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The Effect of **Sawbolt Length on the Yield of Pallet Materials** from Small-Diameter Hardwood Trees

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Abstract

From poletimber stand thinnings, 52 trees were bucked into 8-foot lengths, and 49 trees were felled and bucked into 10-foot lengths. The 8- and 10-foot pieces were sawed into pallet cants and side lumber suitable for pallet parts. The sawed yield, by tree, from each length category was compared to the predicted yield of the same trees if bucked into 4- and 6-foot bolts before sawing. Short-bolt processing of trees would have yielded 11 percent more than actual yields for trees cut into 8-foot sections, and 17 percent more than actual yields for trees cut into 10-foot sections.

Introduction

Sawable bolts and logs from thinned hardwood poletimber stands yield from 2,100 to 4,500 board feet per acre of sawed products. Although thinnings yield very little high quality wood, virtually all of the sawed products are suitable for pallets, blocking, and similar uses (Craft and Baumgras 1978, 1979; Craft and Emanuel 1981). In these studies, thinned trees were bucked into the longest pieces straight enough to yield Sound Square Edge 4-inch by 4-inch by 4-foot or larger cants (National Hardwood Lumber Association 1974). Because of the prevalence of crook and sweep in the cut trees, there was a high percentage of sawable pieces less than 8 feet long.

Most traditional hardwood sawing systems are designed for 8-foot and longer logs. Many newer systems are designed for utilizing small-diameter trees but also process 8-foot or longer pieces. When utilizing trees from thinnings, sawing long pieces results in the loss of potential product yields because of crook and sweep. To quantify these losses, we determined yields of pallet lumber and cants from trees bucked into 8-foot and 10-foot lengths for processing and compared the resulting yields to predicted yields of the same trees if bucked into 4- and 6-foot lengths.

Procedure

One-fifth-acre circular plots were established in overstocked poletimber stands of northern, Allegheny, and upland hardwood timber stands. These plots were marked for thinning according to the appropriate stocking guides (Leak and others 1969; Roach 1977; Roach and Gingrich 1968). Each tree designated for removal was recorded by species and diameter at breast height (dbh). Two cut trees in each 1-inch dbh class from 7 through 12 inches in each of four species groups were designated for bucking into 8-foot pieces, and also two trees in each dbh class were selected for bucking into 10-foot pieces. The species groups were: (1) yellow birch, hard and soft maple; (2) yellow-poplar, cucumbertree; (3) black cherry; and (4) red, white, and chestnut oak. Sample trees were selected at random from the cruise tally.

Each sample tree was felled and marked to simulate bucking into 4- and 6-foot sawbolts. Six-foot bolts were designated except where yield could be improved by cutting 4-foot bolts. Acceptable sawbolts included sound sections with at least 5.6 inches diameter inside bark (dib) at the small end, and with sweep no more than 1-1/2 inches in bolts 5.6 inches dib through 8.5 inches dib, or 2 inches in bolts larger than 8.5 inches dib. Diameters (outside bark) were measured at each bucking point, and deductions for bark thickness were made to derive small-end bolt scaling diameters. Potential sawed product yields from 4- and 6-foot bolts were predicted by applying the bolt dimensions to boltwood pallet stock yield tables (Craft and Emanuel 1981).

After the bolt measurements were made, 52 of the sample trees were bucked into 8-foot lengths, and 49 were bucked into 10-foot lengths. Minimum acceptable piece dib was 5.6 inches. The sections were sawed on a single-saw circular headrig into the 4- by 4-inch and 4- by 6-inch cants and side lumber. The larger cant size was produced whenever the small-end piece dib was large enough. All side lumber was tallied to the nearest equivalent or multiple of 4- and 6-inch wide pieces. The minimum acceptable piece was 4 inches wide by 4 feet long. The yield was compared to the predicted yield of 4- and 6-foot bolts from the same tree.

Net scale volumes (International 1/4-inch rule) for each sample tree were determined by applying the formula rule, to the nearest board foot, to the 8- or 10-foot sections cut from the tree, and the measured 4- or 6-foot bolt sections available from the same tree.

