RADIATA PINE SLASH BURNING GUIDE (Mk 1)

N.D. Burrows

FIRE RESEARCH NOTE 1984

PRESCRIBED BURNING IS FIRE...

- ☐ Applied in a skillful manner
- ☐ Under exacting weather conditions
- ☐ In a definite place
- ☐ For a specific purpose
- ☐ To achieve (certain) results

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- MARK 1 -

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FORESTS DEPT. OF WESTERN AUSTRALIA
RESEARCH BRANCH
MANJIMUP

CONTENTS

RADIATA PINE SLASH BURNING GUIDE

- MARK I -

1. INTRODUCTION

1.1 Thinning and pruning Radiata Pine produces flammable slash. These operations reduce the likelihood of the start and spread of crown fires, but the added quantity of slash fuels result in a threefold increase in the rate of spread of ground fires.

1.2 This is a guide to burning aerated needles in slash without damaging trees. The guide is based on research in second thinned Hills plantations.

1.3 This is a state-of-the-art prescription. It is expected that it will be improved by further research and experience.

2. PLANNING

2.1 The level of plantation protection will be increased if protection requirements have been considered early and in all stages of planning, including plantation design, planting, thinning, pruning and clearfelling.

2.2 If the total area of slash fuels to be burnt exceeds the capacity to burn, then areas must be given a priority based on such factors as:- strategic importance, level of risk, stand value, distance from divisional headquarters and operations and activities in nearby forest and surrounding land.

2.3 Thinning/pruning operations must be supervised to ensure slash is not heaped but is evenly distributed.

2.4 Slash must be less than 1m in height and cleared at least 1m from the base of crop trees on the uphill side and 2m on the downhill side. Crop tree protection to this specification must precede any prescribed burning.

2.5 Thinning/pruning should take place in summer/autumn and the slash burnt the following winter/spring when tops are "red". Avoid leaving "red" tops over summer.

2.6 Slash burns may only be carried out in stands older than 12 years.

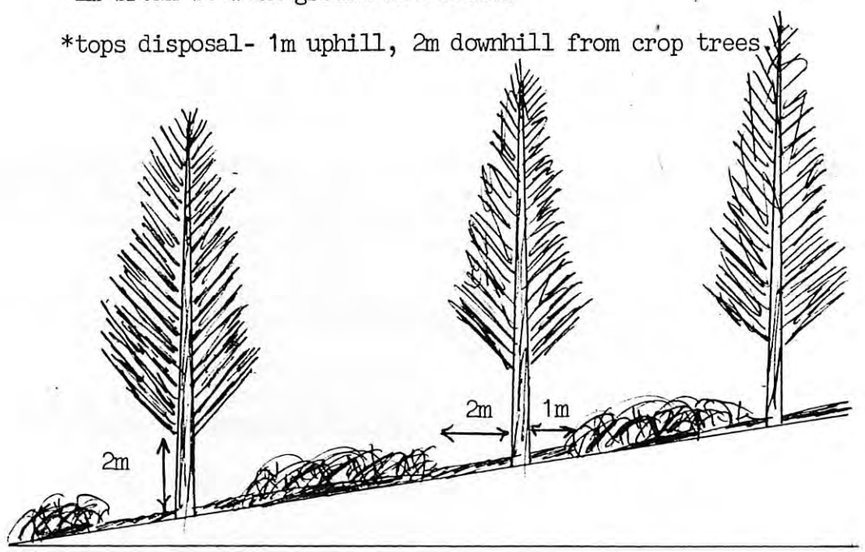
2.7 Areas to be burnt should have a vertical fuel break of 2 - 3m between ground level and suspended fuels in low sections of crowns (see Figure 1).

2.8 Confine burns to small, homogenous units. Burn size will depend on:- variations in fuels, slope, aspect and resources. 10 - 30 hectares is a normal "job" size.

FIGURE 1: Crop tree protection standards for burning slash.

*2m break between ground and crown.

*tops disposal- 1m uphill, 2m downhill from crop trees.



3. FUEL QUANTITY

3.1 This guide applies to needlebed and slash fuels only.

3.2 The objective of burning is to remove all aerated needles and only the top few millimetres of needlebed.

3.3 The total quantity of needlebed fuel can be measured prior to burning by measuring the depth. Areas less than 20 hectares, take 3 - 4 depth measurements per hectare. For larger areas, take 1 - 2 depth measurements per hectare.

3.4 The total quantity of needlebed fuels (in tonnes/ha) can be determined from needlebed depth and by using Table 1 below.

TABLE 1: Determining weight of needlebed fuel from depth of needlebed. (From Forest Fire Behaviour Tables for Western Australia.)

	Depth of Needlebed (mm)													
	5	10	15	20	25	30	35	40	45	50	55	60	65	70
Total Fuel Weight Tonnes/ha	2.8	5.2	7.2	9.0	10.7	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0

3.5 Identify areas of low and high fuel accumulation, as well as the average fuel loading. Record all measurements.

3.6 Use Table 2 to determine total slash fuel quantity.

TABLE 2: Amount of thinning slash (t/ha).

