MARYLAND COOPERATIVE EXTENSION
UNIVERSITY OF MARYLAND
COLLEGE PARK • EASTERN SHORE

Biosolids Fact Sheet Series

EFFECT OF DEEP ROW BIOSOLID APPLICATION ON WATER QUALITY

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
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Formerly known as "sludge," biosolids refers to the soil-like residue of materials removed from the sewage during the wastewater treatment process. Biosolids usually contain from 1-4% nitrogen and are a valuable source of fertilizer for agriculture and forest crops. However, application of biosolids to agricultural areas can create problems with odors and runoff, while landfilling fails to take advantage of the nutrient value and uses valuable landfill space. Deep row incorporation of biosolids on sand and gravel reclamation sites is a unique alternative land application method that solves many of the problems associated with surface application techniques and restores degraded soils.

Figure 1. ERCO site hybrid poplar plantation with three years of growth.

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. This technique was developed by ERCO, Inc, which has operated a 120-acre tree farm on a sand gravel spoil in southern Maryland since 1983 (figure 1). Applying biosolids to fertilize hybrid poplar trees is a technique that is used extensively in the Pacific Northwest and is now being applied in the Mid-Atlantic region. Plantations of hybrid poplar trees can take up to 350 lbs. N per acre each year and are capable of thriving on gravel spoils amended with biosolids.

One of the concerns with applying deep row incorporation of biosolids is the leaching of nitrate and other nutrients from the biosolids into the drinking water supply. Biosolids typically contain large amounts of nutrients such as nitrogen and phosphorus, making them a valuable resource for use in agriculture. If there is an excess of nutrients which cannot be taken up by crops, nutrients may be able to leach, or move through the soil, and possibly enter an underground water supply area. Nitrate levels at or above 10 mg/L are considered unacceptable for drink-

ing water, so it is important to monitor the movement of nutrients out of areas where biosolids have been applied.

Intensive water quality monitoring has found no negative water impacts at the ERCO site. However, in 2002, intensive research was initiated on a 3-acre research site to better understand the fate of the nutrients in the biosolids and if leaching could possibly be a problem.

Two methods of retrieving leachate (fluid from biosolids that seeped into the soil surrounding the application site) were utilized: Thirty pan lysimeters (figure 2) and 150 suction lysimeters (figure 3) were distributed throughout the 3-acre research site. A lysimeter is a device which collects water that moves through soil. A pan lysimeter collects water by allowing it to flow down through the soil and into the collector by gravity. Suction lysimeters actively draw water out of the surrounding soil, allowing for collection of water from unsaturated soils. Holes were drilled under and around the biosolid-containing trenches for the placement of pan and suction lysimeters (figure 4). Figure 5 is a diagram depicting a cross-cut look at a pan lysimeter buried under the biosolid-containing trench. Figure 6 shows the placement of suction lysimeters beneath and beside biosolid-containing trenches.

Figure 2. A pan lysimeter before it was placed in a trench.

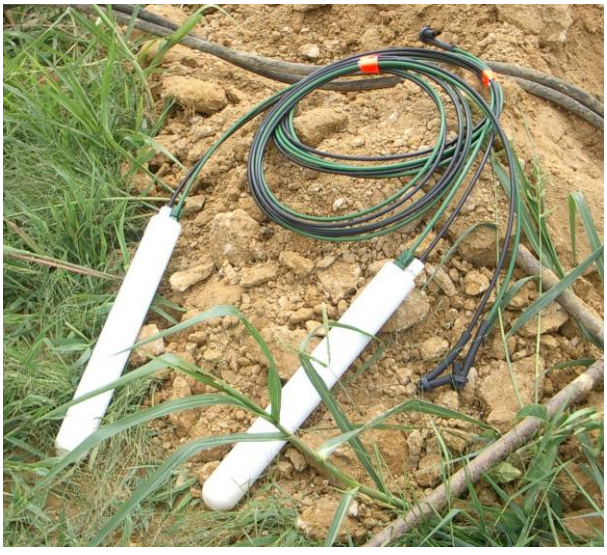

Figure 3. Two suction lysimeters before they have been placed in a trench.

