Renovation of Established Forages with Fertilizer

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Using fertilizers to restore the productivity of established forage crop stands pays major dividends, with the proper balance of nitrogen (N) and phosphorus (P) critical to maximizing yields.

Forage crop fertilization is considered an optional practice for many farmers in the northern Great Plains, especially where dryland conditions limit the forage yields. However, there is a large database to support fertilization of forages as a means of maintaining yield, quality, and stand purity. In fact, the cost of not fertilizing is much higher when stand productivity declines. This project was established to evaluate dry and fluid fertilizer use on old, established stands of grass-legume forages.

Forage crop stands were selected at Scott (Typic Boroll loam soil) and Indian Head (Udic Boroll clay loam soil), Saskatchewan. At Scott, the stand was a mixture of crested wheatgrass, bromegrass, and alfalfa (10%). At Indian Head, it was bromegrass and alfalfa (30%). At Scott, the stand was extensively invaded by fescue and bluegrass species, which are considered less productive when harvested as hay. Both stands were old and nutrient-deficient. However, both were weed-free. Soil tests were taken at the start of the project…N and sulfur (S), 0 to 24 in. deep, P (modified Kelowna) and potassium (K), 0 to 6 in. Results showed 21 lb N/A, 6 lb P/A, >600 lb K/A, and 60 lb S/A at Scott, and 25 lb N/A, 2 lb P/A, >571 lb K/A, and 72 lb S/A at Indian Head.

Fertilizer treatments were applied to the study area in plots 6 ft. by 25 ft. The treatments were 1) unfertilized check, 2) unfertilized check with coulter (12 in. centers) applied in year 1 and coulter applied urea ammonium nitrate (UAN) and ammonium polyphosphate (APP) in year 2 and 3, 3) surface broadcast ammonium nitrate (AN) and monoammonium phosphate (MAP), 4) dribble banded (12 in. centers) UAN and APP, 5) dribble banded UAN and APP with ammonium thio-sulfate (ATS) added at 1% of total solution, 6) coulter injected (12 in. centers) UAN and APP, 7) coulter injected UAN, and 8) coulter injected UAN and APP at three times the annual rate (**Table 1**). Rates of N used at Scott were 53 lb N/A in 2002 and 2004, and 27 lb N/A in 2003. At Indian Head, the rate was 75 lb N/A each year. With the exception of treatment 8, all plots received 30 lb P_2O_5/A each year with the N. Treatment 8 received 90 lb P_2O_5/A in year 1 and then only N each year after. Treatments were applied annually to the same plot area and forage yields were harvested once each year.

Yield response after the first fertilizer application (year 1) was consistent over location years, but in the second and third years of application, there was a significant location by treatment interaction. Most, if not all, the interaction effect could be attributed to a difference in responses to P alone at the 2 locations. At Scott, a small response to N without P was recorded after years 2 and 3, while at Indian Head the N alone treatment yielded the same as the no fertilizer treatment (data not shown).

Dribble banding liquid UAN and APP was an effective means of applying

Table 1. Average yield response to fertilizer N and P additions on established legume-grass forage stands at Scott and Indian Head, SK.

Treatment	Year 1	Year 2	Year 3	Mean
	------ Forage yield, lb/A ------			
1) Check – no fertilizer	1,193	1,210	997	1,130
2) Coulter check – no fertilizer year 1, coulter applied UAN[1] and APP in year 2 and 3	1,059	1,682	2,456	1,736
3) Broadcast AN and MAP	1,771	2,723	3,088	2,528
4) Dribble UAN and APP	1,825	2,706	2,537	2,359
5) Dribble UAN with 10% ATS + APP	1,914	2,581	3,035	2,510
6) Coulter UAN and APP	1,566	2,456	2,830	2,287
7) Coulter UAN	1,406	1,673	1,362	1,477
8) Coulter UAN and 3 X APP[2]	1,914	2,786	3,008	2,572
LSD p=0.05	325	291	354	

[1] UAN = urea-ammonium nitrate; APP = ammonium polyphosphate; ATS = ammonium thiosulfate; AN = ammonium nitrate; MAP = monoammonium phosphate.
N rate was 53 lb N/A in 2002 and 2004, 27 lb N/A in 2003 at Scott; 75 lb N/A in all years at Indian Head. Annual P rate 30 lb P_2O_5/A.
[2] 3 X APP – ammonium polyphosphate applied at 3 times the annual rate (90 lb P_2O_5/A) in year one only, with N applied each year.

fertilizers to old, established forage stands (**Table 1**). The yield was similar for surface broadcasting granular AN and MAP and the fluid UAN and APP. Adding ATS to liquid UAN appeared to provide a slight (not statistically significant) benefit over UAN alone. If this treatment adds little to fertilizer cost, it may be useful as insurance against N losses under adverse conditions. No advantage was recorded to coulter application of the fluid fertilizer bands in this study (**Table 1**). Dribble band application is a lower cost method than use of coulters, and this research would not support the investment, upkeep, and operational cost of using coulters on forage lands.

Applying a 3-year supply of P at the beginning of the project was as effective as applying equal increments of P annually. In fact, at Indian Head, the application of the 3-year P rate in year 1 was always the highest yielding treatment (data not shown). Only when N and P were applied together was there a yield response at Indian Head, indicating that P was the major limiting nutrient. Applying P only at Scott did increase yield, but was ineffective compared to N plus P treatment (P alone yielded 1,566 lb/A compared to no fertilizer at 1,344, and broadcast N and P at 2,314 lb/A).

The residual effect of repeat fertilizer applications to these plots was dramatic. Check yields remained somewhat static, but fertilized yields tended to increase over time, typically increasing by about 50% in the first year of application. In the second year of application, the most effective fertilizer treatments more than doubled yields. In the third year, yields were tripled. These responses support previous research in the region which showed a progressive improvement in forage response to P additions over a series of years. Where banding without fertilizer was done the first year (treatment 2), followed by fertilizing in each of years 2 and 3, yields continued to be lower than where fertilizer N and P were coulter-banded all 3 years.

Where the productivity of established forages has declined over time due to nutrient deficiencies, fertilizer additions can be an effective means of improving yields. Soil testing to evaluate the level of available nutrients is critical to ensure that all deficient nutrients are applied. Correcting deficiencies in P can be critical to achieving a profitable N response in forage crops. BC

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