DIVERSIFIED SPECIES TECHNICAL NOTE

Number: DSTN-026
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What can we learn from Douglas-fir in Europe? A trip report from Freiburg, Germany

Summary

Heidi Dungey visited Freiburg, Germany to attend an international conference on Douglas-fir: "Opportunities and risks for Douglas-fir in a changing climate". This technical note summarises the experiences and ideas of her trip.

Based on presentations at the conference, New Zealand (NZ) scientists can (and should) further investigate scientific advances being made in France, in the research/industry organisation France Douglas and possibly engage in research collaborations with INRA, (literal translation - National Institute of Agricultural Research} particularly INRA Orleans, where Douglas-fir breeding is based. There are opportunities through Scion's TRANZFOR programme to have INRA breeders visit NZ, and this should be supported where possible. Another visit to INRA by a Scion scientist would be helpful to build a collaborative project and INRA interest. Other possible collaborations include with Oregon State University, where hybrid model systems are being used for Douglas-fir forest modelling. Such systems should be investigated for their usefulness in a NZ context. This would also fit with our desire to connect more to the Douglas-fir research organisations in the Pacific Northwest. Scientists should be encouraged to build these international linkages.

The major issues on the radar for European Douglas-fir foresters included:

- In Germany, how to grow enough good quality Douglas-fir in a 'close to nature' forest system, where exotic species of any sort were perceived to be detrimental to biodiversity. In Germany single-species plantations are not publically accepted and 'close to nature' forestry is more likely to be the norm.
- In France, there is a projected increase in demand for Douglas-fir wood because more wooden houses are being built. However, the demand is expected to exceed the supply within the next 50 years.
- There may be an opportunity for NZ Douglas-fir to fill the gap in France. It would be a good idea to visit France Douglas and obtain copies of the grading rules and prices to determine if this would be viable after shipping costs are included.
- NZ needs to keep an eye on the Pine Processionary Moth and how this pest may be adapting to feed on Douglas-fir in Europe.

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Introduction

FFR is interested in understanding the global context of growing Douglas-fir. How do we compare and compete with other international growers, and what can we learn and apply to our own forests?

Heidi Dungey attended an international conference on Douglas-fir. This Technical Note summarises the more interesting and relevant features from the conference.

The Conference

The international conference on Douglas-fir, was focussed on the "Opportunities and risks for Douglas-fir in a changing climate". The conference was a four-day event and was attended by speakers from the USA, Canada, France, Germany, Switzerland, Sweden, and even Iran. Heidi presented a paper on breeding Douglas-fir in New Zealand, and possible changes to the breeding and deployment of Douglas-fir with climate change.

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The conference had 6 keynote speakers. Talks from the most interesting keynote presentations included those from Bruce Larson, from Canada, Jean-Louis Ferron, Philippe Rozenburg, and Alain Roques, (France), and Doug Macguire from the USA.

All the details of the conference, including presentations, are available at http://douglas-fir2010.de/.

The Keynote Speakers

Keynote speakers represented a wide geographical range of experience with Douglas-fir. A summary of their talks is included.

Jean-Louis Ferron, from France Douglas, gave a very interesting talk on the history, recent economic development and the future of Douglas-fir in France. France currently has approximately 420,000 ha (approximately four times that of NZ) of Douglas-fir, mostly in the central mountain ranges. The resource is equivalent to ~90 million m^3. Harvesting of Douglas-fir has increased from 600 m^3/annum in 1990 to approximately 2 million m^3/annum in 2008. This is projected to increase significantly, up to 3 million m^3 sawn timber by 2030. The primary reason for this is increased demand from construction of wooden buildings.
Current Douglas-fir uses include Gluelam (50,000 m^3), structural (350,000 m^3), pallets (250-300,000 m^3) and cladding (30-40,000 m^3).
Primary export markets are Belgium, replacing American imports, Holland, Denmark, Great Britain, and other smaller markets in Italy, Spain and Japan.

Durability is seen as the most important quality of Douglas-fir, and heartwood is used for external cladding. France Douglas is involved in building standards to ensure quality control for this type of product. The specific grade involved is EN335-1.

France Douglas is an organisation recognised as the national reference for Douglas-fir in France. France Douglas is involved in standardisation (e.g. grading rules), research, communication and support for sawmillers and other professionals. The organisation was established in 1993, and has approximately 150 members. One third of these are sawmillers and forest companies, amounting to ~80% of timber production of this species. The four foci of France Douglas are:

1. Standardisation
2. Research
3. Communication
4. Support for sawmillers and other professionals.

Jean-Louis indicated that France Douglas aim to hold an international symposium in two years' time and he would love to involve someone from New Zealand. This will be a great opportunity for FFR/Scion if the symposium goes ahead.

