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Black Cherry Provenances for Planting in Northwestern Pennsylvania

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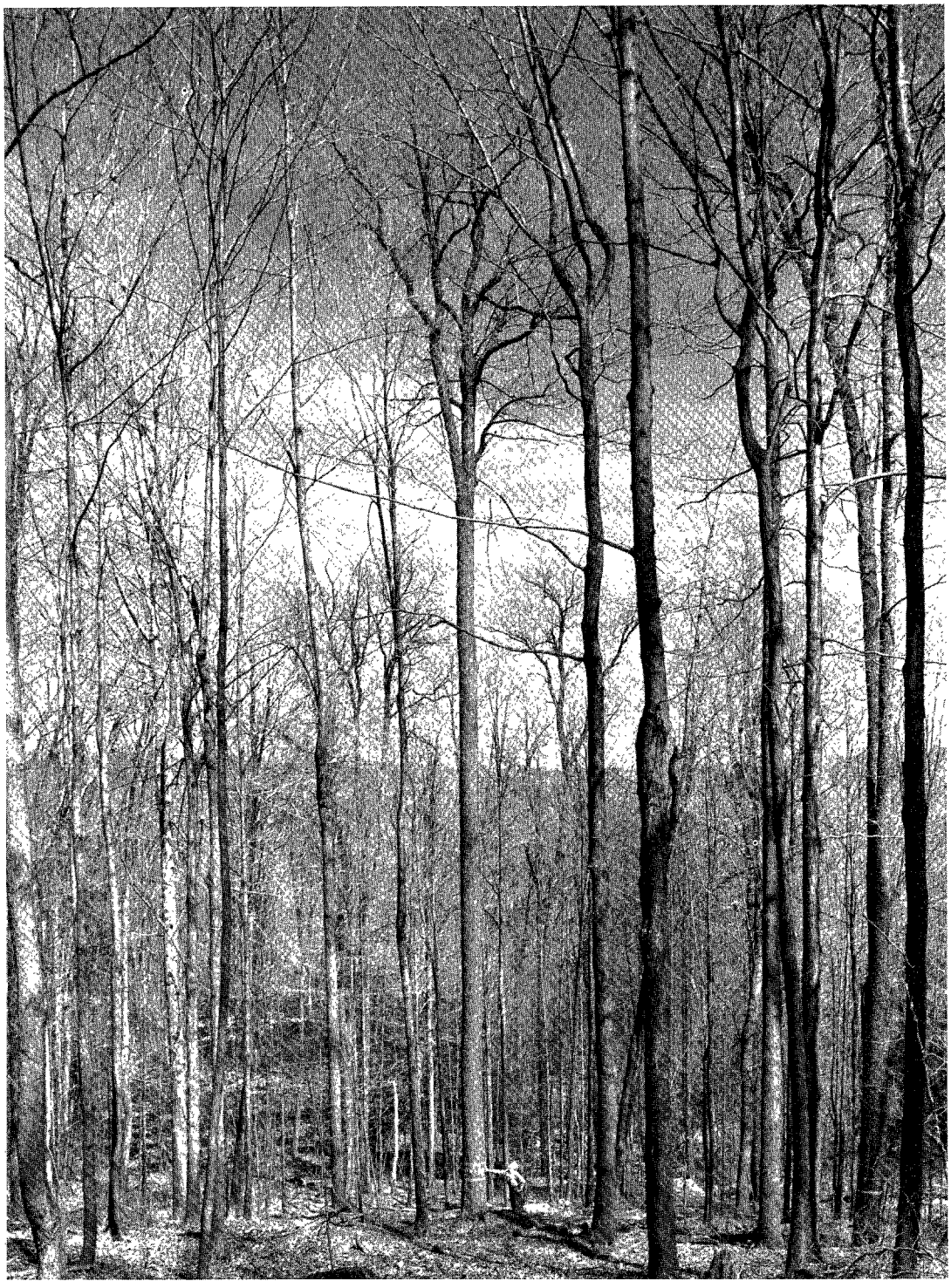

