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Stand Parameters of 11- to 15-Year Old Green Ash Plantings

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SUMMARY

Three green ash *(Fraxinus pennsylvanica* Marsh.) plantings, ages 11, 13, and 15, and a 13-year-old pumpkin ash *(F. profunda* (Bush) Bush) planting were sampled to determine d.b.h. and height development and survival of free-to-grow trees. On medium-textured (Commerce) and clay-capped (Bowdre and Tunica) soils, the average d.b.h. and height mean annual increments (m.a.i.'s) for ash were about 0.5 inch/year and 4 feet/year. M.a.i. values for ash on Sharkey clay were 0.3 inch/year and 2.5 feet/year. Survival was 85+ percent.

Additional keywords: *Fraxinus pennsylvanica, F. profunda,* Sharkey clay, Commerce silt loam, Bowdre soil series, Tunica soil series.

INTRODUCTION

Green ash *(Fraxinus pennsylvanica* Marsh.) is one of the more valuable southern bottomland species. Though not favored for wildlife, it is highly utilized in the wood industry. Young ash is a relatively tolerant tree and frequently occurs in the understory on slackwater sites. In this situation, it is a slow-growing tree. Growth potential of sapling-size green ash, where it competes only with itself, is not well documented. This note presents results of sampling ash plantings at ages 11, 13, and 15 to determine survival and height, diameter, and volume development (fig. 1).

METHODS

The planting locations, first growing seasons (age), soil series, size of planting areas, and sample sizes for green ash were:

1. Delta Experimental Forest, Washington County, Mississippi, 1973 (15 years), Sharkey clay, 9.8 acres, 732 planting spots (343 trees).
2. Huntington Point, Bolivar County, Mississippi, 1975 (13 years), Commerce silt loam, 1.9 acres, 587 planting spots (498 trees).
3. Ajax Bar, Issaquena County, Mississippi, 1977 (11 years), Bowdre (10- to 20-inch clay cap over loamy material) and Tunica (20- to 48-inch clay cap) soils, 14.4 acres, 216 planting spots (203 trees).

In addition, a 1.6-acre, 13-year-old pumpkin ash *(F. profunda* (Bush) Bush) plot planted in 1975 at Ajax Bar was sampled, using 144 planting spots (131 trees).

All plantings were at 12- by 12-foot spacings except the 15-year-old Sharkey clay planting, which was planted at 10- by-10-foot spacing. The latter planting was thinned on alternate diagonals after the 10th year.

Heights and diameters of all sample trees were taken. Volumes were obtained with a dendrometer, with 10 trees being measured in the 1977 Ajax Bar planting (AJ), 12 trees in the 1975 Ajax Bar pumpkin ash planting (PA), and 20 trees each in the 1975 Huntington Point planting (HP) and 1973 Delta Experimental Forest planting (DEF).

RESULTS AND DISCUSSION

Stand parameters of the four plantings were:

Area	Age	D.b.h.	Ht.	Basal area	Cubic volume	Trees/ acre	Survival
	yrs	*in*	*ft*	*ft²/ac*	*ft³/ac*		*%*
AJ	11	6.2	44.6	64	1,120	284	94
AJ	13	6.7	49.2	72	1,275	275	91
HP	13	6.3	51.5	58	1,446	257	85
DEF	15	4.7	36.8	26	456	204	45

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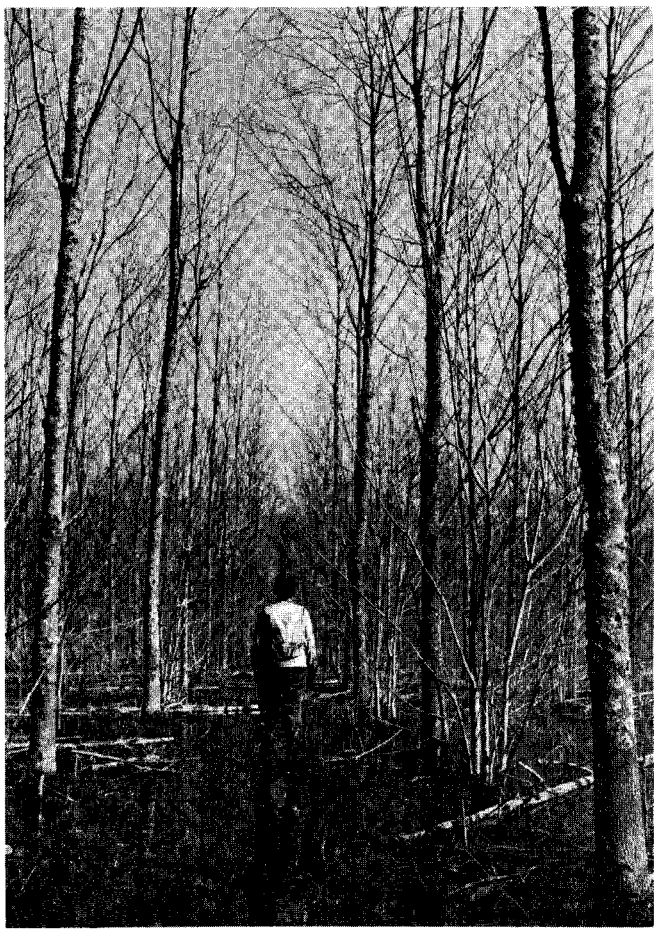

