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Department of Conservation
and Land Management

Wood Utilisation Research Centre

MOISTURE LOSS FROM SMALL JARRAH FIREWOOD BILLETS

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W.U.R.C. Technical Report No. 30

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SUMMARY

The cost of silvicultural treatment to improve stand quality of regrowth jarrah (*Eucalyptus marginata* Donn ex Sm.) forest available for timber production can be partially offset by selling thinnings for firewood. This study assessed drying rates of small jarrah firewood billets, docked to lengths of 150, 325 or 400 mm, which were stored in open bins and their moisture contents (MC) monitored as they dried. The effects of bark removal, horizontal vs. vertical stacking, and covered vs. open storage in drying initially to 30 per cent and then to 25 per cent MC were assessed.

The results indicated that the time required for drying from 80 to 30 per cent MC, was significantly less for the 150 mm length billets with bark removed. Continuing drying to 25 per cent required an overall drying time of 4 to 6 months, by which time treatments had no effect.

INTRODUCTION

Much of the present jarrah (*Eucalyptus marginata* Donn ex Sm.) forest in Western Australia has regenerated after logging activities since the arrival of Europeans. Thinning of the regrowth forest available for timber production by removing the poorer and suppressed trees is essential to optimise the growth of crop trees. Because of the cost, only small areas of the regrowth jarrah forest are treated each year.

In recent years the expanding domestic firewood market, especially in the Perth metropolitan region, has been met by harvesting dead dry trees from the jarrah forest. A local charitable organization approached CALM with the idea of also using thinnings to satisfy a perceived niche in the firewood market, and the time required for green wood to dry to a moisture level acceptable to the market required assessment.

This trial compared different methods of drying firewood billets from regrowth jarrah thinnings, while determining the time needed for billets to dry to usable firewood.

METHOD

The Hadfield Block area in Harvey District had been harvested for sawlogs and poles up to 1985. Jarrah was the principal species harvested, with marri (*E. calophylla* R. Br. ex Lindl.) removal infrequent. Poles and advance growth were the primary stand components, and there were no mature or overmature trees remaining. Substantial lignotuber and sapling regeneration had resulted from the 1985 logging.

The trial used approximately 15 m^3 of small jarrah stems harvested from Hadfield Block in April 1987. Removal of stems from the stand followed the prescription for normal JSI operations, with the restriction that stem diameters underbark were in the range of 50 - 150 mm. Both regrowth and suppressed advance growth stems were removed.

Felling was done by chainsaw, and stems were delimbed as necessary. Log lengths of 2.4 m were cut to facilitate extraction by a CAT930 equipped with logging forks, and transport by truck. Some debarking was done at the bush landing before stems were transported to the Wood Utilisation Research Centre (W.U.R.C.) at Harvey. Some further debarking was carried out on the W.U.R.C. landing to give similar quantities of stems with bark-on or bark-off.

The experimental design was:

	d.f.
Lengths (150, 325 or 400 mm)	2
Bark (on or off)	1
Stacking (vertical or horizontal)	1
Protection (covered or uncovered)	1
Replication	9
Error	225
	239

The logs were then docked into billet lengths of 150, 325 or 400 mm which were stacked into open steel mesh-sided bins (0.6 x 0.6 x 1.2 m), using two stacking patterns (horizontal or vertical). Bark-on and bark-off logs were separated. The 325 and 400 mm billets had two layers in the vertical stacking pattern, while the 150 mm billets had three vertical layers per bin. The layers were supported on weldmesh trays. The bins were either left out in the open or placed under cover, with unrestricted air circulation.

For replication, ten samples were randomly selected from each bin for measuring moisture content (MC) using the oven-dried method (Standards Association of Australia 1972). Mean bin MC was estimated as the average of these samples. Subsequently, the bins were weighed on a platform load cell scale, and the change in weight was related directly to a change in MC.

Bins were weighed at intervals until weight loss indicated that MC was below 25 per cent, at which the billets were considered to be usable firewood. The bins were then resampled by determining the MC of ten billets of smaller size to the original samples. Samples of bark were also taken for MC determination. Past experience had shown that although weight loss is a good indicator of decrease of moisture content, there may be some error associated with the method.

Results were analysed using analysis of variance.

RESULTS AND DISCUSSION

The mean bin MC of the billets at the start of the trial in April ranged from 82 - 99 per cent.

Moisture content loss with time for each individual bin is shown in Figures 1 to 3 which are based on the three length classes. The drying curves have the typical shape for drying of sawn timber. In the initial stages, drying was quite rapid as shown by a steep gradient, it slowed in the middle stages, and became very slow in the final stages.

Because replication in the experimental design was based on ten randomly selected billets, the results give an indication of required drying times, and it is more correct to speak of averages of groups of bins. The effect of climatic conditions in different seasons was not considered.

