2004 Elite Cypress

Forestry Trial – Caveton,

South Australia

A plot of pruned Ovensii in the foreground exhibiting desirable forestry characteristics
Summary:
Eight different cypress cultivars were grown in a replicated trial near Caveton, South Australia. Form and growth characteristics were measured at year five and analysed. Recommendations are presented about the suitability of the various species for forestry use. Ovensii, a cypress clone hybrid between *Chamaecyparis nootkatensis* and *Cupressus lusitanica*, was the best performing cultivar in this trial and is recommended for forestry establishment ahead of the other cypress cultivars tested.

Aim:
Performance test six cypress clonal cultivars and two cypress seed cultivars in South Australia to identify the best cypress cultivars suitable for use in forestry applications in the region.

Objective:
- To import New Zealand’s best cypress (*Cupressus*) genetic material into Australia through the Australian Quarantine process.
- To establish nursery stock of the cypress clonal cultivars and cypress species.
- Establish a trial for assessment to evaluate growth and form of these trees.
- Evaluate the traits of the cypress clonal cultivars and cypress seed cultivars to determine the forestry performance of the cultivars to make recommendations for South Australian conditions.

Introduction
Cypress (*Cupressus*) species have been widely grown in southern Australia, mainly for windbreaks on farmland. Cypress timber that is currently cut from windbreaks has a good niche market with cabinet makers in Australia.

Cypress timber has several advantages over other softwoods. It produces wood of medium density, good colour, figure and lustre, has good machining properties and finish, dimensional stability and naturally durable heartwood (Clifton 1994; MOF and NZFRI 1995; Sim 2002). Cypress wood is easy to saw and season and is suitable for boat building, furniture and joinery, as well as more traditional uses of exterior joinery, weatherboards and outdoor utility timber (Haslett 1986; Clifton 1994; MOF and NZFRI 1995; Miller and Knowles 1996, Sim 2002). For utility uses the naturally durable heartwood should ensure a premium over *Pinus radiata* as a preservative treatment free product. The cypress species are an alternative forestry species to *P. radiata* for farm forestry plantations.

Cypress canker is a disease caused by the *Seiridium* fungus (Self 2003) and a major hurdle to growing cypresses in plantations. The spores are washed onto trees and lodge in tiny crevasses during wet weather. They germinate during warm moist conditions and enter the tree through cracks in the bark.
or wounds caused by the wind or pruning. The canker grows in the cambium and produces
cankering and distortion of the stem or branch (Self 2003). The canker produces toxins as
it grows that are transported by the sap to the branch tips causing dieback. Cypress
canker reduces growth, can deform the stem and kill trees.

Production of planting material for forestry plantings has until now depended upon the use
of seed with the resultant variability in individual trees being evident. New Zealand Forest
Research Institute has implemented a cypress breeding programme since 1980, which
has culminated in the production of superior cypress clones (Miller and Knowles 1996).
The extensive breeding of these superior cypress clones and cultivars could enable
cypress to be included as a productive option for Australian plantation forestry.

Clonal material provides the following benefits over seedlings:
  o A more uniform crop;
  o Lower initial stocking requirements (less/no cull thinning);
  o Reduced pruning costs (smaller and less branching);
  o Consistent wood quality
  o Improved wood processing and recovery percentages;
  o Marketing advantages through uniformity of wood properties and timber
    appearance.

There is a risk that planting identical clones with the same characteristics might increase

Methodology

Cypress cultivars
The cypress clonal cultivar material was imported into Australia in April 2000 from NZ
origin clones and underwent a two year quarantine period. The material was released in
April 2002 and was grown for two years to produce sufficient planting stock for the trial.
Mimosa Farm Trees grew sufficient clonal planting stock along with seedlings of two
cypress species for planting in the winter of 2004.

