

POPLAR CULTURE STUDIES

at the

Ohio Agricultural Experiment Station

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by

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The Forestry Department of Ohio's Agricultural Experiment Station recently initiated cultural studies within two of its poplar plantations in the Secrest Arboretum. Started from unrooted cuttings on upland and bottomland sites, those plantings had been made during 1947 and 1951 respectively. Spacing was 6 x 6 feet for the older treated stand (L-11), and 8 x 8 feet for the younger of the two (M-1). Research Circular 53¹/ covers their habitat, establishment, and early performance.

Poplar hybrids rate as perhaps the fastest growing tree commercially planted in Ohio. Due to its excellent stem form and juvenile growth rate, the McKee hybrid poplar (Populus generosa Henry) supposedly is among the best. It is a patented clone (P. trichocarpa x P. angulata, Strain F.) There are, however, other reputable strains of hybrid poplar, also the native cottonwood (Populus deltoides Marsh), suitable for forest planting. But their respective merits for the production of pulpwood, excelsior, match sticks, veneer stock, or lumber, have not been intensively studied, nor have the best cultural techniques been developed and reported yet for eastern United States. Our poplar silviculture today is still of experimental status.

¹/ Kriebel, H. B., G. L. Lowry, and W. K. Murphey. 1958. The relationship of site conditions to establishment and early growth of McKee hybrid poplar. Research Circular 53, Ohio Agricultural Experiment Station, Wooster, Ohio.

European Experience

Schreiner^{2/} discusses Europe's 200 years of trial and error in poplar management and research, and relates findings adaptable to American conditions. He says there is abundant evidence that single-clone stands of the commercially planted poplars cannot be matured profitably without careful and regular thinning if planted closer than 16 x 16 feet on the best sites, or 26 x 26 feet on ordinary sites. Monoclonal plantings rarely can be retrieved successfully if their vigor is seriously reduced because of too close spacing. The occasional exceptions imply an ideal environment with deep, fertile soil. Forest plantations should be made from mixtures of carefully selected and tested clones of as many parentages as possible.

Europe's most commonly used poplar spacings range from 20 x 20 feet to 26.5 x 26.5 feet, to produce high-quality logs for veneer or lumber. Great Britain, however, recommends poplar plantation spacings as close as 15 x 15 feet. For pure poplar plantations in Austria, wherever a pulpwood market exists, foresters favor 6.6 x 6.6 feet initial spacing, but advise early thinning to 13 x 13 feet and a final spacing of 26 x 26 feet.

Austrian thinnings in 6-year-old stands originally of 6.6 x 6.6 feet spacing have totalled 1,120 cubic feet of pulpwood, roughly 12 cords, to the acre. A yearly per-acre growth between 150 and 160 cubic feet represents about the mean in France's noted poplar plantings.

Good poplar silviculture requires early and regular pruning. Watersprouts of "feathering", however, can be prolific on widely spaced trunks exposed to full sunlight. So-called "filler trees" like the alder or the birch often are interplanted, to shade each pruned poplar

^{2/} Shreiner, E. J. 1959. Production of poplar timber in Europe and its significance and application in the United States. Agricultural Handbook No. 150, U.S.D.A., Forest Service, Washington, D.C.

stem and prevent epicormic branching. Hybrid poplar reproduces oftener by stump sprouts and root suckers than from seed.

Local Experiments on Upland Site (L-11)

Planted during 1947 but inadequately thinned to date, these McKee poplars now show indications of decadence. Practically every tree is afflicted with a few to many trunk and branch cankers.

Trunk canker injury may kill the affected poplar by girdling it, or the wind might break it off at that weakened spot. Branch cankers cause it to succumb gradually, due to its crown reduction over the years. Some of these poplars have already died.

Perhaps poplars which remain vigorous, as a result of cultural treatments, wider initial spacing, or both, could resist canker infection; or, if infected, they may outgrow the injury. Moreover, a spacing of thinned and pruned poplars affording adequate aeration near the ground, and thereby lowering the humidity, should be particularly favorable. Fungi thrive under humid conditions.

Clearcut Plot: One-half of this small plantation was clearcut in September 1959, to test the feasibility of poplar management from sprout and sucker reproduction. Table 1 lists the pulpwood yield of today after 13 growing-seasons.

Thinned Plot: A 1/20-acre sample plot at the western edge of the interior gully was thinned on a pulpwood management basis. This thinning removed half of the stand - 50 percent of its cubic foot volume, 51 percent of its basal area, and 52 percent of its trees. Care was required while selecting the trees to remove, so that the remainder were those of least risk and fairly well spaced.