The Author

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Abstract

Black cherry is one of the most valuable eastern hardwoods, but guides for choosing suitable seed sources for planting stock are limited. After 14 years, survival of 8 of 24 sources planted is greater than 70 percent, and there are no significant differences in height. These sources offer the greatest potential for planting in northwestern Pennsylvania; they include four Pennsylvania sources and one each from Tennessee, West Virginia, Ohio, and Virginia. Although these planted trees survived and grew satisfactorily, they did not grow better than nearby natural seedlings. If natural seedlings are available, the need or desirability of planting is questionable.

Cover Photo

A selected, superior, 26-inch black cherry growing in McKean County, Pennsylvania on the Allegheny National Forest. This tree is 119-feet tall and has 70 feet of clear stem to the first branch.

Introduction

Northwestern Pennsylvania, especially the Allegheny Plateau area, provides much of the black cherry (*Prunus serotina* Ehrh.) wood used commercially in the world. Despite the high value of this resource, foresters have little information to guide them in choosing suitable seed sources for planting. Fourteen years' data from a provenance study suggest few reasons for seeking other than local seed sources.

Black cherry can be more than 100 feet tall and 5 feet in diameter, making it the largest and only commercial lumber producing species in this genus in the United States (Hough 1960). Attributes such as natural beauty, stability, and superior working qualities make it a valuable and highly prized wood for furniture, cabinets, and interior trim.

The natural range of black cherry is one of the most extensive of the eastern hardwoods. It is found from Canada to Florida and west to eastern Texas, Oklahoma, Kansas, Nebraska, and southeastern Minnesota. It also grows in Arizona, Mexico, and Central America. Despite the large extent of this natural range, the commercial range of black cherry is quite small (Fig. 1). Most black cherry wood comes from stands in the northern Allegheny and Pocono Plateaus of Pennsylvania, adjacent areas in the Catskill Mountains of New York, and the mountains of West Virginia, Maryland, and northeastern Ohio (Hough 1960). We did not know what seed sources are best for planting within this commercial range.

Figure 1.—Natural range of black cherry in Eastern North America. Shaded area indicates the commercial range. Numbers show seed collection locations. The square indicates the study site on the Kane Experimental Forest.

The extent of the range of black cherry ensures much variation among geographic sources within the species (McVaugh 1951, Hough 1960). An early limited study bears this out (Genys 1963). In 1966, West Virginia University initiated a comprehensive study of the rangewide variation in growth rate, seed and seedling characteristics, and wood properties of the species. The study also proposed to determine the best seed sources for planting in West Virginia, and to establish a gene pool for future breeding work. Valuable information from this study on geographic variation in seed and seedling characteristics, top and root characteristics, and other observations were reported by Cech and Kitzmiller (1968), Kitzmiller (1968), Brown and Cech (1972), Genys and Cech (1975), Cech and Carter (1979), Carter (1980), and Carter et al. (1984). As a cooperator with West Virginia University in this study, we had an opportunity to establish a comprehensive provenance study in the heart of the commercial range of black cherry.

What We Did

We planted in early May, 1969, using 1-year-old seedlings grown in the Parsons State Nursery, Parsons, West Virginia. The seed sources represent 24 provenances from the northern, central, and southern portion of the range of black cherry in the Eastern United States. Locations of each provenance are listed in Table 1 and shown in Figure 1. Each source consisted of seeds collected from five mother trees growing at least 150 feet apart (Cech and Kitzmiller 1968). The progeny of each mother tree were not kept separate in the plantation.

The study site is located on the Kane Experimental Forest in Elk County, Pennsylvania. The location is within the boundaries of the Allegheny National Forest and represents site conditions found in the commercial range of black cherry. It is located at 41.6 degrees north latitude and 78.8 degrees west longitude, at an elevation of 2000 feet. The latitude adjusted for elevation is 47.1 degrees.