Results and Discussion

Total Yields

The total yield of side lumber plus cants from 8-foot sections averaged 11 percent less than predicted yield per tree from short bolts (Table 1). The total yield from 10-foot sections was 17 percent less than predicted yield from short bolts (Table 2). Paired "t" test indicated that the differences in long-section yields and the predicted bolt yields for all species were statistically significant at the 0.99 level of probability (Table 3).

Cant Yields

In many operations, only cants are produced from small logs; side lumber is not recovered and cannot be considered part of the product yield. The cant-only yield per tree from 8-foot sections was 13 percent less than the predicted cant-only yield from bolts (Table 1); yield of cants from 10-foot sections was 27 percent less than the predicted cant yield from bolts (Table 2). Paired "t" test indicated the differences in long-section yields and the predicted bolt yields for all species were statistically significant at the 0.99 level of probability for both length categories (Table 3).

Table 1.—Comparison of yields from 8-foot lengths to estimated bolt yields by species group

Species	No. samples	Mean total yields		Mean bolt yield improvement	Mean cant yields		Mean bolt yield improvement
		8-foot lengths	Bolts		8-foot lengths	Bolts	
		Board feet/tree		Percent	Board feet/tree		Percent
Birch, maple	15	31.0	33.4	7.7	24.0	28.5	18.8
Yellow-poplar, cucumbertree	13	54.3	60.5	11.6	43.3	45.5	5.1
Cherry	12	35.6	41.4	16.2	27.0	33.3	23.3
Oaks	12	50.3	56.3	11.9	38.8	42.6	9.8
All species	52	42.4	47.2	11.3	32.9	37.1	12.8

Table 2.—Comparison of yields from 10-foot lengths to estimated bolt yields by species group

Species	No. samples	Mean total yields		Mean bolt yield improvement	Mean cant yields		Mean bolt yield improvement
		10-foot lengths	Bolts		10-foot lengths	Bolts	
		Board feet/tree		Percent	Board feet/tree		Percent
Birch, maple	14	33.8	38.7	14.5	26.8	32.9	22.7
Yellow-poplar, cucumbertree	13	50.0	58.5	17.0	36.0	44.2	22.8
Cherry	10	31.8	39.3	23.6	24.2	32.4	33.9
Oaks	12	35.6	41.0	15.2	27.1	36.1	33.2
All species	49	38.1	44.7	17.3	28.8	36.6	27.1

Table 3.—Sample statistics for the difference between actual long-length yields and short-bolt yields, in board feet

Species	Yield comparison	No. samples (N)	Mean difference	Std. dev.	Min. value	Max. value	t-value	PR>|t|
				TOTAL YIELD				
Cherry	Bolts vs. 8'	12	5.9	8.9	- 6.5	22.8	2.29	0.0426
	Bolts vs. 10'	10	8.1	8.2	- 4.5	20.3	3.10	.0127
Birch, maple	Bolts vs. 8'	15	4.5	5.3	- 8.6	8.8	3.34	.0048
	Bolts vs. 10'	14	6.1	7.5	- 5.9	19.0	3.04	.0096
Yellow-poplar, cucumbertree	Bolts vs. 8'	13	2.2	8.3	-20.1	10.4	0.96	.3547
	Bolts vs. 10'	13	8.2	10.6	- 5.5	35.2	2.78	.0166
Oaks	Bolts vs. 8'	12	3.9	11.7	-17.7	27.4	1.13	.2818
	Bolts vs. 10'	12	5.4	7.0	- 1.5	21.3	4.45	.0010
All species	Bolts vs. 8'	52	4.2	8.2	-20.7	27.4	3.70	.0005
	Bolts vs. 10'	49	7.8	8.3	- 5.9	35.2	6.56	.0001
				CANT YIELD				
Cherry	Bolts vs. 8'	12	5.9	8.9	- 6.5	22.8	2.29	0.0426
	Bolts vs. 10'	10	7.5	8.2	- 5.1	20.8	2.90	.0176
Birch, maple	Bolts vs. 8'	15	2.0	5.4	- 8.6	8.8	1.42	.1771
	Bolts vs. 10'	14	4.9	8.0	- 5.1	25.0	2.29	.0390
Yellow-poplar, cucumbertree	Bolts vs. 8'	13	6.1	11.0	-17.8	27.1	2.01	.0678
	Bolts vs. 10'	13	8.5	15.9	- 8.0	44.5	1.93	.0778
Oaks	Bolts vs. 8'	12	5.9	13.3	-18.2	26.2	1.54	.1507
	Bolts vs. 10'	12	5.4	9.2	- 5.9	25.7	2.03	.0675
All species	Bolts vs. 8'	52	4.8	9.8	-18.2	27.1	3.75	.0008
	Bolts vs. 10'	49	6.5	10.7	- 8.0	44.5	4.25	.0001

