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**REGROWTH EUCALYPT
FOR PLYWOOD PRODUCTION**

BY

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FORESTRY COMMISSION OF NEW SOUTH WALES

REGROWTH EUCALYPT FOR VENEER PRODUCTION

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CONTENTS	PAGE
LIST OF TABLES	4
INTRODUCTION	5
MATERIALS	5
1. <i>Log selection and timber properties</i>	5
2. <i>Equipment</i>	6
METHODS	7
RESULTS	8
CONCLUSIONS	15
ACKNOWLEDGEMENTS	15
REFERENCES AND FUTURE READING	16

LIST OF TABLES	PAGE
1. Mechanical properties of selected species	6
2. Dimensions of round-leaved gum billets	8
3. Dimensions of blue-leaved stringybark billets	8
4. Dimensions of brown barrel billets	9
5. Dimensions of Sydney blue gum billets	10
6. Lathe settings for various thickness of veneer	11
7. Estimated recovery of round-leaved gum veneer	12
8. Estimated recovery of blue-leaved stringybark veneer	12
9. Estimated recovery of brown barrel veneer	13
10. Estimated recovery of 2.6 mm thick Sydney blue gum veneer	14

INTRODUCTION

Major N.S.W. rainforest species, which were traditionally used for manufacture of plywood, are presently not available for harvesting. In order to preserve a viable plywood industry in Australia, a research programme has been prepared and carried out in the Plywood and Veneer Section, Wood Technology and Forest Research Division, Forestry Commission of N.S.W., with the aim to establish and promote an alternative raw material resource.

The possibilities of replacing various rainforest timbers, such as hoop pine, black bean, white beech, yellow carabeen etc. by small diameter regrowth eucalypts, currently available in considerable quantities in the coastal regions of N.S.W., were investigated.

In this study, particular emphasis was placed on the production of green veneer suitable for the manufacture of A-bond (waterproof) structural plywood which could be used in buildings and overlaid formwork panels.

MATERIALS

1. Log selection and timber properties

All logs used in the trial were of a good form and were not showing any major visible defects, however, the logs were not specifically selected to meet the highest standards of bole specification. The logs of four species were selected for this trial:

Round-leaved gum (*E. deanei* Maiden)

The logs were obtained from Olney State Forest from a regrowth stand containing Sydney blue gum (*E. saligna* Sm). The species is found on the central and north coast of N.S.W. and southern Queensland, at times extending to the tablelands. A medium to large hardwood, the wood texture is rather coarse and grain is sometimes interlocked (Bootle, 1983). Green density is about 1220 kg/m³ and air dry density is about 960 kg/m³. The timber is not difficult to work and heartwood is moderately durable.

Blue-leaved stringybark (*E. agglomerata* Maiden)

The trees grew on the middle ridge at Ourimbah State Forest near Wyong as part of a regrowth stand aged 30-40 years. The species is one of the main stringybarks of the central tablelands, central coast and south coast of N.S.W. It is a medium sized hardwood of even and medium texture with usually straight grain (Bootle, 1983). Green density is about 1070 kg/m³ and air dry density is about 880 kg/m³. The timber is ^{not} difficult to work, glues satisfactorily and the heartwood is durable.

Brown barrel (*E. fastigata* Deane et Maiden)

The selected trees came from compartment 2307 in Glenbog State Forest near Bega, where shining gum (*E. nitens* Maiden) was present to some extent with silvertop ash (*E. sieberi* L. Johnson) on the ridges. The species is confined to a relatively narrow zone running almost parallel to the N.S.W. coastline with a small extension into the eastern highlands of Victoria.

It is a large hardwood with medium and even texture and grain is often interlocked (Bootle, 1983). Green density is about 1140 kg/m³ and air dry density is about 750 kg/m³. The timber is slow to dry.

Sydney blue gum (*E. saligna* Sm.)