The faster drying bins of jarrah firewood took 4 to 5 months to dry from 80 to 25 per cent MC and the slower drying bins took 5 to 6 months (Table 1, Figs. 1 - 3). When stacked with green billets in late April and early May, the contents of most bins had dried to produce usable firewood by November or December. Residual bark had shrunk to cling tightly to the billets and was difficult to remove, although hitting with the back of an axe was an efficient method of removal.

As the billets were dried in uncontrolled conditions, the drying rate was influenced by weather conditions. The weather in Harvey during that period was slightly drier than average, but otherwise fairly typical of the normal winter climate. Because drying of wood is dependent upon three variables (temperature, relative humidity and air circulation) drying time would be less had the bins been located in a warmer, drier and perhaps windier area, such as Perth. A harvesting operation in spring with the billets drying in summer, would decrease drying times.

Table 1
Mean drying time (days) for various treatments of regrowth jarrah firewood billets

Treatment	Drying time (days)		
	80 - 30 % MC	30 - 25 % MC	Total
Length class			
150 mm	109 *	37	146
325 mm	139	31	170
400 mm	150	25	175
Bark			
On	151 *	26	177
Off	113 *	38	151
Stacking Pattern			
Horizontal	142	34	176
Vertical	122	29	151
Exposure			
Covered	142	25	167
Uncovered	122	37	159

* Significantly different at $P<0.05$

Mean drying times taken to dry the treatments from 80 per cent MC to 30 or 25 per cent respectively are shown in Table 1. The 150 mm length billets took significantly less time to dry from 80 to 30 per cent than either the 325 or 400 mm length classes ($P<0.05$). However, drying from 80 to 25 per cent showed no significant differences in average drying times between length classes.

The only treatments with reduced drying times were docking to 150 mm and removing bark. However, their effect extended to only part of the total drying time. Wood does not dry in a uniform manner, consequently for part of the drying time billets in these treatments dried significantly faster, but over the total drying time there was no difference between any of the treatments. The outer part (case) of the billet dries much faster than the inner core. When the average MC of the sample is 30 per cent, the case may be at 15-20 per cent MC, while the core is still green at 35 to 40 per cent MC. The lower the average MC of a sample, the slower the drying rate of the core. This is reflected in the flattened shapes of the drying curves as 30 per cent MC was approached (Figs. 1 - 3). Although the case was virtually dry, the core still contained moisture, which even in spring and summer drying conditions was difficult to reduce.

It was originally considered that placing bins under cover would shelter billets from winter rain and drying rates would increase. However, the results showed no significant difference between the drying times of bins under cover or those exposed to the weather.

Similarly, it was considered that a vertical stacking pattern would allow more air movement across the billets and shorten drying time, but the results indicated no difference in drying time between vertically or horizontally stacked bins.

The fastest drying bin (150 mm, bark off, vertical stacking, covered) took only 38 days to dry from 80 to 30 per cent MC, while the slowest drying bin (400 mm, bark on, horizontal stacking, uncovered) took 210 days. Drying from 80 to 25 per cent MC took the former bin 95 days and the latter bin 241 days, indicating an extra 57 days and 31 days respectively to lose the additional 5 per cent moisture content.

Bark-off billets took significantly less time to dry from 80 to 30 per cent than bark-on billets, but average drying time from 80 to 25 per cent was not significantly different (Table 1). The type of stacking pattern did not affect drying time, and bins exposed to the weather did not dry faster than those under cover.

Sampling of the bark revealed that the MC of the bark was 8 to 12 per cent when mean MC of the billets in the bin was 20 to 25 per cent.

In the trial, firewood billets cut from green regrowth jarrah thinnings in April took 5 to 6 months to dry to 25 per cent moisture content, in uncontrolled environmental conditions. This trial used a comparatively small sample and drying time is likely to increase if volumes and billet size are increased. The results indicated that there are advantages in smaller billet lengths and removing bark to decrease drying time.

However, the results indicated that if an average billet MC of 30 per cent is satisfactory for efficient burning in slow combustion and open fires, then a significant reduction in drying time can be achieved by debarking and docking to 150 mm lengths.

If 25 per cent average moisture content is required there are no significant reductions possible by any of the treatments tested.