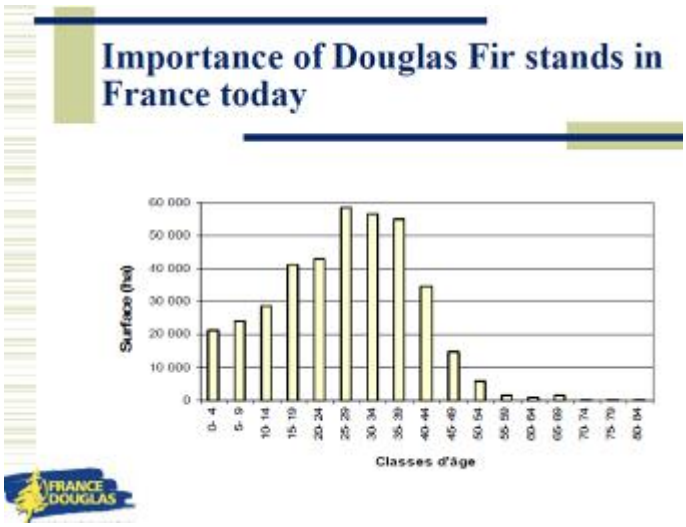

Figure 1 Age class distribution of Douglas-fir forest in France.

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Figure 2: External cladding applications in France

Phillipe Rozenburg (INRA, Orleans, France, below), is the head of the Physiology and Genetics department at INRA Orleans and is interested in adaptation to climate change and physiological characteristics that can be matched to this. The group is particularly interested in wood density, drought response, and the use of X-ray 'microdensity profiles' to correlate drought and density. The research is based on identification of 'phenotypic plasticity' in genotypes, reflecting an individual tree's ability to adjust to new or changing environmental conditions.

Phillipe has shown that the ring structure reflects the climate of the growing season. Higher temperatures and lower rainfall cause more latewood, which is reflected in changes in conduction function of the wood. Ring width and ring mean density have both been shown to reduce with drought, although there is lots of clonal variation and variation between years. Trees that survived a drought in 2003 were shown to have a higher wood density in the latewood, believed to be connected to the sap conduction. Higher wood density gives smaller cells with thicker walls, with improved hydraulic properties. Specific conductivity and vulnerability to cavitation become critical traits to measure to link this proposed function to physiology. New methods have been developed to directly measure this on individual rings (G. DallaSalda INTA, H. Cochard INRA). Studies so far have found higher phenotypic plasticity in trees that survived the 2003 drought versus those that died.

Next steps in the study are likely to be:

- Quantifying genetic variation in hydraulic properties of wood.
- Experiments in controlled conditions to test growing conditions (i.e. climate) vs wood plasticity.
- Measure mortality events in progeny tests for heritability.
- Molecular markers across natural populations.
- Reciprocal common garden experiments.

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Doug Maguire, USA, uses an interesting hybrid approach to modelling. He uses leaf area index (LAI) derived from area of cambium in the tree based on a sapwood taper model. He then adds process components into the empirical models, using information from:

- soil pits to 140 cm
- slope, aspect
- LAI foliar biomass
- vertical distribution of foliage
- climate data.

The final aim is to derive a model for site-specific silvicultural regimes. Doug would be a very useful contact for Dean Meason's work with 3PG

Monika Konnert, with several co-authors (StClaire, Krutovski, Stoehr and others) researched the genetic variance in the natural populations of Douglas-fir. They found that there was reduced variation in British Columbia and California, with 24% of genetic diversity being among populations as opposed to within-population variance. There also appeared to be significant variation at the point of cross-over between the coastal and interior populations. The team also showed that outcrossing was normally 90%, although in artificial populations it has been shown to be around 75-80%. The different flowering times of different material were thought to be the cause of this. Pollen dispersal was approximately 30 m.

Alain Roques presented some very comprehensive information on present and potential pests affecting Douglas-fir in Europe. Conclusions were: there are only a few pests, but there are a few to watch for especially the Pine Processionary Moth and its possible adaptation to Douglas-fir. This is now controlled by a strict requirement for all imports to be treated at 60 degrees Celsius for 30 minutes.

Bruce Larson, from the University of British Columbia gave a general talk on the natural distribution of Douglas-fir, including the clear division between the inland and coastal forms.

Field Trip Highlights

Itinerary of field trip:

1. Un-thinned stand of Douglas-fir
2. Thinning trials
3. 'Close to nature forestry'
4. Visit to merchantable logs of Douglas-fir

Background Discussions

There is a lot of controversy over planting Douglas-fir in 'natural forest'.

The current forestry runs on a system called 'close to nature'. This attempts to replicate natural forests. At the same time, there are no old-growth forests remaining, so there is nothing that this can be modelled on. It seems that the 'close to nature' forests are based on the perceptions of the community, the demands of the people in such a densely populated area of Germany, and in the longer-term sustainable utilisation of the forests. Access to the forests is expected by the people of Germany, as is the ability to remove plant material (as long as it can be carried), and harvest mushrooms. Hunting is undertaken through leasing parts of the forest. Most of the forests in this part of Germany are not leased for hunting, as hunters like to manage their forests to have a good population of deer. This is not great for the forests and can cause too much damage, so foresters tend to cull the deer to the required level of control in the remainder of the forests.