STAND AGE (YRS)	NO. OF STEMS REMOVED PER HA	AERIAL NEEDLES	BRANCHWOOD	STEMWOOD
5	1,200	4.4	6.6	50.5
(non-commercial)	1,000	3.7	5.5	42.1
	900	3.5	5.2	39.9
	850	3.1	4.7	35.7
	750	2.7	4.7	31.6
	600	2.2	3.3	25.2
	400	1.4	2.2	20.5
11	800	6.8	7.8	17.5
(commercial)	700	5.9	6.9	15.3
	600	5.1	5.9	13.1
	500	4.2	4.9	10.9
	400	3.4	3.9	8.7
	300	2.5	2.9	6.5
	200	1.7	1.9	4.4

3.7 The quantity of fuel available for burning effects fire behaviour and intensity, which will influence both the level of damage to crop trees and control difficulty.

3.8 Use Table 3 to determine the quantity of needlebed available for burning (available fuel factor - AFF).

3.9 The available fuel quantity from the needlebed must be less than 3.0 tonnes/ha. If more than this is burnt, crop tree damage will occur.

TABLE 3: Available Fuel Factor (AFF) for Pine Needlebed. (Forest Fire Behaviour Tables for Western Australia.)

MINIMUM SURFACE MOISTURE CONTENT %	MINIMUM PROFILE MOISTURE CONTENT, %							
	30 to 35	36 to 40	41 to 50	51 to 60	61 to 80	81 to 100	101 to 120	121 to 150
5 - 9	1.0	0.9	0.8	0.8	0.8	0.7	-	-
10 - 14	1.0	0.9	0.8	0.7	0.7	0.6	0.5	0.4
15 - 19	1.0	0.8	0.7	0.6	0.6	0.5	0.4	0.3
20 - 24	1.0	0.8	0.6	0.5	0.5	0.4	0.3	0.3
25 - 29	0.9	0.7	0.5	0.4	0.4	0.3	0.2	0.2

3.10 There are three easily recognisable fuel types in slash fuels. These are:- aerated needles, branchwood (< 25mm in diameter) and stemwood. When the moisture content of aerated needles (AMC) exceeds 27%, the needles will not burn without the assistance of wind. Below 27%, all aerated needles will burn. Within the SDI limits specified below (4.1) less than 20% of the branchwood will burn and none of the stemwood (see Table 4). The needlebed must just carry fire as the dryness of aerated fuels alone will not be adequate for a sustaining fire.

TABLE 4: Quantity of fuel available for burning in slash fuels.

FUEL MOISTURE	AVAILABLE FUEL
. AMC < 27%	all aerated needles
. SDI < 250 or SDI fallen by 400	20% of branchwood, no stemwood

3.12 Calculate the total quantity of fuel available for burning by adding the assessed weights of each fuel component. For example:-

FUEL TYPE	QUANTITY AVAILABLE (t/ha)
Needlebed	2.5
Aerated needles	5.0
Branchwood	1.2
Stemwood	0
TOTAL	8.7 t/ha

3.13 The total fuel quantity available for burning must be less than 10 t/ha. Burning more than this will damage crop trees.

4. FUEL MOISTURE

4.1 The Soil Dryness Index (SDI) indicates the dryness of the deep fuel profile, logs, stumps, bark and standing trees. It reflects both fuel availability and the likelihood of re-ignition of logs and stumps.

4.2 In winter and spring, burning must only be carried out when the SDI < 250. In autumn, do not burn until the SDI has fallen by more than 400 units.

4.3 SDI records must be continued throughout the year in Pine divisions. Use rainfall and temperatures from sources near the burn site where possible.

4.4 When the SDI < 250, or has fallen by 400 units, and after the first and consecutive rain free days, field checks on fine fuel moisture content should be carried out in anticipation of burning.

4.5 CAUTION:- Autumn burns can cause more damage to crop trees than winter or spring burns, and autumn weather patterns are less predictable.

4.6 Maintain pine SMC and PMC prediction systems throughout the year (see Forest Fire Behaviour Tables for Western Australia). Correct predictions at least weekly by actual field measurements.

4.7 When pine SMC and PMC predictions are within 10% of the fine fuel moisture contents shown in Table 6, then fine fuel moisture content should be monitored daily at the peak drying time (about 1500 hrs) and especially after rainless days.

4.8 On possible burning days (rain-free days) an officer must be nominated to measure the fine fuel moisture content of the burn area. Table 4 below is a guide to field sampling. Sampling procedures are set down elsewhere.

TABLE 5: Sampling the fine fuel moisture content of slash fuels (this assumes a saturated needlebed profile prior to rain-free days).

	SAMPLE TIME (HOURS)	
DAYS SINCE RAIN	EXPOSED FUELS	SHELTERED FUELS
1	0800	-
2	0800, 1500	1500
3	0800, 1200, 1500	1500
4	0800, 1200, 1500	0800, 1500
5		0800, 1200, 1500
6		0800, 1200, 1500

4.9 Results of field samples should be used in conjunction with the fuel moisture content prediction systems in "Forest Fire Behaviour Tables for Western Australia" to determine the day suitable for burning and ignition time. Generally, suitable burning conditions will not occur on exposed sites for 2 or 3 days after rain and for sheltered sites, 4 - 6 days after rain.

