

FIVE-YEAR STUDY RESULTS OF HYBRID POPLAR CLONE STUDY USING DEEP ROW BIOSOLIDS INCORPORATION

Formerly known as "sludge," biosolids refer to the soil-like residue of materials removed from sewage during the wastewater treatment process. They usually contain from 1-4% nitrogen and are a valuable source of fertilizer for agriculture and forest crops. The utilization of biosolids using forestry plantations of hybrid poplar trees solves many of the problems of traditional application methods and holds great promise for our region. This series of fact sheets will educate the reader about the practical application of research on this topic. More information can be found in the other *Biosolids* fact sheets of this series and at www.naturalresources.umd.edu.

BIOSOLIDS & FORESTS Research & Extension Team



The Baltimore/Washington, D.C. Metro area produces about 1.2 million wet tons of biosolids per year from area treatment plants (2002 data). While much of this material has been applied to agricultural fields in the past, new regulations and the loss of agricultural land to development have required investigating other beneficial uses of biosolids.

Application to native forests has been the dominant method of utilizing biosolids in the Pacific Northwest cities of Seattle and Tacoma, Washington. Negative perceptions and concerns about forest application of biosolids have successfully been addressed after decades of experience. However, the higher population pressures in the Northeast make application of biosolids to native forest questionable.



One year's growth on hybrid poplar plantation.

A promising technique has been developed on one site in the Washington metro area uses hybrid poplar trees planted on abandoned gravel spoils. It is called deep row application. Deep row refers to the application of the biosolids in a series of shallow, wide trenches that are immediately covered, which eliminates odor problems. After the site is graded, it is planted with hybrid poplar trees that grow rapidly for approximately 6 years using the nutrients

in the buried trenches as their nutrient base. The deep clay layer underlying the more than 10,000 acres of gravel spoils in the southern Maryland area minimize leaching. Since 1983, no adverse water quality impacts have occurred.

Deep-row application of biosolids on reclamation sites is a unique alternative land application method that solves

many of the problems associated with surface application techniques. When combined with the growth of nitrogen demanding hybrid poplar trees, it provides a natural recycling system that utilizes nutrients on-site, produces forest products, generates wildlife habitat, and reduces erosion while reclaiming abandoned, biologically dead soils created by sand and gravel surface mining operations.

The combining of lime-

containing biosolids (up to 20% lime) and nutrient-poor native soil creates a unique mix of conditions. The purpose of this study was to test a variety of hybrid poplar clones to see which perform best after five years of growth in this unique application. The clone used in the initial plantings was HP-308, but problems with cottonwood beetle, slow growth, and the changing makeup of biosolids necessitated experimentation with new clones.

Site Description

The ERCO site is located in Prince George's county, MD, about 15 miles from Washington, D.C. It consists of a plateau with steep banks that fall away to a stream incision. All steep banks are covered with permanent forest cover. The edges of the plateau are bermed and runoff is routed to one of four detention ponds. The stream on the east and north sides of the site are protected by an additional three detention ponds (Figure 1).

At any one time, only one or two sections are cleared and replanted. Hence, only 8-16% of the site is subject to significant surface runoff generation. Approximately 25% of the site (13 ha) is in permanent cover, either forested steep slope or detention ponds and buffers.

There are eight monitoring wells placed around the perimeter of the site that are used to sample groundwater at various depths. Since 1983, there have been no negative impacts on water quality.

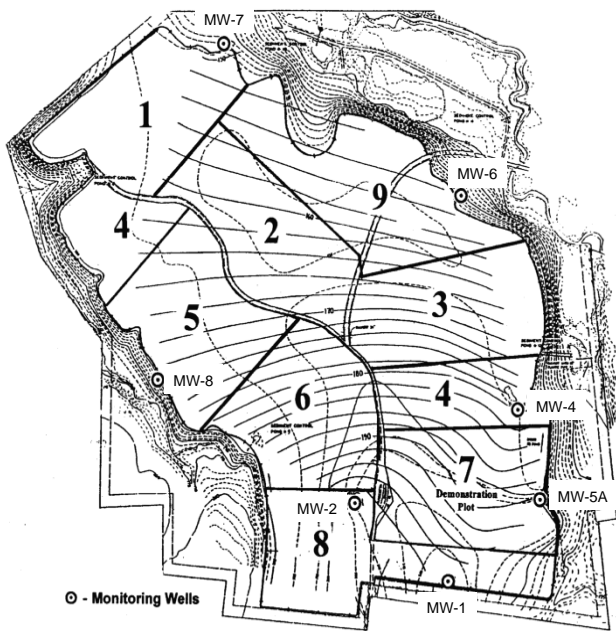


Figure 1. Plot layout of ERCO site showing nine 4.05 ha sections planted with hybrid poplar, as well as seven monitoring wells that are numbered (MW-#). Site is located on an abandoned gravel surface mine.