The trees came from Cumberland State Forest, Sydney, growing on soils derived from Wianamatta shales. The species commonly occurs on the east coast of Australia from Batemans Bay, N.S.W to southern Queensland. It is a large hardwood with moderately coarse and even texture. Grain is straight or slightly interlocked and gum veins are common (Bootle, 1983). Green density is about 1070 kg/m³ and air dry density is about 850 kg/m³. The timber is easy to dry but tangential surfaces are susceptible to surface checking.

Some mechanical properties of the above species are listed in Table 1.

Table 1. Mechanical properties of selected species

Species	Modulus of rupture (MPa)		Modulus of elasticity (GPa)		Max crushing strength (MPa)		Impact (Izod value)(J)		Hardness (Janka) (kN)	
	Green	Dry	Green	Dry	Green	Dry	Green	Dry	Green	Dry
Round-leaved gum	81	140	14	23	38	54	10	11	-	12.0
Blue-leaved stringybark	96	135	14	17	40	63	12	14	5.0	7.5
Brown barrel	80	107	14	14	36	65	18	13	5.7	6.4
Sydney blue gum	91	140	16	18	44	68	16	18	6.4	9.0

2. Equipment

The peeling was carried out on a heavy duty, high speed precision rotary veneer "UROKO" lathe of 1850 mm, model REC-6 with double spindles, capable of producing veneer in a thickness range of 0.5 mm to 6.0 mm.

The continuing ribbon of veneer was transported by the conveyor toward an automatic 2270 mm MATSUNAGA programmed clipper, model MC-75, using a shear-cut system, which allowed the cutting of sharp sheets of various thicknesses.

METHODS

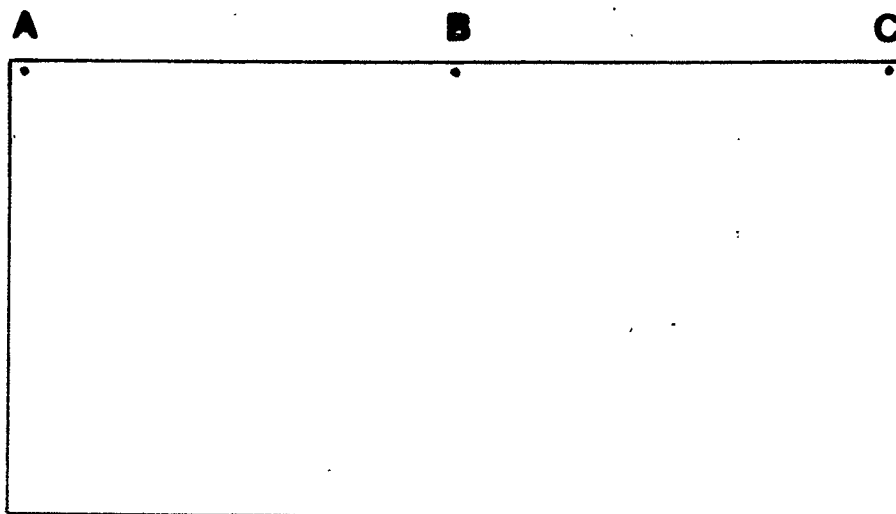
All logs were transported from the forest to West Pennant Hills with the bark left on and ends coated with wax emulsion to protect them against end-splitting. The logs were cross-cut by chainsaw into 1.25 m long billets and promptly re-coated with the anionic wax emulsion MOBILCER M. Billet size was voluntarily limited to fit plywood assemblies into the 1.2 m x 1.2 m hot press. Prior to final conversion into veneers with different thicknesses, all billets were debarked by axe, stored for several days in cold water and then preheated in an insulated aluminium tank, heated by a stainless steel coil filled with hot oil pumped through an automatic gas fired heat-exchanger. The billets were heated in order to achieve approximately a 60 °C temperature of the wood.

When possible, all billets were peeled to the minimum core of 210 mm. Only exceptionally decayed wood in the centre of a billet did not allow peeling down to this limit.

In setting up the lathe, the horizontal nosebar alignment was checked with a dial indicator gauging block. To overcome damage to the knife edge, the anvil of the dial indicator was made out of nylon.

