Plant Community Composition in Pastures Seeded with Native Plant Species in Southwest Saskatchewan

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Key Words

Native prairie grasses, pasture, biological nitrogen fixation, pasture, purple prairie clover

Abstract

Pastures made of native species offer good quality forage for grazing in the warm and dry months of July and August in southwestern Saskatchewan, when cool season species loose feeding quality. Long-term research plots were seeded with seven native grass species, with or without either purple prairie clover or alfalfa to further increase forage quality and sustain high productivity. These stands were compared to meadow brome – alfalfa stands. Triple superphosphate was applied at a rate of 0, 50 or 200 kg P_2O_5 ha^{-1} in an attempt to enhance root growth and facilitate establishment. Phosphorus fertilization had no effect on root length density, plant biomass, or plant proportions. Very little growth was produced in 2006, the year of seeding. But stands grew rapidly in 2007 and in the first week of July, pastures with native grasses produced 1.5 t ha^{-1}, i.e. approximately half the biomass of meadow brome – alfalfa stands. The late season species, blue grama, little bluestem and purple prairie clover, were just starting their growth cycle in 2007 at that time and larger herbage yield in native stands is expected in 2008. Purple prairie clover made up less than 1% of the biomass of stands where it was seeded and alfalfa, about 14%. Weeds, which were abundant in 2006, were effectively suppressed by the forage plants in 2007, particularly in meadow brome – alfalfa stands. We conclude that stands seeded with native species require a longer period of establishment than meadow brome stands. This establishment period could not be enhanced by P fertilization.

Introduction

Models predict for the Canadian mixed grass prairie ecozone, the reversion of climate to conditions that prevailed a century ago and before, i.e. more frequent and sever drough periods (Sauchyn et al. 2002). Native species have evolved into a droughty climate and are better adapted to the conditions brought by a changing climate. Native species can be grazed but are perceived as being less productive than introduced species, in pastures. Some recent research work indicated otherwise (Schellenberg 2008). This research, furthermore, showed a benefit of seeding grass species - native or introduced - in combinations rather than in monocultures (Schellenberg 2008). Recent work from Europe indicates that four to six species mixtures are optimal in low input grazing systems (Kirwan et al 2007). These mixtures contained equal numbers of species of legumes and grasses. Mixtures benefit the herbivore by increasing effective digestion (Schellenberg 2005) and legumes, such alfalfa, are often used to increase the crude protein value of forage.

Inclusion of a legume in pasture can increase herbage production (Bullock et al. 2007). Schellenberg and Banerjee (2002) showed an increase in biomass yield with the native legume purple prairie clover in combination with the native forage shrubs winterfat and Gardners saltbush. Purple prairie clover (*Dalea purpurea* Vent.) was once widely distributed (Graham 1941). It has excellent forage value with high protein and palatability (Stubbendieck et al 1986). This native legume does mature later than alfalfa thus providing quality feed later in late summer when grasses typically loose feeding value. Cattle select purple prairie clover and warm season grasses in the late summer (Iwaasa and Schellenberg 2005).

The overall objective of our study is to create pastures composed of native grass as well as of a legume species, to sustain productivity and improve forage quality in pastures designed for grazing in the late summer. We know by experience that native species and, in particular, late season plants such as purple prairie clover, are slow to establish. Phosphorus is well known to increase root growth (Brady and Weil 2001). In this report, we tested that P fertilization speeds up the establishment of seeded stands of native species and reduces weeds proliferation.

Materials and Methods

The experiment was conducted at the South Farm of the Semiarid Prairie Agricultural Research Centre in Swift Current SK (50°16' N 107°44' W), on a loamy Brown Chernozemic soil. In 2005, the site was fallowed using tillage and one glyphosate application in the fall. In 2006, glyphosate was applied 11 days after seedbed preparation, prior to seeding in 30 cm rows, at a depth of 6 mm. Triple superphosphate was broadcasted at a rate of 0, 50 or 200 kg P_2O_5 ha^{-1} and raked in the soil manually. Factorial combinations of plant (Table 1) and P fertilizer treatments were applied in an experimental layout with four complete blocks. On July 4 2006, glyphosate was wick applied above the young crop plants for weed control. During the first week of July 2007, the plants in two 0.25 m^2 quadrates were cut at soil level, separated by species and dried to constant weight. Weedy species were pooled. Data were analyzed by ANOVA with JMP v. 3.2.6, after transformation of the data that failed the Shapiro-Wilk W test of normality. The non-parametric Kruskal-Wallis test was used with Bonferroni correction using SAS v. 9, on the weed biomass data, as normality could not be reached with transformation. Orthogonal contrast was computed using SAS v. 9 before rejection of our hypothesis of a P fertilization effect on weed biomass.