To prepare a site for this study, we clearcut a 70-year-old hardwood stand during the winter of 1968-69. The site index for black cherry is about 72. Because of potentially heavy deer browse, we planted inside a deer-proof exclosure (Marquis and

Table 1.—Location and elevation of seed sources in the black cherry provenance trial at Kane Experimental Forest

Seed lot number and origin of seed source		Latitude N.	Longitude W.	Elevation	Adjusted latitude[a]	Average planted height in 1964	Average height in 1982	Percent survival in 1982
		Degree		*Feet*	*Degree*	*Feet*		
Northern Sources								
1-CA-1	Ontario, Canada	45.6	78.6	1400	49.5	0.73	9.1	77.8
2-VT-1	Vermont, Chittenden	44.5	72.9	1000	47.3	1.40	9.8	79.5
3-NY-1	New York, Cortland	42.8	76.2	1600	47.2	.84	10.2	76.3
4-MI-1	Michigan, Kalamazoo	42.4	85.4	830	44.7	1.00	11.9	68.4
5-PA-1	Pennsylvania, Warren	41.8	79.3	1200	45.1	.96	12.3	71.8
6-PA-2	Pennsylvania, Potter	41.7	78.0	2000	47.2	1.18	13.3	87.2
7-PA-3	Pennsylvania, McKean	41.8	78.8	1750	46.6	.98	15.0	79.5
8-PA-4	Pennsylvania, Centre	40.9	77.8	1400	44.8	.95	11.9	82.0
Central Sources								
9-OH-1	Ohio, Wayne	40.8	86.9	1100	43.8	.88	12.1	90.0
10-MD-3	Maryland, Anne Arundel	39.1	76.5	25	39.2	1.08	11.2	60.0
11-WV-1	West Virginia, Monongalia	39.7	80.0	2300	46.1	1.18	13.9	94.7
12-WV-2	West Virginia, Wood	39.0	81.5	500	40.4	.85	8.2	61.5
13-WV-3	West Virginia, Tucker	39.1	79.7	2900	47.1	0.98	10.6	89.7
14-WV-4	West Virginia, Greenbrier	37.7	80.2	1750	42.5	1.10	10.5	83.8
15-WV-5	West Virginia, Wayne	38.0	82.3	650	39.8	1.11	11.2	51.4
16-IL-1	Illinois, Williamson	37.7	89.1	455	39.0	.74	6.6	12.8
17-VA-3	Virginia, Wise	37.0	82.6	4000	48.1	.46	11.8	76.9
18-TN-1	Tennessee, Morgan & Scott	36.3	84.5	1900	41.6	1.02	9.6	33.3
19-TN-2	Tennessee, Monroe	35.3	84.3	3800	45.8	1.13	14.3	81.6
Southern Sources								
20-AL-1	Alabama, Lee	32.7	85.5	750	34.8	.59	b	b
21-MS-1	Mississippi, Warren	32.3	91.0	300	33.1	.34	b	b
22-TX-1	Texas, Cherokee	31.8	95.0	300	32.6	.55	b	b
23-FL-3	Florida, Alachua	29.7	82.3	120	30.0	.29	b	b
24-FG-1	Florida, Georgia (combined)	(29.4)	(82.8)		(29.8)	.16	b	b

[a]Latitude plus (elevation/400), based on 400 feet in elevation to 1 degree of latitude (Hopp 1974).
[b]Eliminated from analyses after 1975.

Brenneman 1981). To facilitate planting, we cut and moved slash from the planting lines. As expected, a dense profusion of black cherry and pin cherry seedlings and other vegetation developed inside the fenced area. We removed the natural seedlings from around the planted trees to maintain their identity. In addition, the study trees have been released from competing vegetation as needed, almost annually. The need for the protection given by a fence is demonstrated by the total lack of natural seedlings outside its perimeter (Fig. 2).

