

TIMELY INFORMATION

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Biosolids on Alabama Cropland and Pastures

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Definition

The all-time high cost of fertilizers has Alabama producers looking at alternatives. One of these is biosolids from municipal waste water treatment plants. At one time, the term, “sewage sludge” was used to refer to all byproducts of waste water treatment. In fact, Alabama Cooperative Extension had a 1991 circular ANR-607 entitled, “Land Application of Sludge”. The term, biosolids, was introduced in 1991, mainly to designate those sludges that were suitable for beneficial use on the land. Britannica Concise Encyclopedia (2008)_ defines



Clumps of lime remain clearly visible in a fescue pasture in North Alabama several months after lime stabilized biosolids were applied.

biosolids specifically “For use as a fertilizer in agricultural applications”. US- EPA (2008) defines biosolids as “. . . nutrient-rich organic materials resulting from the treatment of domestic sewage in a treatment facility. When treated and processed, these residuals can be recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth.”

Land Application

In 2002, around 60 percent of all municipal biosolids were being land applied for beneficial use. An Alabama survey of 61 municipal

wastewater treatment plants found that 89% of Alabama biosolids were being land applied (Hankins, 2004). Agricultural lands received 52%, and 37% was used to reclaim mined land. Some nutrient concentrations and other properties of these biosolids are in Table 1.

Classes of Biosolids.

There is a tremendous amount of variability in municipal biosolids (Table 1). This has to do with the sources of biosolids (industrial versus residential), the wastewater treatment process, and the dewatering process. Storage time before land application can also make a difference in nutrient concentration. Waste water may be anaerobically digested, aerobically digested, lime stabilized, or heat treated. Water can be removed by a filter, centrifuge, or gravity.

Some biosolids may be composted to removed pathogens but most are chemically treated with quick lime (CaO) to raise the pH and generate heat. Others may be just heat treated. Regardless of the treatment process, EPA's Title 40 Part 503 of the Code of Federal Regulations basically recognizes the following categories of municipal biosolids that may be land applied based upon the level of pathogens in the biosolids (see Fecal coliform measurements in Table 1.

Class A biosolids are essentially free of pathogens prior to land application. The metal contents requirements under the Part 503 Rule are the same for Class A and Class B biosolids.

Class B biosolids may have low levels of pathogens which rapidly die-off when applied to soils, essentially becoming pathogen-free within a short period following application when the **"Part 503" Rule requirements** are followed.

Exceptional Quality biosolids have lower metals concentration requirements than either Class A or Class B biosolids and have the same pathogen levels as Class A biosolids. These biosolids may be land applied with no restrictions.

Biosolids that contain high levels of one or more pollutants or high levels of pathogens may still be land applied, with certain restrictions that may include (1) limited loading rate, (2) detailed records where it is applied, (3) restrictions to prevent runoff or leaching, increased monitoring of application site(s), etc.

Lime Stabilized Biosolids

Adding quick lime (calcium oxide) to wet biosolids is perhaps one of the least expensive and easiest way to reduce pathogens in the biosolids. The quick lime generates heat and a very high pH (>12.0) which effectively kills pathogens. Note the high pH and low fecal coliform numbers in the Class A biosolids in Table 1. The resulting biosolids may not be as good for crops as the untreated biosolids, especially if the sludge is held for a while before spreading on the soil surface as in pastures and hay fields. Lime stabilized biosolids from an Alabama waste water treatment plant had 30% total neutralizing value and was as effective as ground agricultural limestone (63% effective neutralizing value) at raising the soil pH when incorporated into a sandy loam soil (Hankins, 2004). The problem was that the biosolids contained only 0.5% total N (10 pounds per wet ton). When it was applied as a source of N (equivalent to about 8 wet tons per acre), most of the N was not taken up by plants, presumably because N volatilized because of the high pH (Fig. 1). Only the Class A biosolids in Fig. 1 were lime stabilized. Hankins (2004) concluded that lime stabilized biosolids could be used effectively as a soil liming material but were not very good sources of N whether surface applied or incorporated. He did not study P availability in biosolids but conventional knowledge of P chemistry suggests that P availability to crops would change very little when the biosolids are lime stabilized.

Metals in Biosolids

Heavy metals (Hg, Pb, Cd, Cr, Zn, Co, Cu, etc.) are often cited as concerns in municipal biosolids. At one time when heavy industry was allowed to dump wastewater containing metals into municipal systems, this was a serious concern. Once metals are in the soil, they do not leach out or volatilize like nitrogen. Depending upon soil pH, organic matter, and other factors, some plants could hyper accumulate metals allowing them into the food chain. Partly because of EPA's final 503 Rule in 1993, most municipalities now exclude hazardous industrial wastewater

from the wastewater stream. Biosolids that are recycled come from treated wastewater from our own homes. Note that the mean metal concentration of biosolids in Table 1 fall well within the metal limits listed in Table 2. Only a few maximum values exceed the limit for exceptional quality biosolids.

When Citizens Complain

Because so much biosolids are being recycling onto Alabama farmland and reclaimed mine land, some nearby residents are sure to become concerned. Because Alabama counties have little or no rural zoning and private property rights are precious to most rural residents, there is little a neighbor can do if the landowner/applicator is spreading biosolids according to EPA guidelines. In Alabama, land application of municipal biosolids is enforced by US-EPA Region 4 in Atlanta, Georgia, not the Alabama Department of Environmental Management (ADEM).

