Spiral grain in trees from drought tolerant Eucalyptus species grown on dry land on the west coast of South Africa

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Introduction

In this project titled "Evaluation of drought resistant tree species to alleviate poverty in arid regions of South Africa" trees from a 20-year old field trial from two sites on the dry west coast area of South Africa were recently evaluated for growth characteristics. The three most promising Eucalyptus species, namely *E. gomphocephala*, *E. cladocalyx* and *E. grandis* × *camaldulensis* hybrid, for growth characteristics were selected for further evaluation. The objective of the study reported was to investigate between species variability of selected physical and processing properties determining the suitability of these three species for lumber production. It will also be useful for informing tree breeders and silviculturists to identify which properties need improvement through breeding selection or forest management strategies. And in the future results can hopefully be used for selection of species for small farm plantations which may be processed and sold to generate income.
One of most common reasons for a customer to avoid using wood is the lack of shape stability. There is a clear connection between spiral growth and how twisted the sawn timber will be when it is dried. Depending on the log diameter a grain angle over 3 to 5 degrees will produce sawn wood that will be pronounced to twist. In older softwood trees, the cracks lean mostly to the right. This means that the grain angle is right handed, and the visible cracks create a spiral in an anti-clockwise direction, looking from the base to the top of the tree (Figure 1). In spruce trees, however, the grain angle close to the pith is left-handed, which means that the fibres follow a clockwise spiral up the trunk (Harris 1989).

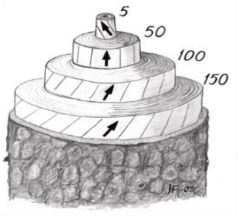

Figure 1. Spiral grain orientation in a log at different annual rings (5, 50, 100 and 150) in an old spruce tree.

Materials and Methods

Spiral grain angle is traditionally measured through scribing on tangential surfaces of discs from trees. There was very limited knowledge of the spiral grain angle in these types of Eucalypts. The project included development and testing of two new measurement methods for measuring spiral grain angle. The first method was using the SilviScan equipment at Innventa AB in Stockholm, SE. The second method was measuring spiral grain angle from measurements with the CT-scanner equipment at Stellenbosch University, SA. The results from these two methods were compared with measurement performed with the scribe method at Linneaus University, SE. Results from the scribe method will be reported here.
Twenty eight, 20–year old trees were obtained from two trial sites on the west coast of South Africa. The mean annual precipitation is 300- 400 mm on these sites. The sample included nine *Eucalyptus gomphocephala* trees, nine *E. cladocalyx* trees, and ten *E. grandis* × *camaldulensis* hybrid trees.
Spiral grain angle was determined on strips sawn across diametrical of discs obtained from billets at four heights. The scribe method, as described by Säll (2002), was used to determine

the grain angle at every 15mm from the pith to bark in the north-south direction by two measurements in both directions (Figure 2).

Figure 2. Marking fibre direction with scriber and the scribe pattern.

Results

The results showed that all three of the species had interlocked grain structure. The spiral grain angle varied from a left handed spiral grain angle to a right handed spiral grain angle and back again in the radial direction. The values could change from +20° to -20° on a radial distance of 3 cm (Figure 4). The method also gave reliable results that can be used to map the spiral grain angle in larger samples and in more directions of the tree to give further understanding of the influence of spiral grain angle and on other wood properties.

The results give grain angle evaluation with distance from pith and height as factors. There is a significant difference between the species (Figure 3).

Spiral grain angle was mostly negative meaning it formed a right handed spiral in the tree. This is similar to most softwoods (Säll, 2002) and results found on other eucalypt species (Thinley et al, 2005). The grain angle of the hybrid *E. grandis X camaldulensis* was less than that of the other two species at nearly all positions in the stem (Figure 3). The patterns of variation between the species were very different. The grain angle of both *E. gomphocephala* and *E. cladocalyx* increased from the pith to bark. And it was more pronounced for *E. cladocalyx.* Height-wise *E. grandis X camaldulensis* and *E. cladocalyx* showed the same pattern whereas *E. gomphocephala*'s grain angle decreased consistently from breast height upwards.

Both the *E. gomphocephala* and *E. cladocalyx* showed wavy grain which was extreme in the case of *E. gomphocephala*. (Figure 4).

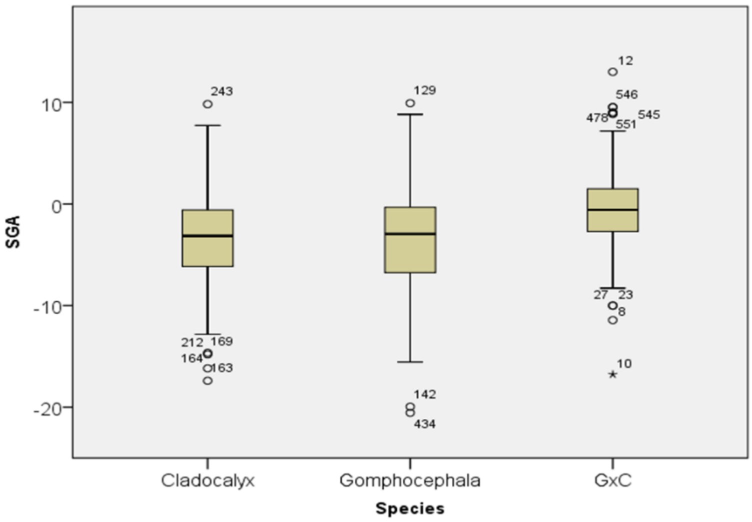

Figure 3. The mean grain angle for the three species *cladocalyx, gomphocepala* and the hybrid of *grandis x camaldulensis.*

