United States
Department of
Agriculture

Forest Service

**Northeastern Forest
Experiment Station**

Research Paper
NE-574

1986

Making Black Cherry Blanks from System 6

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Manuscript received for publication 16 May 1985.

Abstract

Low-grade, small-diameter black cherry (*Prunus serotina*) timber was used to make System 6 cants. Cherry from the Allegheny National Forest (Ludlow, PA), west-central Pennsylvania (Glen Hope, PA), north-central Pennsylvania (Dushore, PA), western Maryland (Oakland, MD), and the Monongahela National Forest (Middle Mountain, WV) was used. The cants were resawed to 4/4 boards, the boards dried, and blanks were made at the Princeton Laboratory's System 6 pilot plant. By varying the rough mill procedures, differences in board quality and cutting bill requirements were accommodated keeping yields high. The cherry from the Pennsylvania and Maryland sites gave similar yields, while the West Virginia cherry gave 5 percent higher yields. Gum streak was not a problem. Pennsylvania and Maryland cherry gave a 39.0 percent return, and West Virginia cherry gave a 50.3 percent return on a $2.2 million 10-year investment.

Black cherry is a highly sought after furniture wood. We undertook a series of studies to determine if it was not only possible but also economically feasible to use small-diameter, low-grade cherry available from timber harvesting and from silvicultural thinnings in Pennsylvania, Maryland, and West Virginia as raw material for System 6 to make high-quality cherry blanks. The blanks would be used as a substitute for high-quality cherry lumber in the furniture industry.

These studies had three purposes:

- To sample small-diameter, low-grade cherry as System 6 bolts taken from Pennsylvania, Maryland, and West Virginia.
- To demonstrate the flexibility of System 6 in converting the cherry from the different sites to varying quantities of blanks.
- To indicate the economic potential for System 6 mills using cherry from the various sites.

System 6 is used to convert small-diameter, low-grade hardwood timber to standard-size blanks. The blanks are used to make the rough dimension parts required for each piece of furniture. This approach to small timber conversion is explained by Reynolds and Gatchell (1979). The technology of System 6 is also covered by Reynolds and Gatchell (1982). Blanks are panels of defect-free wood that are edge glued to standard widths as developed by Araman and others (1982). The design of System 6 mills is covered by Reynolds and Hansen (1984). The economics of System 6 mills is covered by Hansen and Reynolds (1984). We assume that the reader has a working knowledge of System 6 and blanks.

Procedures

In this paper, we cover research on small-diameter, low-grade cherry from five sites. The small timber was made to bolts, the bolts were sawed to two cants per bolt, and the cants were brought to the System 6 pilot plant for conversion to 4/4 C1F (clear-one-face) blanks. The procedures to convert the timber to blanks are covered in this section. The processing yields per site are covered in the Results section.

Sawmills in the five areas had purchased small-diameter cherry timber that was too small to saw to lumber profitably. This is the timber that must be removed to permit the better trees to grow. The timber was bucked to 6-foot bolt lengths and sawed to two round-edge cants per bolt. Cants were either 3-1/4 or 4 inches thick. The cants were then brought to the Forestry Sciences Laboratory at Princeton, West Virginia, for processing to blanks using System 6.

The cants from each site were processed separately. The cants were resawed to 4/4 boards with an actual thickness of 1-3/16 inches. A board was saved if it had at least one 1-1/2- by 15-inch C1F cutting in it. The boards were immediately sticker stacked in 4-foot-wide by 4-foot-high packages using 1/2-inch-thick stickers on 2-foot centers.

The packages of green boards were put into a pre-dryer for about 21 days lowering the MC (moisture content) to 20 percent. Kiln drying, to bring the final MC to 6 percent, lasted 7 days. Equalizing and conditioning were done during this kiln schedule.

