CHAPTER 13

Shifts in Pasture Communities Due to Nutrient Imbalances in the Aspen Parkland

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Permanent pastures in the transitional Parkland ecozone in northeast Saskatchewan were initially established by clearing the native Aspen trees and seeding with forage mixtures consisting of a variety of species (sometimes up to 17), including alfalfa (*Medicago sativa*), an improved jointed grass (coarse, tall growing), typically smooth bromegrass (*Bromus inermis*), and fine grasses such as creeping red fescue (*Festuca rubra*). The pasture plant community gradually shifted away from the alfalfa and tall grasses towards fine grazing-resistant grasses, especially bluegrass (*Poa*) species, creeping red fescue, and broadleaf species referred to generically as forbs. The decline of seeded species is attributed to grazing pressure, which favours shorter grasses and some forbs. Loss of the productive seeded species is a key reason for pasture renovation which is very expensive and often exposes soils to risk of erosion.

We examined the role of soil nutrients (N, P, K and S) on species composition and yield on five typical permanent swards grazed by beef cows on community pastures in the Aspen Parkland of northeast Saskatchewan (Bittman et al. 1997). The study location (Fig. 1) was quite remote from industry and population centres and was probably subject to very little atmospheric deposition of N, P, K or S. All soils in the study were medium textured. The sites varied in soil S based on the Ca-Cl_2 test, with two testing lower than the others. Nutrients (N, P, K and S) in the study were applied as ammonium nitrate, monoammonium phosphate, potassium chloride and sodium sulphate, respectively. Results reported here are means of the five trials.

Unfertilized pastures had the highest proportion of forbs (broadleaf weeds) and legumes which were comprised mainly of alfalfa and a native vetch (Table 1). Applications of N reduced the proportion of forbs and legumes in the

Figure 1. One of the experimental sites used to test the effects of nutrient balances on species composition and productivity of a community pasture sward in the Parkland region of northeast Saskatchewan. The pastures were grazed and plot areas were protected by exclosures which were moved every year. Growth differences are apparent from herbage in the exclosures.

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Table 1. Effect of fertilizer application on yield measured over 10 years and species composition of pasture swards after 7-11 years of fertilizer application in northeast Saskatchewan (mean of 5 trials) (adapted from Bittman et al. 1997).

FERTILIZERS			YIELD	GROUND COVER				
N	P	S		Coarse grasses[1]	Fine grasses[2]	Legume[3]	Forbs[4]	Coarse: fine grasses
kg/ha			t/ha	%				
0	0	0	1.6	35	36	7	22	1.0
45	0	0	2.37	41	42	3	13	1.0
45	20	0	3.13	52	34	1.5	13	1.5
90	0	0	2.34	33	55	0.7	11	0.6
90	20	0	3.96	56	32	0.6	11	1.7
90	20	20	4.02	67	21	0.6	12	3.3

[1]Coarse grasses, mainly smooth bromegrass; [2]fine grasses, mainly Kentucky bluegrass and creeping red fescue; [3]legumes, mainly alfalfa; [4]forbs, broadleaf plants (for T/acre multiply by 0.45).

sward by about half and these plants were replaced mainly by both coarse (mainly smooth bromegrass) and fine grasses (Kentucky bluegrass and creeping red fescue) at the low N rate and mainly by the fine grasses at the high N rate (Table 1; Fig. 2). The increase in proportion of low-yielding fine grasses at the high N rate may have reduced the potential yield response of these swards to fertilization, although growth could have also been limited directly by P deficiency.

Addition of P increased the proportion of coarse to fine grasses from about 1:1 (control and low N treatments) to about 1.5:1 at both the low and high N rates (Table 1; Fig 2). Addition of P also increased yield by 32% at the low N level and by 70% at the high N level, thanks in part to the increased dominance of the taller grasses. Adding S to N (high N level) and P doubled the proportion of coarse:fine grasses (1.7 to 3.3) and the ratio was at least three times higher than on unfertilized or N-only swards. The difference was due mainly to the effect in the 3 (of 5) sites that had lower soil-test values for S, so in those sites (depicted in Fig. 1) the effect was even greater. There was no evidence that K had any effect on species composition but these soils tend to be relatively rich in K.

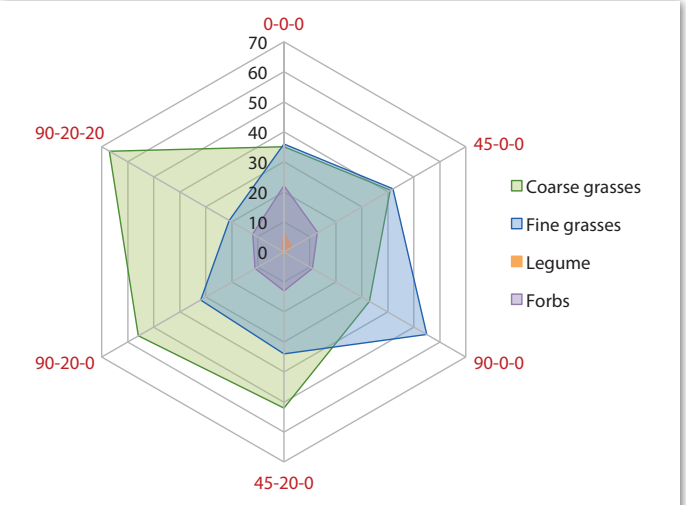

Figure 2. Radar diagram illustrating the effect of fertilizer combinations (in red around the perimeter) on proportions of plant types, as in Table 1. The fertilizer values are N, P and S, respectively, in kg/ha (for lb/ac multiply by 0.9).

These trials show some of the interactive effects of nutrients on pasture swards. A small addition of N increased yield and reduced unproductive forbs, but a larger amount of N failed to further increase yield in part by increasing the prevalence of lower yielding fine grasses. Addition of P seemed to restore balance as evidenced by greatly increasing yield response to N, and this is explained in part by the greater proportion of tall grasses. In fact, in separate experiments we found a positive correlation between yield and proportion of smooth bromegrass across 20 pastures in this region (Bittman, unpublished data). Addition of S further enhanced the proportion of coarse grasses (mostly in 3 of 5 swards with lower soil S) and also increased yield in 2 of 5 swards. It appears that the larger grasses responded more fully to applications of P and S, so that they prevailed over the finer grasses. Prevalence of taller grasses probably increased sward responsiveness to fertilizer. An additional practical benefit is that the shift to coarse grasses results in more even and consistent herbage production because these species have deeper roots and, hence, have better growth both in mid-summer and in dry years. Also, the taller grasses are more suited to stockpile grazing (See Chapters by McCartney; Thompson).

References available online at www.farmwest.com

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