The vertical nosebar settings and alignment were made with a feeler gauge.

After peeling, all material was clipped into sheets of 670 mm width, representing half of a standard panel size for plywood manufacture. The measurements of variation in thickness of green veneer were taken at three points of the veneer sheet, as shown below:



RESULTS

The dimensions of the billets are summarised in Tables 2, 3, 4 and 5.

Table 2. Dimensions of round-leaved gum billets

Log No.	Billet No.*	Length (mm)	End diameter (mm)		Mean centre diameter (mm)	Estimated volume (m ³)	Observation
1	1T	1245	425	450	438	0.1874938	Gum veins
	1B	1230	450	515	483	0.2252521	
2	2T	1240	303	339	321	0.1003000	Gum veins, decentralized pith Star checks
	2B	1250	339	375	357	0.1250592	
3	3T	1255	398	409	404	0.1607962	Star checks Star checks
	3B	1250	409	430	420	0.1730925	
4	4T	1245	373	375	374	0.1367042	Pocket gum Star checks, gum veins
	4TB	1240	375	378	377	0.1383482	
	4B	1250	378	383	381	0.1424391	

* T - Top section of the log; B - Butt section of the log

* TB - Intermediate section between top and butt section

Table 3. Dimensions of blue-leaved stringybark billets

Log No.	Billet No.*	Length (mm)	End diameter (mm)		Mean centre diameter (mm)	Estimated volume (m ³)	Observation
1	1T	1260	392	400	396	0.1551066	Hole 22 mm on billet end
	1B	1260	400	396	398	0.1566773	
2	2T	1270	378	415	397	0.1571282	
	2B	1260	415	408	412	0.1676937	
3	3T	1270	404	425	415	0.1716996	Black heart, star checks Star checks, shape irregular
	3B	1250	425	458	442	0.1917008	
4	4T	1240	397	415	406	0.1604512	Shape irregular Shape irregular
	4B	1260	415	439	427	0.1803415	
5	5T	1250	482	498	490	0.2355981	Shape irregular Shape irregular
	5B	1270	498	540	519	0.2685393	
6	6T	1270	443	465	454	0.2054872	
	6B	1270	465	500	483	0.2325773	

* T - Top section of the log; B - Butt section of the log

Table 4. Dimensions of brown barrel billets

Log No.	Billet No. *	Length (mm)	End diameter (mm)	Mean centre diameter (mm)	Estimated volume (m ³)	Observation
1	1T	1260	453	455	0.2038692	Star checks, irregular shape
	1B	1250	480	453	0.2139997	Gum veins, irregular shape
2	2T	1240	408	423	0.1684526	Star checks
	2B	1240	423	438	0.1808196	Gum veins, gum pockets
3	3T	1260	393	375	0.1458486	Star checks
	3B	1250	410	393	0.1585738	Star checks
4	4T	1240	355	370	0.1282638	Irregular shape
	4B	1250	390	370	0.1416925	Splits, star checks

* T - Top section of the log; B - Butt section of the log

Table 5. Dimensions of Sydney blue gum billets

Log No.	Billet No.	Length (mm)	End diameter (mm)		Mean centre diameter (mm)	Estimated volume (m ³)	Observations
1	1A	1240	510	455	483	0.2270834	Gum pockets
	1B	1260	440	415	428	0.1811872	Insect attack
	1C	1260	418	405	412	0.1678937	
2	2A	1250	570	530	550	0.2968281	
	2B	1260	510	480	495	0.2423541	
	2C	1260	475	465	470	0.2184921	
	2D	1250	415	400	408	0.1633427	
3	3A	1250	470	410	440	0.1899700	
	3B	1250	395	390	393	0.1515530	
	3C	1250	380	360	370	0.1343331	
	3D	1250	350	345	348	0.1188332	
	3E	1260	335	333	334	0.1103399	
4	4A	1260	535	478	507	0.2542470	
	4B	1260	473	433	453	0.2029721	
	4C	1265	425	420	423	0.1776808	Rot in centre
	4D	1260	415	415	415	0.1703477	
	4E	1260	388	378	383	0.1450900	
	4F	1260	380	375	378	0.1413265	
5	5A*	1250	535	435	485	0.2308145	
	5B*	1240	443	410	427	0.1774789	Rot in centre
	5C*	1250	410	400	405	0.1609495	
	5D*	1260	400	395	398	0.1566773	
	5E*	1260	350	338	344	0.1170460	
	5F*	1260	345	333	339	0.1136682	
6	6A	1290	580	490	535	0.2898457	
	6B	1290	480	460	470	0.2236943	
	6C	1250	450	440	445	0.1943120	
	6D	1260	430	430	430	0.1828845	
	6E	1270	420	415	418	0.1741910	