The number of roe deer shot on a regular basis is around 1 per ha. Red deer are particularly destructive and are excluded from as much of

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the productive forest as possible. The area of forest where the red deer are is fully fenced.

One of the perceptions is that Douglas-fir will lower the biodiversity of the forests, and therefore should not be included. I asked if biodiversity had been quantified but I didn't get a full answer. The reaction to my question was quite strong and I think there are large differences in our cultural beliefs on this point. I don't think that they will be measuring biodiversity in the future and it seems to be a cultural belief and is driven more by perception of the community. It is more important to be in sync with the community than to prove or quantify the levels of biodiversity.

Tending of the forests was intensive. This started with:

- Planting in 'groups' in the forest.
- Pre-planting clearing for planting.
- Post-planting control of competition.
- Some re-planting to the required densities was also undertaken.
- Multiple thinnings to the required density on an estate-wide vision, so the forests were driven by the requirements of the forest as a whole, not a set recipe for forest type at each coup.
- Pruning mostly in 1-2 lifts, depending on diameter. Mostly to 10 m in a single lift, with pruning not exceeding 50% of the crown. Further pruning affected the growth of the tree too much..
- Pruning in the best stands to 15 m.

Logs harvested were classified by a system 'a, b, c and d' grades, with 'a' representing the best quality. Most of the pruned butt logs were aimed at grade 'a', with the majority of the value being from this log. Grade 'a' logs were worth €150 at the side of the road (i.e. felled and stacked at the side of the access road) and were defined largely by the ring width being no greater than 8 mm. Existing roading infrastructure was used. Final log prices were up to €200 m^3. An example of a 100-year-old grade 'a' log is given in Figure 4. Logs of this age were still thinnings, and they were expected to continue growing for at least a further 20 years.

In forest economics, no discount rate was used, or for private owners, a discount rate up to 2.5%. The aim of the forests was to break-even.

Figure 3. An example of a 100-year-old grade 'a' Douglas-fir log from the Black Forest, on the side of the road after harvest.

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Visit to an Un-thinned Stand of Douglas-fir

This was the only stand in the area that was not thinned, to see how the trees would react. Again, there is public reaction against pure species stands such as this. The stand was very tall and canopies very short at the end of long, skinny boles (Figures 5-8).

Figure 4. (left)
Douglas-fir forest un-thinned. This was the only stand in the area that was not thinned to see how the trees would react. Again, there is public reaction against pure species stands such as this.

Figure 5. (right)
The local forester (Martin) and one of our hosts from the University, Juli, showing also the beech understorey. Note all hang-ups like the one in the background are extracted and sold

Figure 6.. (above)
Canopy structure of the Douglas-fir un-thinned stand.

Figure 7. (above)
Un-thinned Douglas-fir stand showing beech understorey.

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Visit to the Thinning Trials

The idea of the thinning trials was to optimise value from planting Douglas-fir. Initial spacings in the trial were 500 spha, 1000 spha, 2000 spha and 4000 spha. One treatment of each spacing type (5x4, 3x3.33, 5x2, 3x1.67, 5x1, and 3x0.83) was established in large blocks. These blocks were then subjected to different thinning treatments. Volume was found to be greatest in the lowest stocked stand, which had the advantage of lower management inputs when compared with some other treatments. However, branch size was far from ideal and would have precluded the sale of logs even in some of the lower grades (Figures 9-13).

Figure 8. (above) An example of the canopy structure of one of the high-stocked areas of the experiment.

Figure 9. (right) An example of one of the high-stocked areas of the experiment.

Figure 10. (left)
An example of canopy structure of one of the low stocked areas of the experiment

Figure 11. (right)
An example of the severe branching problems with low stocking

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Visit to Mature, Mixed Stand of Douglas-fir - 'Close to Nature Forestry'

At this site groups of widely-spaced Douglas-fir were planted in gaps of naturally regenerated beech. Economic return from this type of planting was quoted as €56,800 per hectare.

Figure 12. **(above and right)** Examples of the mature Douglas-fir stand, and adjacent pure beech forests

Figure 13. (left)
The value of the Douglas-fir from this stand was estimated to be approximately €56,800 per hectare.
!

Visit to Merchantable Logs of Douglas-fir

Sawmill log sales average €82/m^3, and grade 'a' logs were quoted as being worth €150/m3 at the side of the road. The quality of the logs was impressive (see figures below).

Figure 14. Discussing the qualities of 'a'-grade logs in Kandern forest.

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Figure 15. **(left)**
Grades were determined (in part) by the width of the branches. Branches were clearly visible following chainsaw trimming. The area of the brown branch scar represented the branch size used for grading. The presence of 'rose-bud' scars was also used to grade the quality of the log.

Figure 16. (left and above) An example of how the foresters often demonstrate Grade 'a' status – by sawing through the pruned stem, the branch scar from pruning is clearly visible.