ALFALFA FERTILITY AND COMPOST MANAGEMENT

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RATIONALE

Alfalfa hay generally constitutes 40% of the ration of Idaho's dairy cows. Alfalfa yield and quality may be affected positively or negatively by compost from dairy manure.

Compost is an environmentally-friendly byproduct of the dairy industry. It is logical to return unused nutrients from a dairy to the alfalfa fields which exported them rather than to use only commercial fertilizer to maintain the nutrient balance. Alfalfa yield may be better maintained by applying compost to replace nutrients (N, P, and K) exported from fields by forage harvesting. A study was done near Kimberly to 1) determine effects of applied compost on alfalfa yield in southern Idaho and characterize the forage quality; and 2) develop or refine alfalfa fertility guides to plan for more sustainable agronomic practices of alfalfa production and to solve nutrient cycling problems from dairy manure.

PREVIOUS WORK

A search of the *Agricola* database for "compost and alfalfa" produces 11 records including studies from Egypt and China, but none of the abstracts of the studies reported on the forage quality of alfalfa as affected by compost. Hansen-Sissel (1996) reported that increasing the compost application to provide 90 to 130 to 180 kg N ha^{-1} yr^{-1} increased grass yield but reduced the percentage of legumes in a pasture. A Canadian study (N' Dayegamiye et al. 1997) reported low N mineralization rates from mature compost in a glasshouse study of orchardgrass. Most of the remaining studies in the search reported studies of compost effects on maize, rice, or beans.

A review of current CRIS projects finds some work relating to nutrient cycling but none specifically studying the effect of dairy compost on alfalfa quality.

METHODS

Alfalfa plots at two sites (soils and environments) in south central Idaho were sampled for forage yield and nutrient uptake. The experiment was a randomized complete block design with four replications. Treatments were: 1) an untreated check, 2) application of 2.5 tons compost per acre (C), 3) application of 5 tons compost per acre (C2X), 4) an annual application of 2.5 tons compost per acre (A), 5) commercial fertilizer (F) applied to provide nutrients equivalent to the compost treatments, and 6) 30 lbs/ac monoammonium phosphate (11-52-0).

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Yield, dry matter concentration, stage of maturity (mean-stage-count or mean-stage-weight), and forage quality were determined. Acid detergent fiber (ADF), neutral detergent fiber (NDF), and crude protein were determined by near infrared reflectance spectrophotometry (NIRS) (Schenk et al. 1981) with calibration by wet chemistry. Soils were tested for N-P-K and EC before, after, and annually.

PRELIMINARY RESULTS

Alfalfa yield was not affected by any treatment (Table 1). Apparently the soil test level of 12 ppm P has been adequate to provide ample P to the alfalfa crop during this time period. A long term study would probably reach a point where the treatments would result in a response. Alfalfa forage quality for 3 cuttings during 2003 was not affected by any compost or fertilizer treatment (Table 2). The effects of compost and fertilizer application on soil test levels will be analyzed.

Table 1. The effects of compost on alfalfa yield.

Treatment		3 Year Total Yield Ton/Acre	2003 Total Yield Ton/Acre	First Cutting 6/17/2002 Ton/Acre	Second Cutting 7/31/2002 Ton/Acre	Third Cutting 9/27/2002 Ton/Acre
C	2	7.5	9.3	4.0	3.6	2.2
C2X	1	7.6	9.0	3.9	3.5	2.1
F	3	7.7	9.3	4.2	3.4	2.2
A	4	7.2	9.0	3.8	3.3	2.3
O	5	7.3	9.3	4.1	3.4	2.1
O+F	6	7.6	9.3	4.1	3.2	2.6
Mean		7.5	9.2	4.0	3.4	2.3
LSD (.05)		NS	NS	NS	NS	NS
CV %		10.3	11.1	10.6	11.6	16.2

EXPORT OF NUTRIENTS FROM HARVESTED HAY

The harvest and removal of 10 tons/ac alfalfa forage should export 560 (N), 150 (P_2O_5), 600 (K_2O), 50 (Mg), and 50 lbs/acre (S) annually (Potash & Phosphate Institute, 1998). These nutrients need to be replaced in order to sustain forage production. Dairy compost application should replace the majority of nutrients to provide sustainability for the hay producer while solving the dairy producers need to export nutrients.

Table 2. Effect of compost and fertilizer treatment on alfalfa forage quality on 3 cuttings in 2003 at Kimberly, Idaho.