The clonal cultivars and seed cultivars tested include:

Cloned cultivars
  ▪ **Hycol** - a New Zealand Forest Research *Cupressus lusitanica* clone from
    Columbia seed source
  ▪ **SC5** – a Southern Cypress Ltd. *Cupressus lusitanica* clone
  ▪ **SC2** – a Southern Cypress Ltd. *Cupressus macrocarpa* clone
  ▪ **X Cupressocyparis leylandii “Ferndown”** a clone from a hybrid between
    *Chamaecyparis nootkatensis* and *Cupressus macrocarpa*
  ▪ **X Cupressocyparis leylandii “Leighton Green”** a clone from a hybrid between
    *Chamaecyparis nootkatensis* and *Cupressus macrocarpa*
  ▪ **X Cupressocyparis ovensii “Ovensii”** a clone from a hybrid between
    *Chamaecyparis nootkatensis* and *Cupressus lusitanica*

Seed cultivars
  ▪ **Cupressus lusitanica** – A Lismore improved seed lot of Gwavas, New Zealand
    provenance
  ▪ **Cupressus macrocarpa** – Strathallan, New Zealand, provenance
Site establishment
The trial site was prepared and planted in 2004. It was ripped in mid May 2004 and sprayed in late June 2004. The trial was pegged out for the 24 plots (8 treatments x 3 reps) containing 30 trees per plot. The trial was planted on 9 August 2004 with the area surrounding the trial and remaining block planted on 10 August 2004. Trees were planted with 4 m between rows and 3 m between trees to produce a stocking of 833 stems per hectare (Figure 2).

Figure 2 Aerial photograph of the trial, November 2007. The numbers in bottom left of each plot indicates the cultivar: Ovensii, 1; SC2, 2; C. lusitanica, 3; Leighton Green, 4; Ferndown, 5; C. macrocarpa, 6; Hycol, 7; SC2, 8.

Assessment
Assessments were recorded between August and September 2009 when the trees were aged five. The measurements included DBH, height, erectness, fork, stem straightness, branch angle, Branch Index (BIX), branch frequency, and canker. A description of each measurement is recorded below.

- Stocking was the number of live trees per plot divided by the plot area.
- DBH is the Diameter at Breast Height (1.3m) of each stem (mm).
• Height is the height of tree when vertical; when not vertical it is the length of the stem (m).

• Erectness was assessed as:
  o 1  Not vertical (>15°)
  o 2  Almost vertical (5-15°)
  o 3  Vertical (no lean)

• Fork was a branch or ramicorn that was greater than half the diameter of the leader and showing a tendency towards apical dominance, and assessed as:
  o 1  A fork in the bottom quarter of the tree
  o 2  A fork in the second quarter of the tree
  o 3  A fork in the third quarter of the tree
  o 4  A fork in the top quarter of the tree
  o 5  No forks

• Stem straightness was the number of bends within the first three metres of the stem that were either a small bend; stem edge reaches about the stem centre line, or large bend; the stem edge reaches the line on the opposite edge.

• Branch angle was the average branch angle within the first three metres of the stem, measured from vertical and assessed as:
  o 0  90°-80° flat
  o 1  80°-60° moderately flat
  o 2  60°-40° erect
  o 3  40°-20° very erect
  o 4  20°-0°

• BIX is the Branch Index, which is the mean diameter (in mm) of the largest branch per quadrant (Inglis and Cleland 1982) within the first three metres. The quartiles were divided by the row direction and a line perpendicular to the row.

• Branching frequency was a count of the number of branches in a one metre section from 1.3 m to 2.3 m of the stem.

• Canker severity was assessed as:
  o 0  No sign
  o 1  One minor infection
  o 2  Multiple minor infections
  o 3  One severe infection on the stem
  o 4  Multiple severe infections on stem
  o 5  Dead/dying from infection

• Canker incidence utilised this data to determine presence and absence.

Data analysis
The data was analysed using a single factor analysis of variance (ANOVA). The level of significance was set at 0.05. The Tukey test was used to identify which means were significantly different at the 95 % confidence limit.
Results

Stocking
There was no significant difference in the stocking between varieties at age five (P = 0.56). Stocking represents survival with the average stocking of 774 stems/ha, which is a survival rate at age five of 94 percent. The cultivar SC5 had the highest survival at 99 percent and SC2 and C. macrocarpa the lowest survival with 91 percent.

