

Hybrid Poplar Cultivars for Maximizing Phytomass Production on Gold Mine Tailings in the Black Hills

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Abstract. Twenty-six hybrid poplar clones were planted as cuttings on a gold mine tailings in the Black Hills. Four exhibited very good survival and growth. Other clones had relatively high (exceeding 50 percent) survival but slow growth (below 60 cm) over a 5-year period.

Introduction

State and federal mining laws require the established vegetation on postmined sites to equal or exceed production and desirability of the pre-mined vegetation. These requirements have encouraged use of genetically improved or selected planting stock. Some of the genetically improved stock has been produced by hybridization.

The use of hybrid poplar began with the introduction to the United States of Lombardy poplar *Populus nigra* L. cv. 'Italica' (Rehder 1954). In 1924, hybridization of poplar was initiated in Rumford, Maine by the Oxford Paper Company, now Boise Cascade Paper Group, in cooperation with the New York Botanical Garden. Inter- and intraspecific crosses were made from collections of poplars planted at the New York Botanical Garden and wild trees of *Populus deltoides* (Demerett 1981).² The USDA Forest Service, Northeastern Forest Experiment Station, is currently testing 199 poplar clones--158 clones from the New York hybridization study and 41 clones from Canadian and European selections (Demerett 1981).

High percentage survival is the first priority to provide spoil cover; the second consideration is rapid growth. Hybrid poplars have been of interest to people who are looking for trees which would become readily established and produce browse for wildlife. This interest is important to people complying with mine reclamation regulations.

This paper discusses the survival and growth of 26 clones of hybrid poplar planted on a gold mine tailing in the Black Hills.

Method

The area of this study was a gold mine tailings dump of about 44 acres. The material con-

sisted of dolomites, quartzite, sandstone, and crushed shale which had been processed to remove the gold. The material classified as a brown sandy loam soil type.

The mine tailings used in this study were very low (0.7%) in organic matter, slightly acidic, and very low in fertility. Soil tests indicated NPK was 5, 18, and 140 lb/acre, respectively (South Dakota State University Soil Testing Laboratory). Representative soils contain 2400, 3000 and 48,000 lb₃/acre of NPK, respectively (Lyon et al. 1956).³ Electrical conductivity was 0.2 mmho/cm.

Thirteen cuttings of twenty-six hybrid poplar clones of various parentage were planted in split plot design in the spring of 1978 (Table 1). These clones were grown in the USDA Forest Service Nursery at Coeur D'Alene, Idaho. The clones were supplied in the form of cuttings 3/8 inch diameter and 12 inches long, taken in the fall and stored over winter. Upon receiving the cuttings in the spring, we placed them in control climate coolers until field conditions were ready for planting.

The planting medium, of relatively sandy loam texture, allowed easy planting with the use of a dibble. The dibble was designed to be slightly larger than the diameter of the cutting and long enough to allow approximately 2-3 inches of the cutting to protrude above the ground surface. The soil around the planted cuttings was packed against the cutting to insure soil contact. One-half gallon of water was applied immediately after planting.

Survival and height (from tree base to top of terminal bud) was measured after leaf drop, in October. Measurements were recorded annually; but in this paper, results are based on the survival and growth after the fifth growing season.

Table 1. Listing of hybrid poplar clones by clone number and parentage.

Northeastern Station	
clone numbers	Parentage (female x male)
NE-4	<i>P. nigra</i> x <i>P. laurifolia</i>
NE-9	<i>P. nigra</i> x <i>P. trichocarpa</i>
NE-11	<i>P. nigra</i> x <i>P. trichocarpa</i>
NE-17	<i>P. cv.</i> 'Charkoviensis' x <i>P. cv.</i> 'Caudina'
NE-29	<i>P. cv.</i> Charkoviensis x <i>P. trichocarpa</i>
NE-32	<i>P. cv.</i> 'Angulata' x <i>P. cv.</i> 'Berolinensis'
NE-35	<i>P. cv.</i> 'Angulata' x <i>P. cv.</i> 'Plantierensis'
NE-40	<i>P. cv.</i> 'Petrowskyana' x <i>P. cv.</i> 'Caudina'
NE-42	<i>P. maximowiczii</i> x <i>P. trichocarpa</i>
NE-44	<i>P. maximowiczii</i> x <i>P. cv.</i> 'Berolinensis'
NE-50	<i>P. maximowiczii</i> x <i>P. cv.</i> 'Berolinensis'
NE-51	<i>P. maximowiczii</i> x <i>P. cv.</i> 'Plantierensis'
NE-52	<i>P. maximowiczii</i> x <i>P. cv.</i> 'Plantierensis'
NE-53	<i>P. maximowiczii</i> x <i>P. cv.</i> 'Caudina'
NE-207	<i>P. deltoides</i> x <i>P. trichocarpa</i>
NE-216	<i>P. deltoides</i> x <i>P. trichocarpa</i>
NE-241	<i>P. deltoides</i> x <i>P. cv.</i> 'Plantierensis'
NE-258	<i>P. cv.</i> 'Angulata' x <i>P. deltoides</i>
NE-278	<i>P. nigra</i> x <i>P. cv.</i> 'Eugenei'
NE-279	<i>P. nigra</i> x <i>P. laurifolia</i>
NE-302	<i>P. cv.</i> 'Betulifolia' x <i>P. trichocarpa</i>
NE-316	<i>P. cv.</i> 'Charkoviensis' x <i>P. cv.</i> 'Robusta'
NE-327	<i>P. cv.</i> 'Candicans' x <i>P. cv.</i> 'Berolinensis'
NE-341	<i>P. cv.</i> 'Rasumowskyana' x <i>P. cv.</i> 'Plantierensis'
NE-353	<i>P. deltoides</i> x <i>P. cv.</i> 'Caudina'
NE-368	<i>P. maximowiczii</i> x <i>P. trichocarpa</i>

