# *Permanent Sample Plots (PSPs)* for long-term measurements in farm forestry clearwood woodlots

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**Installation of Permanent Sample Plots (PSPs): The aim of installing PSPs is to enable a small number of trees to be repeatedly measured over time in a stand, yet still obtain information on growth that accurately reflects that of the whole stand. Growth curves can then be constructed and MAI data calculated.**

There are two basic approaches to installing PSPs. The approach taken by the NZ Agroforestry Research Collaborative (Dean 1989) was to select *at least* 2 (more with large woodlots) sample areas in the stand, each with about 20 trees after thinning, and to monitor all of trees in the sample areas. The alternative is to select trees at random throughout the stand, an approach that suits smaller woodlots.

Ideally, PSPs should be installed when the trees are very small, because growth changes are most rapid in the first 5 years and information gaps then make it hard to plot a growth curve. In setting up the PSPs we must allow for thinning over time. For eucalypts, the stand might be stocked at 1100 trees/ha and the final stocking might be only 100 per ha. We need to allow for the loss of up to 90% of the PSP trees over time and still have enough trees present towards the end of the cycle to give reliable estimates of growth.

One protocol suggests that plots should contain 30-50 measurement trees *at the end* of the cycle. On that basis, if we allocate the PSP trees at random through the woodlot and expect to lose 90% over the life of the trees, then we would need to *start* measuring 300-500 trees! That is a tall order – how many PSP trees do you really need? The answer depends on the variability among the trees on your site, the precision that you are looking for, and at what point you *begin* the process.

We suggest starting measurements of DBH (1.3 m above ground) and height at a stage when the trees are *at least* 2.6 m (and preferably 4 m) tall. DBH measurements made at 1.3 m height before that stage are of little use, since the variability is very high (some short trees will be very thin at the 1.3 m mark). On our thinning schedules, first thinning (50% of the stand) will occur when the trees are 6-8 m tall. So, when installing PSP trees, select trees at random *among the best 50%* of trees on the site, ignoring the 50% that will be felled in the next year or two. This approach will reduce the number of PSP trees required by 50%. Mark the PSP trees with numbered tags and measure their height and diameter (at 1.3 m) to begin the collection of data. A summary of the PSP installation and measurement process is given below.

We estimated the likely numbers of PSP-trees required, using a spotted gum trial of 10 seedlots (0.6 ha) established in September 1995 at PVI, as the basis.

From the sample standard deviation from the mean, and applying statistical theory, we can determine the number of trees that we need to measure to get a reasonable estimate of the site average.

Allowable error (L) = $1.96(s.d./\sqrt{n})$

$\therefore n = 4\ s.d.^2/L^2$, or $n = 4(CV\%)^2/(L\%)^2$

From these data the variation in diameter is greater than for height, but both appear to be decreasing with time. If we base our calculations on diameter, using a CV of 23.6%, we find that we would need to sample only 22 trees to get within 10% of the true mean. If we wanted to get within 5% then we would need 89 trees. Two years later the numbers required were about 14 and 57 trees, respectively.

An operator can use the above approach to check the numbers required for other cases. We have used the results above to set up PSPs in over 60 sites, using an allowable error of 10%. To allow for losses of PSP trees over time due to thinning and accident, we have increased the sample size from 20 trees for a woodlot having 200 trees initially, to 30, 40, 50, 60 and 70 trees for sites having 400, 600, 800, 1000 and 1200 trees initially. Allowing for 50% of the PSP trees to be culled in the *second and subsequent* thinnings, we would be left with 10-35 PSP trees per plot at maturity, for plots stocked then at about 250 trees/ha.

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**Table 1. Height and diameter data for a spotted gum seedlot trial at Hamilton established in September 1995. All of the trees (n = 449) in the stand were measured at each time.**

| | Height | | | Diameter | | |
|---|---|---|---|---|---|---|
| | Mean | s.d. | CV% | Mean | s.d. | CV% |
| Mar. 1997 | 195 cm | 46.1 cm | 23.6 | - | - | - |
| Feb. 1999 | 504 cm | 82.9 cm | 16.4 | 6.2 cm | 1.46 cm | 23.6 |
| Mar. 2001 | 822 cm | 122.8 cm | 14.9 | 11.4 | 2.14 cm | 18.8 |

s.d. is standard deviation of the mean; CV% is the s.d as a percentage of the mean.

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### Summary of process of installing PSPs in the field

Step 1 Identify the top 50% of trees in the stand, selecting the best 2 trees in groups of 4 along each row. Mark the cull-trees with tape and prune the selected trees.

Step 2 Calculate the appropriate number of PSP trees to mark.

Step 3 Select the PSP trees *at random* from the unmarked trees. The selection may be done on the site map by choosing, say, every 20th tree. If, upon inspection at the site, that tree happened to be a cull, then choose the *nearest* available tree along the row.

