PERFORMANCE OF WHITE ASH PROGENIES AFTER 7 YEARS IN A WEST VIRGINIA PLANTING

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ABSTRACT. -- White ash seedlings from 45 sources representing 29 counties in 15 states were outplanted in West Virginia in April 1976. At the end of 7 years, overall survival is 61 percent. Average survival of the Arkansas, Louisiana, Mississippi, and Alabama families was 27 percent compared to 75 percent for the families north of southern Tennessee. Average total height was 4.7 feet for the 33 families used in the analysis; average 7-year height growth was 3.8 feet. Average stem diameter was 0.7 inch and 7-year average stem diameter growth was 0.5 inch. The best performance was recorded for Barbour County, WV, families. All of the best performers, however, were from latitudes between 38° and 40° N. Families from latitudes south of Tennessee are not recommended for planting in West Virginia.

INTRODUCTION

White ash, (*Fraxinus americana* L.) is one of the fine hardwoods common to the forests in the central Appalachian mountains. It occurs in mixture with northern red oak (*Quercus rubra* L.), yellow-poplar (*Liriodendron tulipifera* L.), sugar maple (*Acer saccharum* Marsh.), black cherry (*Prunus serotina* Ehrh.), and American basswood (*Tilia americana* L.).

White ash has not been widely planted in the Central Appalachians but early studies in the Lake States and the Central States have shown survival to be variable and early growth to be poor (Minckler 1952; Stoeckler and Limstrom 1950).

One of the earliest studies dealing with genotypic variation in white ash was conducted by Wright (1944) at Petersham, Massachusetts. The study included progeny of 155 trees from 28 localities in the Eastern United States, and Canada. At the end of 2 years, Wright reported that three ecotypes were represented--northern, ranging from Pennsylvania to Michigan northward; southern, ranging from Maryland to southern Indiana; and southward and intermediate, confined to a narrow belt from southern Pennsylvania to Ohio. The southern ecotype had the poorest survival and the greatest amount of winter topkill. The northern and intermediate ecotypes had the greatest total height at the end of 2 years. Other differences among ecotypes were in the root systems, leaf size, foliage characteristics, and differences in chromosome numbers. More recently, however, Clausen et al. (1981) showed that variation in several traits was clinal or due to ploidy levels and that there probably were no true ecotypes in white ash.

This paper reports on the 7-year growth and survival of 45 white ash provenances outplanted on the Fernow Experimental Forest in the spring of 1976.

METHODS

Study Area

The study area is on the Fernow Experimental Forest near Parsons, West Virginia, latitude 39°-02'N and longitude 79°-41'E. Elevation is approximately 2,700 feet above sea level. The Fernow Experimental Forest has a rainy and cool climate. Mean annual precipitation is about 58 inches and is distributed evenly throughout the year. Mean annual temperature is about 48°F and the frost-free season is about 145 days.

The soil on the study area is classified as a Meckesville silt loam, a colluvial soil derived from the Greenbrier, Mauch Chunk, and Pottsville formations. It is influenced by limestone from the Greenbrier formation, which lies just above it. Meckesville soil is well drained, 3 to 4 feet deep, and considered one of the more productive forest soils in the area. Oak site index is about 80.

The area was previously forested with a 70-year-old stand of mixed hardwoods, composed mainly of black cherry, northern red oak, yellow-poplar, sugar maple, and white ash. Site preparation consisted of skyline logging of all merchantable stems 5.0 inches in dbh and larger on the area. The slash and other brush were pulled from the area by winching with a tractor from the perimeter of the area.

Plot Layout

A randomized block with five replications was used. Trees from 45 families were planted in five tree row plots at a spacing of 10 by 10 feet.

Planting Stock

Seedlings from 45 families were furnished by the North Central Forest Experiment Station. The families originated from 29 counties in 15 states, which covers much of the white ash natural range (Table 1) (Fig. 1). Seedlings for the study were grown at the State Nursery in Jonesboro, Illinois, for 1 year before being lifted and shipped to the various cooperators. Initial height of planting stock ranged from 0.5 to 2.5 feet and averaged about 1.1 feet over all blocks and families. Average stem diameter 1.0 inch above ground at planting time was about 0.2 inch. At time of planting, the condition of the planting stock was judged to be fair.

