Firewood production for home use in SW Victoria

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Introduction

Growing native tree species to provide firewood for home use is easy and can also provide environmental benefits. The information provided includes notes on firewood properties, suitable species, establishment methods, layouts, management, harvesting, drying and likely yields. The sources of the information is provided in the Reference section.

Species

The ten species listed below cover the range of sites one might have in this region and all have fairly dense wood that can provide firewood that burns well. Other species, such as Ironbark (*Eucalyptus tricarpa*) and Yellow Box (*E. melliodora*) and Blackwood (*Acacia melanoxylon*) could also be used.

1. Sugar Gum (*Eucalyptus cladocalyx*) is a species that will perform well in this environment, particularly if global warming creates a drier local landscape. The species coppices well and is easily established by direct-seeding or seedling. It is the main species proposed here for drier sites. It may be frost-tender when young – the coppice shoots are also frost-tender.

2. River Red Gum (*E. camaldulensis*) can be grown on sites that are not dominated by dense clay, and preferably where moisture is available. Its growth rate is similar to that of Sugar Gum. The species can coppice. It has a moderate tolerance of salinity and high tolerance of frost.

3. Spotted Gum (*Corymbia maculata*) is a fast-growing, attractive species that is a good high-value timber and firewood species. It grows well on most well-drained but moist soils and its blossom attracts many bird species. The tree will coppice. It is easy to grow by direct-sowing.

4. Yellow Gum (*E. leucoxylon*) is an alternative to River Red Gum, with much the same properties. It prefers a well-drained lower slope site with some sand in the profile.

5. Swamp Gum (*E. ovata*) is a robust local tree that will tolerate wet clays on basalt plains soils – situations that other eucalypts find problematic.

6. Swamp Yate (*E. occidentatus*) is a fast-growing hardwood tolerant of extreme salinity and seasonal waterlogging. The species coppices well. Superior provenances should be sought.

7. Black Wattle (*A. mearnsii*) is a very fast-growing species. The wood is hard and it contains silica which, when the wood is dry, rapidly blunts saws. It splits easily. It does not coppice and so must be replanted or re-sown. It grows best on moist soils. Borers infest trees older than about 10 years, especially on stressful sites. The trees are best harvested at that stage.

8. Drooping Sheoak (*Allocasuarina verticillata*) is an indigenous local species that produces very hard wood that splits easily and burns well. It may not coppice. The tree grows well on hard sites but it will not tolerate water-logging.

9. River Sheoak (*Casuarina cunninghamiana*) is an attractive fast-growing species with excellent form that grows well on a moist site.

10. Salt Oak (*Casuarina obesa*) is a fast-growing, non-suckering species tolerant of extreme salinity and seasonal waterlogging. Some selections have better form and growth than others.

Heating Value and green and dry-weight relationships

Firewood can be described as:

- Green (deemed to be 100% moisture content) with energy ~ 8.5 mJ/kg
- Partly Dry (~50% mc) with energy ~ 12.1 mJ/kg
- Air Dry (~20% mc) with energy ~ 15.7 mJ/kg
- Bone dry (<5% mc) with energy ~ 19.3 mJ/kg

Most wood averages around 20 mJ/kg on a dried basis. Compared with hardwoods, softwoods have a higher lignin content and a slightly higher heat value per kg mass. Hardwoods have a greater density, so a cubic metre of hardwood gives much more energy than can be obtained from softwood (e.g. Radiata Pine has about 50% less energy for the same mass of Sugar Gum, Yellow Box or Ironbark.

The wood of Sugar Gum is more dense than River Red Gum (but less dense than Grey Box *E. microcarpa* or Buloke *Allocas. luehmannii*) and burns as well, with fewer sparks, therefore is superior as a firewood species.

About half of the heat value of wood is lost by burning green or wet fuel. Firewood should be air-dried in the open during summer and stored under cover for the winter. Ideally it should not be used until it has dried in the stack over another summer. For those who want to know the moisture content of their firewood it can be determined as follows:

- Select 3 blocks from the stack and split them
- Slice a few thin pieces from each split piece, from inside (heartwood) and outside (sapwood)
- Chop these pieces into ~30 mm bit samples
- Weigh the combined samples on a balance or kitchen scales
- Spread the bits on a tray and heat at 100 degrees C in an oven for 4-5 hours
- Reweigh the wood direct from the oven
- % moisture of the firewood = (Orig. W minus Dry W) x 100/Orig. W. If >30% then the wood is far too wet to use efficiently. A better value is 20%, or less.