	First Cutting June 22			Second Cutting August 4			Third Cutting October 4		
Entry	CP (%)	ADF (%)	RFV	CP (%)	ADF (%)	RFV	CP (%)	ADF (%)	RFV
C 2	19.7	32.4	148	21.7	28.1	178	20.8	30.6	159
C2X 1	19.8	33.5	141	20.2	28.5	174	21.7	30.6	159
F 3	19.1	34.2	138	20.0	28.9	171	21.0	29.5	167
A 4	18.1	34.4	136	19.6	29.5	167	21.4	29.3	169
O 5	19.3	34.4	137	19.8	29.5	167	21.6	29.1	170
O+F 6	19.4	33.9	139	19.6	29.6	166	21.5	29.2	169
Mean	19.2	33.8	140	20.2	29.0	170	21.3	29.7	165
LSD (.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV %	7.5	6.5	11.6	7.5	6.6	8.6	5.9	5.9	9.7

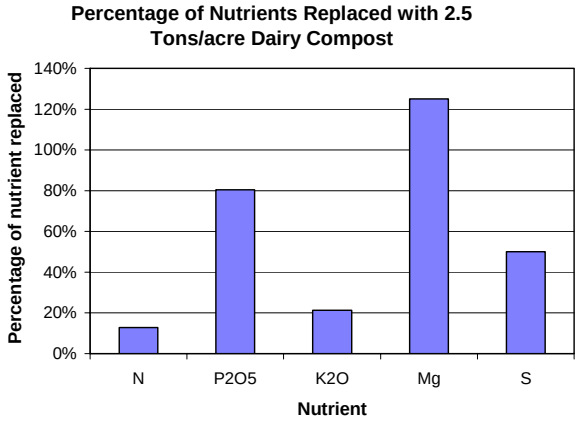

Figure 1. The nutrients removed in 8 tons alfalfa per acre.

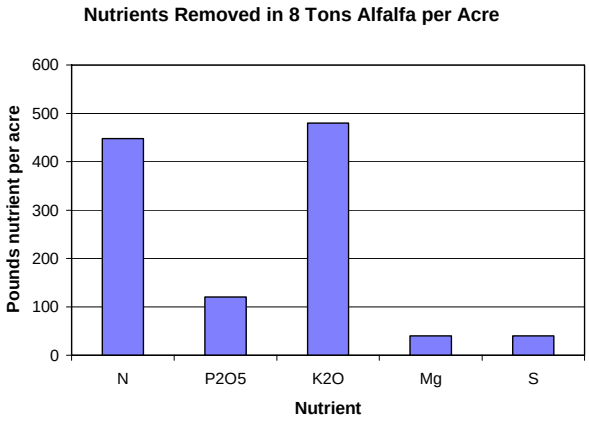

Figure 2. The percentage of nutrients replaced with 2.5 tons per acre application of dairy compost.

The incorporation of compost did not affect forage yields of the annual legumes kudzu, cowpea, soybean, or peanut in a dryland situation (Muir 2002), but two years of compost application produced a fourfold increase in soil P.

RECOMMENDATIONS

Soil Test for Alfalfa Fertility

The first step in fertility management for alfalfa is to adequately sample the soil in a field prior to planting. It is important to soil test prior to planting so that nutrients from fertilizer, compost, or manure can be incorporated into the soil prior to alfalfa establishment. The following gives guidelines for alfalfa fertility:

Soil samples should at least represent the top 12 in. of soil because alfalfa obtains > 70% of its nutrition from the top 2 feet of soil depth. The soil should also be sampled from 1 to 2 feet of depth periodically. If soil tests indicate fertilizer is needed, apply and work the fertilizer 4-6 in. into the surface when preparing the seed bed. Alfalfa will respond to P, K, S, Zn, and B when these nutrients are deficient. Most likely, phosphorus will be the nutrient most needed. Use your soil test information to consult the Southern Idaho Fertilizer Guide: Irrigated Alfalfa (CIS 1102) http://info.ag.uidaho.edu:591/catalog/fertilizers.html for recommended application of nutrients from compost or fertilizer.

Compost or Manure Application on Alfalfa

Compost can be applied pre-plant or annually in the fall. The application rate should be based on a soil test and fertilizer guidelines. Alfalfa will recycle nutrients and can use up to 300 lbs of N/acre per year. Alfalfa will preferentially use supplied N rather than N fixed from atmospheric sources through Rhizobia. Alfalfa can extract nutrients to great depths and can withstand multiple applications.

Manure can be applied preplant in seeding year, topdressed to established alfalfa, or at plowdown (not recommended). Manure can negatively affect yield, increase weeds, and accumulate tissue nutrient accumulations. Up to 12 tons/acre can be applied if mixed in soil.

Truck traffic from either manure or compost application can damage the alfalfa crowns allowing opportunities for disease, regardless of when it occurs. We recommend using varieties of alfalfa that have been selected under grazing pressure because they are more resistant to crown damage and are generally highly resistant to crown diseases. Manure or compost application is the spring will leave noticeable tracks in the alfalfa where the growth will be 4 to 6 inches less than undamaged alfalfa. Fall application and use of floatation equipment is recommended.

Manure applied to established Alfalfa

- Can be risky
- Nutrient runoff can be high if applied to frozen ground
- Management
  - Apply to older stands
  - Grassy stands benefit most
  - May get yield response

- Limit rates to 3,000 to 5,000 gal/a or 10 tons dry
- Apply immediately after harvest

Application at plowdown is not recommended because there is no fertilizer response to corn following alfalfa, and excess nutrients may be lost.

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