Prior to treatment, a mean of both the plots showed 500 poplars per acre having a diameter range of 3.7 to 9.1 inches (mean 6.7), a height range of 28 to 62 feet (mean 49), and yielding 2,925 cubic feet or 32.5 cords. That is a yearly per acre growth of 225 cubic feet, well above Schreiner's estimate of the mean productivity of French poplar plantings.

As hybrid poplar volume tables are non-existent, the writer used for his studies one covering large-tooth aspen which he had previously constructed in Pennsylvania (See Table 4).

Cultural Studies on Bottomland Area (M-1)

This bottomland planting, alongside an intermittent brook subject to seasonal flooding, was undertaken the spring of 1951. The area formerly was a pasture overrun with high grass and weeds. It makes a seemingly good poplar site; i.e. low ground, moist but not marshy throughout the year.

Five acres were planted here to McKee hybrid poplar at a spacing of 8 x 8 feet. Unrooted 12-inch cuttings were set with a mechanical tree planter to a depth of 10 inches in plowed ground. Initial survival had been approximately 80 percent.

These hybrid poplars exhibit very few cankers, and any in evidence appear to have partially healed over. Frost-crack injury at the tree bases, however, is quite common, resulting from our severe winter of 1958-59.

1956-57 Discing and Fertilizing: During the spring of 1956 an experiment had been initiated to test the effect of discing and fertilizing. It can be termed exploratory in nature, merely one step towards getting the maximum possible production from planted poplars if managed at an intensity level comparable to that of agriculture.

In this experiment, 5 rows of planted trees had been disced, 5 disced and fertilized, and 5 left untreated, which, after 3 repli-

Table 1. - Thirteen years of growth in McKee poplar plantation, and summary of 1959 cultural studies, on upland site (L-11)^{1/}

(Data on per acre basis)

Plot No.	Treatment	Trees No.	D.B.H.			Basal Area	Height			Volume		M.A.I. ^{4/} Cu.Ft. _{4/}
			Min.	Max.	Av.		Min.	Max.	Av.	Cu.Ft. _{2/}	Cords _{3/}	
1	Clearcut for pulpwood Before	500	3.7	8.3	6.4	111.4	28	54	45	2400	26.7	184.6
2	Thinned for pulpwood Before	500	5.5	9.1	7.1	136.0	42	62	53	3451	38.3	265.5
	Cut	260	5.5	9.1	7.0	68.8	42	62	52	1711	19.0	-
	Left	240	5.8	8.4	7.2	67.2	42	60	54	1740	19.3	-
Average of both plots Before		500	-	-	6.7	123.7	-	-	49	2925	32.5	225.0

^{1/} Listed as Plot L-11 in "Performance Records of Woody Plants in the Secret Arboretum".

^{2/} Taken from Pennsylvania aspen volume table. See Table 4.

^{3/} With a converting factor of 90 cu.ft. per cord.

^{4/} Average annual growth, during 13 growing-seasons.

Table 2. - Effect of site treatments on poplar growth in bottomland area (M-1)

Block No. ^{1/}	Treatment in 1956 & 1957	Mean D.B.H. ^{2/}	Range of D.B.H. ^{2/}	Mean Ht. ^{3/}	Range of Ht. ^{3/}	Basis No. of Trees
1A	Check or control	4.5	0.9 - 6.4	39	12 - 49	48
2A	Disked & fertilized	4.5	1.3 - 6.6	36	16 - 48	51
3A	Disked	4.4	0.8 - 6.7	36	12 - 49	55
1B	Check or control	4.2	1.8 - 6.2	34	20 - 46	52
2B	Disked & fertilized	4.7	2.4 - 6.4	39	26 - 48	60
3B	Disked	4.6	1.2 - 7.4	38	17 - 48	45
1C	Check or control	4.2	1.1 - 6.1	37	15 - 50	68
2C	Disked & fertilized	4.6	0.8 - 6.9	39	12 - 50	70
3C	Disked	4.9	1.2 - 7.3	37	16 - 46	45

^{1/} Five rows of poplars included in each block.

^{2/} Diameter at breast height ($4\frac{1}{2}$ feet above ground) measured with steel diameter tape.

^{3/} Total height, measured with hypsometer and tape.

Note: Tree averages listed above fall slightly under those in Table 3 because they represent the entire stand (494 trees) rather than just the 231 trees on the sample plots. Poplars on row-ends outside the plots occupy wetter ground and hence many are of smaller size.

cations, made 9 consecutive blocks containing 45 rows in all. Rate of fertilization was 1,000 pounds of 4-16-8 to the acre, sowed with a drill and disced in; which treatment was repeated the spring of 1957. This entire plantation had been disced twice during each of its first two years (1951 and 1952).