5. MEASURING PRE-BURN WEATHER

5.1 Initially, weather forecasts are adequate to decide if closer monitoring of weather is necessary. If, on the basis of the forecast, conditions will be suitable, then weather conditions on the burn site should be closely monitored prior to ignition and during burning.

5.2 Wind speed is measured using a hand held anemometer and under the canopy.

5.3 Temperature and relative humidity are measured using a whirling or aspirated physchrometer.

5.4 Obtain updated forecasts during burning.

6. BURN PRESCRIPTION

6.1 Pine slash burns must comply with the following restraints:

TABLE 6: Prescribed conditions for slash burning under Radiata Pine plantations.

SDI		SMC %	PMC %	AMC %	TEMP °C	RH	WIND KPH	MAX. RATE OF SPREAD (m/hr)		MAX. FLAME HT (m)	
SPRING	AUTUMN							TOPS	NEEDLEBED	TOPS	NEEDLEBE
<250	SDI to fall 400 Units from summer max.	17-24* (19-25**)	≥45* (≥60**)	16-24* (18-25**)	≤22* (<20**)	≥50* (≥55**)	≤5* (≤3**)	50	30	1.8	.20

* Conditions suitable for backfiring.

** Conditions suitable for headfiring.

TABLE 7: Expected range of spread rates for fires burning over the range of recommended conditions. (mhr^{-1})

FUEL M.C. (SURFACE/ AERIAL) %	HEADFIRE SLASH FUELS	BACKFIRE SLASH FUELS	HEADFIRE NEEDLEBED FUEL	BACKFIRE NEEDLEBED FUEL
16	72 - 88	30 - 35	31 - 37	10 - 15
17	59 - 72	25 - 30	24 - 30	10 - 15
18	50 - 62	20 - 25	18 - 24	10 - 15
19	42 - 50	20 - 25	15 - 18	<10
20	36 - 44	15 - 20	0 - 15	<10
21	31 - 37	15 - 20	<10	<10
22	28 - 34	15 - 20	<10	<10
23	25 - 30	10 - 15	<10	<10
24	23 - 28	10 - 15	<10	<10
25	22 - 26	10 - 15	<10	<10
26	20 - 24	10 - 15	-	-

Table 7 is for flat or gently undulating sites (<4°).

McArthur Slope Corrections.

SLOPE (°)	SPREAD FACTOR
-10	.6
-5	.8
0-4	1.0
4+	1.2
6+	1.4
8+	1.6
10+	1.9
15+	2.7
20+	3.9

7. BURNING TECHNIQUE

7.1 Use drip torches and commence with a line of backfire. If conditions are suitable (Table 6) a line of spots can be placed 30 - 50 metres downwind of the first line. Best burning conditions are usually between 1200 - 1500 hours.

7.2 Use headfiring when wind speed is low and fuel moisture is too high for backfiring.

7.3 Proceed with caution if burning conditions are approaching the upper limits.

7.4 Use Table 7 as a guide to ignition pattern.

7.5 Ensure junction zones do not co-incide with planting lines.

7.6 If burning conditions deteriorate, cease lighting.

8. WEATHER, FUEL AND FIRE BEHAVIOUR

8.1 A fire weather officer must be responsible for measuring and recording fuel moisture content, temperature, relative humidity, wind speed/direction, fire rate of spread and flame height.

8.2 Fire behaviour and wind speed/direction observations should be half hourly or more frequently if wind conditions are variable.

8.3 Other weather observations made hourly.

8.4 Aerated and surface needlebed fuel moisture content to be measured hourly using a marconi moisture meter.

8.5 Note and record any unusual fire behaviour such as torching, spotting.

8.6 Results of all observations to be recorded and communicated to the fire boss.

8.7 When conditions deteriorate, cease lighting and prepare to mop-up or extinguish fires.

9. MOP-UP

9.1 There should be little or no mop under winter/spring conditions. Mop-up may be necessary in autumn.

9.2 Slash burns must be left black-out to prevent later re-ignition.

9.3 In autumn it may be necessary to extinguish individual trees if the resinous bark ignites. This can be done using pack sprays.

10. POST BURN ASSESSMENT AND REPORTING

10.1 Assess the results of the burn 2 - 3 weeks after.

10.2 Repeat the pre-burn fuel sampling procedure to determine the quantity and type of fuel removed.

10.3 Visually assess the level of scorch, deaths or stem damage.

10.4 Record all observations and place on appropriate file. Forward copies to OIC, Manjimup Research Station.

10.5 Reports to be submitted according to standing orders.

10.6 Re-code fuel and hazard plans.

ACKNOWLEDGEMENTS

I thank Bob Voutier, Bob Smith and Alex Robinson for their assistance in the field. I also thank the Victorian Forests Commission for their helpful advice and Roger Underwood for his useful comments.