The Effects Of Crop Residue Removal And Nitrogen Fertilization On Meadow Bromegrass (*Bromus riparius* Rehm.) Seed Production

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Introduction

Smooth bromegrass has been a part of the W. Canadian landscape since the late 1800's. Meadow bromegrass, on the other, is a relative newcomer to the Prairie forage 'scene'. It was introduced into N. America from Europe in the late 1960's and the first Canadian varieties, 'Paddock' and 'Fleet', were released in 1987. It is similar to smooth bromegrass in adaptation and quality, however, meadow bromegrass regrows more quickly after cutting or grazing and it retains its quality later in the fall than smooth bromegrass. These qualities have made this perennial bunchgrass popular with forage producers, which has led to a strong demand for seed. Meadow bromegrass, however, is a relatively poor seed producer. A good seed stand of smooth bromegrass will produce seed for 10 years or more, whereas meadow bromegrass seed production declines markedly after 2-3 years of production (Knowles et al. 1993, Upton 1983). Much of the cost of production is associated with establishment, and this cost must be 'amortized' over the productive life of the stand. Consequently, prolonging the life of the stand could significantly improve the economics of meadow bromegrass seed production. Researchers have found that seed yield can be increased in other grasses through timely removal of residue and fertilization with nitrogen (Canode 1978, Klebesadel 1970, Knowles 1966, Nordestgaard 1980). The objectives of this study were to determine whether removing crop residue at particular times after harvest and applying nitrogen in fall would prolong seed production. The response of 2 cultivars of meadow bromegrass was compared to 'Carlton' smooth bromegrass and a hybrid of meadow and smooth bromegrass. 'S-9 197'.

Materials and Methods

The bromegrass was seeded at Outlook (irrigated) and Saskatoon (rainfed) in 1994 at a seeding rate of 8 kg/ha and row spacing of 12 inches. This is slightly denser than normal to hasten the decline in the stand. The experiment was designed as a split - split plot with nitrogen as the main plot to minimize nitrogen leaching between treatments. Nitrogen rates of 0, 50 and 100 kg/ha were applied in September each year. Residue removal treatments, the sub-plots, consisted of close mowing (to approximately 2.5 cm) right after harvest, in October, both after harvest and October and a check that was left unmown. The species and cultivars, 'Paddock' and 'Regar' meadow bromegrass, 'S-9197' hybrid bromegrass, and 'Carlton' smooth bromegrass were planted within the residue removal treatments to form sub-sub plots. Seed and seed yield components were measured each year, as well as tiller density, stage of development, and leaf area index each fall and spring and silvertop incidence at maturity. No control measures were exercised for silvertop to determine whether residue removal or fertilization affected silvertop incidence.

Results and Discussion

Seed yield declined more rapidly in meadow bromegrass than in either smooth bromegrass or the hybrid (Table 1). However, mowing right after harvest and fertilizing with 50 kg/ha of nitrogen increased seed yield of all bromegrass tested. Removing residue after harvest and adding 50 kg/ha of nitrogen increased meadow bromegrass yield by 310 kg/ha in 1996. At the current price of approximately $2.20/kg that would give a return of over $600 on an investment of approximately $25. Other cropping options might be more profitable than meadow bromegrass was in 1997, with a yield increase of only 68 kg/ha. Smooth and hybrid bromegrass seed yield was sustained at profitable levels in both 1996 & 1997 by removing residue and adding 50 kg/ha of nitrogen.

Table 1. The effect of residue removal and nitrogen fertilization on bromegrass seed yield (kg/ha) over time.

	No residue removal No nitrogen			Residue removed after harvest 50 kg/ha of nitrogen		
	Paddock	s-9197	Carlton	Paddock	s-9197	Carl ton
1995	613	513	842	613	513	842
1996	148	251	251	458	398	561
1997	22	125	180	90	411	545

In 1996, bromegrass species and varieties responded differently to the residue management treatments at Outlook and Saskatoon (Site*Res*Var p>f=O.O157). At Outlook, residue removal in October, alone or with residue removal after harvest, reduced seed yield compared to removal only after harvest (Fig. 1).