The dried boards were graded using the National Hardwood Lumber Association grade rules for standard hardwood lumber. Board width and length distribution requirements per grade were dropped, but all other criteria were kept. Because of the small size of the System 6 boards, No. 1 Common is the highest possible grade. No boards were rejected. All boards not meeting or exceeding the No. 3A Common grade were tallied as "below grade." Gum streak, when found, was not considered a defect as cherry is graded by standard rules.

The kiln-dried boards were hit-and-miss planed to 1.000 inch thickness. The boards were then gang crosscut to 1, 2, or 3 pieces per board depending on board quality. The pieces without a 1-1/2- by 15-inch cutting were discarded. The good ones were ripped to 1-1/2, 2, 2-1/2, 3, or 3-1/2 inch widths depending on defect location. The pieces were end trimmed to the longest blank length possible. Any remaining edge defects, as in 25 percent of the pieces leaving the end-trim step when the mill is operated well, were ripped out in the last step. The defect-free pieces were edge glued to 26-inch-width panels in each length. Planing to 7/8 of an inch completed the process.

In System 6 processing, choices are made in gang crosscutting to permit optimal efficiencies in making the required number of blanks in the standard lengths. These choices are called "GCL's" for gang crosscut lengths. The C1F blank lengths used were 72, 60, 50, 45, 38, 33, 29, 25, 21, 18, and 15 inches. A research paper (Reynolds 1984) has been written explaining GCL choices. There is no one GCL that will make blanks in all 11 lengths efficiently.

Results

The best black cherry timber is said to grow in northwestern Pennsylvania. We sampled this area's small-diameter, low-grade cherry timber by getting 222 cants from the Allegheny National Forest at Ludlow, Pennsylvania. We also sampled similar sized Pennsylvania cherry timber by getting 210 cants from the west-central part of the state at Glen Hope and 152 cants from the north-central part of the state at Dushore.

In addition, we sampled the small-diameter cherry timber available to western Maryland sawmillers by getting 170 cants from Oakland, Maryland, and 182 cherry cants from the Monongahela National Forest in east-central West Virginia at Middle Mountain. The five cant samples were of similar size and were large enough to determine variations in quality between sites.

The distribution by grade of all dried boards from each site is given in Table 1. The grade distributions of the boards from all three Pennsylvania sites and the Maryland site are very much alike. However, the West Virginia site shows better quality. Experience has shown that small-diameter, low-grade hardwood timber that yields 50 percent or less below-grade dried boards is of high enough quality to be used in System 6. The timber from all sites met this criteria; that from West Virginia exceeded this criteria by a wide margin.

The kiln-dried boards were cut up to C1F pieces. We studied six ways to make 4/4 C1F pieces. Each way to cut up boards to pieces is called a GCL. To select a GCL, the first thing to do is to determine which of the standard blank lengths will be in greatest demand. These target lengths are used to set the saw spacings on the gang crosscut saw. The length choices per GCL are limited to three. Boards can be end trimmed to make one long piece or two medium pieces or three short pieces.

Table 1.—Board grade distribution (In percent of board feet)

Site	1C	2C	3AC	Below grade	Total
Ludlow, PA	1	23	29	47	100
Glen Hope, PA	3	18	23	56	100
Dushore, PA	3	23	24	50	100
Oakland, MD	2	24	24	50	100
M. Mountain, WV	11	33	23	33	100

However, the GCL's can be made more flexible by changing the sorting criteria used to determine which boards will be gang crosscut to 1, 2, or 3 pieces. The longer the sort criteria, the fewer boards will be selected. For instance, if the criteria used to select boards to be end trimmed to one piece per board were set at 72 inches, few boards would qualify. If this criteria were reduced to 50 inches, then more boards would be selected.

The six GCL target lengths, saw spacings, and sort criteria are outlined in Table 2. The GCL's affect operation of the gang crosscut saw only. All other rough-mill operations proceed the same way regardless of GCL being used.

