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Assessing Economic Value of Biosolids[1]

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Economic values are determined by the marketplace of goods and services for which people are willing and able to pay. What are growers and farmers willing to pay for a ton of biosolids? A grower should be willing to pay for biosolids only if the product increases overall net returns. An increase in net returns can be achieved by reducing production costs and/or increasing crop yield or quality. Growers and farmers purchase fertilizers and liming materials, and the extent to which biosolids provide plant nutrients and/or liming capacity provides a basis for valuing biosolids.

Nutrient concentrations, i.e., nitrogen (N), phosphorus (P), and potassium (K), in one ton of a selected biosolid are presented in Table 1. Since the material was lime-stabilized, one ton of product also provides the equivalent of 700 pounds of dolomite lime. By multiplying the unit prices of commercially available products by the quantities of plant nutrients and lime equivalents, one can compute a per-ton value of biosolids. As shown in Table 1, $12.36 is the value of N, P, K, and dolomite lime in one ton of the particular biosolid. While it is convenient to stop at this point and simply conclude that the economic value of this biosolid is $12.36 per ton, it is important to consider how the biosolid material is utilized.

Biosolids pose a management challenge in that they do not deliver plant nutrients in the same proportion required for crop production. Presented in Table 1 are the major plant nutrient and liming requirements for one acre of Hamlin oranges producing between 450 and 500 boxes, annually. More than $100 of fertilizer and lime products will be purchased to supply an acre of grove with its required nutrition. Dividing the required amount of plant nutrient by the amount in one ton of biosolids gives the application rate to supply the particular plant nutrient solely through biosolids. For example, one ton of biosolids would satisfy the liming requirement. As Table 2 and Table 3 illustrate, the economic value of a biosolid depends not only on the nutrient composition of the material, but also on the application rate.

For the biosolid sample and Hamlin grove considered in Table 1, an application rate of one ton per acre would satisfy the liming requirements (Table 2). Along with the equivalent of 700 pounds of dolomite lime, the biosolid application rate provides 19, 5, and 2 pounds per acre of nitrogen, phosphate, and potash, respectively. If we assume that all the nutrients in the biosolid are utilized, full value, or $12.36, can be credited to the biosolid application.

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To meet crop nutrient requirements, commercial fertilizers costing $88.29 must be applied. The application of one ton of biosolids reduced the fertilizer expenditure by only $12.36 per acre.

Alternatively, if we assume that all the N contained in the biosolids is available during the first year of application, 10.7 tons per acre would satisfy the N requirements of the Hamlin grove. Table 3 summarizes the quantity of nutrients delivered by the biosolid application. In addition to N, P and liming requirements are met at the higher application rate. Potassium requirements are not met, however. An application of potash fertilizer costing $37.51 is required to meet crop potassium needs. Overall, the 10.7 ton biosolid application rate reduced fertilizer and lime expenditures by $63.14 per acre. At the higher application rate, almost two half-tons of excess dolomite equivalents are delivered to the grove. A significant elevation in the soil pH may induce adverse effects, such as micronutrient deficiencies. In situations where the soil pH is already near 7, these lime-stabilized biosolids should not be used and may actually be a detriment.

Increasing the application rate from one ton to more than ten tons per acre decreases the per ton value of the biosolid from $12.36 to $5.90. At the higher application rate, a greater portion of nutrients from the biosolid are not utilized. Excess plant nutrients from biosolids supplied at a rate greater than what would have been supplied through commercial fertilizer sources have zero value because a grower would not have been willing to pay for extra nutrients that do not support higher production (i.e. boxes/acre).

The economic valuation of biosolids can be expanded to include micronutrients. Most biosolids contain micronutrients in a natural “chelated” form. Commercially available chelated products can be expensive. For example, iron chelate costs more than $4.40 per pound. A biosolid material can supply close to six pounds per ton of iron in a slow-release form. As with other plant nutrients, values for micronutrients can only be credited for what is utilized by the crop.

Computing a value for biosolids is a worthwhile exercise for the grower who is considering supplying a portion of plant nutrient requirements with biosolids rather than with commercial sources. While the actual material may be “free,” other costs such as transportation and field application have to be considered. If the “value” of the biosolid is less than these costs, applying biosolids will not be a wise economic choice. The value of a biosolid will depend on the nutrient analysis of the material and amount of nutrients which will be utilized at a specified application rate.

Improvements to soil tilth, microbial populations, and disease suppression are other benefits associated with applying biosolids. The discussion in this article did not consider these benefits because, to date, there has been little documentation quantifying them in terms of yield gains, lower crop yield variability, or further reductions in total plant nutrient requirements. If such associations can be quantified, the value of biosolid applications to agricultural cropland will be enhanced.

References

1. DACS. Florida Commercial Fertilizer Law, Rules and Regulations, Chapter 576 Florida Statutes, Chapter 5E-1 Florida Administrative Code, Jan. 1, 1999, pages 28-30.

2. Muchovej and Obreza, Biosolids: Are These Residuals All the Same? Fact Sheet SS-AGR-167. 2001.

3. Muraro et al., Budgeting Costs and Returns for Southwest Florida Citrus, 1997-98.

Table 1. Commercial fertilizer values, biosolid nutrient content, and nutrient requirements for one acre of Hamlin oranges.

Plant Nutrient	**Commercial Nutrient Values $/lb**	**Nutrient concentrations of lime stabilized biosolid lb/ton (% dry weight)**	**Nutrient requirements Hamlin oranges lb/ac-yr (% fertilizer analysis)**
Nitrogen (total)	$0.215	19 (3.8%)	204 (17%)
Phosphorus (P_2O_5)	$0.173	5 (1.0%)	48 (4%)
Potassium (K_2O)	$0.205	2 (0.4%)	204 (17%)
Dolomite lime	$0.010	700 (CCE of 32.7)	667 (1 ton/3 years)
Value of biosolid ($/ton)		$12.36	
Value of fertilizer requirements ($/ac)			$100.65

Table 2. Value of satisfying liming requirements for one acre of Hamlin oranges with biosolids.

Biosolid application rate: 1 ton/acre		
Plant Nutrient	**Delivered Nutrients from biosolids lbs/ac**	**Comparisons with crop requirements Excess (+), Deficit (-)**
Nitrogen (total)	19	-185
Phosphorus (P_2O_5)	5	-43
Potassium (K_2O)	2	-202
Dolomite lime	700	0
Value of utilized biosolid nutrients ($/ton)		$12.36
Value of replaced commercial fertilizer/lime ($/ac)		$12.36

Table 3. Value of satisfying nitrogen requirements for one acre of Hamlin oranges with biosolids.

Biosolid application rate: 10.7 tons/ac		
Plant Nutrient	**Delivered Nutrients from biosolids lbs/ac**	**Comparisons with crop requirements Excess (+), Deficit (-)**
Nitrogen (total)	204	0
Phosphorus (P2O5)	54	+6
Potassium (K2O)	21	-183
Dolomite lime	7,490	+6,823
Value of utilized biosolid nutrients ($/ton)		$5.90
Value of replaced commercial fertilizer/lime ($/ac)		$63.14