Our study design was a randomized complete block, with 10 replications of four-tree row plots for each of the 24 seed sources. The rows are 12 feet apart, with 10 feet between trees in each row. The plantation contained 960 study trees.

Results

Southern Sources

The seedlings from the southern sources (20-AL-1, 21-MS-1, 22-TX-1, 23-FL-3, 24-FG-1) did not survive or grow well in our northwestern Pennsylvania plantation. This trend became apparent almost immediately after planting. By 1975, survival of these sources ranged from a high of 45 percent to complete failure (Table 2). This contrasts with an average survival of 95.8 percent for all other sources, with none lower than 80 percent. In addition, the surviving southern source trees always were shorter than the more northerly sources because of continued top dieback and resprouting. These sources apparently are not well adapted to the locality and did not show desirable characteristics for breeding purposes. Therefore, they were deleted from further analyses in this study. The same trend was reported for a Maryland plantation (Genys and Cech 1975) and for two West Virginia plantations (Cech and Carter 1979).

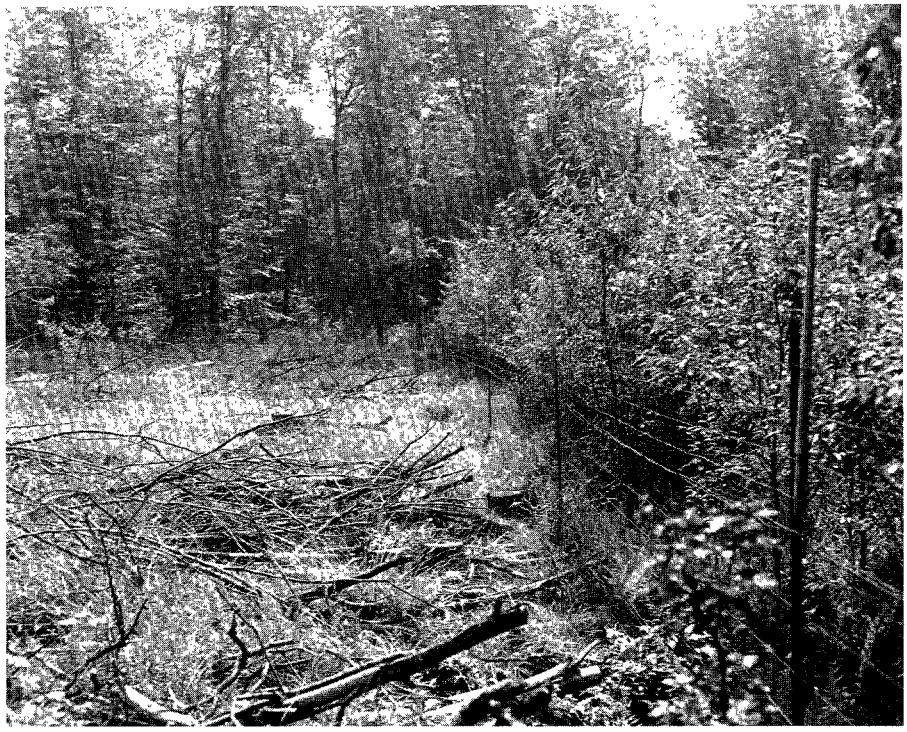

Figure 2.—This fence protects natural regeneration from browsing deer. At least, regeneration has been eliminated by browsing.

Table 2.—Height and survival of five southern sources after 7 years

Source	Average planted height in 1969	Average height in 1975	Percent survival in 1975
	Feet		
20-AL-1	0.59	0.99	45.0
21-MS-1	.34	1.97	25.0
22-TX-1	.55	3.16	40.0
23-FL-3	.29	0.00	0.0
24-FG-1	.16	.70	12.5
All others	.98	5.28	95.8