Table 1. White ash families planted in West Virginia

Family Number	State	County	Latitude (N)	Longitude (W)	Elevation
			Degrees - - -		Feet
672010	NE	Nemaha	40.5	95.7	760
672102	IL	Williamson	37.8	89.1	400
672104	IL	Jackson	37.7	89.3	420
672110	IL	Jackson	37.7	89.4	620
672309	WI	Forest	45.7	89.0	1,675
672602	IL	Pike	39.8	90.7	700
672809	TN	Franklin	35.2	85.9	1,180
672810	TN	Franklin	35.2	85.9	1,160
673201	OH	Wayne	40.8	81.9	910
673302	AL	Madison	34.5	86.5	1,000
673303	AL	Madison	34.5	86.5	1,000
673404	KY	Trigg	36.8	88.1	490
673405	KY	Trigg	36.1	88.1	510
673501	AR	Boone	36.4	93.0	850
673502	AR	Marion	36.4	92.8	850
673504	AR	Marion	36.4	92.8	800
673705	MS	George	49.5	88.8	250
673802	LA	East Baton Rouge	31.5	91.0	30
673803	LA	East Baton Rouge	31.5	91.0	30
673805	LA	East Baton Rouge	31.5	91.0	30
674002	MS	Oktibbeha	33.4	88.8	380
674004	MS	Oktibbeha	33.4	88.8	380
674005	MS	Oktibbeha	33.4	88.8	380
674006	MS	Oktibbeha	33.4	88.8	380
677109	IL	Effingham	39.1	88.4	600
677110	IL	Shelby	39.3	88.6	630
677804	WV	Randolph	38.9	79.6	3,300
677806	WV	Randolph	38.9	79.7	3,200
677808	WV	Tucker	39.1	79.5	2,500
678605	ME	Penobscot	44.8	69.0	280
678607	ME	Penobscot	44.8	69.0	280
679305	NY	Cortland	42.7	76.1	1,900
679410	CT	New Haven	41.3	73.0	10
679503	IN	Washington	37.6	86.1	800
680605	WV	Barbour	39.1	80.1	1,580
680606	WV	Harrison	39.2	80.2	1,010
680609	WV	Taylor	39.3	80.2	1,320
686206	TN	McMinn	35.3	84.5	825
686212	TN	McMinn	35.3	84.5	825
686404	TN	Overton	36.5	85.4	1,180
686405	TN	Overton	36.5	85.4	1,180
686406	TN	Overton	36.5	85.4	1,160
687304	TN	Marshall	35.4	87.7	800
687305	TN	Marshall	35.4	87.7	800
687306	TN	Marshall	35.4	87.7	800