Figure 1.— *General views of (left) 15-year-old ash on Sharkey clay, with nearest trees 5.7 and 5.5 inches d.b.h. and 42 and 44 feet tall and (right) 13-year-old ash on Commerce silt loam, with two closest trees 8.0 and 7.7 inches d.b.h. and 61 and 57 feet tall. Note sprouting from stumps of diagonal row thinning done after the 10th year on the clay site.*

Height and diameter distributions are shown in table 1. From sprout and/or stump counts, DEF had 93 percent survival through age 10 (420 trees/acre) before thinning. Volumes outside bark from a 1-foot stump to the tip were calculated from separate volume equations for each planting (table 2) rather than a combined equation because of differences between slopes and/or intercepts among the various equations.

Because of different ages, sites may be compared using mean annual increments (m.a.i.'s) in a one-way analysis of variance (table 3). Average height m.a.i. for the DEF (2.5 feet/year) was significantly less at the 0.05 level, using Duncan's multiple range test for an unequal number of replications, than that for the other three plantings. PA (3.8 feet/year) was less than AJ (4.1 feet/year), while HP (3.9 feet/year) did not differ from either PA or AJ.

Volume, average d.b.h., and basal area m.a.i. comparisons were made without DEF because that planting had different initial spacing and had been thinned. The d.b.h. m.a.i. for AJ (0.57 inch/year) was greater than that for the other two areas (HP, 0.48; and PA, 0.52 inch/year), while the basal area m.a.i. for HP (4.5 ft^2/acre/year) was less than that for PA and AJ (5.5 and 5.8 ft^2/acre/year). Volume m.a.i. in cubic feet/acre/year of 98 for HP, 102 for AJ, and 111 for PA did not differ among areas (table 3).

Some prior measurements of AJ, PA, and HP provide information on stand development as well as 11- and 13-year values. Wells (1986) gives 5- and 10-year heights of the 15-year-old DEF planting.

The only planting heights were measured for PA, where seedlings averaged 2.2 feet and ranged from 0.9 to 3.7 feet. At the end of the first growing season, the average height was the same, 2.2 feet, with a range in heights of 0.1 to 4.3 feet. This survival without growth was attributed mainly to March-April and some May flooding in 1975. HP seedlings received less

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Table 1.—*Number of trees per acre for four ash planting areas by 2-inch d.b.h. classes and 10-foot height classes.*

D.b.h. class (in)	Area (age) AJ* (11)	AJ (13)	HP† (13)	DEF≠ (15)	Height class (ft)	Area (age) AJ* (11)	AJ (13)	HP† (13)	DEF≠ (15)
≤2	12	8	8	19	<20	4	2	...	5
4	48	27	36	94	20/29	9	4	5	23
6	126	116	125	86	30/39	28	6	11	96
8	84	103	84	5	40/49	177	120	57	77
10	14	15	4	...	50/59	66	143	167	3
12	...	6	...	...	60/69	...	...	17	...
Total	284	275	257	204	Total	284	275	257	204

* Ajax Bar.
† Huntington Point.
≠ Delta Experimental Forest.

Table 2.—*Volume equations for ash by site and age, where V = cubic feet outside bark from 1-foot stump to tip, D = d.b.h., and H = total height*

Ajax Bar, age 11
$V = 0.182 + 0.001912\ D^2H$
$n = 10,\ r^2 = 0.978,\ S_{y.x} = 0.41,\ CV = 7.7\%,\ \overline{V} = 5.27$

Ajax Bar, age 13 (pumpkin ash)
$V = 1.258 + 0.001623\ D^2H$
$n = 12,\ r^2 = 0.984,\ S_{y.x} = 0.47,\ CV = 7.3\%,\ \overline{V} = 6.43$

Huntington Point, age 13
$V = 0.719 + 0.001899\ D^2H$
$n = 20,\ r^2 = 0.962,\ S_{y.x} = 0.64,\ CV = 10.1\%,\ \overline{V} = 6.32$

Delta Experimental Forest, age 15
$V = 0.175 + 0.002177\ D^2H$
$n = 20,\ r^2 = 0.989,\ S_{y.x} = 0.18,\ CV = 5.7\%,\ \overline{V} = 3.14$

Table 3—*Analyses of variance of mean annual increments*

Variable	Source	df	Error mean square	F
Height	Sites	3	6.3215	156.8
	Error	31	0.0403	
D.b.h.	Sites	2	0.0127	12.0
	Error	18	0.0011	
Basal area	Sites	2	3.4171	8.2
	Error	18	0.4177	
Volume	Sites	2	286.9796	1.4
	Error	18	207.8104	

than 3 weeks of flooding in April and averaged 4.0 feet at the end of 1 year.

