Nine-Year Outplanting Test of Cottonwood and Hybrid Poplar Clones in Northwestern Ontario

Robert E. Farmer, Jr., C. Lynn Palmer, Harvey W. Anderson, Louis Zsuffa, and Gwenoth O'Reilly

Professor, Lakehead University School of Forestry, Thunder Bay, ON; tree improvement forester, Ontario Tree Improvement Council, Thunder Bay, ON; research scientist, Ontario Forest Research Institute, Maple, ON; professor, University of Toronto Faculty of Forestry, Toronto, ON; and research associate, Lakehead University School of Forestry, Thunder Bay, ON

Twenty-two poplar clones (Populus deltoides Bartr. ex Marsh., P. balsamifera L., and their hybrids), selected for frost resistance and growth in nursery trials, were outplanted and compared for nine growing seasons in a randomized complete block experiment in northwestern Ontario (49° 20' N, 82° 05' W). Fifteen of the clones were moderately to severely infected with stem cankers by their ninth growing season. Five relatively disease free clones, ramets of which were 6 to 7 meters in height at year 9, were selected for further testing and pilot-scale use in northwestern Ontario. Tree Planters' Notes 42(2):49-51; 1991.

Although the greatest potential for increased production of poplar in the boreal forest region exists in managing natural stands of aspen, there are some opportunities for planting rapidly growing, climatically adapted material from *Populus deltoides* Bartr. ex Marsh (eastern cottonwood), *P. balsamifera* L. (balsam poplar), and their hybrids. The Ontario Forest Research Institute began informal nursery adaptability tests during the 1970's with the objective of developing suitable clones for northern plantings (latitudes higher than 47°). These were followed by formal clonal tests of material exhibiting good survival and growth under northern nursery conditions. Here we report 9-year results from such a clonal test planted in 1981 near Kapuskasing, ON (49° 20'), about 2° above the northern edge of *P. deltoides'* range in eastern North America.

Methods

Twenty-two clones (table 1) were selected for the test after being informally evaluated in Swastika and Thunder Bay, ON, nurseries for initial growth, frost hardiness, and freedom from diseases. These 22 clones were the best of the several hundred clones evaluated. Detailed information on their origin can be obtained from the senior author; nomenclature is that of the Ontario Ministry of Natural Resources.

The soil on the old-field site where the test was established has a sandy loam A horizon about 30 cm deep, a sandy clay loam B horizon from 31 to 45 cm, and a sandy clay C horizon. The site is moderately well drained. The site was ploughed and disked several times prior to being planted in the spring of 1981.

Unrooted 25-cm-long cuttings were planted flush with the soil surface in a randomized complete block design that included four replications of 4-ramet-square plots planted at 3-mby 2-m spacing. During the first two growing seasons, the planting was kept free of weeds by disking between rows and hand cultivation around trees. In later years, the test site was mowed at least once a year to control competition until crown closure.

Height was measured and observations of frost and disease damage were noted in 1982, 1983, and 1985 by the Ontario Forest Research Institute. In 1986, the forest genetics group at Lakehead University, financed by a Canada-Ontario Forest Resources Development Agreement grant, assumed responsibility for measurement and analysis. Observations of height, diameter and apparent frost damage, and incidence of canker disease were recorded annually in late September and October from 1986 to 1989. Mean clone height and dbh were used to compute relative volume using D^2H (dbH^2 x height) (table 2).