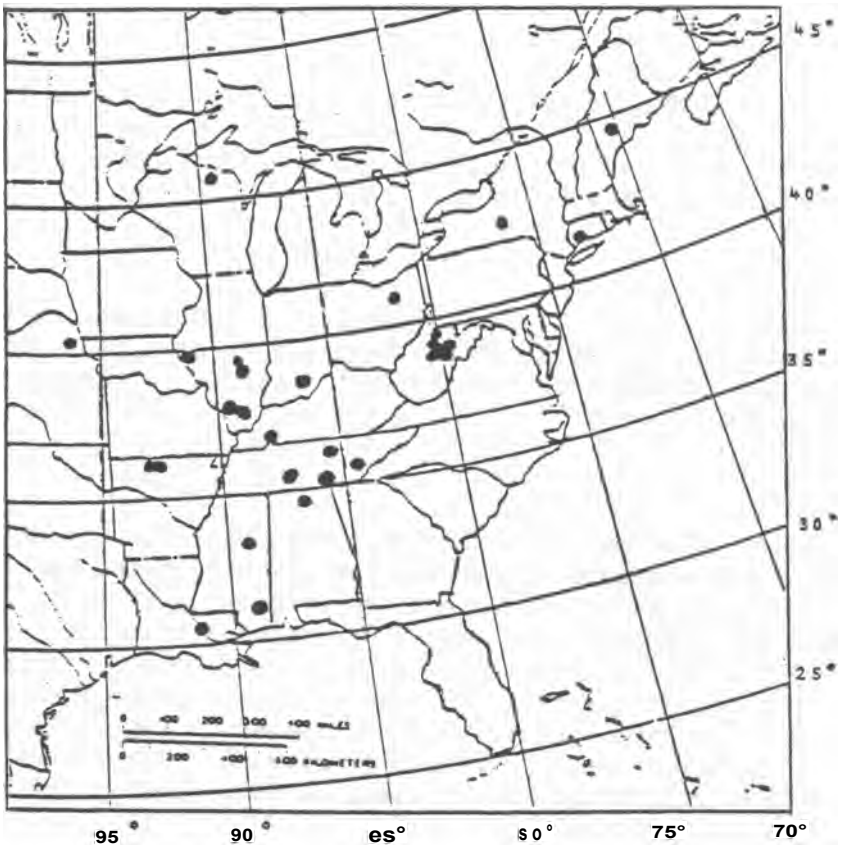

Figure 1. White ash family origins represented in the West Virginia planting.

Planting

Seedlings from the 45 families were planted in April 1976. A 3-hp portable power auger with an 8-inch-diameter bit was used to dig the holes. Families were mapped and marked in the field for future reference.

Cultural Work

During the 7 years, the plantation was released four times with gas-powered brush cutters. Hardwood sprouts, blackberries and other competing stems were cut to the ground. The last release was made in November 1982 at the end of the seventh growing season.

Measurements

Survival and height growth were recorded at the end of the first five growing seasons and at the end of the seventh growing season. Stem diamete 1 inch above ground was recorded for all trees after planting and at the end of seven growing seasons.

RESULTS

Analyses of the 7-year height and diameter data included all families in which there was at least one survivor in each plot and in each block (Table 2). Survival of families not included in the overall analyses are shown in Table 3.

Survival

Survival at the end of 7 years was significantly different among families and averaged 61 percent for all blocks and families. For the 33 families included in the height and diameter analyses (Table 2), survival averaged 75 percent. For the 12 provenances that suffered the highest mortality, survival averaged 27 percent. With a few exceptions, all of the poor survival was in families originating south of Tennessee. Sources from Washington County, Indiana, and Williamson County, Illinois, had the best survival, 96 percent. Survivals greater than 90 percent also were recorded for several West Virginia families, an Ohio family, and two other Indiana and Illinois families.

Total Height and Height Growth

There was a significant difference in 7-year total height among families. Total height ranged from 3.2 to 6.4 feet and averaged 4.7 feet (Table 2). The tallest family was from Barbour County, West Virginia; the shortest was from northern Wisconsin. Two families--674005 from Oktibbeha County, Mississippi, and 672309 from Forest County, Wisconsin--were significantly different from all other families by the Newman-Keuls multiple range test.

Table 2. Average survival, total height, height growth, stem diameter, stem diameter growth, and dbh of 33 white ash families at the end of 7 growing seasons.

Number	County	State	Percent survival	Total height 1982	Height growth 1976-82	Stem diameter 1982	Stem diameter growth 1976-82	Rank
				Feet		Inches		
680605	Barbour	WV	92	6.4	5.1	1.08	0.81	1
680606	Harrison	WV	92	6.1	5.2	0.91	0,71	4
679503	Washington	IN	96	6.1	5.2	0.98	0.77	2
672104	Jackson	IL	80	5.9	4.8	0.95	0.78	5
672110	Union	IL	88	5.9	4.8	1.04	0.84	3
677110	Shelby	IL	92	5.7	4.4	0.79	0.57	8
677804	Randolph	WV	84	5.6	5.0	0.82	0.64	7
672102	Williamson	IL	96	5.4	4.4	0.94	0.76	6
677806	Randolph	WV	84	5.4	4.3	0.75	0.47	13
673405	Trigg	KY	60	5.3	4.4	0.73	0.56	14
680609	Taylor	WV	92	5.2	4.1	0.79	0.59	11
679305	Cortland	NY	80	5.1	4.2	0.81	0.61	10
686406	Overton	TN	72	5.1	4.4	0.82	0.66	9
673201	Wayne	OH	92	5.1	3.8	0.80	0.53	13
672602	Pike	IL	88	4.8	3.7	0.79	0.60	12
673504	Marion	AR	56	4.8	3.6	0.71	0.53	20
686405	Overton	TN	68	4.8	3.8	0.73	0.52	17
677808	Tucker	WV	72	4.8	3.4	0.72	0.49	18
687306	Marshall	TN	48	4.7	3.9	0.80	0.64	15
687305	Marshall	TN	72	4.6	3.8	0.66	0.45	21
686206	McMinn	TN	56	4.5	3.7	0.73	0.55	19
686404	Overton	TN	72	4.2	3.4	0.82	0.58	16
677109	Effingham	IL	76	4.1	3.2	0.52	0.37	25
687304	Marshall	TN	56	4.0	3.4	0.63	0.47	23
678607	Penobscot	ME	88	3.8	2.4	0.62	0.36	25
686212	McMinn	TN	68	3.8	3.1	0.66	0.49	22
672010	Nemaha	NE	48	3.8	3.2	0.54	0.41	27
679410	New Haven	CT	80	3.7	2.9	0.61	0.44	24
672809	Franklin	TN	72	3.7	2.5	0.60	0.42	26
673501	Boone	AR	64	3.6	2.8	0.57	0.41	27
678605	Penobscot	ME	80	3.6	2.6	0.49	0.27	28
674005	Oktibbeha	MS	32	3.3	2.0	0.45	0.24	30
672309	Forest	WI	68	3.2	2.3	0.56	0.36	29
Average			75	4.7	3.8	0.74	0.54	