There were only two different gang saw spacings used—1 set for GCL's 1, 3, and 5 and one set for GCL's 2, 4, and 6. By altering the decision rules as to which saws will be used, we forced more or fewer boards to be gang crosscut to one piece (the "long" boards) or forced more or fewer boards to be gang crosscut to two pieces (the "half" boards). All boards not meeting the "long" or "half" criteria were gang crosscut to three pieces. The exception to this three-piece gang crosscutting was GCL 2 where all boards except the "long" boards were gang crosscut to two pieces.

Table 2. GCL's tested

GCL	Target lengths	Sort criteria	Saw spacing
	Inches	*Inches*	
1	72, 45, 25, 21	Long: 1 1/2 × 72 Half: 1 1/2 × 45	1-2, 25 inch 2-3, 22 inch 3-4, 25 inch
2	72, 38, 33	Long: 1 1/2 × 72 Half: All other boards	1-2, 38 inch 2-4, 39 inch 3 not used
3	72, 45, 25, 21	Long: 1 1/2 × 50 Half: 1 1/2 × 29	1-2, 25 inch 2-3, 22 inch 3-4, 25 inch
4	72, 38, 33, 21, 18	Long: None Half: 1 1/2 × 29	1-2, 33 inch 2-3, 18 inch 3-4, 21 inch
5	45, 25, 21	Long: None Half: 1 1/2 × 29	1-2, 25 inch 2-3, 22 inch 3-4, 25 inch
6	38, 33, 21, 18	Long: None Half: 1 1/2 × 29	1-2, 33 inch 2-3, 18 inch 3-4, 25 inch

The results by GCL are in the form of blank quantity per blank length for each board grade and width. There are four grades of boards in System 6: No. 1 Common, No. 2 Common, No. 3A Common, and below grade. There are two board widths: 3-1/4 and 4 inches since only 3-1/4- and 4-inch cant thicknesses are sawed from the bolt. There are 11 standard blank lengths when 4/4, clear quality blanks are made from 6-foot boards. For each GCL, there is a one-row, eight-column matrix generated giving the total blank yields per board grade and width. The 1 by 8 total yield matrices for each of the six GCL's are shown in Table 3. There is another matrix of 11 rows and 8 columns generated that gives the yield by blank length for each board grade and width. These two matrices constitute a yield table that can be used repeatedly. The 11 by 8 matrices are not reproduced in this report for purposes of brevity.

By multiplying the yield per grade and width (Table 3) as a decimal by the grade/width distribution (Table 4) from the five sites, the yield in square feet of blanks per grade and width of board by site is found. In 4/4 boards, the board footage and square footage are the same. Adding up the square feet yield per board grade and width will give the total yield. The 30 total yield values (5 sites times 6 GCL's per site) are shown in Table 5.

In comparing blank yield values among the various sites (Table 5), it is apparent that yields from four sites—Ludlow, Pennsylvania; Glen Hope, Pennsylvania; Dushore, Pennsylvania; and Oakland, Maryland—are very similar, while the yields from the Middle Mountain, West Virginia, site are higher. Comparing the yield values from Middle Mountain with the other four sites, by GCL's, the Middle Mountain yields range from 2.3 to

Table 3.—Yield values for each GCL per board grade and width

(In square feet of blanks/100 board feet of boards)

Grade width	1C		2C		3AC		Below grade	
	3″	4″	3″	4″	3″	4″	3″	4″
GCL-1	77.8	77.2	48.3	40.3	46.4	55.5	36.0	47.4
GCL-2	64.4	66.3	55.7	59.7	49.1	47.3	34.4	33.2
GCL-3	67.3	60.1	60.4	60.4	51.7	57.3	34.8	34.8
GCL-4	68.5	74.7	52.2	64.4	54.3	60.3	37.5	39.1
GCL-5	76.0	72.7	63.4	64.0	56.7	52.2	35.4	35.4
GCL-6	70.0	76.3	60.5	66.4	58.4	58.0	44.4	37.6

Table 4.—Board grade and width distribution

(In board feet)