Experiment Description

The design and suggested layout of the clone trial was developed by Mike VanHam of Sylvis Environmental in British Columbia, Canada, a private consultant who is retained by ERCO, Inc. The actual site location, data collection and analysis were completed by Eric Flamino of

ERCO, Inc. and Jonathan Kays of Maryland Cooperative Extension.

The entire test area is 400 ft. by 360 ft. (Table 1) and is located in Area 5 on the site map. The test plots were divided into 12 equal sized blocks, which are 100 feet by 120 feet. Each block was planted with a single hybrid poplar clone. Eleven clones were selected based on recommendations by Sylvis Environmental, Inc.

The twelfth plot was planted with seedlings of *Paulownia tomentosa* but were not included in the study. Individual trees were planted on a 10 ft. by 10 ft. spacing. Each block contained 120 trees. Only the thickest and best looking planting stock was planted. The planting stock consisted of a cut branch stem about one foot long and 1/2 inch in diameter. During the month of April, the cuttings were planted firmly into the ground with the top bud showing. The vegetation competition between the rows was controlled by periodic mowing.

Total tree height was measured using a telescoping pole at the end of the first and second growing seasons. Height was measured by in the following years using an electronic device. Diameter was only measured in year five. The data were analyzed using SAS (Statistical Analysis System). Initial analysis of the data distribution indicated that using the square of the height measurements provided a better data distribution for analysis.

Table 1. Hybrid poplar clonal study ploy layout.

DN 17	OP 367	DN 5		120'	Main Road
DN 82	HP 308	DN 70	184-411	120'	
50-197	NM 6	DN 34	15-029	120'	
100'	100'	100'	100'		

Results

Survival

Survival after the second growing season was greater than 90% for three clones with three other clones in the 80-90% range (Figure 2 and Table 2). These clones are: OP-367 (96%); DN-70 (94%); DN-5 (93%); DN-82 (88%); NM-6 (87%); and DN-34 (82%). The survival of clone 15-029 at 70% was lower than the others, but should receive some consideration due to its good performance in total height measures. The survival of other clones was under 80%, which would indicate they are not well adapted to survive in this environment. Deer may have had some impact on some clones to survive and grow.

Height

The OP-367 was significantly taller than all the other clones after the end of year 1 and year 2 (Figure 3). The height growth in the second year was 165 cm, 50 cm more than the next best performer DN-34 at 115 cm (Table 2).

After 5 years, OP-367 had the greatest height of all clones. DN-17 and 15-029 had the second and third greatest height growth, respectively. The average heights of clones are shown in Table 2, separated by year.

Conclusions

The OP-367 clone was the best performer in terms of survival (96%) and total height growth after 5 years (9.3 m). Though clone DN-17 had good height growth (8.3 m), the low survival rate (47%) reduces the advantage in using this clone. However, there is a possibility that deer browsing

may have impacted the survival, thus more analysis needs to be completed before discounting the possible benefits of using this clone.

Field notes indicated that deer had caused serious mortality on some clones. When a stem was damaged by deer browsing or rubbing, it typically died back to the base. In many cases these stems died, impacting overall survival. For those stems that did grow, the lower heights could also impact the overall mean height of the entire treatment.

When survival and height growth are considered together, the DN-34, NM-6, and DN-5 clones were the next three clones behind the OP367 that should be considered for use at the ERCO site. However, if poor survival can be improved through irrigation or protection from deer, then the DN-17 clone should be considered, due to its superior height growth.

