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Products Australia
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USER GUIDE

Commercial model to assess
pruning and thinning options in
eucalypt plantations for
appearance grade products
(**TreeTOP Software**)

This report can also be viewed on the FWPA website

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Publication: User Guide - Commercial model to assess pruning and thinning options in eucalypt plantations for appearance grade products (TreeTOP Software)

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Program Overview and Aim

TreeTOP is a generic stand growth model which has the aim of helping users decide when and whether Tree Thinning or Pruning (Tree T.o.P) is viable. The default functions and values have been set to approximate reasonable values based on silvicultural trials, but TreeTOP may not be highly reliable as a yield predictor unless calibrated with user data from stands with similar species, site and silviculture. In particular data from older pruned plantations is extremely limited, and users should treat the model's default predictions with due caution.

The model is Microsoft Excel based, reasonably sophisticated in its thinning/pruning capabilities and easy to use (requires some knowledge of Microsoft Excel). Instructions are included.

Please address questions relating to application of the model, via email to rod.meynink@mbac.com.au. IT aspects of the software download are not supported.

To download software, visit FWPA website:

http://www.fwpa.com.au/treetops_disclaimer.aspx

Users should at all times be aware of this limitation and not rely primarily on TreeTOP for commercial investment decisions.

Assumptions

To keep the model workable, it was necessary to make some simplifying assumptions. The important ones are:

- i. Thinning always occurs from below, i.e. the weakest and smallest stems are prioritised for removal. Hence there is a "jump" in the mean DBH after thinning.
- ii. Stand basal area growth follows an S-shaped curve (Chapman-Richards function) and reaches a maximum (asymptote) for any given site. This maximum is the value defined by site quality SQ
- iii. The stand responds to release from competition after thinning. The response depends on species, site, age, stocking, and current DBH
- iv. Pruning does not impact negatively on tree growth. This means that the user must be careful to specify pruning only to a height which does not remove too much green crown.

- v. There is no limitation of minimum viable commercial volume. If TreeTOP finds 1.2m³/ha of sawlogs, then the stand will be valued as such even if this is not a viable extraction rate.
- vi. There are only four types of log products recognised, and their relative output proportion can be controlled by the user based on the mean DBH of thinned trees
- vii. There are some likely growth benefits from intensive site preparation and subsequent fertilising.

User Control

Many of the cells are locked and cannot be changed by the user. This to prevent accidental overwrite. If you want to access the cell results from another program or spreadsheet, you can refer to them by the usual methods. Some working sheets are hidden to avoid confusion and complication. Contact Rod Meynink [rod.meynink@mbac.com.au] if you need access to hidden sheets. Attributes which can be changed by the user include species inherent growth rate and competition tolerance, site quality, DBH distribution before and after thinning and product grade recoveries from different log sizes. All attributes have some starting default values. The user has great flexibility & control over silviculture, within the framework of three thinnings (one non-commercial), two prunings and a 50 year rotation. Management costs and Log prices are specified directly for locally relevant markets; short cut entry methods, slider controls and charts facilitate "what-if" testing.

Optimum Outcomes

There is no simple way to optimise the silviculture since the number of options is vast and outcomes are non-linear. Heuristic procedures are required.

Note: although TreeTOP is a stand-level model, multiple stands or strata of uniform quality can be aggregated to form a plantation "estate".

TreeTOP can be used to guide management of the strata so as to produce optimum outcomes and/or even wood flows from the estate. Users who wish to use TreeTOP to investigate optimum management in specific situations, or to generate stand tables for exporting into other applications, or to generate multi-dimensional response surfaces for sensitivity testing, are invited to contact Rod Meynink [rod.meynink@mbac.com.au].

An Example

Suppose a landowner and mill owner each consider the management of a plantation area so as to meet their particular aims. The landowner's prime commercial aim is to earn at least 5% p.a real rate of return on the (non-land) investment. The mill owner's prime aim is to obtain plentiful quantities of

low cost large diameter high quality pruned sawlogs and veneer logs in as short a space of time as possible. What sort of silvicultural strategies should be employed?

Is it better to plant fewer trees and prune? Or plant more and thin to waste and for pulp?

Is it worth investing in intensive site preparation, or accept some loss of growth in return for reduced start-up costs?

For either established or new stands, when is the best time to thin, and how much should be removed?

How much increase in recovery of higher grade logs is needed to justify pruning the trees, and up to what height and when?

How much would the mill owner have to pay in order to encourage the landowner to prune and thin?

Or, how much pruning and thinning can be viably undertaken by the landowner at current prices?

How is the answer to these questions different for low quality sites and high quality sites?

Rather than produce a specific answer here, the user can try the following steps:

1. Choose the species and the site quality.
2. Choose an intensive establishment and management regime
3. Set up a conventional silvicultural schedule for thinning
4. Open the charts and tables windows and observe the outcomes

Now try changing parameters such as the planting density and thinning and pruning intensities and ages in the Silvis window

How to Use the Model

NOTE: enable macros to access program in Excel (found: Tools - Options - Security - Macros)

Press any of the buttons on the start page in sequence top to bottom and enter your parameters as required. The Command Buttons on some pages are only active if that is the only window (other than the start page) which is open. If the buttons do not work, close all windows other than the start page, re-open the appropriate window, and press the button.