Site	1C		2C		3AC		Below grade		
	3″	4″	3″	4″	3″	4″	3″	4″	Total
Ludlow, PA	10	2	110	118	180	110	300	170	1000
Glen Hope, PA	27	4	118	59	168	67	401	155	1000
Dushore, PA	10	22	79	147	110	134	225	273	1000
Oakland, MD	10	10	150	90	170	70	350	150	1000
M. Mountain, WV	30	80	130	200	110	120	190	140	1000

Table 5.—Total 4/4 C1F blank yield values for five cherry sites using six GCL's

(In percent of board feet)

Site	GCL-1	GCL-2	GCL-3	GCL-4	GCL-5	GCL-6
Ludlow, PA	44.3	44.0	46.1	48.2	48.0	51.9
Glen Hope, PA	43.8	42.5	44.2	46.4	46.3	50.6
Dushore, PA	45.8	43.8	46.3	49.1	47.6	51.3
Oakland, MD	43.9	43.7	45.6	47.5	47.7	51.6
M. Mountain, WV	48.1	48.7	51.4	53.5	53.4	56.4

7.2 percent higher with an average of 5.3 percent higher. Comparing the Ludlow, Pennsylvania, site yields, by GCL's, with the other three similar sites—Glenn Hope, Pennsylvania; Dushore, Pennsylvania; and Oakland, Maryland—the Ludlow yields range from 2.1 percent higher to 1.5 percent lower with an average of only 0.6 percent higher. But the C1F blank yields are all uniformly good with one site giving approximately 5 percent higher yields.

Values for total yield are valid in a market sense, only if all blanks can be used no matter how many are made in each length. For instance, one site could have most of the blanks in short lengths while another site could have long and short blanks even though they show an identical total yield value. In the processing control section, we will consider the effect that market demand for specific lengths has on total yield.

Production Control

System 6 rough-mill production runs are preplanned. Three sets of data are needed for the production planning:

- Board-Grade Data: The timber coming from each site or from each cant supplier must be tested to determine the distribution of boards in each grade and width. The data in Table 4 illustrate the board-grade data requirement. All timber or cants coming from the same site or supplier will have a similar grade/width distribution as that found by test. We have shown how these data are obtained.
- GCL Yield Data: These yield data are found when a GCL is tested. In effect, these data are a yield table for that GCL. The yield data will be valid for all boards graded by the standard hardwood grading rules. We have shown how these data are obtained.
- Blank Requirements: The quantity of blanks in each length to be made during the production run.

We know the total industry demand for blanks by length (Araman et al. 1982) for furniture and cabinets. But blanks must be made for individual orders or groups of orders and not for annual demands. In running a furniture or cabinet factory, cutting bills giving the quantity of rough parts by size are made for each production run. The blank maker will be required to supply the blanks necessary for each parts cutting bill. Thus, blank demands, by quantity per length, will vary and the blank maker will make up his own blank cutting bills. Program BLANKS (Araman 1983) is used to determine blank cutting bills and has been programmed for use on the microcomputer (Reynolds and Araman, 1986).

For this paper, we have set up a wide range of blank cutting bills going from one extreme—no long blanks required—to the other extreme—40 percent long blanks required. The nine cutting bills are outlined in Table 6. Long blanks are the limiting factor in the yield per cutting bill as long blanks can be trimmed to make shorter blanks but an excess of shorter blanks must be considered waste.

Table 6.—Cutting bills
(In percent of surface area per length class)

Length class	Cutting bill number								
	1	2	3	4	5	6	7	8	9
Long (72-50)	0	5	10	15	20	25	30	35	40
Medium (49-32)	10	15	20	25	30	35	40	45	50
Short (31-21)	50	45	40	35	30	25	20	15	10
Salvage[a] (20 or less)	40	35	30	25	20	15	10	5	0
Total	100	100	100	100	100	100	100	100	100

[a] May be less than, but no more than the requirements given.