Table 3. Families with very poor survival that were not included in the analyses because of incomplete data in one or more blocks.

Number	County	State	Percent survival
673302	Madison	AL	28
673303	Madison	AL	28
673404	Trigg	KY	52
673502	Marion	AR	44
673705	George	MS	12
673802	East Baton Rouge	LA	8
673803	East Baton Rouge	LA	8
673805	East Baton Rouge	LA	8
672810	Franklin	TN	24
674006	Oktibbeha	MS	16
674002	Oktibbeha	MS	20
674004	Oktibbeha	MS	20

There was a strong correlation between 1982 total height and 7-year height growth. Southern families that had poor survival also showed poor 7-year height growth.

Average Stem Diameter and Stem Diameter Growth

Stem diameter 1.0 inch above ground averaged 0.7 inch and differed significantly at the 1-percent level among families (Table 2). Thirty-six percent of the families that were used in the analysis had stem diameters below the average for the plantation.

Seven-year stem diameter growth averaged 0.5 inch and ranged from 0.2 to 0.8 inch (Table 2). Stem diameter growth was significantly different, among families at the 1-percent level.

Family Rankings

The 33 families that were used in the analysis were compared by ranking the families by performance for each of the parameters shown in Table 2. The lower the ranking, the better was the performance for that trait. To determine overall performance in relation to other provenances, the ranks for all parameters were summed; the family with the lowest sum was ranked number one. When two families had the same overall sum, they were assigned the same ranking.

The 10 best performing families with the exception of the Cortland, New York, family were from latitudes between 38° and 40° N. In general, the best performing families were the tallest, had the largest stem diameter, and usually had high survival.

White Ash Damage

The first year after outplanting, about 12 percent of the seedlings had dead terminal shoots or new shoots that resprouted from below the dead terminal shoots. During the second remeasurement, it was noted that about 81 percent of the seedlings sustained severe damage that was attributed to a late killing frost on June 9, 1977. Damage occurred in all families and was not correlated with seed origin. Nearly all damaged seedlings resprouted from the ground or from buds below the topkill area. Browsing by deer was a major problem in the third year, with about 25 percent of the seedlings showing severe damage. Browsing amounted to about 1 percent during the first 2 years; the reason for the rapid increase the third year is not known. After the third year, browsing subsided and has amounted to about 4 or 5 percent a year.

DISCUSSION

Early damage from frost and deer have reduced growth during the 7-year study period. Competing vegetation was mowed several times during the 7 years, but the high incidence of top dieback of white ash from winter kill and other agencies has reduced height growth, and the effects of competition control have been diminished. Although there was a difference of about 3.0 feet in average 1982 total height among families, only two families were significantly different from all others. The large number of insignificant differences probably is due to the large variation in 1982 height within plots and blocks for a given family.

The 7-year data show that the more southern white ash sources, particularly those from Louisiana, Mississippi, and Alabama, are not good risks for planting in climates similar to those in West Virginia. However, those families from the same general latitude as the planting site in West Virginia, 38° to 40° N have survived and performed relatively well in the outplanting. Families from several border locations, particularly Arkansas and southern Tennessee, survived better than the southern families but not as well as those from more northern areas.

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