Figure 2. Survival of hybrid poplar clones after first & second growing season

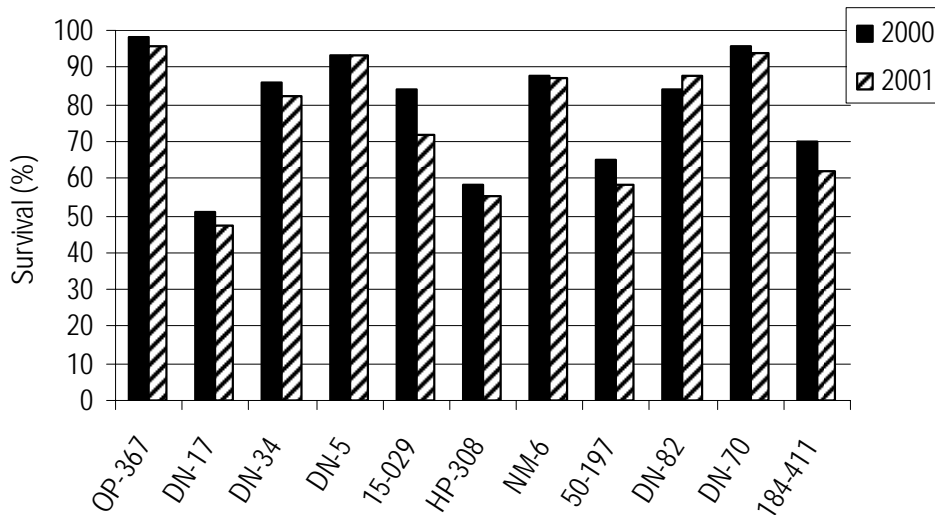


Figure 3. Height of hybrid poplar clones after 5 years of growth at ERCO site.

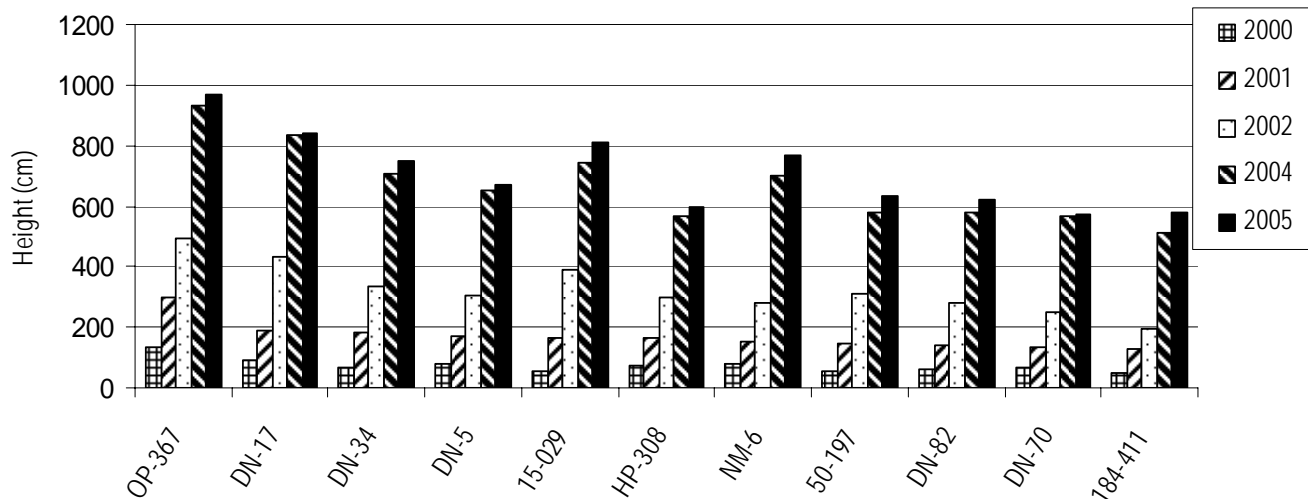


Table 2. Survival and Growth of Hybrid Poplar Clones at ERCO Site.

Clone	Survival Rate (%)		Total Height (cm)				Height growth yr. 1 - 2	Height growth yr. 2-3	Height growth yr. 3-5
	2000	2001	2000	2001	2002	2004			
OP-367	98	96	131	297	494	933	165	197	439
DN-17	51	47	92	190	434	833	98	244	399
DN-34	86	82	69	184	334	708	115	150	374
DN-5	93	93	78	172	303	652	94	131	349
15-029	84	72	53	166	393	743	113	227	350
HP-308	58	55	72	165	297	566	93	133	268
NM-6	88	87	81	150	278	701	69	129	422
50-197	65	58	56	145	309	577	89	164	268
DN-82	84	88	60	141	283	582	81	142	299
DN-70	96	94	67	134	248	564	67	114	316
184-411	70	62	46	126	193	509	80	67	317

References

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- Felton, G. K, J. S. Kays, C. U. Buswell, & E. Flamino. (2005). Determination of Optimal Tree Density and Biosolid Application Rate and the Effect on Water Quality and Tree Growth Using the Deep Row Biosolids Incorporation Method. Keedysville, MD: UMCP, MCE. 127 pp.
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