Now we have cherry from five sites, six ways to cut up the boards (GCL's), and nine cutting bills. A rough-mill production run using cherry from any one of the five sites to make blanks needed for any cutting bill is preplanned. Linear programming (LP) was used to determine the minimum number of boards needed for each cutting bill from each site (Reynolds 1984). These minimal solutions—how many board feet are to be cut up per GCL for each cutting bill using cherry from each site—are shown in the Appendix.

As a preplanning example, consider using the Ludlow, Pennsylvania, cherry to make the blanks required by System 6. Table 13, Appendix, shows that 75 percent of all boards should be cut up using GCL1; 25 percent of all boards should be cut up by GCL4. The LP program output would show that for 10,000 square feet of blanks production, 22,075 board feet of boards would have to be used. Table 5 shows Ludlow, Pennsylvania, yields are 44.3 percent for GCL1 and 48.2 percent for GCL4. The total yield would be 45.3 percent (44.3 × .75 + 48.2 × .25 = 45.3). Using GCL1, 16,556 board feet of boards would be cut up. Using GCL 4, 5,519 board feet of boards would be cut up.

Discussion

The results of the LP solutions are shown in Table 7. They were very good for cutting bills that required no more than 15 percent long blanks; that is, cutting bills 1 through 4 for Ludlow, Pennsylvania, and the other three similar sites. The Middle Mountain, West Virginia, site was very good for cutting bills that required no more than 30 percent long blanks; that is, cutting bills 1 through 7. Yields over 45 percent were considered very good.

As demand for long blanks increased, two things were apparent from the LP solutions: (1) more medium and short blanks were made than were needed; and (2) more salvage blanks were made than were permitted. Although they were good blanks, they were considered extra. Tables 8 and 9 show the percent yield considered extra in these categories.

When all the yields from Tables 7, 8 and 9 are added per site and cutting bill, a strange thing is apparent. The total yields shown in Table 10 are very consistent regardless of the cutting bill requirements. From this, we deduce that the six GCL's used permit sufficient flexibility within the System 6 rough mill to

Table 7.—Blank yields per cutting bill from each site

(In percent of board feet)

Site	Cutting bill								
	1	2	3	4	5	6	7	8	9
Ludlow, PA	44.8	45.5	46.0	46.8	35.8	38.7	33.4	29.5	26.2
Glen Hope, PA	43.7	45.0	45.4	45.2	34.2	36.6	31.6	27.7	24.6
Dushore, PA	44.6	45.2	45.5	46.4	37.4	40.2	34.4	30.4	27.0
Oakland, MD	44.7	45.4	45.9	46.4	36.1	33.7	30.8	28.3	26.5
M. Mountain, WV	51.8	52.3	52.7	53.1	53.2	49.9	43.4	38.7	34.4

Table 8.—Medium and short blank yields per cutting bill and site in excess of requirements

(In percent of board feet)

Site	Cutting bill[a]				
	5	6	7	8	9
Ludlow, PA	2.0	5.0	7.5	9.5	11.4
Glen Hope, PA	3.2	6.5	9.2	11.3	13.0
Dushore, PA	1.3	4.5	7.2	9.2	11.3
Oakland, MD	1.6	4.5	7.0	9.3	11.1
M. Mountain, WV	0.0	2.0	4.8	7.5	9.9

[a] No excess of requirements for cutting bills 1-4.

get consistently encouraging yields. In other words, changing the cutting bill does not lower yield, it just means that extra blanks are made at that time.

The LP solution gives the board quantity to be cut up using each GCL. The rough mill is run and the blanks are made until all the boards to be cut have been used. Then the longer blanks in excess of requirements are trimmed to meet the shortages in shorter blanks. Board cutup and blank trim are considered within the LP run. The amount of longer blank trimming per cutting bill is shown in Table 11 for each site.

The figures in Table 11, per cutting bill, are remarkably consistent. The quantity of longer blanks trimmed to fulfill the shorter blank requirements is similar for each cutting bill, though the Middle Mountain site cherry board grade distribution is different from that of the other four sites. The LP technique is able to make compensation for the various input board grade differences from each site.

