Using Dairy Manure Compost for Specialty Forages

J. Muir, T. Butler, and M. McFarland

Dairy Compost Utilization

Specialty forages are those that do not have a wide application in animal production systems of Texas. Other than beef cattle, systems that use cultivated forage can be considered atypical in our state. These include white-tailed deer, game birds (quail or turkey), exotic game, goats, sheep, domesticated rabbits or any other species that is primarily an herbivore. These animals generally require greater quality in their diets than do bulk (undiscriminating) grazers such as cattle, horses, donkeys, bison or Asiatic water buffalo. Selective grazers/browsers (the latter pluck individual leaves off forbs, bushes, trees and grass) usually harvest individual plant parts such as seeds, fruits or new leaves, which provide a greater concentration of available nutrients but are more difficult to collect. Grasses and legumes more palatable to selective grazers tend to be more difficult to maintain in pastures or range since they are generally less adapted to local conditions and are grazed (browsed) out more easily.

The fertilizer requirements of specialty forages will depend on the fertility status of the specific field, the plant species, the type and degree of grazing, and whether compost or other organic nutrient sources are to be used along with inorganic fertilizer. Livestock manures have been used for centuries in crop production systems as a source of nutrients and organic matter. However, raw manure typically has a high moisture content, which increases transportation costs and can be a significant source of soluble nutrients, viable weed seeds and fecal bacteria that may be conveyed to surface water in runoff. Increasingly, composting is used to improve the characteristics of manure for beneficial reuse in crop production systems. However, the first step in developing an effective nutrient management plan is to obtain a soil analysis for each production field.

BENEFITS OF COMPOSTED MANURE

Composting is the biological decomposition of organic materials such as manure to a relatively stable endpoint. Fresh livestock manure is a mixture of urine and feces, varying in chemical and biological composition which is determined by the species of animal and their diet. Because bedding material is consequently harvested with raw manure during traditional collection practices, resulting compost contains additional components such as straw or sand. Biological activity, ventilation and heat generated during the composting process remove much of the moisture in raw manure, reduce odors, and kill most weed seeds and most disease microbes and parasites. In addition, composting reduces the total volume of manure by as much as 50%.

Composted manure can be a significant source of essential plant nutrients including nitrogen, phosphorus, potassium, calcium, magnesium and sulfur, as well as, micronutrients such as zinc, iron, copper and manganese. However, the nutrient concentrations can vary widely from one manure compost to another. To determine appropriate compost application rates, it is important to obtain laboratory nutrient analysis of the production field and selected compost product. Table 1 shows the average and range in nutrient concentrations in composts made from different materials. The ratio of nutrient concentrations in a compost product is rarely an exact fit for crop needs. In particular, an application of compost that meets nitrogen requirements will often provide excess phosphorus. As a result, compost application

Texas Water Resources Institute
make every drop count

PREPARED IN COOPERATION WITH THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
AND U.S. ENVIRONMENTAL PROTECTION AGENCY
The preparation of this report was financed through grants from the U.S. Environmental Protection Agency through the Texas Commission on Environmental Quality.

Texas Cooperative EXTENSION
The Texas A&M University System

rate should be determined based on crop phosphorus requirements and a phosphorus free inorganic fertilizer should be used to complete crop nitrogen and/or potassium requirements.

Nutrient levels in compost are generally organic. Therefore, it is important to account for their slow release rate. Preliminary research using dairy manure compost in the production of warm-season grasses has indicated that nitrogen release rates are in the range of 30-35% of total N in the first year with decreasing rates the following years. As a result, fast growing, high nutrient demand crops typically require some amount of supplemental inorganic fertilizer to achieve optimum yields.

In addition to serving as a nutrient source, compost supplies stabilized organic matter, which is an important component of soils. Organic matter serves a special role in soils acting in the formation of very small soil clods, called aggregates, which improve soil structure and tilth and increase water infiltration and water holding capacity. Organic matter also functions similar to clay in soils by increasing the cation exchange capacity, or the nutrient holding potential of a soil. Increasing soil organic matter with compost or other supplements is particularly important for maintaining soil quality in cropping systems where most of the above-ground biomass such as through grazing.

Table 1. Average and range ( ) in nutrient values for various composts (McFarland, 2003; Risse, 2003; Brodie et al., 1996)

Compost Type	Dry Matter	Nitrogen (N)	Phosphorus (P_2O_5)	Potassium (K_2O)
	%		lbs/ton	
Dairy Manure	**70 (58-80)**	**16 (11-23)**	**18 (6-31)**	**21 (8-48)**
Beef Manure	81	10	14	12
Poultry Litter	30 (22-36)	18 (11-25)	31 (11-52)	17 (10-21)
Municipal Solid Waste	40	24	15	6
Yard Trimming	38	26 (6-84)	9 (2-23)	9 (1-65)

SPECIALTY FORAGE DATA FROM STEPHENVILLE

The forage program at Stephenville has focused on specialty systems for the past five years. Most of these systems were legumes originally intended for wildlife plots, but they also have wider application such as for small ruminant systems. Due to the seasonal nature of their production, species adapted to cool-season and warm-season were studied separately. As indicated in Table 2, cultivated cool season legumes generally had very high quality indicators such as low levels of acid detergent fiber (quicker passage rates through digestive tracts) and high crude protein concentrations. Some of the medics and all the annual clovers had lower levels of lignin (indigestible fiber) than the vetches. The warm season legumes studied in Stephenville were also of general high quality (Table 2) while non-leguminous forbs were slightly lower. Legumes did not receive N fertilizer while the non-leguminous forbs did receive commercial rates of N.