Table 1—*Survival, frost damage, and disease characteristics of poplar* (Populus) *clones tested at Bonner Tree Improvement Center, Ontario*

Clone	Origin of clone	Percent survival		Percent with frost damage	Percent forked	Percent with major stem cankers
		1986	1989	1986	1989	1989
D189	*P. deltoides* cv Brooks #1, AB	94	94	0	6	13
D190	*P. deltoides* cv Brooks #4, AB	100	100	0	25	0
D191	*P. deltoides* cv Brooks #6, AB	94	94	0	20	0
D195	*P. deltoides* cv Walker, SK	87	62	0	0	70
D198	*P. deltoides* cv *angustifolia,* SK	94	94	6	47	0
D207	*P. deltoides* cv Brooks #1, AB	94	94	0	0	6
DN41	*P. euramericana* Grand Falls, NF	100	100	0	25	25
DN42	*P. euramericana* Grand Falls, NF	100	100	12	37	25
DTACN1	*P. candicans* × *berolinensis,* PQ	100	100	0	19	6
JAC14	*P.* × *jackii* Grand Falls, NF	87	75	19	0	25
JAC22	*P.* × *jackii* Quebec City, PQ	100	100	0	12	0
JAC23	*P.* × *jackii* Quebec City, PQ	94	94	6	0	25
JAC25	*P.* × *jackii* Charlesbourg, PQ	100	100	12	0	0
JAC27	*P.* × *jackii* Charlesbourg, PQ	100	100	0	0	70
JAC28	*P.* × *jackii* Winnipeg, MB	100	94	6	13	0
JAC29	*P.* × *jackii* Winnipeg, MB	94	87	6		25
JAC30	*P.* × *jackii* Winnipeg, MB	87	81	12	0	17
JAC31	*P.* × *jackii* Winnipeg, MB	100	100	0	6	6
JAC35	*P.* × *jackii* Timmins, ON	94	94	21	0	13
TAC10	*P. tacamahaca* Winnipeg, MB	100	94	12	0	0
TAC9	*P. tacamahaca* Winnipeg, MB	69	56	33	0	high mortality due to canker
TACN1	*P.* × *berolinenis* cv Berlin Poplar, SK	94	94	0	6	0

Results and Discussion

Mean clone heights throughout the test period are presented in table 2, where clones are ranked by 1989 (9-year) height. During the period, height increment of individual clones had a mostly uniform linear relationship with time. Therefore, relative shoot growth rates (2) for the 7-year period from 1982 to 1989 were calculated (table 2) using clone means; these ranged from .19 to .28 m/m/yr. Coefficients for linear correlations of clone means for height in 1989 and earlier years were as follows: 1982, .62; 1983, .75; 1985, .90; 1986, .94; and 1987, .98. Clone means for diameter at breast height (dbh) in 1989 ranged from 2.4 to 9.8 cm.

With three exceptions (D195, JAC14, and TAC9), all of the clones exhibited good survival (> 80%). Fifty percent of the clones exhibited some evidence of frost damage by 1986 (table 1). This took the form of necrosis on the current year's annual shoot growth, which subsequently caused some deformity to the stem.

None of the clones were killed back to the ground by freezing. Fifty percent of the clones exhibited forking near the ground level, which resulted in dual stems on 6 to 47% of their ramets (table 1). Mechanical pruning to a single stem during the first year's growth will eliminate this tendency, which is probably a function of the number of cutting buds sprouting after

Table 2—*Growth characteristics of poplar clones tested at Bonner Tree Improvement Center*