The differences in board qualities from each site can be compensated for through the judicious balancing of the quantities of boards to be cut up using each GCL. However, these compensations have a limit. When demand for long blanks exceeds 15 percent (cutting bills 5 through 9), yields in required blanks drop though total yield of blanks in all lengths remains high.

Table 9.—Salvage blank yields per cutting bill and site in excess of permitted quantities

(In percent of board feet)

Site	Cutting bill[a]				
	5	6	7	8	9
Ludlow, PA	8.4	2.5	4.6	6.6	8.0
Glen Hope, PA	7.8	1.6	3.8	5.7	7.0
Dushore, PA	8.6	2.5	5.0	7.1	8.4
Oakland, MD	8.3	2.2	4.4	6.2	7.7
M. Mountain, WV	0.0	0.7	3.6	5.8	9.7

[a] *No excess of permitted quantities for cutting bills 1–4.*

Table 10.—Total yield of blanks per cutting bill and site

(In percent of board feet)

Site	Cutting bill								
	1	2	3	4	5	6	7	8	9
Ludlow, PA	44.8	45.5	46.0	46.8	46.2	46.2	45.5	45.6	45.6
Glen Hope, PA	43.7	45.0	45.4	45.2	45.2	44.7	44.6	44.7	44.6
Dushore, PA	44.6	45.2	45.5	46.4	47.3	47.2	46.6	46.7	46.7
Oakland, MD	44.7	45.4	45.9	46.4	46.0	40.4	42.2	43.8	45.3
M. Mountain, WV	51.8	52.3	52.7	53.1	53.2	52.6	51.8	52.0	54.0

Table 11.—Trimming of longer blanks to fulfill shorter blank requirements

(In percent of square feet of blank requirements)

Site	Cutting bill								
	1	2	3	4	5	6	7	8	9
Ludlow, PA	35.8	26.5	17.9	8.2	6.4	3.0	2.5	4.9	4.0
Glen Hope, PA	33.7	23.8	15.4	7.2	4.5	3.3	3.6	4.6	5.7
Dushore, PA	36.8	27.4	18.8	9.8	7.6	3.7	4.5	4.7	3.7
Oakland, MD	35.0	24.3	14.9	8.8	4.8	3.4	2.6	3.4	2.6
M. Mountain, WV	36.9	26.0	16.0	9.5	5.4	7.3	7.2	6.5	6.9

Economics

A new System 6 mill requires an initial capital investment of roughly $2 million plus $200,000 of working capital. We will consider a 16 Mbf (thousand board feet) per shift input mill (Hansen and Reynolds 1984) with a 15-percent increase in machinery prices from mid-1981. We believe that a successful blanks business would require at least a 20-percent IRR (internal rate of return) after taxes.

Sawmillers can buy small-diameter, low-grade cherry logs and bolts at $100 per Mbf international 1/4-inch scale, no scaling deductions used. This is equivalent to $45 per cord. Experience with small sawmillers has shown that sawing bolts to cants at $50 per Mbf is profitable. A thousand board feet of bolts equals 1,000 board feet of cants as cants are the only products made and no overrun is considered. At $30 per Mbf for hauling, the f.o.b. (free on board) System 6 plant cant price is $180 per Mbf. The System 6 mill manager will be assured of a cant supply at this price.

Rough-dimension parts are conventionally made by purchasing No. 1 Common or Better lumber, kiln drying the lumber, then rough milling it to parts. There are no parts pricing reports, though there are hardwood lumber price reports. In 1984, Appalachian black cherry, 4/4 thickness, No. 1 Common grade, had a $600 Mbf average price. We feel that this green lumber price will dictate a $2.50 per square foot average selling price for 4/4 cherry rough-dimension parts. We allowed a 12-percent discount for converting blanks to parts and arrived at the $2.20 per square foot average price for 4/4 C1F blanks.