Survival

After 14 years, survival among the 19 northern and central sources ranged from a high of 94.7 percent (11-WV-1) to a low of 12.8 percent (16-IL-1) (Table 1). Regression of seed source latitude accounts for about 42 percent of the variation in survival. However, when we adjusted latitude for elevation of the seed source site (latitude + elevation/400 feet) (Hopp 1974), the regression accounts for up to 73 percent of the variability. This regression curve is shown in Figure 3 and reflects the lower survival performance of southerly sources brought north. There also is a slight tendency for the far northern sources to survive less well when planted in more southerly locations. Adjusting seed source latitude for elevation helps explain the good performance of two high-elevation sources (17-VA-3, 19-TN-2) from Virginia and Tennessee. These sources were collected at elevations of 4,000 and 3,800 feet above sea level, respectively, where climatic conditions are similar to more northerly locations.

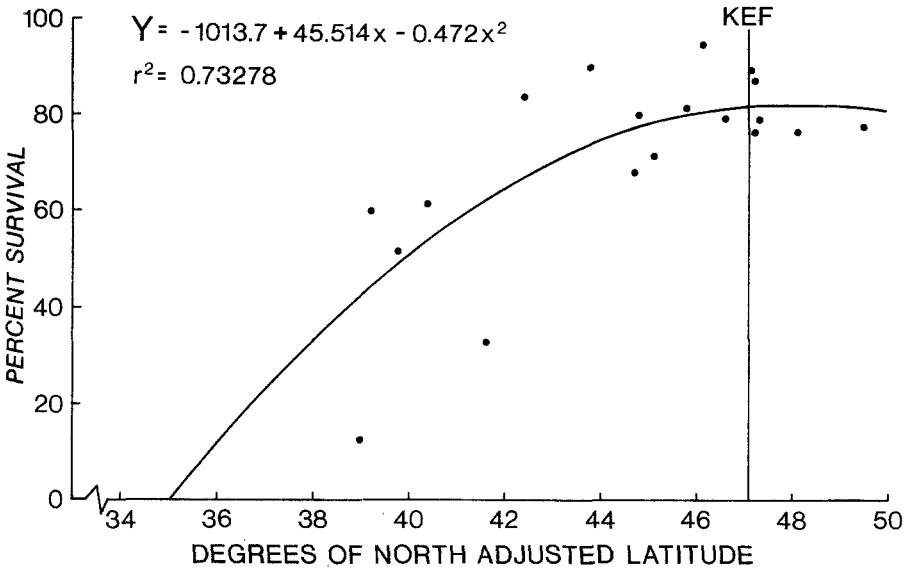

Figure 3.—Survival of the 19 northern and central sources on latitude of seed source location adjusted for elevation (r^2 of 0.73, significant at 1 percent level of probability).

Tree planting is only useful if the trees survive and grow well. With the range in survival that we observed, there are obvious differences. But I chose to use a threshold survival of 70 percent as acceptable. By 1982, 13 provenances were surviving at or better than the threshold level:

Provenance	1982 height (Feet)	1982 survival (Percent)
7-PA-3	15.0	79.5
19-TN-2	14.3	81.6
11-WV-1	13.9	94.7
6-PA-2	13.3	87.2
5-PA-1	12.3	71.8
9-OH-1	12.1	90.0
8-PA-4	11.9	82.0
17-VA-3	11.8	76.9
13-WV-3	10.6	89.7
14-WV-4	10.5	83.8
3-NY-1	10.2	76.3
2-VT-1	9.8	79.5
1-CA-1	9.1	77.8

Total Height

I will only compare heights among those 13 seed sources surviving at rates greater than the selected threshold rate of 70 percent. These are listed in the above tabulation in descending order of total average height. The height differential range is nearly 6 feet, from 15.0 to 9.1 feet. Analysis of variance detects significant differences among these sources at the 5 percent level. The brackets in the previous tabulation enclose those provenances that do not show statistically significant differences. The eight tallest seed sources are not different. These include all four of the Pennsylvania sources. Two nearby sources, one each from Ohio and West Virginia, and two more southerly, high elevation sources from Virginia and Tennessee complete the list. However, none of the planted trees is notably taller than the natural seedlings in the adjacent spaces between the rows, despite the fact that they were released from competition nearly every year.

