SDR IMPROVES YIELD OF EASTERN BLACK WALNUT LUMBER FROM AN AGROFORESTRY PLANTATION

Peter Y. S. Chen, Principal Forest Products Technologist
USDA Forest Service, North Central Forest Experiment Station
Carbondale, IL

John E. Phelps, Associate Professor
Department of Forestry, Southern Illinois University
Carbondale, IL

Robert E. Bodkin, Physical Science Technician
USDA Forest Service, North Central Forest Experiment Station
Carbondale, IL

ABSTRACT

The saw, dry, and rip (SDR) process has been shown to be capable of producing better hardwood studs than the conventional process in which lumber is ripped before it is dried. We conducted a study to test how the SDR process affected drying characteristics and yield of 4/4 eastern black walnut lumber from a 14-year-old agroforestry plantation. The SDR process produced walnut lumber with (1) greater thickness shrinkage, (2) much smaller crook warpage, and (3) greater usable board feet than the conventional process did. Thickness and volumetric shrinkage of lumber produced in an intensively managed agroforestry plantation in southwestern Missouri was markedly less than that for walnut lumber from a 22-year-old plantation in southern Illinois. Warpage was similar for lumber from both plantations.

INTRODUCTION

The saw, dry, and rip (SDR) process developed by the Forest Products Laboratory, USDA Forest Service, has been shown in previous studies to be capable of producing better hardwood studs than the conventional process in which lumber is ripped before it is dried. The SDR process produced superior studs by reducing the stresses responsible for excessive warping, especially in wood from young trees. Maeglin and Boone (2) found that 8-foot-long yellow-poplar studs produced from small diameter logs by the SDR process had 67% less average crook than studs conventionally sawn and dried. Maeglin and Boone (3) also found that the SDR process increased the number of 2 by 4 studs of random length yellow-poplar that met Select Structural grade limits for warp by nearly 24% compared to the conventional process.

This paper describes the effect of the SDR process on drying properties and yield of lumber from juvenile eastern black walnut thinned from an agroforestry plantation.

MATERIALS AND METHODS

Materials

Forty-four eastern black walnut (Juglans nigra L.) logs, 8 feet 4 inches in length with top diameters (outside bark) from 6 to 9 inches, were selected for this study. These trees, planted in 1976 in the agroforestry plantation of Hammons Products Company in southwest Missouri, were cut during a thinning operation in the spring of 1990. Logs were stored under two big trees near the plantation. Forty-four logs were brought to the North Central Station's Wood Processing Pilot Plant at Carterville, IL, end-coated, and stored under a shed in the winter of 1990. They were then sawn and dried in the spring of 1991.

Sawing

Each larger log was sawn into four 1-inch-thick flitches. Two 1-inch-thick flitches were cut and labelled as board 1 and board 2 (nearer to the pith). The log was then turned 180 degrees, and another two 1-inch-thick flitches were cut and labelled as board 3 and board 4 (Figure 1). The center flitch containing the pith was discarded. A few smaller logs were each sawn into two 1-inch-thick flitches in a similar manner. Then, one-half of the flitches from each log were randomly

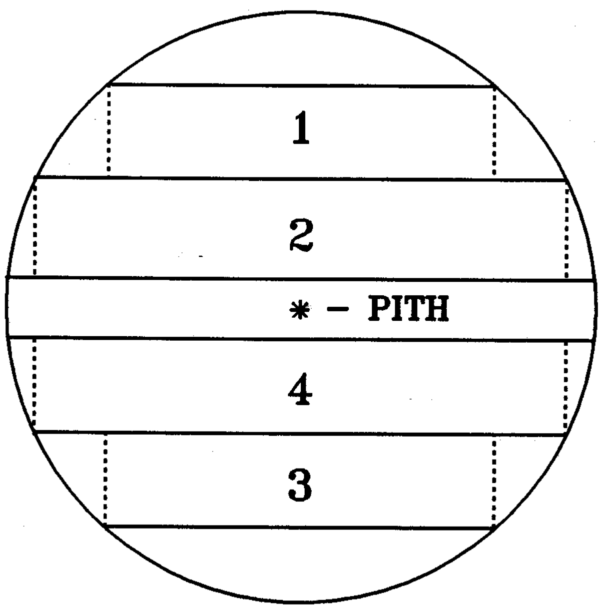

Figure 1. Location of boards or flitches.

assigned to either SDR or control(conventional process) groups. The control flitches were ripped before kiln drying; the SDR flitches were kiln dried before ripping.

Drying

Eighty-one control boards and 81 SDR boards (flitches) were kiln dried in the same charge, using the standard schedule T6D4 for 4/4 black walnut (4) in an experimental steam-heated dry kiln. All boards or flitches were 8 feet 4 inches long and 3 to 8 inches wide excluding bark. They were dried from green to 7% MC and conditioned to final MC of 8%.