When cherry from the three Pennsylvania sites and the Maryland site is used to meet the normal demand for blanks, the average yield would be 45 percent. If all the blanks produced were sold at the average price of $2.20 per square foot, the rate of return would be approximately 39 percent. The operating costs, revenues, and investments are shown in Table 12. When cherry from the West Virginia site is used, the yield averages 53 percent, and the rate of return is about 50 percent.

Table 12.—Annual operating costs and revenues (CIF blanks from all sites except Middle Moutain and all blanks sold)

Item		Year 1*	Years 2–10
Costs: Variable			
Cants 180/Mbf × 16 Mbf/shift × 240 shifts/year		$ 346,000	$ 691,000
Labor 45 men @ $6.60/hr + 2 men @ $11/hr	$638,000		
Supplies	57,000		
Utilities	76,000		
Total: Other Variable Costs	$771,000	$ 386,000	$ 771,000
Sales costs (5% sales)		95,000	190,000
Costs: Fixed			
Management and administrative	85,000		
Insurance	48,000		
Maintenance	160,000		
Total: Fixed Costs	$293,000	$ 293,000	$ 293,000
Costs: Total		$1,120,000	$1,945,000 (51% of sales)
Revenues:			
CIF blanks at 45% yield and $2.20/sq ft			
3,840,000 bd ft cants × 0.45 = 1,728,000			
Sq ft blanks × 2.20 = 3,802,000		$1,901,000	$3,802,000

*During the first year, only half the annual production will be made.

Capital Investment:		
	Land	$ 100,000
	Machinery	900,000
	Kilns and boilers	700,000
	Buildings	300,000
	Working capital	200,000
	Total	$2,200,000

The demand for long blanks is an important production problem. When long blanks are limited to the normal 15 percent of total output, the production controls can function efficiently with wood from all sites and return on investments will be very good. When the Middle Mountain cherry is used, long-blank production can be allowed to rise to 25 percent of total output without negatively affecting return on investment.

When long-blank requirements rise above 15 percent (25 percent for Middle Mountain cherry), yields in required blanks decrease and income may fall. One way to possibly alleviate this problem is to increase prices for the long blanks raising income to the required level. A companion paper has been written to study this problem in detail (Reynolds and Hansen, 1986). We found that by chipping some of the poorest boards, buying additional cants to keep the production level constant, and selling the extra short blanks at reduced prices, the surcharge for long blanks could be kept low. For cutting bill 9 (40 percent long blanks), the surcharge needed was only 18 percent over normal blank price. When blank customers are willing to pay substantial surcharges for long blanks, opportunities for additional profits rise.

Conclusions

Opportunities are available for foresters, sawmillers, dimension plants, furniture makers, and kitchen cabinet companies by utilizing the small-diameter cherry. Small-diameter bolts from cherry thinning and first commercial cuts prescribed under the best silvicultural practices can be utilized profitably. Sawmillers can make System 6 cants for profitable sale rather than sawing and trying to sell the No. 2 Common and poorer lumber. Dimension plants, using System 6 technology, can buy cants and make blanks and earn competitive returns. Furniture and kitchen cabinet companies can buy blanks, or make them themselves, for the manufacture of fine solid cherry offerings. The opportunity for using cherry to make informal furniture is very intriguing.

After we had completed our cherry studies, we contacted furniture companies in Pennsylvania and North Carolina and asked them for cutting bills for some of their furniture. Using the blanks we had made, we made rough-dimension parts that they included in regular production runs. In all instances, the parts we furnished were equal in quality and acceptability to their own parts. Consequently, we do not hesitate to recommend the use of small-diameter, low-grade cherry with System 6 to make blanks for furniture and kitchen cabinet products.