Samples from the lysimeters were collected monthly or bi-monthly over a two year period—from April 2003 to April 2005.

Figure 4. Holes were excavated through the sides of the trenches to place lysimeters.

Results and Conclusions

Regardless of the type of soil, it appears nitrate was not being produced or leached into the water table, even before the tree roots were in place. Nitrate levels in samples from nearby wells were never above the maximum contaminant limit (MCL) but this confirms nitrate is not leaving the trenches.

In general, nitrate concentrations were extremely low in both pan and suction lysimeters. Of the 521 pan and 1,820 suction lysimeter results taken from 11/03 to 4/05, only 5 results (0.2%) exceeded the drinking water MCL of 10 mg/L (figure 7). The majority of samples (98%) contained less than 1 mg/L nitrate.

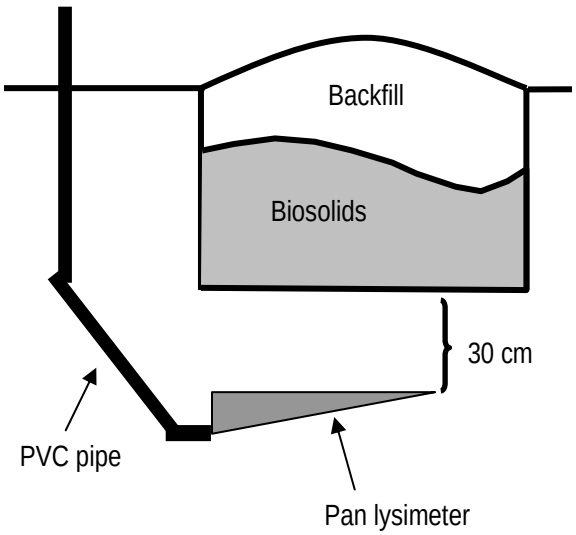

Figure 5. Pan lysimeter placed under a biosolid-filled trench

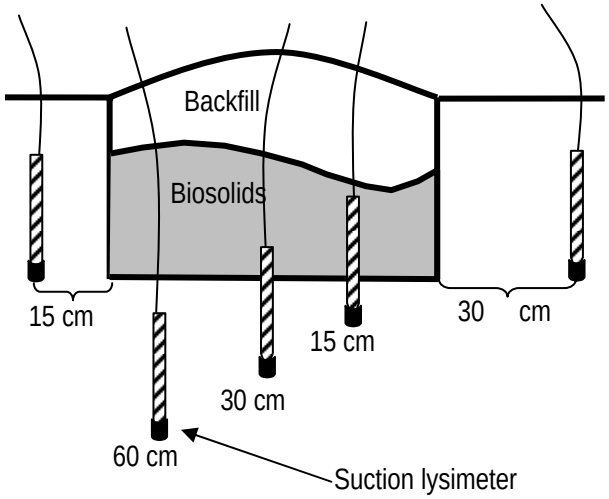

Figure 6. Suction lysimeter placed under a biosolid-filled trench.

In samples from the pan lysimeters, just 3 of 470 (0.6%) contained nitrate in excess of 10 mg/L. However, 2 of the 3 high nitrate samples were from the control areas to which no biosolids were applied.

The results of this testing suggest:

•Biosolid application had no affect on nitrate levels in the surrounding soil, regardless of biosolid application rate, tree density, and/or time.

•There is a need to look at conclusions as to why there was no leaching.

What does this mean for the future of biosolids application using deep row incorporation?

The findings of this study show that applying biosolids using deep row incorporation with trees on old gravel spoils does not result in raising levels of nitrates in the water supply. There are thousands of acres of this type of land use in southern Maryland and this study along with long term well monitoring data suggest that this technique can be applied elsewhere.