The relationship between green weight and air-dried weight gives an indication of the heating value of different woods. Thus if 100 g of 'green' firewood (sapwood & heartwood) weighed 60 g after air-drying, the % of air-dried to green weight is 60%.

Jeff Fairlamb (1999) has determined that Sugar Gum averaged about 63-70% air-dry (specified as 12% mc in the sawlog industry) to green weight, whereas River Red Gum averaged around 61-63%. Other eucalypt species varied around 52-65%.

According to Hamilton (2000), woodcutters in the Lismore area estimate that 1 m^3 of air-dried Sugar Gum wood when stacked equals 850 kg (or 1 tonne of wood occupies 1.2 m^3 of space when stacked). That value of air-dry density (850 kg/m^3) is greater than the 600 kg/m^3 quoted by Lyons (1984) for Red Gum. Borschmann (2003) suggests 790 kg/m^3 for Sugar Gum, based on a measurement made by Andrew Lang at Lismore. A value of 800 kg/m^3 may be appropriate for Sugar Gum.

The published density values for unseasoned, green sawn timber boards from Sugar Gum, River Red Gum & Black Wattle are about 1200, 1100 & 1000 kg/m^3, respectively, and the seasoned (air-dry density values of boards dried to 12% mc) are about 1090, 900 & 800 kg/m^3, respectively. See Bird (2000) for other species. These values relate to heartwood in sawn boards, whereas firewood includes sapwood and is usually ≥20% mc rather than 12% mc.

Estimated growth rates for firewood species and requirement for a household for heating
One estimate (Charles Pawsley 1984) is that 18 tonne of wood may be needed annually and that could be obtained by planting 0.3 ha (at 1,110 stems/ha) annually for 10-12 years.

Another estimate (Bob Lyons 1984) is that 1 ha of woodlot (spaced 1,110 stems/ha) would yield from 3-9 m^3/yr (ave. 5.4), with a density of 600 kg/ m^3, therefore producing 3 t fuel/ha/year. He contends that this may be enough wood for a household, with the 1 ha producing on a 10-year rotation basis.

Sonogan & Trapnell (1998) or Trapnell & Sonogan (2000) used a value of 10 t/ha/yr for their calculations. If one uses a dry density value of 0.8/m^3, that suggests a mean annual increment (MAI) of around 13 m^3, a value easily achieved on high rainfall sites with species such as Tasmanian Blue gum (*E. globulus*) or Sydney Blue Gum (*E. saligna*).

Hamilton (2000) had students measure the MAI of merchantable firewood from direct-seeded, unmanaged Sugar Gum shelterbelts at Lismore and concluded that the MAI was around 14 m^3 for 10 of the 11 plantations assessed. That would give a yield of approx. 11 t/ha/year for Sugar Gum.
Based on the 3 examples above, consider a range of 5-10 t/ha/yr as the likely growth outcome.

Establishment

Detailed information on site selection for the various species, establishment and management of the trees can be found in Bird (2000) and Bird, Kearney & Jowett (1996).

Weed control – weed control before establishment and in the first year after is the key to success. Where weeds are a severe problem the early work may be needed in the spring in the year before planting is due. This is then followed up the next year in late winter (before plants can exploit the soil water) and again before planting, if that is needed to catch any late germinants. Unless Phalaris is widespread at the site it is sufficient to spray strips 1.5-2 m wide along the projected tree lines.

Glyphosate is commonly used (e.g. 150 mL/10 L spray) and a residual herbicide (e.g. *Chlorsulfuron*, at 30 g/ha) can also be applied in the pre-planting spray. That is intended to prevent weed germination over spring and through the summer. Problems with weeds later on are dealt with in Bird *et al*. (1996) and Bird (2000).