Not all trees were the same height at time of planting (Table 1). Cech and Kitzmiller (1968) noted that although these differences were great enough to be statistically significant, there were no geographic trends. Our observations generally agree, except for the sources from the deep south. Most of those trees were very short and appeared unthrifty, and many had dead tops. As was noted, these southern sources did not perform well.

There were differences among the heights of the seed source planting stock, but this had little influence on total heights after 14 years. A correlation of the 1982 total average height for each provenance with its average planted height shows little relationship. The correlation coefficient (r^2) was 0.167 and not significant. This seems to indicate that 1-year seedling height in the nursery is not a reliable indicator of the expected performance of a provenance when outplanted.

Tree Form

Tree form as representative of stem straightness, limbiness, and forkedness is an important attribute to consider when judging the suitability of a seed source. No seed source produced trees of outstanding form. However, the Kane plantation probably is not well suited for evaluating tree form, since these trees repeatedly have been released from competing vegetation. Black cherry is shade intolerant and needs some side competition to promote natural pruning and to train the stem toward straightness. Trees from Monroe County, Tennessee (19-TN-2) and Potter County, Pennsylvania (6-PA-2) have been especially noted for their superior form in plantation in West Virginia (Cech and Carter 1979, Carter 1980, Carter et al. 1984) and in Maryland (Genys and Cech 1975). Both of those sources have performed well in the Kane plantation. The average height of Tennessee trees is 14 feet and the average for Pennsylvania trees is 13 feet, the survival rate of each is better than 80 percent.

Conclusions

Results from this study indicate that planted black cherry can grow and survive satisfactorily in northwestern Pennsylvania. However, any black cherry trees planted here must be protected from deer browsing. On the basis of survival and total height after 14 years, eight of the provenances tested offer the greatest potential for use in northwestern Pennsylvania. These are the tallest from the tabulation and include all four of the Pennsylvania sources and one each from Tennessee, Virginia, West Virginia, and Ohio. The mean total heights of these eight provenances are not statistically different from each other.

Good survival and growth of the Pennsylvania sources in the Kane Experimental Forest plantation suggests that planting stock for use in Pennsylvania should come from seed collected nearby. However, this good performance of the Pennsylvania trees may be more than local seed sources responding to local conditions. It also suggests that these sources may be genetically better. These same provenances also performed well in Maryland (Genys and Cech 1975), in West Virginia (Cech and Carter 1979), and in Vermont (Carter 1980, Carter et al. 1984). Further, Pitcher (1982) compared many other Pennsylvania and West Virginia open-pollinated families in a West Virginia plantation and found the Pennsylvania sources superior. He concluded that geographic origin had a stronger influence on progeny performance than did parental phenotype. His best performing trees came from stands in McKean and Elk Counties in Pennsylvania. It is noteworthy that the tallest source in our plantation, Pennsylvania (7-PA-3), also was from McKean County.

Even though our planted trees survived and grew satisfactorily, they did not grow better than nearby natural seedlings. Therefore, if natural regeneration is available, the need or desirability of planting is questionable. However, if superior black cherry seedlings become available in the future, this question will need reevaluation. But for the present, if one wishes to plant black cherry seedlings in Pennsylvania, our results suggest that the seed should be collected from good parental phenotypes in Pennsylvania stands within the commercial range of the species. Pitcher (1982) further suggests making the collections in McKean and Elk Counties. This advice also seems valid for planting in areas outside the commercial range.

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After 14 years, survival of 8 of 25 planted black cherry sources is greater than 70 percent, and there are no significant differences in height. These sources offer the greater potential for planting in northwestern Pennsylvania; they include four Pennsylvania sources plus one each from Tennessee, West Virginia, Ohio, and Virginia. Planted trees did not grow better than nearby natural seedlings.

ODC 232.12

Keywords: Hardwood tree planting; planting stock; seed source; genetic variation.

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