Table 1 Stocking, height, DBH and Mean Tree Volume means for the eight cypress cultivars with significance ranking. Means followed by the same letter are not significantly different at P<0.05.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Stocking (trees/ha)</th>
<th>Height (m)</th>
<th>DBH (mm)</th>
<th>Mean Tree Volume (m3/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovensii</td>
<td>803 a</td>
<td>5.27 a</td>
<td>80 a</td>
<td>0.0094 a</td>
</tr>
<tr>
<td>SC5</td>
<td>813 a</td>
<td>4.51 ab</td>
<td>93 a</td>
<td>0.0105 a</td>
</tr>
<tr>
<td>Cupressus lusitanica</td>
<td>763 a</td>
<td>4.32 b</td>
<td>96 a</td>
<td>0.0118 a</td>
</tr>
<tr>
<td>Leighton Green</td>
<td>775 a</td>
<td>4.96 ab</td>
<td>85 a</td>
<td>0.0104 a</td>
</tr>
<tr>
<td>Ferndown</td>
<td>764 a</td>
<td>4.47 ab</td>
<td>75 a</td>
<td>0.0076 a</td>
</tr>
<tr>
<td>Cupressus macrocarpa</td>
<td>737 a</td>
<td>4.42 ab</td>
<td>95 a</td>
<td>0.0134 a</td>
</tr>
<tr>
<td>Hycol</td>
<td>783 a</td>
<td>4.29 b</td>
<td>97 a</td>
<td>0.0126 a</td>
</tr>
<tr>
<td>SC2</td>
<td>747 a</td>
<td>3.26 c</td>
<td>71 a</td>
<td>0.0068 a</td>
</tr>
</tbody>
</table>

Height, Diameter and Mean Tree Volume
Height, diameter (DBH) and Mean Tree Volume are related assessments. There was no significant difference in DBH (P = 0.08) or Mean Tree Volume (0.06) due to large variation within cultivars. There was a significant difference in height (P = 5.0x10^-5). Ovensii was the tallest cultivar with a mean height of 5.27 m and significantly taller than C. lusitanica, Hycol and SC2 (Table 1). At 3.26 m, SC2 was significantly shorter than the rest of the varieties (Table 1).

Forking
There was a significant difference in forking (P=0.003). Ovensii is the least likely to fork, often with no fork or forks only in the top quarter of the stem. A Tukey test identified that Ovensii has significantly less propensity to fork than Hycol, C. macrocarpa and SC2 (Table 2). Another hybrid cultivar, Ferndown, was identified by the Tukey test to have significantly less propensity to fork than SC2 (Table 2). The hybrids had the least propensity to fork of all of the cultivars.

Table 2 Forking ranking and erectness ranking means for the eight cypress cultivars with significance ranking. Means followed by the same letter are not significantly different at P<0.05.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Forking</th>
<th>Erectness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovensii</td>
<td>4.89 a</td>
<td>2.88 a</td>
</tr>
<tr>
<td>SC5</td>
<td>4.15 abc</td>
<td>2.90 a</td>
</tr>
<tr>
<td>Cupressus lusitanica</td>
<td>4.12 abc</td>
<td>2.75 a</td>
</tr>
<tr>
<td>Leighton Green</td>
<td>4.33 abc</td>
<td>2.91 a</td>
</tr>
<tr>
<td>Ferndown</td>
<td>4.50 ab</td>
<td>2.86 a</td>
</tr>
<tr>
<td>Cupressus macrocarpa</td>
<td>3.33 bc</td>
<td>2.80 a</td>
</tr>
<tr>
<td>Hycol</td>
<td>3.54 bc</td>
<td>1.43 b</td>
</tr>
<tr>
<td>SC2</td>
<td>3.14 c</td>
<td>1.41 b</td>
</tr>
</tbody>
</table>
Erectness
There was a significant difference in erectness (P=9.9x10^{-7}). A large proportion of SC2 and Hycol had low erectness scores of 1.41 and 1.43, respectively, because a large proportion of trees were leaning greater than 15 degrees and very few trees vertical. Both of these cultivars were significantly different in erectness from the other varieties (Table 2). All other varieties were erect and suitable for timber production.