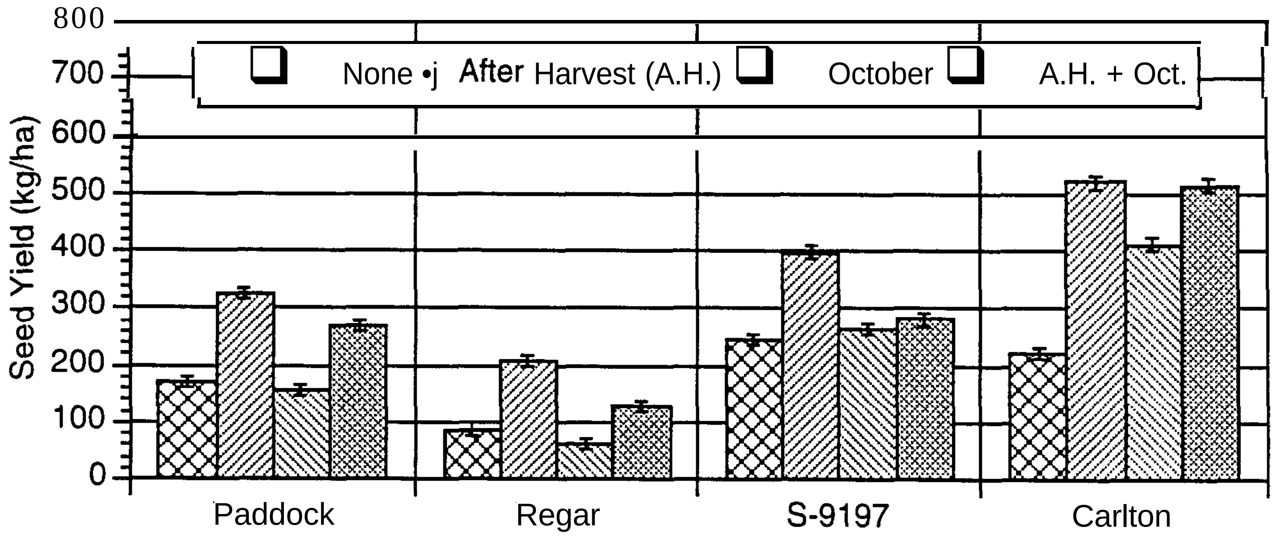

Figure 1. The effect of residue removal on bromegrass seed yield at Outlook, 1996.

More winter injury was observed at Outlook than in Saskatoon. Late residue removal and high nitrogen (100 kg/ha) resulted in reduced seed yield compared to the most productive treatments. In Saskatoon, cutting only in October provided less benefit than cutting after harvest or both after harvest and October, particularly for the meadow bromegrass cultivars (Fig. 2). Smooth bromegrass yield increased with residue removal, but timing wasn't as critical as with meadow bromegrass. The hybrid response was intermediate to the two parent species.