Height and diameter measurements of the 494 poplar survivors were taken in August 1959. Table 2 indicates that the differences in growth response between treatments after four growing-seasons were slight. Provided growth acceleration is tardy, it may show later inside the treated blocks.

Cultivating or discing for at least two years after planting generally is needed to control any rank competitors. Sod for instance has an inhibiting influence on the successful establishment of poplar. It also is quite intolerant of shade, so will not thrive beneath even a sparse overstory of vegetation.

1959 Silvicultural Treatments: During August 1959 five 1/10-acre sample plots were installed in this stand. Two plots were thinned on a pulpwood management basis, two were treated for an eventual yield of lumber or veneer, and the fifth was left as a check or control plot. Table 3 presents a summary of this experiment to date.

In thinning for pulpwood none but the poplars of merchantable size were harvested. Our cut comprised 8.3 cords per acre on Plot No. 1, and 7.3 cords per acre on Plot No. 4. After being bucked into 5-foot lengths to a minimum top diameter of 4 inches, this pulpwood was sold to a local buyer.

With lumber or veneer as the objective the largest and best poplars were left. There remained 170 and 220 select trees per acre on plots No. 5 and No. 2 respectively. A later thinning, following crown closure, should reduce this stand to 125-175 trees to the acre at the end of a 35-year rotation.

Table 3. - Nine years of growth in McKee poplar plantation^{1/}, and
summary of 1959 cultural studies on bottomland site (M-1)

(Data on per acre basis)

Plot No.	Treatment	Trees No.	D.B.H.			Basal Area	Height			Volume		M.A.I. Cu.Ft. ^{5/}
			Min.	Max.	Av.		Min.	Max.	Av.	Cu.Ft. ^{3/}	Cords ^{4/}	
1	For pulpwood											
	Before	520	0.8	7.1	4.7	61.6	12	51	38.9	1297	14.4	144.1
	Cut	200	4.0	6.8	4.6	34.2	39	51	45.7	754	8.3	-
	Left	320	0.8	7.1	4.0	27.4	12	47	37.7	543	6.1	-
2	For lumber or veneer											
	Before	470	1.2	7.3	4.6	53.4	13	49	40.5	1110	12.3	123.3
	Cut	250	1.2	6.0	4.3	24.7	13	49	38.9	505	5.6	-
	Left ^{2/}	220	3.1	7.3	4.9	28.7	33	49	42.4	605	6.7	-
3	Check or control											
	No cutting	440	2.3	6.3	4.7	53.0	27	52	40.2	1073	11.9	119.2
4	For pulpwood											
	Before	440	1.4	6.6	4.9	57.0	18	50	40.9	1190	13.2	132.2
	Cut	180	4.5	6.6	5.5	29.4	40	50	45.4	653	7.3	-
	Left	260	1.4	6.4	4.4	27.6	18	50	37.8	537	5.9	-
5	For lumber or veneer											
	Before	440	1.8	6.7	5.0	60.8	19	49	40.5	1233	13.7	137.0
	Cut	270	1.8	6.3	4.7	33.1	19	49	38.7	641	7.1	-
	Left ^{2/}	170	4.0	6.7	5.5	27.7	37	47	43.3	592	6.6	-
Average of all plots												
	Before	462	-	-	4.8	57.2	-	-	40.2	1181	13.1	131.2

1/ Listed as Plot M-1 in "Performance Records of Woody Plants in the Secest Arboretum".

2/ Banded crop trees, all pruned to 17 feet above ground.

3/ Taken from Pennsylvania aspen volume table. See Table 4.

4/ With a converting factor of 90 cu.ft. per cord.

5/ Average annual growth, during 9 growing-seasons.

Every poplar was pruned to 7 feet above ground. Crop trees were then selected, banded with white paint, and high-pruned to 17 feet, on plots No. 2 and No. 5. In addition, on the south side of the plantation road (no plots) some 30 potential crop trees were chosen, marked, and high-pruned. Approximately one-half the standing tree volume was cut into pulp and excelsior wood.

An average of the 5 plots prior to treatment shows 462 live poplars per acre having a diameter range of 0.8 to 7.3 inches (mean 4.8), a height range of 12 to 52 feet (mean 40), and a production of 1,181 cubic feet or 13.1 cords. That represents a mean annual increment, from 9 growing-seasons, of 131.2 cubic feet as shown in Table 3.

MacDonald^{3/} has reported that for 35-year-old Iowa cottonwood plantations 30,000 board feet of lumber and 50 cords of firewood per acre is not unusual. It must be understood, however, that such phenomenal growth is representative of plantings in alluvial soils on the Mississippi bottomlands. Final yields of Ohio grown hybrid poplars may be somewhat less than that. Our future stand appraisals will tell.