Stem straightness
There was a significant difference in the count of small bends (P=0.01). The range for average count of small bends in the first three metres of the stem was within a narrow range for the eight cultivars. SC5 had the least small bends at 0.50, which was significantly smaller than Ovensii (1.42) and Ferndown (1.39) (Table 3). The other hybrid, Leighton Green had the third largest count of small bends at 1.28 (Table 3). The hybrid cultivars had some of the smaller average DBH measurements and greater heights (Table 1) compared with the other varieties resulting in slender trees. This partially explains why they have a significantly higher count of small bends, as a small deviation is more pronounced on a slender stem. Over time these small bends will become less noticeable as stem diameter increases.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Small bend (count)</th>
<th>Large bend (count)</th>
<th>Total bend (count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovensii</td>
<td>1.42 b</td>
<td>1.06 ab</td>
<td>2.48 abc</td>
</tr>
<tr>
<td>SC5</td>
<td>0.50 a</td>
<td>0.54 a</td>
<td>1.03 a</td>
</tr>
<tr>
<td>Cupressus lusitanica</td>
<td>1.02 ab</td>
<td>1.19 ab</td>
<td>2.21 ab</td>
</tr>
<tr>
<td>Leighton Green</td>
<td>1.28 ab</td>
<td>1.28 ab</td>
<td>2.57 abc</td>
</tr>
<tr>
<td>Ferndown</td>
<td>1.39 b</td>
<td>2.31 bc</td>
<td>3.70 cd</td>
</tr>
<tr>
<td>Cupressus macrocarpa</td>
<td>0.76 ab</td>
<td>1.23 ab</td>
<td>2.00 ab</td>
</tr>
<tr>
<td>Hycol</td>
<td>1.24 ab</td>
<td>3.90 d</td>
<td>5.13 d</td>
</tr>
<tr>
<td>SC2</td>
<td>1.24 ab</td>
<td>3.35 cd</td>
<td>4.59 d</td>
</tr>
</tbody>
</table>

There was a significant difference in the count of large bends (P=3.5x10^{-6}). The two varieties that had excessive leans, Hycol and SC2 also had significantly higher counts of large bends in the first three metres of the stem (Table 3). Hycol had the largest count of large bends with an average of 3.90, which was significantly higher than all varieties except SC2 (Table 3). With an average of 3.35 large bends, SC2 had a significantly greater average count than the other cultivars except Ferndown and Hycol (Table 3). SC5 had the lowest average count of large bends at 0.54, which was significantly fewer than Ferndown, SC2 and Hycol (Table 3).

There was a significant difference in the count of total bends (P=1.2x10^{-5}). The high count of large bends for Hycol and SC2 also had significantly higher counts of total bends in the first three metres of the stem than all other cultivars except Ferndown (Table 3). Hycol had the largest count of large bends with an average count of 5.14 bends and SC2 with an average count of 4.98 bends (Table 3). Ferndown had a high count of total bends with an average count of 3.70 bends that was significantly greater than SC5, Cupressus macrocarpa, and Cupressus lusitanica (Table 3).
Branch angle
There was a significant difference in branch angle (P=7.1x10^{-7}). The mean branch angle of Hycol is closest to horizontal and significantly flatter than C. lusitanica, SC5, Leighton Green and C. macrocarpa (Table 4). Ferndown and SC2 have mean branch angles that are close to horizontal and significantly flatter than Leighton Green and C. macrocarpa (Table 4). The seedling grown C. macrocarpa cultivar has the steepest branch angle and is significantly more erect than all of the other cultivars (Table 4).