* Not suitable for peeling

Various settings of the lathe for various thickness of veneer were used during these tests. The settings are shown in Table 6.

Table 6. Lathe settings for various thickness of veneer

	Veneer thickness (mm)							
	1.25	2.60	1.25	1.60	2.60	1.60	2.60	2.60
	Lathe setting gap (mm)							
	Round-leaved gum	Blue-leaved stringybark			Brown barrel		Sydney blue gum	
Horizontal	0.96	2.48	0.96	1.25	2.48	1.25	2.48	2.48
Vertical	1.52	1.52	1.52	1.52	1.52	1.52	1.52	2.05

The wedge angle (formed by the principal working surfaces of the knife) in all runs was 20 degrees, whilst the cutting angle remained constant at 20.5 degrees.

The total yield of green veneer is provided in Tables 7, 8, 9 and 10. As these figures show, the estimated recovery of green veneer for each species varied as follows:

Round-leaved gum	25% - 63%
Blue-leaved stringybark	38% - 67%
Brown barrel	32% - 55%
Sydney blue gum	33% - 59%

Table 7. Estimated recovery of round-leaved gum veneer

Billet No.	Veneer thickness (mm)	Clipper reading (Lin.m)	Core diameter (mm)	Calculated recovery (m ³)	Estimated recovery (%)
1T	2.60	38	210	0.11856	63
1B	1.25	44	210	0.06600	29
2T	2.60	9	220	0.02808	30
2B	1.25	21	270	0.03150	25
3T	2.60	28	210	0.08736	54
3B	2.60	32	210	0.09984	58
4T	2.60	19	210	0.05928	43
4TB	2.60	21	210	0.06552	47
4B	2.60	25	210	0.07800	55

* T - Top section of the log; B - Butt section of the log

* TB - Intermediate section between top and butt section

Table 8. Estimated recovery of blue-leaved stringybark veneer

Billet No.	Veneer thickness (mm)	Clipper reading (Lin.m)	Calculated recovery (m ³)	Estimated recovery (%)
1T	1.60	38	0.07296	47
1B	1.60	39	0.07488	48
2T	1.60	39	0.07488	48
2B	1.60	36	0.06912	41
3T	1.60	35	0.06720	39
3B	1.60	56	0.10752	56
4T	1.25	57	0.08550	53
4B	1.25	46	0.06900	38
5T	2.60	46	0.14352	61
5B	2.60	47	0.14664	55
6T	2.60	42	0.13104	64
6B	2.60	50	0.15600	67

* T - Top section of the log; B - Butt section of the log

Table 9. Estimated recovery of brown barrel veneer

Billet No.	Veneer thickness (mm)	Clipper reading (Lin.m)	Calculated recovery (m ³)	Estimated recovery (%)
1T	2.6	36	0.11232	55
1B	2.6	31	0.09672	45
2T	2.6	28	0.08736	52
2B	2.6	31	0.09672	53
3B	2.6	26	0.08112	51
3T	1.6	24	0.04608	32
4B	2.6	22	0.06864	48
4T	1.6	28	0.05376	42

