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Biosolids Fact Sheet Series

SITE PREPARATON AND THE EFFECT OF SUBSOILING ON SURVIVAL AND GROWTH OF HYBRID POPLAR

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
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One of the major issues with agricultural use of biosolids is planting a crop that is able to take up large amounts of nitrogen and not cause odors and nutrient runoff. Hybrid poplar trees, related to native cottonwood trees, can use up to 350 lbs. N per acre each year and are capable of thriving on gravel spoils and farm fields amended with biosolids. Deep-row incorporation involves the one-time application of biosolids in a wide and shallow trench that is covered with overburden, and planted with hybrid poplar cuttings that utilize the nutrients over a 7-9 year rotation.

A study was conducted to investigate 1) the effect of planting technique on mortality and early growth of hybrid poplar cuttings; 2) the effect of tree density and biosolid application rate on foliar nutrient levels of two-year old hybrid poplar cuttings.

Samples taken from biosolids used in this study contained an average of 1.16% total nitrogen. The experimental application rates of 4,000, 8,000, and 12, 000 lbs/N per acre were deemed to be the most appropriate application rates that would result in higher crop production while protecting water quality.

Deep-row incorporation involves the one-time application of biosolids in a wide and shallow trench that is covered with overburden, and planted with hybrid poplar cuttings that utilize the nutrient over a 7-9 year rotation. The widths of the deep rows were maintained at 42 inches and the depths were adjusted (as shown in table 1) to accommodate the required amount of biosolids and allow for 10-12" of cover on top of the biosolids (figure 1). The maximum depth of the deep rows is limited by the depth to which the poplar tree roots can reliably grow. If trench depth exceeds seven or eight feet, (which is likely too deep to be sure that roots can reach the material), nitrates could possibly leach into the groundwater.

Figure 1. Dumping biosolids next to a prepared trench.

Tree Planting Method

The operational technique involved attaching booms to a bulldozer so that the ends were 10' apart (figure 2a). The bulldozer had a subsoiling bar that created a trench about 1 foot deep. By subsoiling, the compacted soil was broken up prior to planting so that the newly planted cuttings could quickly form roots and access the soil moisture and nutrients in the biosolids. The bulldozer then created another planting row 10 feet from the existing row by aligning the boom on the existing row. When completed, the cuttings were planted where the 10 foot planting rows intersected (figure 2b), creating an accu-

rate 10 foot planting pattern. Cuttings were hand-planted using a dibble bar to create the hole for the cutting, then used to pack the surrounding dirt to seal out air.

Weed Management

Vegetation management was implemented by applying herbicides in the spring to control vegetation growth in 3-foot strips on each side of the trees. PendulumÒ, a pre-emergent herbicide, was sprayed over the top of the planted cuttings in June. This herbicide could be sprayed without concern for damage to the cuttings because it does not damage actively growing hybrid poplar trees. GoalÒ, a pre-emergent herbicide with some post-emergent control, was sprayed in March of 2004 and 2005 at a rate of 8 pints per acre. It was sprayed prior to budbreak to avoid damage to the trees. All herbicides provided fair to good control of vegetation.

Tree Measurement

The total height and basal diameter (5 mm above the growth from the cutting) was measured for each tree after the first and second growing seasons (2003 & 2004) in the research plot, and for a subset of trees in adjacent plots. Deer had a major impact on height growth in this area due to browsing of the stems, so frequency of browsing was assessed. It was assumed that browsing would have a negative impact on first year height growth.

Figure 2a, 2b. a) Bulldozer with subsoiling bar and 10' boom attached. b) 10' by 10' planting grid. Hybrid poplar cuttings were planted at the grid intersections.

Results of Subsoiling Comparison

After one year, the mortality of cuttings on the plots with subsoiling was much lower (1.7%) compared to the cuttings planted without subsoiling (14.2%) (table 2). Height growth of the cuttings planted with subsoiling was much higher (52.4 cm) than the cuttings planted without subsoiling (33.9 cm). The lower mortality and better height growth of cuttings planted with subsoiling occurred even though these stems sustained a much higher amount of deer browse (51% for subsoiled plots compared to 20% for plots without subsoiling). It would be expected that a higher percentage of stems browsed would likely reduce overall height growth and survival, but this did not occur.

It was assumed that the better growing conditions created by subsoiling were in part the cause of these differences in mortality and height growth. The long-term impacts of planting without subsoiling are that trees will take longer to establish themselves and that rotation length may need to be extended to accrue similar amounts of biomass compared to trees planting with subsoiling. This can have economic implications as rotation length has a direct impact on how quickly the site can be reapplied. The first year results indicate that subsoiling is an essential part of site preparation for planting and is critical to good survival and rapid site colonization by hybrid poplar.

In general, the benefits of subsoiling using the operational technique described are as follows:

- Provides a symmetrical layout that will ease vegetation management and other stand entries throughout the rotation
- Is essential to reduce compaction of dense soils, thus reducing seedling mortality (increasing survival) and increasing early height growth
- Allows young trees to overcome the negative impact of deer browsing

Therefore, it is recommended that this subsoiling technique be used in future, similar plantings.

Table 1. Treatment rates, depth of biosolids in the trench, total trench depth, and approximate biosolids application rate.

Application Rate (lbs N/A)	Inches of Biosolids	Total Depth of Deep Row in Inches (12" overburden)	Dry Tons / Acre
4,000	12.5	24	172
8,000	25.0	37	345
12,000	37.5	49	517

Table 2. Effect of planting method on first year mortality, height growth, and deer browsing.

	Research Plots: Cuttings Planted with subsoiling	Adjacent to Research Plots: Cuttings Planted without subsoiling
Mortality after one year	1.7%	14.2%
Height after one growing season (cm)	52.4	33.9
Live stems browsed	51%	20%

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