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Grass Response to N Fertilizer

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Grass yield and quality response to nitrogen (N) fertilizers is dependent on plant available nutrients, water, climate and other agronomic factors. Fertilizer application can be a key management tool, if soil test levels are less than optimum, economics are favorable, and the environment will not be adversely impacted.

Two dryland grass experiments were conducted at the Northern Agricultural Research Center (48^{o} 30' N; 109^{o} 47' 30" W) at Havre, MT, to evaluate grass specie response to a single N application. Both used ten common grass species (basin wildrye (BWI), beardless wheatgrass (BWH), crested wheatgrass (CWH), green needlegrass (GNE), "Greenar" and "Oahe" intermediate wheatgrasses (GIW & OIW), pubescent wheatgrass (PWH), Russian wildrye (RWI), thickspike wheatgrass (TWH and western wheatgrass (WWH)) that were seeded in the early spring and fertilized in the fall. Nitrogen fertilizer (34-0-0) was applied in Trial 1 at 0, 50 and 100 lbs N/a and in Trial 2 at 0, 100, and 200 lbs N/a. Dry matter production was measured after the first year of production and annually for four years.

Cumulative Production

In both trials, N fertilization increased forage production (Table 1). In Trial 1, averaging all species, cumulative yield over the 4 years increased from 5384 lbs/a for the check to 6580 lbs/a with 50 lbs N/a, and to 6867 lbs/a with 100 lbs N/a. If only the four greatest producing grasses are considered, cumulative yield increased from 6216 lbs/a for the check to 8148 lbs/a with 50 lbs N/a, and to 8427 lbs/a with 100 lbs N/a.

Table 1. Cumulative 4-year yields for two trials.

		Cumulative Yield	
Grass	N Rate	Trial 1	Trial 2
	---- lbs/a ----		
BWI	0	4800	3438
	50	5770	
	100	6004	5743
	200		6127
BWH	0	4073	3304
	50	4646	
	100	4768	5646
	200		7353
CWH	0	6231	5573
	50	7535	
	100	7852	10036
	200		13400
GNE	0	6001	3335
	50	6442	
	100	6886	5658
	200		7177

GIW	0	6669	4037
	50	7897	
	100	8664	7975
	200		9186
OIW	0	6557	5019
	50	9056	
	100	9717	9199
	200		10433
PWH	0	5408	3641
	50	8103	
	100	7476	7213
	200		8626
RWI	0	4273	2859
	50	5339	
	100	5451	5438
	200		6653
TWH	0	5770	3542
	50	6090	
	100	7151	6288
	200		7550
WWH	0	4054	3253
	50	4921	6047
	100	4702	
	200		7388

In Trial 2, averaging all species, cumulative yield increased from 3800 lbs/a for the check to 6924 lbs/a with 100 lbs N/a, and to 8389 lbs/a with 200 lbs N/a. Again, looking only at the four greatest producers, cumulative yield increased from 4567 lbs/a with the check to 8606 lbs/a with 100 lbs N/a, and to 10411 lbs/a with 200 lbs N/a.

A single N fertilizer application continued to show a response in some cases four years after application. Apparently, if growing conditions are poor, residual N remains in the soil/plant system, increasing production in subsequent, more favorable years. The N response was greater in Trial 2 due to the more favorable timing of precipitation (Table 2).

Table 2. Comparison of annual yields in two trials at two rates.

10 grass average	N Rate	Year 1	Year 2	Year 3	Year 4
	---------- lbs/ac ----------				
Trial 1	0	780	1978	1335	1291
	100	918	2579	1820	1549
Trial 2	0	1539	627	564	1071
	100	3663	1356	666	1239

N Response by Species

The individual species responded differently to N applications. Crested wheatgrass, both intermediate wheatgrasses and pubescent wheatgrass produced large yields and consistently responded the most to N fertilization.

Fertilizer Use Efficiency

A fertilizer use efficiency (FUE) value was calculated as pounds of grass greater than the check per pound of applied N. In Trial 1, grasses treated with 50 lbs N/a were more efficient than 100 lbs N/a (23.9 and 14.8 lbs grass/lbs N, respectively), and in Trial 2, 100 lbs N/a produced more efficient response than 200 lbs N/a (31.2 and 22.9 lbs grass/lbs N, respectively).

Economic Implications

A simple cost-benefit analysis was made using prevailing values ($210 per ton N, $40 per ton hay). The fertilizer cost (without application cost) is $11.41, $22.82 and $45.64 per acre for 50, 100, and 200 lbs/a applications, respectively. In order to break even, a cumulative production increase of 570, 1140 and 2280 lbs/a is needed to offset just the fertilizer cost of 50, 100, and 200 lbs N/a, respectively. More simply, an 11.4 lb forage production increase is needed for every lb N applied to pay for the applied N.

In Trial 1, 50 lbs N/a produced this minimal level in 8 of 10 species with pubescent wheatgrass returning the most hay per fertilizer dollar, and thickspike wheatgrass the least. With 100 lbs N/a, 7 of 10 species produced more than the economic break even point with "Oahe" intermediate wheatgrass the most economical, and western wheatgrass the least. In Trial 2, all 10 species at both fertilization levels produced economic responses, with crested wheatgrass producing the most hay per fertilizer dollar and basin wildrye the least at both N levels. Clearly, to produce enough hay to justify the cost of fertilizer, the species composition, fertilizer rate, market factors and application costs needs to be carefully considered.

Fertilizer Facts

- Grasses respond to fertilizer N applications with the magnitude of response species dependent
- Crested wheatgrass, "Greenar" and "Oahe" intermediate wheatgrasses and pubescent wheatgrass were consistently the highest producers
- These four grasses are most likely to give increased hay value for every invested fertilizer dollar
- During dry seasons, N can remain in the soil or plant system for use in later, more favorable seasons
- N fertilizer can remain in soil and boost production for several years, and therefore fertilizer may not need to be applied each year