Survival changed only 1 percentage point from the end of the first growing season to the last measurement at both AJ (from 95 to 94 percent at age 11) and PA (from 92 to 91 percent at age 13). HP had 96 percent survival at the end of 1 year, then from the 2d through 8th years 70 trees (36/acre) died from what was thought to be a root rot, possibly a *Clitocybe*. Maximum mortality (40 trees, or 21/acre) occurred in the 4th year. Typically, an affected tree did not produce leaves in the spring, but the bark did remain green for most of the growing season. The only other natural damage of any kind in the four plantings was from stem borers in the DEF. Mortality since thinning following the 10th year occurred from trees breaking off (apparently borer-caused), and other trees are candidates for breaking off in the near future because of heavy borer damage. The borers involved are the lilac borer, *Podosesia syringae* (Harris), the banded ash borer, *Podosesia aureocincta* Purrington & Nielsen, and the carpenterworm, *Prionoxystus robiniae* (Peck).

Because of opposite branching in ash, damage to the terminal produces forking. A measure of the amount of forking was made at HP after the 5th year. For trees ≥20 feet tall, 93/acre did not have a fork within 17 feet, or one log, of the ground. Those trees represented 31 percent of the planted trees, 35 percent of stems living 5 years, and 41 percent of trees ≥20 feet tall. For trees that did fork within 17 feet of the ground, height of the first fork was <5 feet in 14 percent, 5 to 9 feet in 19 percent, 10 to 13 feet in 41 percent, and 13 to 17 feet in 26 percent of the occurrences. Average height of the forked trees was 25.0 feet and of the one-stem trees, 25.7 feet.

Averaged over AJ, PA and HP, average heights and diameters that may be expected from green and/or pumpkin ash planted at 12 by 12 feet on clay-capped or medium-textured soils are 12 feet in 3 years, 21 feet

and 3.0 inches in 5 years, 30 feet and 4.1 inches in 7 years, 45 feet and 6.0 inches in 10 years, and 50 feet and 6.5 inches in 13 years. The Sharkey clay planting on the DEF, a provenance test comprised of 78 half-sib families gathered over nine areas from the Mississippi River Valley and the Carolinas, averaged 18 feet (range 16 to 21 feet by areas) at age 5 and 31 feet (range 29 to 34 feet) at age 10. The 37 feet in height after 15 years was nearly the same as another Sharkey clay planting on the same experimental forest that averaged 36 feet in height at age 15 (Krinard and Kennedy 1987). Although Sharkey and Commerce soils are quite different, with Commerce being the better site, Broadfoot (1976) lists estimated site index ranges for natural stands of green ash at age 50 for both soils as 75 to 95 feet. The site index range for Tunica is estimated as 70 to 90 feet.

The wood properties of green and pumpkin ash are so similar that it is not practical to separate the two species in practice (Putnam and others 1960). Trees on wetter sites with more swollen butts are generally considered to be pumpkin ash whether they are the actual species or not.

Pumpkin ash is a true-breeding hexaploid species that probably originated as a cross between green ash and white ash *(Fraxinus americana* L.) (Wright 1959). The leaves, twigs, and fruit of pumpkin ash are generally larger than those of the other two species. Vines (1960) lists green ash fruit as being 1 to 2 inches long and pumpkin ash fruit as being 2 to 3 inches long.

Seed rachises and some seeds were on the 15-year-old DEF trees. Seeds were first noticed after the 9th year at HP on 33 trees (6.5 percent of the stand). No seeds were produced in the 10th or 11th years, but they did occur on one tree in the 12th year and on 42 trees (8.4 percent of the stand) in the 13th year. Of the 13-year-old seed producing trees, 52 percent (22 trees) had also produced seeds after the 9th year. Seeds collected at HP ranged from 2 to 3 inches in length, which would indicate that the planting may be pumpkin ash rather than green ash. Seed production has not yet been observed for AJ and PA, so no comparisons of seed sizes have been possible.

Through the first dozen years or so on sites other than Sharkey clay, planted ash—whether green or pumpkin—grows fairly similarly. A reasonable expectation from a plantation would be 85+ percent survival, average d.b.h. growth of about one-half inch a year, and average height growth of about 4 feet a year. Spacings much wider than 12 by 12 feet, or less than 200 trees per acre, may be questionable because of forking problems. Although ash does not grow as well on Sharkey, neither do other species. Even 17-year-old dominant/codominant ash of mainly sprout origin that developed on a cleared site on the DEF averaged only 34.5 feet in 17 years, with a maximum individual tree height of 48 feet. The maximum tree height of the planted DEF ash in 15 years was 57 feet.

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