Fig. 1. Moisture content loss with time for 150 mm length billets

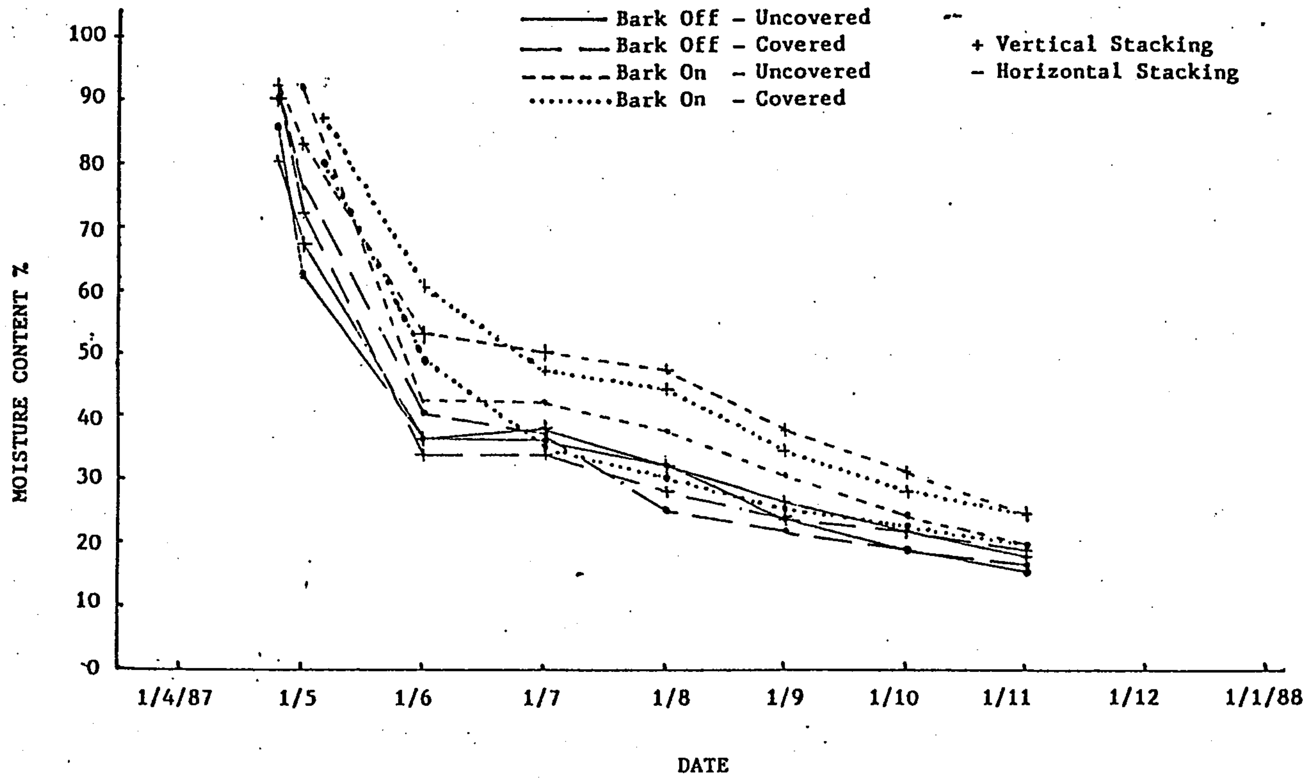


Fig. 2. Moisture content loss with time for 325 mm length billets

