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Growth and Flowering of NC-99 Cottonwood Seed Sources in Minnesota^{1/}

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Observations on growth through six seasons and flowering in three successive years of a cottonwood (Populus deltoides Bart.) provenance test established in 1965 at the University of Minnesota's Rosemount Agriculture Station, Dakota County, Minnesota (44°45'N) are summarized below. These data supplement the report by Mohn and Pauley^{3/} on growth, survival and winter injury during the first two years following planting and give further insight into the development of cottonwood seed sources under Minnesota conditions.

Materials and Methods

The test was established on an old-field site using 1-0 seedlings provided by the University of Illinois. Materials represented 108 open-pollinated families. Seed came from trees in natural stands in the central and western portion of the species range. The state and latitude of collection areas and the number of trees planted from each are given in Table 1. In planting, a randomized complete-block design was used with each family represented by one tree in each of five replications. Spacing was 10 x 10 feet and the entire planting was surrounded by a 1-tree border row of local origin. Seedlings were cut back to the ground immediately after planting and pruned to a single stem during the first growing season. In 1965 and 1966 weeds were controlled in the planting by disking, and in subsequent years the planting has been mowed at irregular intervals.

In early 1971, six growing seasons after planting, surviving plants were evaluated and the following recorded:

- a) height of trees to the nearest foot
- b) diameter at breast height to the nearest 0.1 inch
- c) number of stems per tree
- d) form value, a subjective rating of from 1 (poorest) to 5 (best) using the plantation average as a standard.

Trees also were classified as flowering or non-flowering and their sex noted in 1971, 1972 and 1973.

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^{3/}Mohn, C. A. and S. S. Pauley. 1969. Early Performance of Cottonwood Seed Sources in Minnesota. Minnesota Forestry Research Note No. 207. 4 pp.

Results and Discussion

Survival after seven years, as summarized by Table 1, strongly reflects the influence of seed source. Survival of materials from north of 38°N was fair (above 70%) with the highest survival (95%) in local (Minnesota) material. Survival of materials from between 37 and 38°N was relatively low, and all materials from south of 37°N were eliminated by 1971. These data indicate that selection of materials for direct use under Minnesota conditions should be carried out in natural populations north of the 38th parallel.

Examination of height and diameter data using analysis of variance indicated significant differences (.05 level) between seed sources. The Nebraska, Minnesota and Missouri sources were above average in both mean height and mean diameter (Table 1). The Indiana collection was above average in diameter but below average in total height (Table 1). Local (Minnesota), Missouri, Nebraska and Indiana populations all appear to be promising sources of rapid growing materials. However, data related to both Nebraska and Indiana collections must be viewed with caution because of the small number of trees involved (Table 1).

Cottonwood can be propagated asexually with ease, and the proportion of outstanding individuals within a population is critical to selection. The proportion of trees in each seed source which exceeded the plantation mean for height and diameter by 1.5 standard deviations is given in Table 1. On the basis of these data the Missouri source in which more than 10 percent of the trees were outstanding for both parameters is the most promising non-local population in which to select for growth. Exceptionally vigorous individuals were also found in both the Nebraska and Indiana populations. In these cases the small number of trees tested make conclusions tenuous and additional materials from these origins should be evaluated.

The proportion of flowering trees in the plantation was 52 percent in 1971 and increased to 75 percent by 1973 (Table 2). In 1971 a higher proportion of the flowering trees were female, but by 1973 the male-female ratio was close to 1:1 (Table 2). There was no clear relationship between origin and flowering (Table 1) although flowering appeared to be associated with the more vigorous trees. Viable seeds have been obtained from many of the trees. The relatively early and extensive flowering of trees of both sexes and its continuation over a number of years can be viewed as favorable for breeding work with this species in Minnesota.

Data on the number of stems and the rating of stem form were also evaluated using analysis of variance. No differences (.05 level) were found among source means for either character.

Table 2. Flowering in Rosemount cottonwood Plantation 1971-1973.

Year	Number Flowering Trees	Proportion Trees Flowering	Female:Male Ratio
1971	177	.52	1.27
1972	223	.65	1.13
1973	258	.75	1.08

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Table 1. Field performance of eastern cottonwood seed sources in Minnesota.

Seed Source (Latitude)	No. of ^{1/} Trees Planted (No. of Families)	No. of Living Trees 1971	Survival to 1971 (%)	Flowering Trees in 1973 (%)	6th year height		6th year dbh		No. of Stems/tree Mean \pm SE	Stem Form Index ^{3/} Mean \pm SE
					Mean \pm SE (ft)	Exceptional ^{2/} Trees (% of Surviving Trees)	Mean \pm SE (inch)	Exceptional ^{2/} Trees (% of Surviving Trees)		
Minnesota (44-46°N)	130 (26)	122	95	82	22.8 \pm .2	2	3.6 \pm .1	5	1.4 \pm 0	2.9 \pm 0
South Dakota (44°N)	5 (1)	4	80	75	18.0 \pm 1.7	0	2.3 \pm .5	0	1.0 \pm 0	3.0 \pm 0
N. Illinois (41-42°N)	80 (16)	57	71	61	20.6 \pm .5	0	3.1 \pm .1	0	1.3 \pm .1	2.8 \pm .1
Nebraska (40-41°N)	15 (3)	13	87	85	24.2 \pm .8	8	3.8 \pm .2	0	1.1 \pm .1	2.8 \pm .2
Indiana (40-41°N)	20 (4)	18	90	83	20.3 \pm .8	0	3.6 \pm .2	12	1.2 \pm .1	2.7 \pm .2
Ohio (38-41°N)	60 (12)	52	87	69	19.5 \pm .6	0	3.1 \pm .1	0	1.4 \pm .1	2.7 \pm .1
Missouri (38-39°N)	75 (15)	61	83	80	22.7 \pm .5	10	3.4 \pm .1	11	1.2 \pm .1	2.8 \pm .1
Kansas (37-39°N)	10 (2)	4	40	100	20.3 \pm .3	0	2.9 \pm .4	0	1.4 \pm .1	2.7 \pm .1
S. Illinois (37-38°N)	35 (7)	11	34	45	19.4 \pm 1.5	0	3.1 \pm .4	0	1.5 \pm .3	2.3 \pm .2
Alabama, Arkansas, Texas, Mississippi, Louisiana (<37°N)	110 (22)	0	0	--	--	--	--	--	--	--
Total or Plantation Mean	540 (108)	342	63	75	21.6	3	3.4	4	1.3	2.8

^{1/}Trees planted as 1-0 stock in spring 1965; families are open-pollinated.

^{2/}Trees with height or dbh 1.5 standard deviations greater than plantation mean.

^{3/}On scale: 1 (poorest) - 5 (best)