* T - Top section of the log; B - Butt section of the log

Table 10. Estimated recovery of 2.6 mm thick Sydney blue gum veneer

Log No.	Billet No.	Clipper reading (Lin.m)	Core diameter (mm)	Calculated recovery (m ³)	Estimated recovery (%)	Observations
1	1A	27.543	230	0.0859341	38	Good quality veneer, some insect damage close to core
	1B	26.032	210	0.0812198	45	
	1C	20.408	210	0.0636729	38	
2	2A	39.189	210	0.1222696	41	Bad quality veneer with insect damage, branch knots, gum veins and blue stain Medium roughness, slight wavy grain Medium roughness, slight wavy grain Good quality veneer, slight wavy grain
	2B	34.971	210	0.1091095	45	
	2C	32.416	210	0.1011379	46	
	2D	28.022	210	0.0874286	54	
3	3A	26.684	210	0.0832540	44	Bad quality veneer with gum veins and insect damage Medium roughness Medium roughness
	3B	24.331	210	0.0759127	50	
	3C	17.495	210	0.0545844	41	
	3D	12.432	210	0.0387878	33	
	3E	11.633	215	0.0362949	33	
4	4A	34.210	210	0.1067352	42	Smooth veneer, big branch knot
	4B	31.883	210	0.0994749	49	
	4C	29.789	210	0.0929416	55	
	4D	18.963	210	0.0591645	41	
	4E	15.220	210	0.0474864	34	
6	6A	40.064	220	0.1249996	43	Rough veneer, multiple branch knots, insect damage Smooth veneer, some insect damage Smooth veneer with some defects Smooth good quality veneer
	6B	37.562	210	0.1171934	52	
	6C	29.630	210	0.0924456	48	
	6D	27.594	210	0.0860932	47	
	6E	32.864	210	0.1025356	59	

The recoveries shown in Tables 7, 8, 9 and 10 are based on the total length of veneer web clipped after roundings. Major defect portions and cores were deducted. The volume of veneer recovered as clipped was divided by the total original volume of each billet including core volume. It is important to realize that the recovery percentages do not correspond exactly to the recoveries as calculated in a commercial plymill, where most defect would be clipped out at the green clipper. A reasonable approximation to commercial recoveries might be obtained by multiplying the recovery percentages by a factor of 0.85.

Although the tightness of round-leaved gum veneer was good, the veneer obtained from the sapwood showed greater variation in thickness, than that from heartwood. This type of veneer had numerous defects which were mainly due to gum veins and insect attack. It is considered that veneer of this species can be used as a core ply in plywood manufacture.

It has been observed that 1.6 mm veneer of blue-leaved stringybark had smaller variation in thickness, than 1.25 and 2.60 mm veneer obtained from the same species. It was possible to conclude that the green veneer obtained from this species was generally of a good quality. These sheets, free of defects, with uniform yellowish pale brown colour, shiny surface, and tight texture, can be used as face material. Others, having some defects, such as scattered pinholes for example, could be covered with phenolic overlay paper, so the veneer could be used as a face veneer in concrete formwork plywood.

The veneer of 1.6 mm obtained from brown barrel had somewhat greater variation in thickness than that of 2.60 mm. To offset this problem, it is recommended that a smaller horizontal gap be tried in future tests. The veneer obtained from this species was smooth, tight, generally uniform for all thicknesses and of a good quality. It has pale brown colour, slightly open texture and can be attractive as a face veneer. It can be utilised also in panelling, furniture, utility grades and formwork.

Veneer of Sydney blue gum has both an attractive figure and colour, which can vary from dark pink to red-brown with a slight purplish tinge. During the peeling of this species, it was observed that the lower part of the tree provided a considerable number of billets containing various defects. Consequently, both the quality and the recovery of green veneer from these butt billets was considerably lower than that obtained from the top part of the tree, which consistently was of a better quality.

CONCLUSIONS

Based on this preliminary investigation on a limited number of billets, it can be assumed that all four species tested can be peeled successfully.

Green veneer produced from these timbers was generally of a good quality and uniform in thickness and therefore can be successfully used as a face and/or core ply for the manufacture of structural plywood.

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