixture is roughly comparable. The major difference is that the family mixture stand will contain trees which have 15% to 22% larger diameter after 15 years (depends on the choice of family mixture).

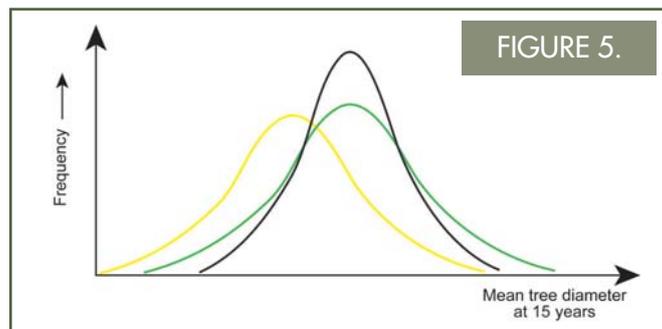
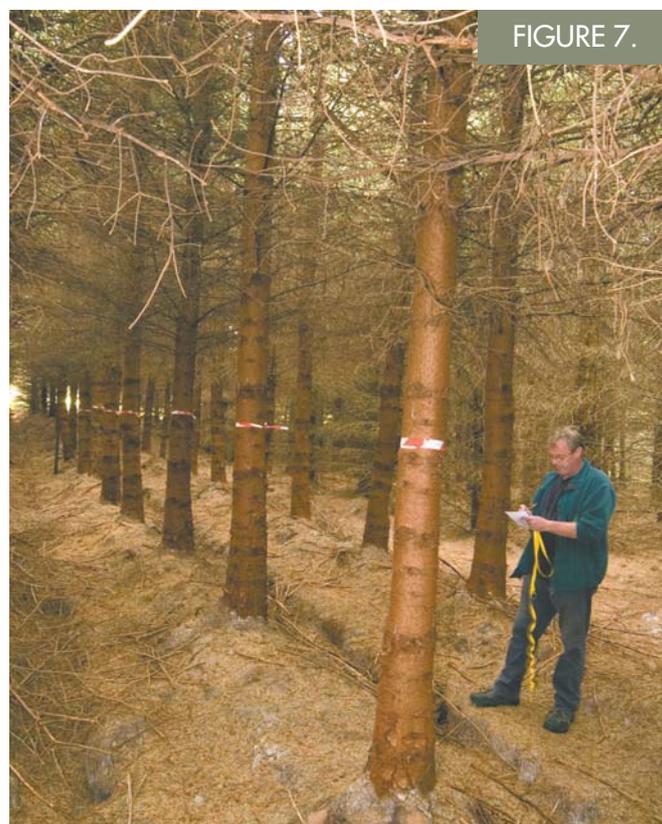
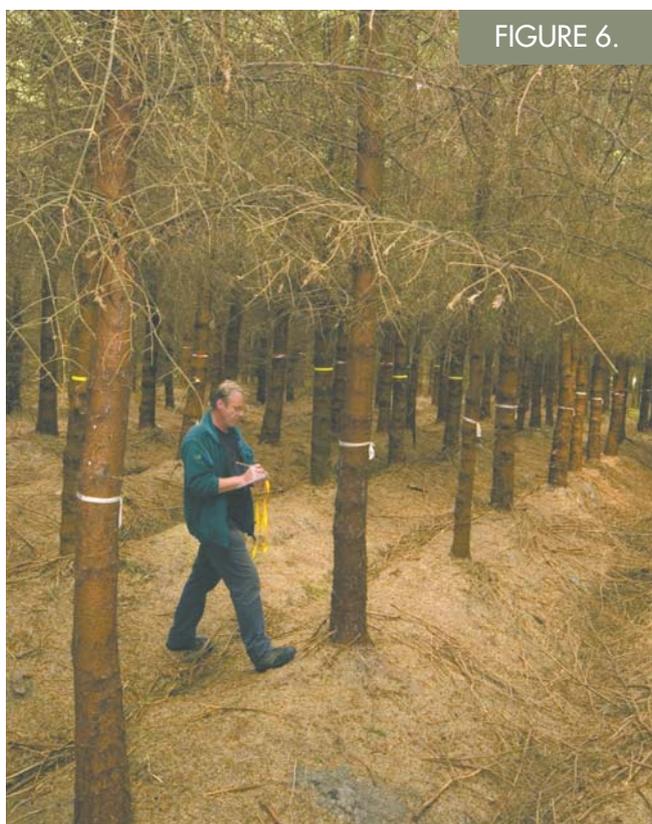


Fig. 5. The black line represents the difference in variation between a full-sib family and the half-sib family mixture. Since the parentage of the full-sib family is much reduced compared to the family mixture (2 relative to 40), the uniformity of the full-sib stand will be improved.

Figs 6. and 7. A line of unimproved QCI planting stock (white tape) and a superior full-sib family growing in adjacent plots in a Sitka spruce progeny test. The trees within the full-sib family are not only straighter and more vigorous but also demonstrate much less tree to tree variation.



DEPLOYMENT IN THE FOREST

There is now the opportunity for forest managers to plant single full-sib families or alternatively to mix a limited number of families with similar genetic gains. It follows that genetic and economic gain is maximised as variation is reduced so a single full-sib family would yield a greater gain than a combination of mixtures. The full-sib families available for deployment will change year on year as new, favourable pair-matings are identified in

progeny tests. Currently, only a limited number of full-sib families have been screened and just 20 have been selected for possible future deployment. This is likely to increase in the near future as Forest Research screen a further 200 families over the next two growing seasons.

The predicted genetic gains of all existing seed orchards and family mixtures are available on-line at www.forestresearch.gov.uk/treeimprovement.

Visiting this web-site will give a flavour of the full range of genetic gains which

are now available from a number of commercial nurseries.

* For further information on the breeding of conifer species in Britain contact Steve Lee at steve.lee@forestry.gsi.gov.uk.

REFERENCES

Lee, S. and Matthews, R. (2004) An indication of the likely volume gains from improved Sitka spruce planting stock. Forestry Commission Information Note 55. 4pp.