Table 4 Branch angle rank, Branch index and number of branches means of the eight cypress cultivars with significance ranking. Means followed by the same letter are not significantly different at P<0.05.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Branch Angle (rank)</th>
<th>BIX (mm)</th>
<th>Number of Branches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovensii</td>
<td>0.47 abc</td>
<td>35.7 a</td>
<td>21 a</td>
</tr>
<tr>
<td>SC5</td>
<td>0.73 bc</td>
<td>53.9 d</td>
<td>31 cd</td>
</tr>
<tr>
<td>Cupressus lusitanica</td>
<td>0.70 bc</td>
<td>45.4 bc</td>
<td>26 b</td>
</tr>
<tr>
<td>Leighton Green</td>
<td>0.95 c</td>
<td>37.7 ab</td>
<td>30 bcd</td>
</tr>
<tr>
<td>Ferndown</td>
<td>0.23 ab</td>
<td>36.3 a</td>
<td>33 de</td>
</tr>
<tr>
<td>Cupressus macrocarpa</td>
<td>1.59 d</td>
<td>52.6 cd</td>
<td>36 e</td>
</tr>
<tr>
<td>Hycol</td>
<td>0.07 a</td>
<td>48.6 cd</td>
<td>27 bc</td>
</tr>
<tr>
<td>SC2</td>
<td>0.27 ab</td>
<td>45.5 bc</td>
<td>28 bc</td>
</tr>
</tbody>
</table>

BIX
There was a significant difference in BIX (P=1.4x10^{-6}). Both Ovensii and Ferndown had small BIX measurements averaging 35.7 mm and 36.3 mm respectively (Table 4). These measurements were significantly smaller than the mean BIX for C. lusitanica, SC2, Hycol, C. macrocarpa and SC5 (Table 4). The other hybrid Leighton Green also had a small average BIX of 37.7 that was significantly smaller than Hycol, C. macrocarpa and SC5 (Table 4). The largest average BIX was measured on SC5 at 53.9 and was significantly larger than the hybrids as well as C. lusitanica and SC2 (Table 4).

Branch frequency
There was a significant difference in branch frequency (P=1.4x10^{-8}). Ovensii had an average of 21 branches on the stem between 1.3 to 2.3 m above ground level. This was significantly fewer branches than any of the other cultivars (Table 4). C. lusitanica had a low branch frequency with 26 branches that was significantly fewer than SC5, Ferndown and C. macrocarpa (Table 4). The cultivar with the greatest number of branches was C. macrocarpa with an average of 36 branches. This was significantly more branches than all other cultivars, except Ferndown that averaged 33 branches on the stem between 1.3 and 2.3 m above ground level (Table 4).

Cypress canker
There was a significant difference in canker incidence (P=2.77x10^{-7}) and canker severity (P=3.36x10^{-8}). There was no cypress canker found on SC5, as a result it had significantly less incidence of cypress canker and a significantly lower severity ranking of cypress canker than SC2, Leighton Green, Ferndown, and C. macrocarpa (Table 5). C. lusitanica, Ovensii and Hycol had significantly less incidence of cypress canker than Leighton Green, Ferndown and C. macrocarpa. Only C. lusitanica and Ovensii had significantly lower severity ranking of cypress canker than the same three cultivars. C. macrocarpa had the highest severity ranking at 2.18 followed closely by Ferndown with 2.09. Both of these cultivars had significantly higher severity ranking of cypress canker than all the other
varieties (Table 5). Although *C. macrocarpa* had the highest severity ranking of cypress canker, Ferndown had a higher incidence with cypress canker identified on 93% of the trees compared with 80% of the *C. macrocarpa* trees, however analysis deemed that there was no significant difference.

Table 5 Number of cypress canker signs (incidence) and average cypress canker severity means of the eight cypress cultivars with significance ranking. Means followed by the same letter are not significantly different at P<0.05.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Canker Incidence</th>
<th>Average Canker severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovensii</td>
<td>24% ab</td>
<td>0.34 ab</td>
</tr>
<tr>
<td>SC5</td>
<td>0% a</td>
<td>0.00 a</td>
</tr>
<tr>
<td><em>Cupressus lusitanica</em></td>
<td>12% ab</td>
<td>0.29 ab</td>
</tr>
<tr>
<td>Leighton Green</td>
<td>64% cd</td>
<td>1.12 c</td>
</tr>
<tr>
<td>Ferndown</td>
<td>93% cd</td>
<td>2.09 d</td>
</tr>
<tr>
<td><em>Cupressus macrocarpa</em></td>
<td>80% cd</td>
<td>2.18 d</td>
</tr>
<tr>
<td>Hycol</td>
<td>24% ab</td>
<td>0.55 abc</td>
</tr>
<tr>
<td>SC2</td>
<td>36% bc</td>
<td>0.91 bc</td>
</tr>
</tbody>
</table>