Odor usually triggers most complaints. Odor problems can be reduced by using best management practices when land applying any organic byproduct. Fortunately, a good rainfall usually dissipates most odors from manure or biosolid applications. Injection into the soil helps but this is not always possible. While odors can be unpleasant and annoying, they are not chronic. Furthermore, Alabama landowners have traditionally been protected from such nuisance complaints.

Recently, some Alabama farmers have taken advantage of land application of biosolids from out-of-state sources. While our data show that the N benefit from lime stabilized biosolids is low, these alternative sources of nutrients are inexpensive and provide our growers with a way to contribute to beneficial recycling of nutrients from our ever growing urban populations.

References

- Britannica, Encyclopedia online. 2008. <http://www.britannica.com/>.
 Hankins, G.C. Jr. 2004. Inventory and Evaluation of Biosolids. M.S. Thesis. Auburn University, AL.
 US-EPA. 2008. A Plain English Guide to the EPA Part 503 Biosolids Rule. United States Environ. Protect. Service. Washington, DC. <http://www.epa.gov/owm/mtb/biosolids/503pe/>

Table 1. Properties of some Alabama generated, municipal biosolids on a dry matter basis (from Hankins, 2004)				
Variable	Mean	Standard error	Minimum value	Maximum value
<u>Class B Biosolids from 28 Municipalities</u>				
Total N (%)	3.7	0.4	0.04	9.1
NH ₄ -N	0.8	0.2	<0.01	4.2
NO ₃ -N	0.2	0.1	<0.01	1.5
Total P ₂ O ₅ (%)	6.0	0.8	<0.01	43.7
Total K ₂ O (%)	not determined			
Solids (%)	21.9	4.6	1.6	91.0
pH	7.4	0.80	6.9	9.6
As (mg/kg)	5.7	1.3	0.3	44
Hg	2.4	0.4	0.1	14.6
Se	4	1	<1	40

Mo	18	2	2	58
Cu	355	53	11	1830
Zn	762	91	57	2320
Cr	35	5	1	126
Pb	67	15	5	430
Cd	6.0	2.2	<0.1	77.6
Ni	30	5	1	192
Fecal coliform no.	65000	23000	3	370900
<u>Class A Biosolids from 5 Municipalities</u>				
pH	12.7	0.1	12.6	12.7
Fecal coliform no,	36	21	14	79

Table 2. Metal limits for Exceptional Quality Class A biosolids (US-EPA, 2008).	
Metal	mg/kg
Arsenic (As)	41
Cadmium Cd)	39
Copper (Cu0	1500
Lead (Pb)	300
Mercury (Hg)	17
Nickel (Ni)	420
Selenium (Se)	100
Zinc (Zn)	2600

Table 3. Mean soil pH over a 100-day period after applying equivalent rates of 3 liming materials including a lime-stabilized biosolid from a North Alabama waste water treatment plant.	
Treatment	Mean soil pH during 8-wk incubationm (g/kg)
Control (no lime)	5.5
Ground, dolomitic limestone	6.7
Lime stabilized biosolids	6.5
Reagent-grade Ca(OH) ₂	6.5

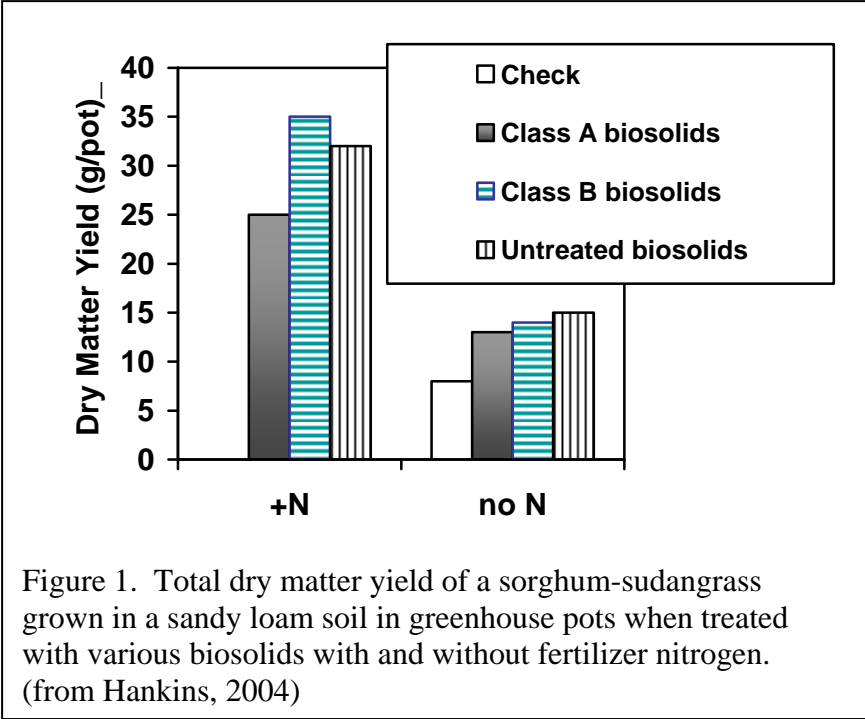


Figure 1. Total dry matter yield of a sorghum-sudangrass grown in a sandy loam soil in greenhouse pots when treated with various biosolids with and without fertilizer nitrogen. (from Hankins, 2004)