Split N Fertilizer vs. Dairy Manure on Harvested Perennial Grasses

by Jerry Cherney, Quirine Ketterings, Mike Davis, and Debbie Cherney, Cornell University; Adapted by Paul Peterson, University of Minnesota

Perennial grasses harvested for conserved forage can utilize large amounts of nutrients, increasing nutrient management options and reducing the risk of negative environmental impacts. A study was conducted at Willsboro, NY to determine the effects of nutrient application source and timing on yield and quality of 'Okay' orchardgrass, 'Rival' reed canarygrass, and 'Select' tall fescue.

Six treatments were applied four consecutive years (Table 1). Three of the treatments received 200 lb N/ac/yr applied as ammonium nitrate in: a single application at spring green-up, split-applied at green-up (100 lb) and after 1st cut (100 lb), or split-applied at green-up (100 lb) and after 1st (50 lb) and 2nd (50 lb) cuts.

Table 1. *Total N, P, and K applications annually 2001-2004 from fertilizer and dairy manure (40t/ac/yr) for 6 nutrient application treatments in northern NY.*

Nutrient Treatment *(Split application at spring green-up & after 1st & 2nd cuts)*	Annual Nutrient Application (lb/ac)						
	Fertilizer N	Manure NH_4-N	Manure Organic N	Fertilizer P	Manure P	Fertilizer K	Manure K
0 + 0 + 0	0	0	0	0-17	0	0-37	0
100 + 50 + 50	200	0	0	0-17	0	0-37	0
100 + 100 + 0	200	0	0	0-17	0	0-37	0
200 + 0 + 0	200	0	0	0-17	0	0-37	0
20t + 20t + 0	0	65-142	208-237	0	70-98	0	214-258
20t/50 + 20t/50 + 50	150	65-142	208-237	0	70-98	0	214-258

Two treatments received semi-solid dairy manure (with sawdust bedding) applied at 40 ton/ac/yr with manure split between spring green-up (20 t) and after 1st cut (20 t), or manure split-applied plus 50 lb N fertilizer/ac/cutting. The 6th treatment received no manure or N. All non-manure treatments received P and K based on soil tests (Table 1). At the start of the experiment, the site was low in P but high in K.

A 3-cut system was used. Spring harvest occurred the last week of May or first week of June. Second harvest was the last week of June or first week of July. The target for the first 2 harvests was 55% NDF, suitable for lactating dairy cow diets. Third/final cuts were in September or early October. Growing-season rainfall was near the 16" long-term average 1 year, above average 2 years, and below average only 1 year.

With annual manure applications, P, OM, pH, and nitrate all increased (Table 2); in contrast, they decreased with annual N fertilization (P, OM, and pH) or increased more slowly (nitrate). Grass species had no effect on soil pH, OM, or P levels. While manure increased soil P and K to high levels, manure combined with N removed more P and K due to higher yields (Table 3).

Table 2. *Soil test values (Cornell Morgan Extraction) in spring 2005 after 4 years of 6 nutrient application treatments (averaged over 3 grass species cut 3 times/yr).*

Nutrient Treatment *(N Fert. and/or manure)*	P *(lb/ac)*	K *(lb/ac)*	OM *(%)*	pH	Nitrate *(lb/ac)*
0 + 0 + 0	3.3	148	5.5	6.38	13
100 + 50 + 50	2.4	116	5.7	6.30	16
100 + 100 + 0	2.3	125	5.5	6.22	20
200 + 0 + 0	2.5	125	5.7	6.25	14
20t + 20t + 0	14.6	205	6.4	6.56	21
20t/50+ 20t/50 + 50	11.6	168	6.3	6.55	29
SED	1.0	6	0.1	0.04	3

SED - Standard error of difference

Manure plus N produced greatest DM and milk yields (Milk2000; Table 3). By 2004, manure (without N) produced similar DM yields to N. Split-applied (100 + 100) N increased DM yield over a single spring application of 200 lb N/ac, but did not affect N recovery or forage quality (Tables 3 & 4). Splitting the 2nd 100 lb N/ac application over 2nd and 3rd cuts (50 + 50) did not affect yield or N recovery. Grasses had similar N recovery. Tall fescue produced greater milk yields and more uniform yield distribution than other grasses (Table 3). Reed canarygrass produced less yield than orchardgrass and tall fescue, but produced higher quality forage at spring harvest (Table 4).

Table 3. *Annual average yields of DM, N, and potential milk; and apparent recovery of N fertilizer for 5 nutrient application treatments during 2001-2004.*

Factor	Treatment	DM Yield *(lb/ac)*	Milk Yield *(lb/ac)*	Yield in Cuts 1 + 2 *(%)*	N Uptake *(lb/ac)*	N Recovery *(%)*
Species	'Okay' Orchardgrass	7460	12,900	77	168	58
	'Rival' Reed Canarygrass	6620	11,700	75	183	50
	'Select' Tall Fescue	7820	13,800	70	172	61
	SED	210	400	2	5	8
Nutrient Treatment	100 + 50 + 50	7710	13,400	71	180	53
	100 + 100 + 0	7510	13,200	76	185	56
	200 + 0 + 0	7130	12,600	80	194	60
	20t + 20t + 0	5970	10,700	74	126	-
	20t/50 + 20t/50 + 50	8180	14,100	70	187	-
	SED	180	300	1	4	2

Table 4. *Forage quality at 3 harvests averaged over 5 nutrient treatments & 4 years.*

Cutting	Species	NDF *(% DM)*	CP *(% DM)*	NDFD *(% NDF)*	RFQ *(Index)*	Milk/ton *(lb/ton)*
1st ~June 1	'Okay' Orchardgrass	56.6	16.3	75	169	3690
	'Rival' Reed Canarygrass	49.9	21.3	79	202	3950
	'Select' Tall Fescue	53.8	16.8	75	178	3740
	SED	0.9	0.5	1	5	50
2nd ~July 1	'Okay' Orchardgrass	57.8	13.9	70	153	3480
	'Rival' Reed Canarygrass	55.0	16.9	67	151	3380
	'Select' Tall Fescue	54.5	14.2	69	160	3510
	SED	0.4	0.3	1	3	30
3rd ~late Sept.	'Okay' Orchardgrass	57.2	11.7	65	141	3260
	'Rival' Reed Canarygrass	47.8	14.1	62	163	3370
	'Select' Tall Fescue	55.1	10.3	67	152	3400
	SED	0.5	0.3	1	2	40