Species (see species list)

- species selection has effects on yield outcomes through the parameters of tolerance (TOL) and inherent growth rate (GRO)
- Species which are more tolerant of shade and competition are assumed to have lower mortality rates, greater number of retained branches, and less dispersed DBH frequency distribution.

- The user can assign TOL values for any species; for Myrtaceous sclerophylls including eucalypts, the values range from 1 (light demanding, e.g. *E. grandis*, *E. regnans*) to (4) moderately shade tolerant (*E. microcorys*, *Lophostemon confertus*).
- TOL need not be an integer; TreeTOP can accept TOL values from 0.1 to 8 (e.g. hemlock).
- GRO is the inherent potential of a species to achieve rapid growth when free from competition (e.g. open grown) on a good quality site.
- The scale is an arbitrary 0.1 (extremely slow, e.g. huon pine) to 4 (very fast, e.g. *E. dunnii*)
- Since GRO and TOL can be assigned for a wide range of values found in natural species, TreeTOP could emulate many species behaviour in monspecific stands.
- Species are also assumed to have an inherent height growth pattern (HT), which has parameters of rapidity and asymptote. These parameters can be changed in the table or temporarily on the charts page
- Some species will grow tall quite early in the rotation and then not develop further; others will grow somewhat more slowly but over a longer period and may achieve a greater final height.

Site (see site quality attributes list)

- Site quality (SQ) is assumed to be the maximum (asymptotic) basal area carried on a site at maturity with native species in healthy silvicultural condition
- In general terms SQ for commercial forestry sites may vary between 30 and 60 (m²/ha), although TreeTOP will accept inputs from about 20-80.
- The program author devised an algorithm for estimating SQ from environmental parameters of monthly rainfall, evaporation, temperature, solar radiation, and soil properties and has mapped SQ using GIS at 25m pixel resolution for north-east NSW. This mapping, when intersected with a forest types layer, indicated a
- Relative frequency distribution of natural occurrences of floristic-based forest types in the higher rainfall subtropics. The median is about SQ=45 m²/ha, sd.~7.
- SQ v. low to v. high (scale 1-5 incl.) represent the 10,30,50,70 & 90th percentiles of the range of natural occurrence of the species

- In temperate zones, SQ (mature forest BA) is likely to be somewhat higher than in tropical zones because of reduced evaporation and dark respiration.
- SQ may be modified by intensive site preparation, fertiliser (and irrigation, although this is not available in TreeTOP)
- Using the approach of Laffan (1997, Forest Tas Soils Tech Report no.3), various soil and climate parameters can be used to define a minimum set of requirements for SQ; if any of these is not satisfied it should indicate to the user that SQ may be overestimated for that site.

Silvics

- The **Command Buttons** are only active if that is the only window which is open.
- If the buttons do not work, close all windows other than the HOME page, re-open the appropriate window, and press the button.
- The Auto Harvest settings can be adjusted by following the "details" link. Choosing Establishment and Management regimes affects growth and costs as indicated when the "details" link is followed.
- Choosing a silviculture regime by ticking boxes will allow or disallow various options such as thinning and pruning. This is a convenient way to create standard settings for say thinning age and intensity and test the effect of turning them off altogether.
- It is also a means of cross-referencing the selected regime to the research plot database.
- Change the NCT, T1, T2, CF, P1 and P2 settings simply by direct entry into blue cells from the keyboard, or by using the spinner buttons.

Costs

- Costs can be entered either directly in the 3 boxes shown, or indirectly and with more detail via the Costs Table. Click on the **command button** to flip between those options.
- Use the multiplier slider bar as a convenient short cut for testing the effect of increasing or reducing all costs compared to the benchmark

- Cost of felling & haulage can be entered in this table if known, and net stumpage calculated by deducting these from Mill Door Log Value (MDLV). Else net stumpage can be entered directly (see "Prices" below)
- Fixed overheads at harvest and waste-harvest costs (including non-commercial thinning NCT) are treated as line items in the cash flow, not as factors to deduct in calculating net stumpage

Prices

- Click on the **command button** to flip between the option of entering stumpage directly, or entering Mill Door Log Value and calculating $\text{Stumpage} = [\text{MDLV} - \text{logging costs}]$
- When entering stumpage prices directly, a change in either harvest costs or stumpage will show the required MDLV based on $\text{Stumpage} = [\text{MDLV} - \text{logging costs}]$
- Changes in harvest & haulage costs do NOT affect financial results, since those depend on stumpage which is either entered directly or calculated as a residual. However the total costs as shown may be useful for cash flow forecasting.
- What-if questions can be answered by using the slider bar which affects either MDLV or stumpage, depending on which is the currently active entry method.
- For financial analysis, the base assumption is that costs and prices will change equally over time. However future price changes for either stumpage or MDLV can also be modelled as an annual percentage real change, i.e. over and above inflation.
- The outcomes from change in real price and multiplier are shown in the tables below the data entry point