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APPENDIX

Table 13.—Minimal board input solutions for Ludlow, Pennsylvania, cherry

(Percent input board feet to be cut up by each GCL)

Cutting bill	GCL 1	2	3	4	5	6	Total
1	75	0	0	25	0	0	100
2	68	0	0	32	0	0	100
3	63	0	0	36	0	0	100
4	31	0	64	5	0	0	100
5	7	17	43	0	32	0	100
6	8	15	31	0	46	0	100
7	10	14	9	0	66	0	100
8	0	23	0	5	72	0	100
9	4	21	0	5	70	0	100

Table 14.—Minimal board input solutions for Glen Hope, Pennsylvania, cherry

(Percent input board feet to be cut up by each GCL)

Cutting bill	GCL 1	2	3	4	5	6	Total
1	74	0	0	26	0	0	100
2	67	0	0	33	0	0	100
3	62	0	0	38	0	0	100
4	29	0	70	1	0	0	100
5	40	0	60	0	0	0	100
6	58	0	42	0	0	0	100
7	67	0	25	0	7	0	100
8	59	0	38	0	3	0	100
9	60	0	38	0	2	0	100

Table 15.—Minimal board input solutions for Dushore, Pennsylvania, cherry

(Percent input board feet to be cut up by each GCL)

Cutting bill	GCL 1	2	3	4	5	6	Total
1	78	0	0	22	0	0	100
2	71	0	0	29	0	0	100
3	62	0	8	30	0	0	100
4	46	0	37	17	0	0	100
5	10	13	52	0	25	0	100
6	11	7	47	0	34	0	100
7	12	5	38	2	43	0	100
8	12	35	0	53	0	0	100
9	9	10	34	0	47	0	100

Table 16.—Minimal board input solutions for Oakland, Maryland, cherry

(Percent input board feet to be cut up by each GCL)

Cutting bill	GCL 1	2	3	4	5	6	Total
1	72	0	0	28	0	0	100
2	65	0	0	35	0	0	100
3	52	0	0	36	12	0	100
4	22	0	26	21	29	2	100
5	0	12	49	0	39	0	100
6	0	17	29	0	54	0	100
7	5	15	0	9	71	0	100
8	12	35	0	53	0	0	100
9	0	22	0	5	73	0	100

Table 17.—Minimal board input solutions for Middle, Mountain, West Virginia, cherry

(Percent input board feet to be cut up by each GCL)

Cutting bill	GCL 1	2	3	4	5	6	Total
1	0	0	49	7	0	44	100
2	0	0	49	12	0	39	100
3	0	0	53	13	0	34	100
4	0	0	72	5	0	23	100
5	0	0	80	3	4	13	100
6	0	0	75	0	25	0	100
7	0	0	22	10	68	0	100
8	0	0	0	16	84	0	100
9	0	0	0	15	85	0	100

Reynolds, Hugh W.; Hansen, Bruce G. **Making black cherry blanks from System 6.** Res. Pap. NE-574. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 10 p.

Low-grade, small-diameter black cherry *(Prunus serotina)* timber was used to make System 6 cants. Cherry from the Allegheny National Forest (Ludlow, PA), west-central Pennsylvania (Glen Hope, PA), north-central Pennsylvania (Dushore, PA), western Maryland (Oakland, MD), and the Monongahela National Forest (Middle Mountain; WV) was used. The cants were resawed to 4/4 boards, the boards dried, and blanks were made at the Princeton Laboratory's System 6 pilot plant. By varying the rough mill procedures, differences in board quality and cutting bill requirements were accommodated keeping yields high. The cherry from the Pennsylvania and Maryland sites gave similar yields, while the West Virginia cherry gave 5 percent higher yields. Gum streak was not a problem. Pennsylvania and Maryland cherry gave a 39.0 percent return, and West Virginia cherry gave a 50.3 percent return on a $2.2 million 10-year investment.

ODC 836.1; 847.1/2

Keywords: Low-grade utilization, hardwood dimension.

Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories are maintained at:

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- Berea, Kentucky, in cooperation with Berea College.
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*U.S. GOVERNMENT PRINTING OFFICE: 1986-605-026;20039