BENEFITS OF INCORPORATING COMPOST INTO SPECIALTY FORAGE SYSTEMS

Application of dairy manure compost at rates of 18 tons/acre/year for two years to dryland cool season legumes increased yields by 48%, making this investment worthwhile (Table 3). In contrast, compost at 10 tons/acre/year over two years had no noticeable effect on warm-season dryland forage legumes. Lack of moisture (yields were generally low in drought years) appears to inhibit positive legume response to compost application since the same forages, when grown under more ideal irrigated conditions, did respond positively to compost application at 11 tons/acre/year, increasing yields by an average of 13%.

A review of the research to date at Stephenville indicates that, at least in the short term (all experiments were conducted for only two years) and at the levels applied (10 to 18 tons/ac.), compost did not improve forage quality. Even P levels in the forage did not improve, despite large increases in plant-available P in the soils. Other experiments have indicated that increasing soil P will often improve legume growth in infertile soils because this element is important for proper rhizobium development. However, the amounts of compost applied and the duration of the trials may not have given these crops sufficient time to show an effect of compost on nutritive quality.

SUMMARY

Application of dairy manure compost can significantly increase herbage yields of some specialty forage crops. This is especially apparent in the case of cool-season legumes, where compost nearly doubled yields under dryland conditions. Irrigated warm-season forbs appear to respond to dairy manure compost application more readily than do dryland systems, especially in drought years when moisture stress masks the benefits of compost. Although the growth response to compost addition was substantial for most crops, compost did not affect the nutritive value of these crops.

Table 2. Forage crude protein (CP), acid detergent fiber (ADF) and lignin concentration of cool season annual legumes, compiled from various experiments at Stephenville, TX

Forage Variety	CP	ADF	Lignin
		% of forage	
Cool-Season Legumes			
Medics			
Jemalong Barrel Medic	23.4	26.7	5.1
Little Medic, Devine	18.9	28.6	6.4
Black Medic, Beeville	23.5	25.0	5.6
Estes Button Medic	24.1	20.1	4.1
Button Medic, Stephenville	24.8	21.7	4.5
George Black Medic	20.9	20.7	4.9
Armadillo Burr Medic	24.6	29.9	6.6
Burr Medic, Stephenville	23.3	29.9	6.1
Burr Medic, Beeville	23.1	32.8	7.5
Spotted Medic, Stephenville	22.0	25.8	6.6
Cogwheel Medic, Stephenville	14.0	30.7	6.2
Clovers			
Dixie Crimson Clover	20.4	29.8	4.9
Overton R18 Rose Clover	17.1	35.5	4.2
AU Sunrise Crimson Clover	21.3	28.6	5.3
Common Ball clover	22.3	26.9	5.3
Vetches			
Common (narrowleaf) vetch	17.8	31.5	7.7
Hairy vetch	22.1	38.3	8.3
Llama vetch	17.4	36.8	8.6
Deerpea vetch (native)	18.4	32.6	7.9
Warm-Season Legumes			
Partridge Pea	18.1	19.4	5.9
Peanut	20.0	24.3	3.6
Phasey Bean	19.3	21.4	6.4
Tecomate lablab	19.7	23.7	4.5
Soybean (forage)	11.0	19.6	4.2
Iron-clay cowpea	18.7	21.3	3.9
Kudzu	15.3	25.1	6.1
Rayado bundleflower	16.9	17.1	4.4
Illinois bundleflower	13.5	19.3	5.0
Other Forbs			
Sunflower (oil type)	9.2	32.4	6.1
India Kenaf	14.9	26.9	3.6

Table 3. Forage dry matter yield of specialty forages grown with and without dairy manure compost in various experiments at Stephenville, TX

Forage Variety	Control Yield	Compost Yield
	lb/A	
Warm-Season Legumes (dryland) @ 10 tons compost per acre		
Partridge Pea	1050	NS[1]
Peanut	1350	NS
Phasey Bean	620	NS
Tecomate lablab	1400	NS
Soybean (forage)	600	NS
Iron-clay cowpea	1850	NS
Warm-Season Forbs (irrigated) @ 11 tons compost per acre		
Sunflower (oil type)	4650	5350
Kenaf (India)	12800	14750
Lablab (Tecomate)	7350	8500
Cowpea (Iron-clay)	4000	4600
Cool-Season Legumes (dryland) @ 18 tons compost per acre		
Yuchi arrowleaf clover	1850	3300
Common vetch	440	600
Armadillo burr medic	200	450
Estes button medic	500	1250
Black medic (North Texas)	100	250
Little burr medic (Devine)	100	250

[1]Compost plots produced greater (P>0.05) yields unless noted as not significant (NS).