

Biosolids Increase Soil Fertility in Dryland Pasture - Part II

Researchers and Collaborators

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Spring growth with biosolids (above) vs. no biosolids (below)

Background

This Note summarizes the impact of annual biosolids applications on soil fertility at Madison Farms near Hermiston, Oregon. A companion Note highlights forage yield and quality response to biosolids at this farm. A more extensive report of crop and soil monitoring data from this site is available at:

<http://www.nwbiosolids.org/Pubs/BiosolidsGrassSoilFertility.pdf>

Objective

Measure long-term effects of biosolids application on soil fertility.

Methods

Biosolids

- City of Portland, Oregon
- Class B biosolids
- Surface-applied each year (3 to 5 dry ton/ac) starting in 1990
- Approximate cumulative application rates
 - 1999: 40 dry ton/ac*
 - 2007: 75 dry ton/ac*

Sampling protocol

- Samples collected annually. 2+ fields sampled each year. Sites with biosolids application compared to nearby no-biosolids control sites.
- Sampling depth: 1996 to 1999: 0-6 inch depth. 1999 to 2005: 0-3 inch depth.
- Sampling intensity: 30 cores per sample representing 40 acres
- Samples collected in April or May of each year, in same field used for measurement of annual forage yields.

Results

Key soil fertility results are shown in Table 1. Surface soil pH for the biosolids site was approximately 1 pH unit lower (more acidic) than for the no-biosolids control. The decreased pH (greater acidity) is not an immediate concern for site productivity, but merits future monitoring. Soil pH values less than 5.5 would be a concern (present values are near 6.5). Soil salinity (as indicated by EC, electrical conductivity) remained low at all sampling dates, indicating that biosolids application did not pose a long-term risk for salt accumulation, even in a non-irrigated semi-arid pasture. Nitrate-N, a mobile nutrient, was not monitored at these sites because of the shallow sampling depth. Data on soil profile nitrate-N is given in a more extensive monitoring report at:

<http://www.nwbiosolids.org/Pubs/BiosolidsGrassSoilFertility.pdf>

Significance

Biosolids increased plant-available nutrients in soil as demonstrated by agronomic soil testing. Soil test values have remained stable since the monitoring reported here began (1996). Apparently, soil test values increased substantially with the first applications of biosolids at these sites (1990 to 1995), then came into equilibrium with a regime of annual biosolids applications. This dataset suggests that the soil/plant system is removing or converting nutrients to non-available forms at approximately the same rate as “new” soluble nutrients are being added by annual biosolids applications. The only major route for nutrient removal at the site is grazing. The monitoring data from these sites suggests that at cumulative biosolids application rates above 30 to 40 dry ton/acre, biosolids chemistry controls soil test values. The inherent soil fertility at these sites is very low, so it is easily obscured by nutrient-rich biosolids.

Long-term biosolids application resulted in doubling of surface soil organic matter from approximately 1% to 2% (0 to 6 inch depth). Like nutrients, organic matter content in biosolids-fertilized soil apparently increased rapidly during the first years of biosolids application, and has now reached a new “equilibrium value” in balance with a regime of annual biosolids applications. This data suggests that carbon sequestration (fixation of carbon within soil organic matter) is more likely to occur on new biosolids application sites than on long-established application sites.

Table 1. Soil test values for monitoring sites receiving biosolids vs. no-biosolids control sites.

Soil Test	Average		Average	
	1996-1999		1999 to 2005	
	(0-6 in.)		(0-3 in)	
	Biosolids (BS)		Biosolids (BS)	
	none	+	none	+
pH	7.5	6.7	7.2	6.2
EC (mmho/cm)	0.2	0.3	0.1	0.2
Organic Matter (%)	1.2	2.2	1.5	3.1
Phosphorus (mg/kg)	14	71	18	116
Copper (mg/kg)	0.8	7.4	0.7	8.1
Zinc (mg/kg)	0.5	9.6	0.6	11.1