Clone	Height (m)							Relative ht growth rate (m/m/year)	dbh (cm) 1989	Volume 1989	
	1982	1983	1985	1986	1987	1988	1989*			D^2H	dm^3
JAC31	1.18	2.20	3.99	4.77	5.39	6.37	7.42 a	0.26	9.68	695	23.33
D191	1.00	2.04	3.48	4.44	5.04	5.96	7.02 ab	0.28	9.19	593	19.88
D190	1.10	2.02	3.70	4.51	5.13	5.98	6.93 ab	0.26	8.65	518	17.38
DTACN1	1.24	1.95	3.61	4.22	4.79	5.48	6.46 ab	0.24	9.76	615	20.60
JAC27	1.27	2.04	3.37	4.06	4.75	5.49	6.27 ab	0.23	7.68	370	12.38
DN41	1.49	2.27	4.01	4.32	4.75	5.37	6.24 ab	0.20	9.32	542	18.14
D195	1.33	2.44	4.32	4.85	5.02	5.59	6.10 abc	0.22	5.99	219	7.32
TACN1	1.14	1.89	3.32	3.95	4.43	5.17	6.02 abc	0.24	8.77	463	15.49
D207	1.54	1.48	3.05	3.56	4.14	5.01	5.88 abc	0.19	7.15	300	10.05
JAC30	1.08	1.92	3.20	3.85	3.96	4.54	5.59 abcd	0.23	4.81	129	4.32
JAC25	1.10	1.95	3.08	3.55	4.22	4.99	5.57 abcd	0.23	6.12	208	6.97
JAC29	0.87	1.64	2.74	3.11	3.79	4.53	5.49 bcd	0.26	6.59	238	7.96
D189	0.86	1.95	3.23	3.77	4.18	4.75	5.46 bcd	0.26	6.44	226	7.56
JAC22	1.22	2.17	3.10	3.47	4.05	4.92	5.40 bcd	0.21	6.96	262	8.74
D198	1.04	1.74	2.85	3.34	4.01	4.58	5.36 bcd	0.23	7.18	276	9.23
JAC23	1.07	1.95	2.93	3.46	3.90	4.59	5.33 bcd	0.23	6.65	236	7.87
DN42	1.16	1.75	2.79	3.13	3.64	4.25	5.00 cd	0.21	6.26	196	6.54
TAC10	1.01	1.88	2.75	3.06	3.44	3.96	4.38 cd	0.21	4.67	96	3.18
JAC28	1.04	1.85	2.67	2.89	3.36	3.85	4.19 cd	0.20	4.85	98	3.28
JAC14	0.61	1.41	2.40	2.77	3.11	3.51	3.92 d	0.27	6.22	152	5.05
JAC35	0.92	1.56	2.37	2.59	2.97	3.40	3.78 d	0.20	4.41	74	2.45
TAC9	0.47	0.97	1.41	1.82	1.91	1.95	2.32	0.23	2.36	13	0.43

*Clone heights for 1989 with the same letter in common do not differ significantly at 0.05 level of probability.

planting rather than disease or frost damage. However, by 1989 there were moderate to severe stem cankers (probably due to *Septoria)* on 68% of the clones. In the most severe cases (for example, D195, JAC27, and TAC9), canker disease is resulting in elimination of susceptible clones from the test.

Growth and freedom from disease and frost damage were considered in selecting five clones that show promise for use in northern plantings: D190, D191, JAC31, TACN 1, and DTACN 1. Of these, JAC31 and DTACNI had at least one ramet with a moderately severe canker in 1989. All will require further observation before their operational use can be recommended. It is noteworthy, however, that 9-year height of the five clones equals that of quaking aspen *(P. tremuloides* Michx.) on good sites (site class 70 to 80) in northern Ontario (1). Considering that the aspen is usually recruited as root sucker stands with early support by extensive root systems, the juvenile performance of these clones planted as unrooted cuttings is good relative to natural stands of aspen. The poplars' good performances are undoubtedly due, in part, to excellent weed control during initial years, an essential condition for establishment of poplar plantations. Thus, although disease susceptibility remains reason for caution, it appears that some clones of *P. deltoides and* its hybrid with *P. balsamifera* may be suitable for planting on better sites in northwestern Ontario, well beyond the normal range of *P. deltoides.*

Literature Cited

1. Carmean, W. H.; Hahn, J. T.; Jacobs, R. D. 1989. Site index curves for forest tree species in the eastern United States. Gen. Tech. Rep. NC-128. St. Paul, MN: USDA Forest Service, North Central Forest Experiment Station. 142 p.
2. Evans, G. C. 1972. The quantitative analysis of plant growth. Berkeley, CA: University of California Press. 734 p.