Table 2. Five-year survival, in percentage, and height, in centimeters, of the 10 hybrid poplar clones with least mortality.

Clone ID	Survival (%)	Height (cm)
NE-341	92	77
NE-302	92	28
NE-42	85	60
NE-50	85	51
NE-4	77	63
NE-207	77	70
NE-11	69	61
NE-32	69	65
NE-216	69	63
NE-258	69	94

Table 4. Four-year height, in feet, of hybrid poplar clones grown in Pennsylvania, Maryland, South Dakota, and Pakistan.

Clone ID	Pennsylvania ¹	Maryland ¹	South Dakota	Pakistan ²
NE-17	22	16	2	
NE-41	21	16	2	-
NE-316	19	15	1	-
NE-359	22	16	2	-
DN-22	21	19	-	50

¹ According to Demeritt (1961)²

² According to Hussain and Sheikh (1961)⁸

Results and Discussion

Survival of the clones after 5 growing seasons ranged from 92 percent to 8 percent, with an average of 58 percent. For simplicity in this paper, survival top 10 clones ranged from 92 percent to 69 percent, with an average of 78 percent (Table 2). Comparable high survivals have been observed in Nebraska (Bagley 1973) on southern sites of the United States (Maisenhelder 1970), and in southwestern Ontario (Von Althen 1981).^{4,5,6} One of the best survivors--NE-302 had a low 5-year height growth--the lowest of the top 10 (Table 2). These data indicate NE-341, with a survival of 92 percent and height growth of 77 cm, which is second from the highest height growth of 94 cm, would be considered most encouraging to both survival and height growth.

When using height growth as the major criterion for selection of the most encouraging clone for establishing high performance poplars on tailing in the Black Hills, NE-278 had the greatest height growth of 98 cm after 5 growing seasons (Table 3). However, the survival of NE-278 was only 38 percent--the lowest of the top 10 according to height. Other clones of more encouraging values would be NE-258, 341, 207, and 32 with heights/survivals of 94/69, 77/92, 70/77, and 65/69, respectively.

These height growths--94 cm per 5-year period--without cultural treatments are very respectable when considering soil type, precipitation, and other studies on mine reclamation (Bjugstad et al. 1981). However, they are somewhat lacking when compared to height growth data from Pennsylvania, Maryland, and Pakistan (Table 4). In addition,

Table 3. Five-year height, in centimeters, and survival, in percentage, of the 10 tallest hybrid poplar clones.

Clone ID	Height (cm)	Survival (%)
NE-278	98	38
NE-258	94	69
NE-5	90	46
NE-35	88	54
NE-341	77	92
NE-40	75	46
NE-327	71	46
NE-207	70	77
NE-32	65	69
NE-44	64	46

the cuttings in Pennsylvania, Maryland, and Pakistan (Husrain and Sheikh 1981) were planted on soils, compared to the relatively inert mine tailings in the Black Hills.⁸

Conclusions

Four of 26 hybrid poplar clones planted as cuttings on a gold mine tailing exhibited very encouraging survival and growth. These four were NE-258 (P. cv. 'Angulata' x P. deltooides), NE-341 (P. cv. 'Rasumowskyana' x p.cv. 'Plantierensis'), NE-207 (P. deltooides x P. trichocarpa), and NE-32 (P. CV. 'Angulata' x P.cv. 'Berolinensis'). Other clones had relatively high (exceeding 50 percent) survival but slow growth (below 60 cm) over the 5-year period.

Acknowledgements

Access to and the use of the gold mine tailings provided by Homestake Mining Company is gratefully acknowledged.

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