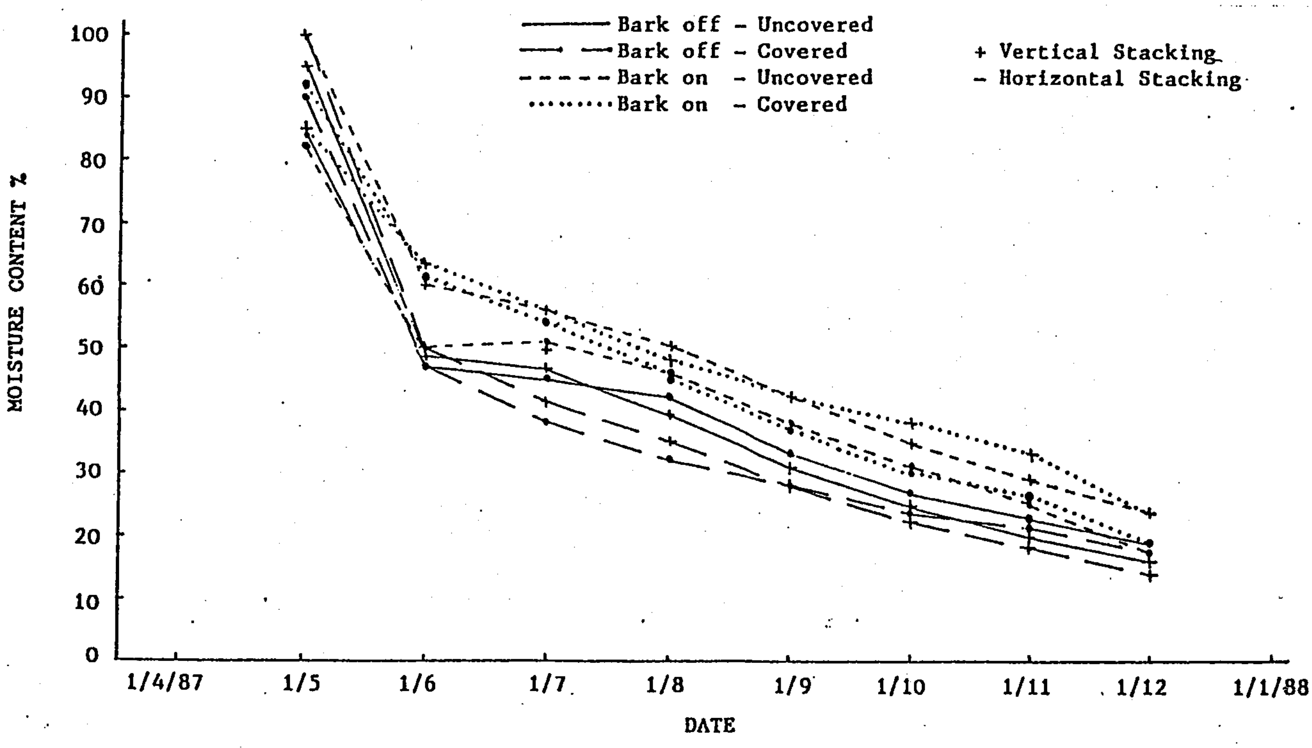
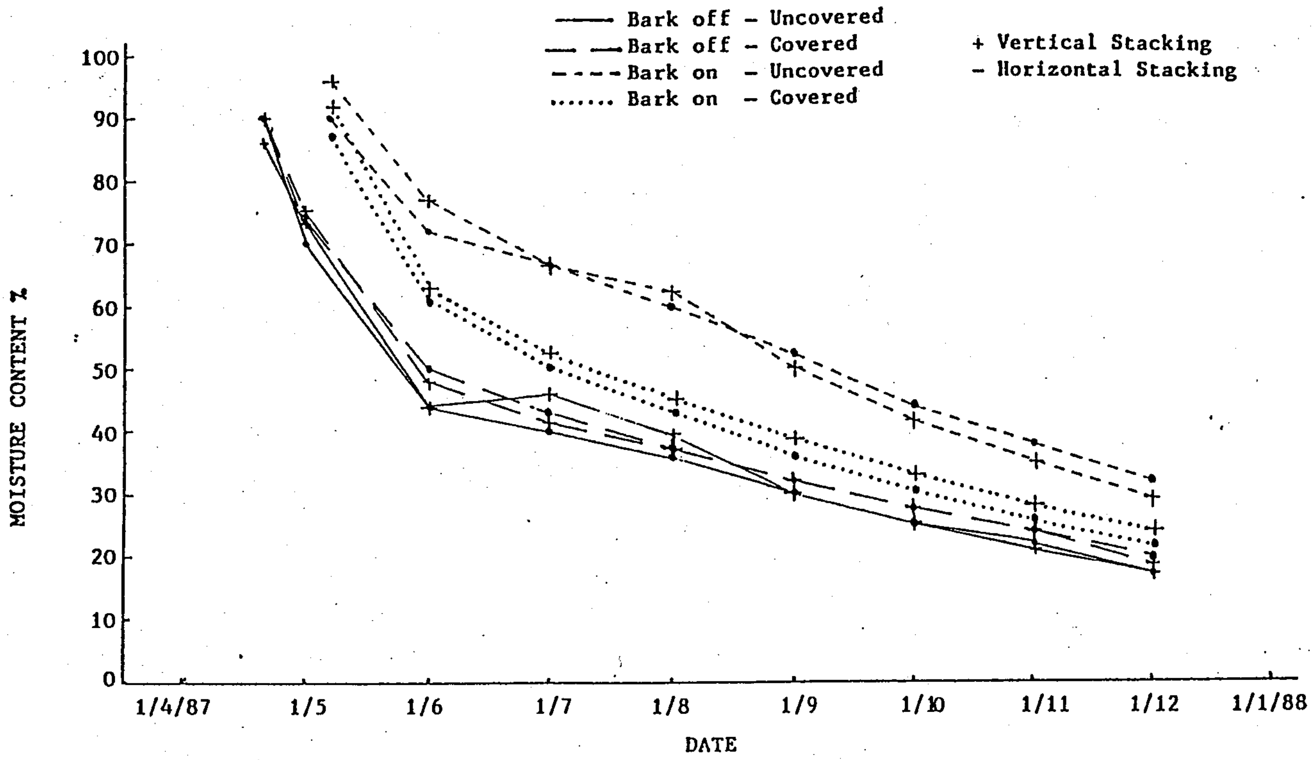


Fig. 3. Moisture content loss with time for 400 mm length billets



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