Measurements and analyses

A set of calipers was used to measure the dimensions of boards and flitches. Two points each for thickness and width of all boards and flitches were measured to one-thousandth of an inch before and after kiln drying. The thickness and width of each control board were measured 1 foot from each end of the board. The thickness of SDR flitches was measured at both ends of the flitch, and the width of flitches was determined by two marks placed 1 foot from each end on one surface of each flitch. Non-paired t-tests were conducted for the 162 boards and flitches for thickness and width shrinkages. After kiln drying, the SDR flitches were ripped. All boards, both the SDR and controls, were measured to one-hundredth of an inch, using a steel rule, for their maximum crook, bow, cup, and twist (4). Crook was measured by placing the board edgewise on a flat table, and the maximum deviation from the surface of the table was recorded. Bow was measured by placing the board flatwise on the table, and the maximum deviation from the surface of the table was recorded. Cup was measured by placing the board flatwise on the table, and maximum deviation from the surface of the table across one end of the board was recorded. Twist was measured by placing the board flatwise on the table, and the maximum deviation from the table surface was recorded while one corner of the board was pressed against the table. Also, non-paired t-tests were performed for the 162 boards for the warpage measurements. Finally, all boards were planed, some control boards were ripped again, and board feet were calculated.

RESULTS AND DISCUSSION

Thickness shrinkage was found to be greater for SDR lumber than for control boards apparently because the SDR flitches dried mostly from both surfaces and much less from the bark-covered edges.

There was more crook warpage in the control boards after drying than in the SDR lumber (Table 1). Obviously, kiln drying caused crook to develop in some boards and in some flitches. However, any crook that developed in flitches due to drying was eliminated by ripping after kiln drying in the SDR lumber. The need to rip some control boards the second time after kiln drying reduced final board feet for the control by more than 13% compared to the SDR process.

Table 1. Drying data for 4/4 lumber and flitches from juvenile black walnut thinned from a 14-year-old agroforestry plantation.

	SDR	Control
MC(%):		
Green	56.	56.5
Dry	7.9	7.9
Drying time (days):	9	9
Shrinkage (%):		
Thickness	1.9*	1.6
Width	5.9^NS	6.3
Volume	7.7^NS	7.8
Warpage (in.):		
Twist	0.13^NS	0.13
Bow	0.26^NS	0.26
Cup	0.10^NS	0.11
Crook	0.03**	0.37
Final board feet: (after dressing)	234.9	207.2

* = Indicates that the data within the row are significantly different at the 5% level.
** = Significant at the 1% level.
NS = Not significant.

On average, the walnut lumber from the Missouri agroforestry plantation had much less volumetric and thickness (mostly radial) shrinkage compared to previously reported values for walnut lumber from a 22-year-old Illinois plantation (Table 2). However, lumber from both Missouri and Illinois plantations had similar width (mostly tangential) shrinkage. It is not clear why the walnut lumber from the Illinois plantation had four times greater radial shrinkage than walnut lumber from the Missouri plantation. Plantation site, tree genetics, and weed control may all have contributed to the difference. The warpage properties were found to be very similar for walnut lumber from both Missouri and Illinois plantations when processed in the conventional way.

Table 2. Comparison of shrinkage and warpage of plantation walnut lumber from Missouri and Illinois.

	Missouri SDR	Missouri Control	Illinois Plantation[a]
Shrinkage (%):			
Thickness	1.9	1.6	6.6
Width	5.9	6.3	6.3
Volume	7.7	7.8	12.5
Warpage (in.):			
Twist	0.13	0.13	0.12
Bow	0.26	0.26	0.22
Cup	0.10	0.11	0.12
Crook	0.03	0.37	0.33

[a] Some data from Chen and Phelps (1). Logs were processed similar to those in the Missouri control group.

CONCLUSIONS

The SDR process produced walnut lumber with (1) greater thickness (mostly radial) shrinkage, (2) much smaller crook warpage, and (3) more usable board feet than the conventional process did.

ACKNOWLEDGMENT

We wish to thank the Hammons Products Company, Stockton, Missouri, for providing the logs used in this study.

LITERATURE CITED

1. Chen, P. Y. S. and J. E. Phelps. 1989. Effects of selected management practices on lumber grade and drying properties of two central hardwood species. In Proceedings of the 41st Annual Meeting of Western Dry Kiln Clubs, May 3-5, 1989, Coeur d'Alene, ID. p. 46-52.

2. Maeglin, R. R. and R. S. Boone. 1983. Manufacture of quality yellow-poplar studs using the saw-dry-rip concept. Forest Products Journal 33(3):10-18.

3. Maeglin, R. R. and R. S. Boone. 1988. Saw-dry-rip improves quality of random-length yellow-poplar 2 by 4's. Res. Pap. FPL-490. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 15 p.

4. Rasmussen, E. F. 1961. Dry kiln operator's manual. Agr. Handb. No. 188. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 197 p.