Table 1. Plant stands tested

1.	Mix of 7 native grasses*
2.	Mix of 7 native grasses plus purple prairie clover (*Dalea purpurea* Vent.)
3.	Mix of 7 native grasses plus alfalfa (*Medicago sativa* L.) cv. Spredor 4
4.	Meadow brome cv. Montana plus alfalfa cv. Spredor 4

* Western wheatgrass (*Agropyron smithii* Rydb.), northern wheatgrass [*A. dasystachyum* (Hook.) Scribn.], Awned wheatgrass [*A. subsecundum* (Link) Hitchc.], Canada wildrye (*Elymus canadensis* L.), Green needlegrass (*Stipa viridula* Trin.), little bluestem [*Schizachyrium scoparium* (Michx.) Nash], blue grama [*Bouteloua gracilis* (H.B.K.) Lag ex Steud.].

Results and Discussion

Plants grew very little in 2006, the year of seeding. In the first week of 2007, northern and western wheatgrass made up more than 60% of the plant community biomass, on a dry basis, in plots seeded with native grasses. Awned wheatgrass accounted for about 9% of the forage biomass, Canada wildrye for about 12%, and green needlegrass for about 9% (data not shown). Taken together, the warm season grasses little bluestem and blue grama, which were just starting their growth period at the time of sampling, accounted for 0.58 % of the forage yield. Purple prairie clover, another warm season species, accounted for about 0.07 % of the forage stands where it was seeded. In contrast, alfalfa accounted for about 13% of forage biomass in stands where it was seeded.

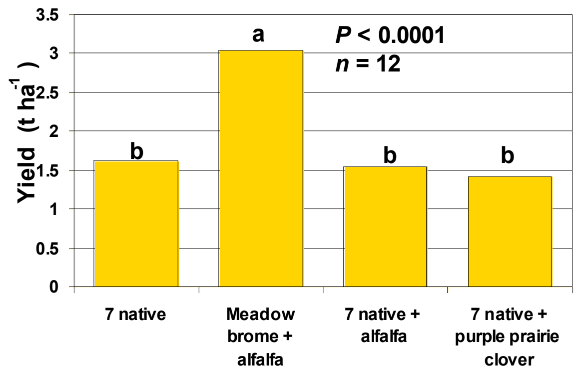

Fig. 1. Yield of the different forage stands in early July of 2007. Seeding year was 2006.

Fig. 2. Low plant density in a stand of native grasses at harvest, in early July of 2007. Seeding year was 2006.

Stands seeded with native grasses yielded less than meadow brome-alfalfa stands (Fig. 1), which also had less weeds (P = 0.01; data not shown). Weed biomass was less than 10% of total biomass in all plots. Inclusion of a legume had no influence on yield. In contrast to meadow brome – alfalfa stands, stands with native grasses were thin and their canopy was not yet closed at the time of harvest (Fig. 2). Seeds of native plants are relatively expensive and the seeding rate recommended for optimal economic efficiency in pastures seeded with native grasses may be suboptimal for biomass production the year after seeding. Delayed growth of the warm season plants also partly explains the lower productivity of stands seeded with native grasses. The two warm season grasses were just starting their second growth cycle at the time of harvest, whereas cool season grasses including meadow brome had almost completed two full growth cycles. Higher productivity is expected in native grass stands, in 2008. In fact, recent research (Schellenberg 2008) indicates that natives are at least as productive as introduced species in a semi-arid environment.

Larger root length densities were also found in meadow brome – alfalfa stands (Fig. 3). Native species are known for having extensive root systems. We sampled only the top 7.5 cm layer of the soil. Root should be sampled at deeper depths in the future to obtain a better estimate of root development in stand seeded with native grasses.

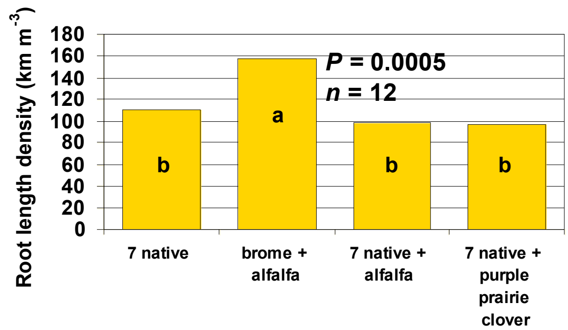

Fig. 3. Root length density in the different forage stands in early July of 2007. Seeding year was 2006.

Phosphorus fertilization did not influence root growth, plant biomass or proportion (data not shown). It remains to be seen if the initial P application will influence biological N_2-fixation and plant community structure as stands will mature.

Conclusion

The poor productivity of native grasses in early July of the year following the seeding year, which was attributed to suboptimal seeding density and the naturally slow establishment of warm season grasses, means that forage stands seeded with native species require a longer period of establishment than meadow brome stands. This establishment period could not be enhanced by P fertilization even at a rate of 200 kg P_2O_5 ha^{-1}.

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