Auto Harvest Age determination

- The settings in the auto regime table create rules that will undertake a harvest when either one or both of two criteria are true.
- The criteria are that current BA exceeds a certain proportion of the sites potential, and/or that the annual increase in standing value has fallen below a specified rate.
- When the criteria are met, the stand is harvested so as to remove BA which is specified by the user below the criteria table. (cells L7 and M7)

- Note that this is not an optimiser as such. The user must still specify the standing BA and/or value change criteria and how much BA is to be removed when the criteria are met.
- Some logic constraints are that age at CF > T2 > T1 and CF ≤ 50. Note also that if the user-specified "OR" criteria for clearfell would allow the CF at or before T2 age, (for example if the CF is set so as to occur when value gain is < 5% and the stand is already at that point by T2 age)
- Then the user's T2 BA removal is overridden to become 100% (i.e. CF occurs at T2 age)
- When the tick-boxes for T1 and T2 are "OFF", the BA removal is set to zero and CF age is determined as if there are no thinning

Thinning and pruning regimes

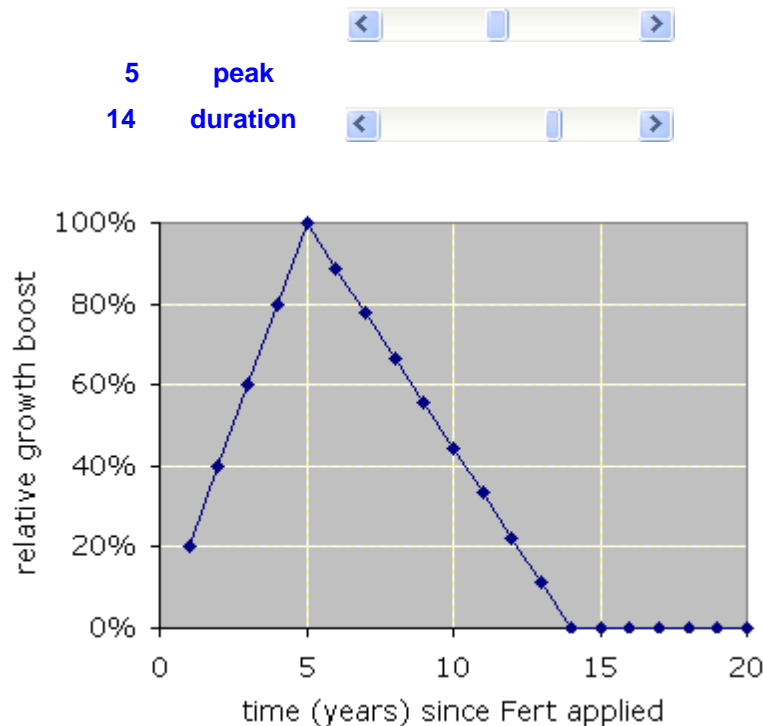
- A "1" in the column indicates that the action is allowable under the selected regime
- The user can create and name their own regimes in the space provided
- Yellow highlighted cells can be amended by the user

Establish regime

- A "1" in the column indicates that the action is allowable under the selected regime.
- The user can create and name their own regimes in the space provided.
- Yellow highlighted cells can be amended by the user
- The growth effects of intensive site preparation are handled by the table of m & k multipliers at right
- Use the supplied defaults unless better information is available
- Alternatively, a lasting effect of extra fertiliser etc can be modelled simply by increasing the SQ

Maintenance regime

- A "1" in the column indicates that the action is allowable under the selected regime.
- The user can create and name their own regimes in the space provided.
- Yellow highlighted cells can be amended by the user
- Response to later age fertiliser is assumed to be variable in magnitude, time of peak and duration; these can be specified by the user.



Benchmarking

- Calibrating TreeTOP to a known plot result is referred to as Benchmarking.
- Recalling and using a saved benchmark calibration is done on the Benchmark and DBH/BA charts sheets
- Enter your plot data or predictions in cells Benchmark! A4:D9. Up to 6 ages can be entered.
- Then enter the species, site and silvic information in the usual way (e.g. starting from the HOME page).
- This data appears as points on the charts sheet. You can then use the spinners to align the TreeTOP chart results

- To match your data. Similar plots from the research database can be compared to your benchmark
- Once the plot has been calibrated you can capture (save) the settings which are shown in
- The box below the "capture" button on the charts sheets. "Capture" will transfer the settings into cells A2:D9
- On the "Benchmark" sheet, from where it can be transferred to any other Excel data file or simply stored
- Further down the page. In either case, this is done simply by using normal copy-and-paste actions.
- After calibrating you can change the silviculture and investigate alternative management strategies and outcomes.
- You can copy-and-paste a saved benchmark stand back to cell Benchmark!A2 and use the command button

NOTE: only the basic growth settings are saved. Costs, stumpage and minor factors must be checked manually when a saved stand is recalled and applied in the model.