Ripping is optional – it may, in some circumstances (e.g. dry first summer), give a benefit but it has a cost. Planting can be easier when there is a rip line, but the plant should generally not be planted directly in the rip. On clay soils the rip line is liable to crack open in summer, killing the seedling. That does not occur if a small mound is made over the rip line.

Mounding is also optional – it confers an early advantage in growth of perhaps 5-20% but is costly and causes difficulties in subsequent access. Mounding does, however, enable planters such as the Pottiputki to be used effectively, much increasing the rate the trees can be planted.

Seedlings - the seedlings may cost $1 or more, depending on the type of container. The aim is to plant ~1110 trees/ha (i.e. 3 m x 3 m spacing) or 833 trees/ha (4 m x 3 m spacing). A wider spacing allows faster growth but the closer spacing allows for deaths of trees in the first rotation and loss of some stumps in subsequent coppice rotations.

Spring planting is advised when the species are frost-sensitive. September-October has proved to be successful over many years in SW Victoria, however August planting is advised on dry sites (particularly north or west-facing slopes). Planting in winter does not confer much, if any, advantage because cold and wet conditions do not allow growth, whilst pests and weeds can affect the seedlings. Spring planting also enables good weed suppression prior to planting.

Direct-sowing – the advantage of this method is the lower cost. However, it is not always successful, for it depends on good, moist conditions to allow germination and establishment of seedlings. Details of methods are given in Bird *et al*. (1996) and Bird (2000). The species given above are all capable of being direct-sown and the seed required to achieve success are given in above reports. Thus, to obtain approx. 1 tree/m along the tree line the following amounts of seed are probably needed:

Acacia mearnsii	100-150 g/km
Allocas. verticillata	100-200 g/km
Corymbia maculata	100-250 g/km
E. camaldulensis	100-200 g/km
E. cladocalyx	200-300 g/km
E. occidentalis	200-450 g/km
E. ovata	60-600 g/km
E. leucoxylon	160-1200 g/km

Acacia seed needs to be heat-treated to ensure germination. Heat a large pot of water to boiling and suspend the seed (contained in flywire mesh) in the water for 1 minute. The ratio of seed to water is about 100 g seed/3 L water. The seed can then be laid on paper and air-dried in the sun and stored indefinitely until required, or it can be sown immediately if the soil is damp. If the soil is dry and no rain falls then the damp seed may sprout and die.

When there are patches without seedlings some extra planting is needed next year. However, one only needs trees roughly at 2-3 m spacing and one may need to do some culling in the early stages to achieve a good spacing. It is most convenient to pull seedlings before they get too difficult to dislodge. However, that should not be too early because most deaths by various causes (stock, hares, rabbits, grasshoppers, frost, drought, fire or herbicide) occur in the first 18 months.

It is also possible to leave thinning of direct-sown trees until year 3-6, when there could be significant amounts of small-diameter wood forthcoming, particularly if Black Wattle was grown. A chain-saw is used then to thin the stand and reduce the stems to 30-cm lengths.

In order to supply a steady amount of wood there would need to be planting and harvesting on an annual basis, beginning perhaps 10 years after planting the first block. To supply a household with an adequate, sustainable wood supply would mean that 0.1 ha of trees should be planted each year until the first plot is harvested. The first 0.1 ha woodlot is either regenerated from coppice shoots, replanted or re-sown. The process is then repeated for succeeding years and plots.

Falling trees, de-barking and splitting firewood

The best time to fall the trees is in early to mid spring, in order that coppice shoots avoid the worst of winter-spring frosts but are tough enough to withstand the summer heat. The logs (or cross-cut billets) could be left for several months on the ground to dislodge the bark before carting away.

Cross-cutting into billets can be done by chainsaw or on a saw bench. The wood is cut into 2 main sizes: 25-30 cm and 45-60 cm lengths. Firewood mills are available that crosscut and split the billets (Borschmann 2003). Mechanical splitters are commonly used in woodyards or in the paddock to split large billets. The max. size for split or unsplit wood is 15 cm.

The stump should be trimmed with a sloping cut approx. 10-15 cm from the ground. That allows the establishment of firm shoots. Excess shoots should be removed next spring, leaving the best 1-2 shoots. That process is done by bashing with the back of an axe but a chain saw could be used.

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