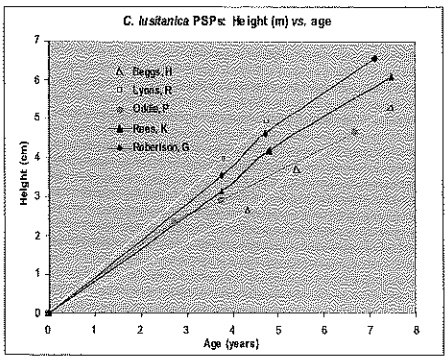
Step 4 Mark each PSP tree with a numbered tag on a wire near the base. Also mark the position of these trees on a site map. Use paint to mark the tree at 1.3 m.

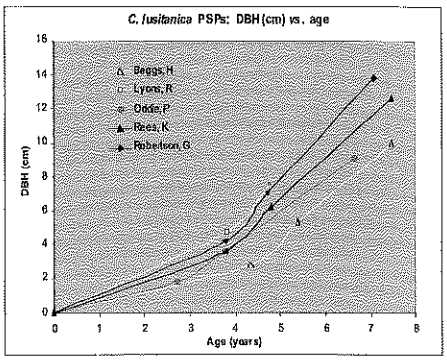
Step 5 Measure diameter and height of the PSP trees every 2 years in the early phase and every 4 years later on.

Step 6 At the *second and subsequent* thinning operations, cull any PSP trees that *should* be rejected on the basis of not meeting the required standard of growth. However, where PSP numbers are very limited, it is permitted to retain some trees that would otherwise have been rejected on the basis of poor form (e.g. double leaders, etc).

***Example of the use of PSPs to generate growth curves***

**Figure 1. Early growth of *Cupressus lusitanica* (Mexican cypress) at five sites in SW Victoria**




# Documenting *your forest*

*Mike Edwards, Otway Agroforestry Network*

It was once said that growing trees is like 'writing a history on the landscape'. Unfortunately as trees grow they hide so much of this history below the bark. Other aspects of the history, such as the source of planting sock, the site establish methods and the timing of any silvicultural treatments must be recorded by those involved or it will be lost forever. Keeping records not only helps us learn from our experiences but may also be critical if we hope to sell tree products such as tree seed or even timber. Records may include simple notes, a calendar of events, photos, video recordings, and field measurements.

For those growers who prune for timber records may be critical in order to demonstrate that pruning was done 'on time, everytime'. This can give future log buyers the confidence to pay more for our timber. For those planting native species have proof that the trees were indeed planted may satisfy environmental groups or government authorities that it is indeed not native forest that you wish to harvest.

When it comes to learning from our past, documenting what we have done to compare with other stands will be essential to discover the long term affect of certain practices. Overtime the experience and knowledge gained from careful observation and measurement will provide the best guidance for future plantings.

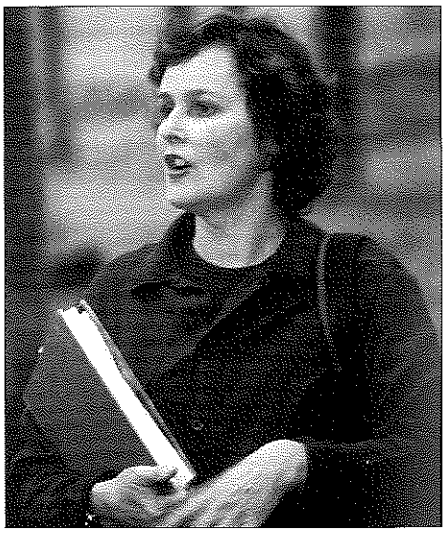
For those watching the dollars, maintaining a record of cash in and cash out, the time spent managing the trees and the cost of equipment required to manage the trees will allow for a detailed financial assessment of the investment. This may be essential for tax purposes or simply a guide to weather it was worth the costs.

By repeatedly measuring trees in permanent sample plots it is possible to develop growth functions and make sound judgements as to the most appropriate time to undertake thinning and harvesting operations.

A well-managed forest can be a valuable source of seed for other growers. In order to sell seed it is often critical be able to provide a description of the seed sources used at the time of establishment. We generally need to record the origins or seed used, the provenance and diversity of sources.

In our experience, while farmers acknowledge the importance of recording farm forestry information they rarely get around to it. Being unable to keep it all together in a useful place frustrates many of those who do try. The Otway Agroforestry Network in consultation with tree growers across the country are producing a TREEdiary that we hope will stand the test of time. The diary will be made to be durable, usable in the field and serve to record all the important details that growers may like to record from plantation establishment through to marketing. Farmers will be able to add photos, make regular notes and add measurement data as they comes available. They will also be able to quickly add useful observations they may make at any time. The TREEdiary is designed by farm foresters who know the type of information that matters and the difficulty farmers have in finding the time to maintain their records.

The TREEdiary is expected to be on sale this coming spring and will be available through your local Network.



*A Western Australian Master TreeGrower, Jenny Dewing, clutching her 'tree diary' in which she records all her tree work and observations.*