**Discussion**

The best performing variety was Ovensii. It has fast initial growth, straight form, and small branches that are easier to prune (Anonymous 2009) this makes them highly suited to a pruned silvicultural regime. Of the eleven variables for which significant differences were identified, Ovensii had the best or acceptable values for ten of them. It only performed poorly with respect to the count of small bends, which is relative to the slenderness of the trees. As the trees increase in size over time, the small bends will become negligible. It is a healthy, vigorous and adaptable clone, but it is very intolerant of hot, dry or exposed sites and salt laden winds (Milne 2005, Milne 2006a). In summary Ovensii had: grown the tallest; the lowest incidence of forking; grown erect; a low count of large and total bends; relatively flat branch angle; the smallest BIX; the lowest number of branches, low cypress canker incidence and a low ranking of cypress canker severity. Ovensii would be the recommended variety for establishing a cypress plantation on sites that were not exposed to salt laden winds or exposed dry sites in the region.

*Cupressus lusitanica* performed well in this trial. It had good or acceptable values for all eleven variables for which significant differences were identified. It had acceptable height, although not as tall as Ovensii. The significant difference in height at age five may only be a function of the different growth strategy of Ovensii in the early growth phase as it has been reported that Ovensii are “very quick out of the blocks” (Anonymous, 2009). The height and

Figure 3 Example of an Ovensii hybrid exhibiting excellent characteristics making it suitable for forestry establishment.
DBH results are supported by findings from a trial in Balclutha, New Zealand, where *C. lusitanica*, *C. macrocarpa* and Ferndown had very similar measurements at age 5 (Milne 2006b). The height results are comparable to trial results in Balclutha, New Zealand, at the same age, but the *C. lusitanica* in this South Australian trial has much better DBH measures (Milne 2006b). It had acceptable forking and was erect. The count of small, large and total bends was low. Although the branch angle was not as horizontal as the best variety and the BIX was middle of the range, it had very few branches. It also had very limited cypress canker incidence and low severity of cypress canker. These characteristics favour *C. lusitanica* as a suitable cultivar, but care must be exercised as it is intolerant of salt laden winds, which damage the foliage, and exposed sites that are prone to drought (Milne 2006a). *C. lusitanica* would be recommended on suitable sites.

SC5, like *C. lusitanica*, performed well in this trial. SC5 had some quality features including the straightest stems and no cypress canker. Other characteristics were good or acceptable including tree height, forking propensity, erectness and branch angle. However, there were two characteristics that may affect forestry performance - a large number of branches of approximately 30 per metre and the largest BIX. These characteristics will increase the time and cost to prune each stem and produce stems with a larger defect core than the other two recommended species. SC5 is a *C. lusitanica* clone, so it will be intolerant of salt laden winds and exposed drought prone sites. SC5 would be recommended on suitable sites especially where canker was prevalent, but would not be suitable if pruning for clearwood is planned.

![Figure 4a Pruned SC5 exhibiting excellent growth and form](image1)

![Figure 4b The branching characteristics of SC5 - numerous branches with some very large branches](image2)

Hycol and SC2 had the shortest height measurements, a propensity to fork, were not erect, and had the highest count of large and total bends. The two characteristics with the greatest impact on forestry performance were the excessively large bends and lean with numerous SC2 trees being prostrate, for example. This has affected the form of the trees and reduced the suitability of these varieties for sawlogs. Because these two cultivars would produce very few suitable sawlog then both Hycol and SC2 would not be recommended as forestry species for this region.
The impact of cypress canker on the varieties is consistent with Self (2003) who reported the susceptibility of trees to cypress canker in approximate order of decreasing susceptibility: *Cupressus macrocarpa*, *X Cupressocyparis leylandii*, *X Cupressocyparis ovensii* and *Cupressus lusitanica*. The *Cupressus macrocarpa* cultivars and *X Cupressocyparis leylandii* cultivars had the worst incidence and severity of cypress canker.