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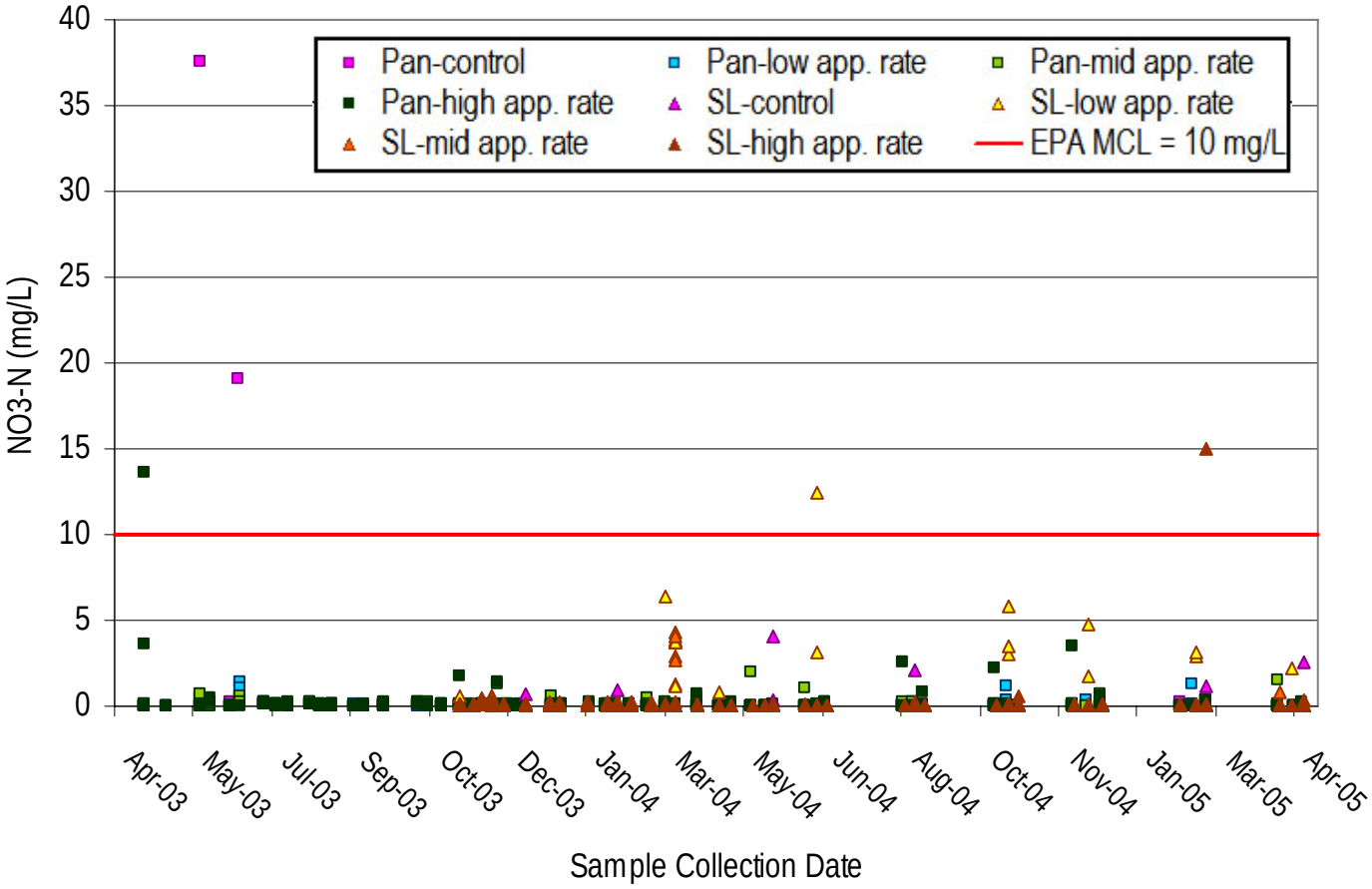

Figure 7. Graph of pan and suction lysimeter sample data April 2003 through April 2005 collection.