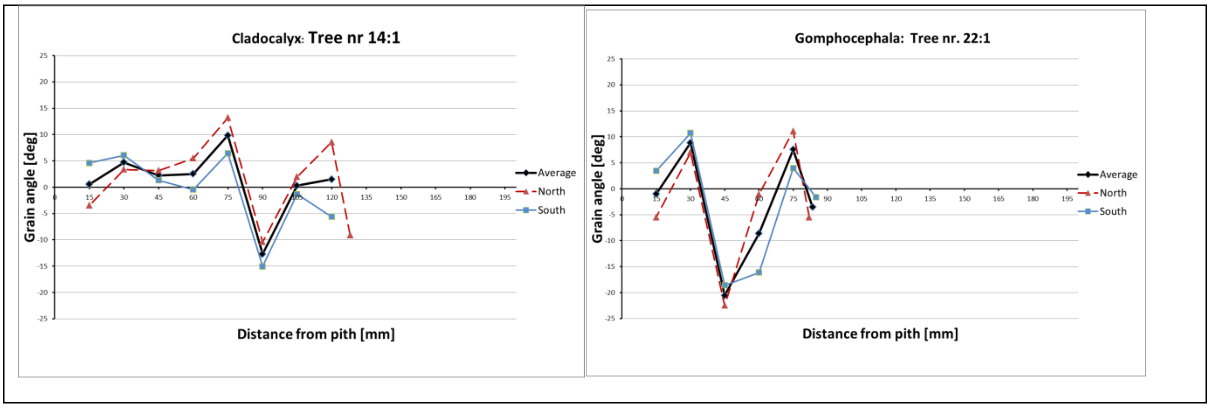

Figure 4. The grain angle pattern in two individual trees at breast height. *cladocalyx*, tree number 14 and *gomphocephala*, tree number 22.

Conclusions

The spiral grain pattern of *E. grandis X camaldulensis* hybrid were in general different to the other two species. The spiral grain angle was relatively low and not so wavy and interlocked, subsequently the twist of sawn boards will also be lower compared to the other two species. *E. gomphocephala* had the highest grain angles close to the pit. *E. cladocalyx* had also relatively high grain angles. As with *E. gomphocephala*, the main challenge of this species will be high levels of twist in boards – although twist will be slightly lower than that of *E. gomphocephala*. For this species, in terms of wood properties and processing, future research should focus on reducing the levels of twist of boards. It might be possible to utilise tree breeding selection strategies to reduce grain angles. Research on other species indicated that spiral grain angle is under genetic control – although there might also be environmental factors involved (Säll, 2002).

References

Harris, J. M. (1989). Spiral grain and wave phenomena in wood formation. Springer-Verlag, Berlin.

Säll H (2002) Spiral grain in Norway spruce. Acta Wexionesia No. 22/2002. ISBN: 91-7636-356-2. Dissertation, Växjö University

Thinley C, Palmer G, Vanclay JK, Henson M (2005. Spiral and interlocking grain in Eucalyptus dunnii. Holz als Roh- und Werkstoff 63: 372–379

Theme: Silviculture regimes and management systems for Dryland Forestry.

Theme: Silviculture regimes and management systems for Dryland Forestry. Chairmen: Dean da Costa; Dr. Steven Dovey		
08:30	**Keynote 7:** Eucalypt plantation management in regions with high water stress.	Prof. Dr. Leonardo Gonçalves, Univ. of São Paulo, Brazil
09:00	Review of the use of hydrogel (polymer) to improve establishment success and results from a field trial testing different quantities of hydrogel and two methods of placement.	Dr. Jacob Crous, Sappi, RSA
09:20	Eucalyptus nutrient omission study in northern Brazil.	Rafaela Carneiro, Brazil
09:40	A business case for *Eucalyptus* pulpwood production in Zululand.	Dr. Marius du Plessis, Mondi, RSA
10:00	**Questions**	
10:10	**Coffee Break**	
10:40	Eucalypt coppice management for rurally based, small-scale timber growers in South Africa.	Dr. Keith Little, NMMU, RSA
11:00	Effects of mineral fertilization and climatic variables on the dynamics of seasonal growth of clonal plantations of *E. urophylla x globulus*.	Andrea Wenzel et al, São Paulo University, Brazil.
11:20	Productivity of *Eucalyptus grandis* plantation under different forest residue management in South Eastern Brazil.	Ayeska Hubner, Brazil
11:40	Biomass equations for selected drought tolerant eucalypts in South Africa.	Darius Phiri, SU, RSA
12:00	Solubility of phosphate fertilizers and P availability of soil and plant in early growth of *Eucalyptus grandis* at South Eastern of Brazil.	José Bazani, Brazil