Cypress canker is an issue for Ferndown and *Cupressus macrocarpa*. Cypress canker signs had already appeared on the *C. macrocarpa* in August 2006 when the trees were two years old. *C. macrocarpa* had the most severe cypress canker damage and had
already lost trees to this disease resulting in the lowest survival rate of 91%. There were numerous sick trees and poor stem form as a result of the infection, which was not assessed but will affect sawlog production and survival. Ferndown is a hybrid of *C. macrocarpa* and appears to inherit the susceptibility to cypress canker when grown in this region. It does not have the same cypress canker severity, but the disease may have a greater impact on future performance if it is already prevalent in this cultivar at age five. Ferndown is more suitable than *C. macrocarpa* for forestry application as it has significantly better branching characteristics with respect to branch angle and branch size and has less propensity to fork. These two cultivars should be avoided if there is a risk of canker as they have high incidence and severity of this disease.

Ferndown had a high count of large bends and total bends. This was the result of this cultivar leaning in the first year possibly because the trees were planted in the rip lines. However Ferndown recovered from the early lean and is now erect, but a large number of trees have a noticeable butt sweep in the first 30 cm which has impacted on the count of large and total bends.

![Figure 7a](image1.jpg) The Ferndown trees have straightened up from an initial lean resulting in large bends at the base of the trees.

![Figure 7b](image2.jpg) The steeper branch angle of Leighton Green is evident in this.

The cultivar Leighton Green was the mediocre performer. Leighton Green had some good characteristics including; height, erectness, low propensity to fork and a small BIX. The results for the number of branches and count of small, large and total bends were acceptable. The average branch angle was the second steepest, but not significantly different from the three recommended cultivars. Leighton Green however, like the other X *Cupressocyparis leylandii*, Ferndown, has significantly more incidence and a higher
severity ranking of cypress canker than the three recommended varieties. It is for this reason that Leighton Green would not be recommended if cypress canker is a risk to a plantation.

The performance of Leighton Green and Ferndown in this trial has been very similar. Leighton Green does have significantly steeper branch angle, but significantly less canker severity than Ferndown. Both of these varieties would be preferred over *C. macrocarpa* where salt laden winds are a potential problem for a plantation. Ferndown has been the pick of the Leyland cypresses at Murchison, an inland location in the South Island of New Zealand, and preferred over *C. macrocarpa* because its form is straight with minimal forking and they are much less prone to wind socketing, due to small sail area and more flexible branches (Anonymous 2009). In coastal situations where the growth and performance of the recommended *C. lusitanica* cultivars or hybrids of *C. lusitanica* may be affected by salt laden winds then Ferndown and Leighton Green would be recommended.

**Conclusion**

The best cypress cultivar in this trial was Ovensii. This cultivar performed well for growth, form and health traits. It is recommended for forestry applications in the region where there is little risk of salt laden winds, exposure and the impact of drought. *C. lusitanica* and SC5 both performed well with the characteristics of *C. lusitanica* making it a suitable choice for use in forestry plantations in the region. SC5 would not be suitable for a clearwood regime due to numerous large branches. *C. lusitanica* is a sound low cost alternative choice and could be interplanted with Ovensii to increase the stocking level. Like Ovensii, *C. lusitanica* should not be located where salt laden winds are prevalent or on exposed drought prone sites.

Both Hycol and SC2 are not recommended due to the severe lean and large stem sweeps that developed from a young age. These two varieties will produce very few trees of suitable form for sawlogs, therefore they are not recommended for forestry use.

*C. macrocarpa*, Ferndown and Leighton Green would not be recommended due to the high incidence and severity of cypress canker. The cypress canker infection may cause more deaths over time thereby reducing the stocking and potentially disfiguring the main stems of the remaining trees. This would lead to reduced harvest volumes of high value saw logs. However, despite the high incidence and severity of canker, Ferndown and Leighton Green would be recommended instead of Ovensii, *C. lusitanica* or SC5 in coastal situations where salt laden winds are an issue.
Reference