^{3/} MacDonald, G. B. 1924. The growth, returns and uses of planted cottonwood in Iowa. Bulletin 223. Iowa Agr. Expt. Station, Forestry Section, Ames, Iowa.

Table 4. - Large-tooth Aspen Volume Table
(*Populus grandidentata* Michx.)

J. E. Aughanbaugh		1937								C.C.C. & W.P.A.
Diameter	Total height of tree -- feet									Basis
Breast-	10	20	30	40	50	60	70	80	90	(No. of
high	Total Volume -- cubic feet									trees)
(Inches)										
1	.05	.09	.13	.....	.....	.....	.....	.....	.....	9
2	.20	.27	.38	.53	.....	.....	.....	.....	.....	114
3	.42	.60	.82	1.10	1.49	.....	.....	.....	.....	271
4	...	1.04	1.40	1.79	2.22	.....	.....	.....	.....	257
5	...	1.90	2.30	2.70	3.30	3.90	.....	.....	.....	184
6	...	.....	3.30	3.80	4.60	5.80	7.50	.....	.....	100
7	...	.....	4.50	5.20	6.30	7.80	9.80	.....	.....	55
8	...	.....	5.90	6.80	8.10	10.00	12.40	15.3	.....	60
9	...	.....	.....	8.60	10.20	12.40	15.30	18.8	.....	43
10	...	.....	.....	10.60	12.60	15.30	18.70	22.6	27.4	51
11	...	.....	.....	.....	15.20	18.50	22.40	26.9	32.0	37
12	...	.....	.....	.....	18.00	21.90	26.40	31.5	37.1	30
13	...	.....	.....	.....	.....	25.60	30.70	36.3	42.4	23
14	...	.....	.....	.....	.....	29.60	35.30	41.4	48.0	8
15	...	.....	.....	.....	.....	.....	40.00	46.6	54.0	4
16	...	.....	.....	.....	.....	.....	44.90	52.0	60.6	4
Basis	1	155	377	352	112	73	107	73	0	1250

Volume includes stump, stem, top and bark, but no limbwood. Based on taper measurements at 4-foot intervals. Most field data came from 34 different C.C.C. camps, and was collected in 18 different counties in Pennsylvania. Office computations with W.P.A. assistance. W. G. Grieve aided in making the table. Average deviation of individual tree volumes from interpolated tabular volumes \pm 3.39 percent; aggregate difference .65 percent low. Block indicates the extent of the original data.



Photo No. 1

Discing hybrid poplar planting during first growing-season, summer of 1951.



Photo No. 2

McKee poplar on bottomland site (M-1) after being fertilized and disced, spring of 1956.

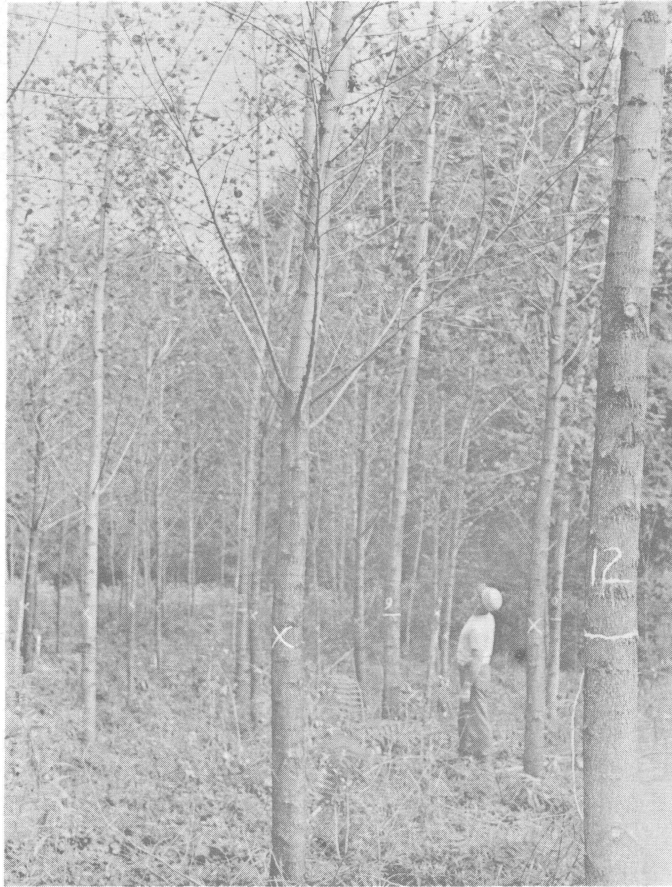


Photo No. 3

Sample plot No. 2 marked for treatment, on bottomland site (M-1). Numbered poplars are crop trees. "X" trees to be cut for pulpwood.