Comparisons of Tree-Scale Volume

International 1/4-inch scale volume for 4- and 6-foot bolts averaged about 20 percent more per tree than scale volumes for 8- and 10-foot sections from the same tree (Table 4). The difference was mainly due to scale deductions for crook and sweep in the 8- and 10-foot sections. The predicted total length of sawable short bolts averaged 1.8 feet more per tree than the actual totals for long-bolt bucking. This advantage for short bolts was offset because an average of 1.6 feet per tree for additional trim allowance is required for short-bolt bucking. The net advantage from the additional sawable bolt length was less than 1 percent of total volume.

Small-diameter, crooked roundwood can be sawed in 8-foot and longer lengths on single-saw headrigs. But, in addition to losing potential product volume, the products will be shorter than parent log lengths. In this study, 8-foot pieces yielded 83 percent of product volume in 8-foot lengths; 10-foot pieces yielded only 57 percent of volume in 10-foot lengths (Table 5).

Many firms processing small-diameter roundwood use twin-saw scrag-type headrigs. Feeding long, crooked pieces through these headrigs is extremely difficult. And, unless slab resaw equipment is available, the resulting product yields are even lower than experienced in our study. Regardless of the type of headrig used, processing crooked pieces lowers productivity.

Table 4—Comparison of International 1/4-inch scale volume for trees cut into 8- or 10-foot lengths versus scale for the same trees cut into 4- and 6-foot lengths

Species	International 1/4-inch log scale	International 1/4-inch bolt scale	Gain in scale volume for 4- and 6-foot lengths
	Board feet/tree		Percent
		8-FOOT LENGTHS	
Birch, maple	22.9	27.5	20.1
Yellow-poplar, cucumbertree	37.8	43.5	15.1
Cherry	24.9	32.3	29.7
Oaks	37.1	43.8	18.1
All species	30.4	36.4	19.7
		10-FOOT LENGTHS	
Birch, maple	26.4	31.9	20.8
Yellow-poplar, cucumbertree	36.0	43.0	19.4
Cherry	25.0	29.4	17.6
Oaks	27.1	31.6	16.6
All species	28.5	34.3	20.4

Table 5—Sawed product yields from 8- and 10-foot pieces, by length of product

Length (feet)	Cants only			Total, cants and side lumber		
	No. samples	Volume		No. samples	Volume	
		Board feet	Percent		Board feet	Percent
			8-FOOT LENGTHS			
4	5	33	2	21	63	3
5	1	7	0	6	14	1
6	18	168	9	51	271	11
7	3	28	2	12	43	2
8	118	1,542	87	199	1,990	83
Totals	144	1,778	100	289	2,381	100
			10-FOOT LENGTHS			
4	8	55	4	28	107	5
5	2	14	1	9	37	2
6	10	76	5	26	130	7
7	5	52	4	10	73	4
8	28	364	25	44	427	22
9	3	48	3	6	60	3
10	55	819	58	101	1,131	57
Totals	111	1,428	100	224	1,965	100

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From overstocked poletimber thinnings, 52 sample trees were bucked into 8-foot lengths, and 49 trees were bucked into 10-foot lengths. These lengths were sawed into pallet parts and pallet cants. The sawed yield from 8- and 10-foot lengths is compared to the predicted yield from sawing 4- and 6-foot bolts from the same trees.

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Keywords: Product yields, poletimber thinnings, pallet parts, and cants

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