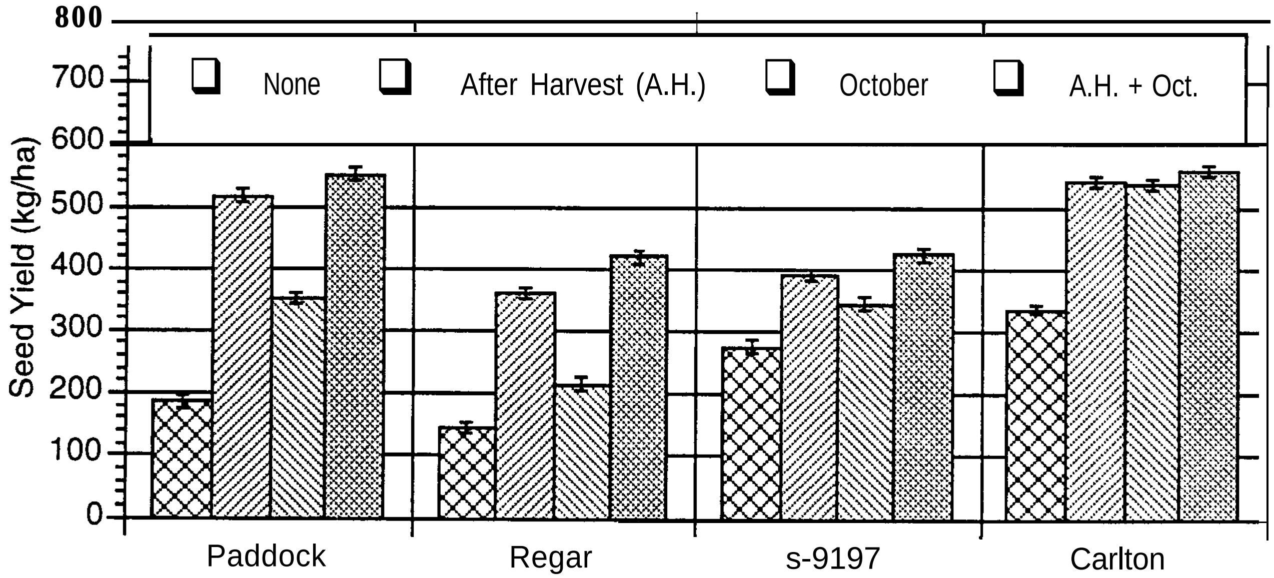

Figure 2. The effect of residue removal on bromegrass seed yield at Saskatoon, 1996.

In 1997, meadow bromegrass seed yield was low regardless of residue removal or nitrogen fertilization . At both locations, removing residue after harvest, with or without another mowing in October, increased seed yield but these increases were not always statistically significant (Fig. 3).

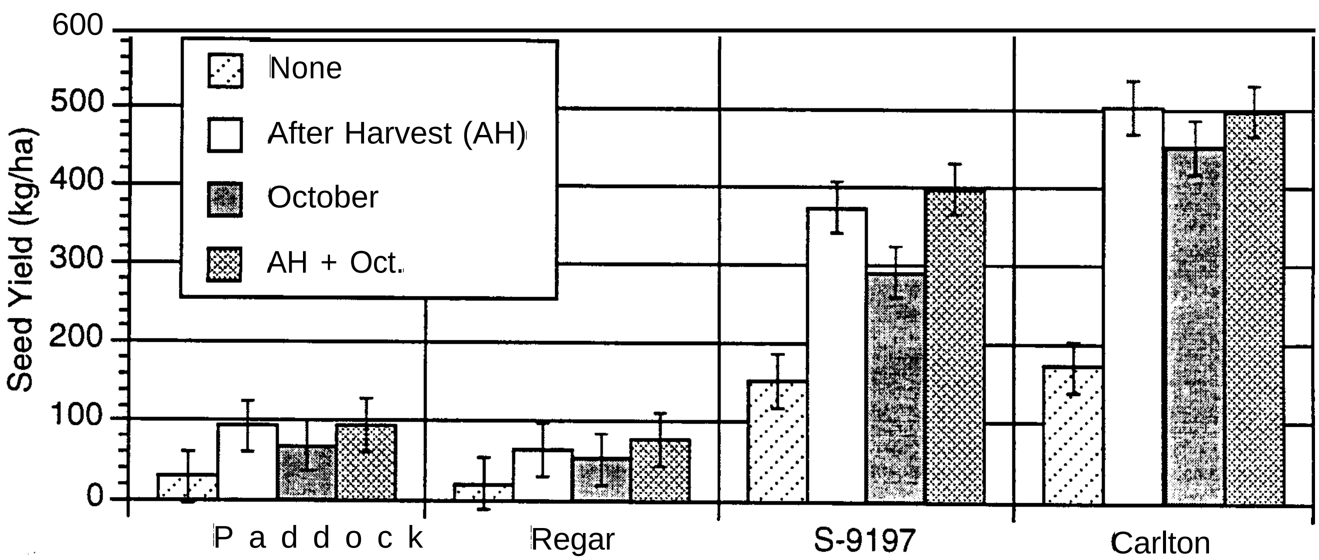

Figure 3. The effect of residue removal on bromegrass seed yield in 1997 (Mean of 2 sites).

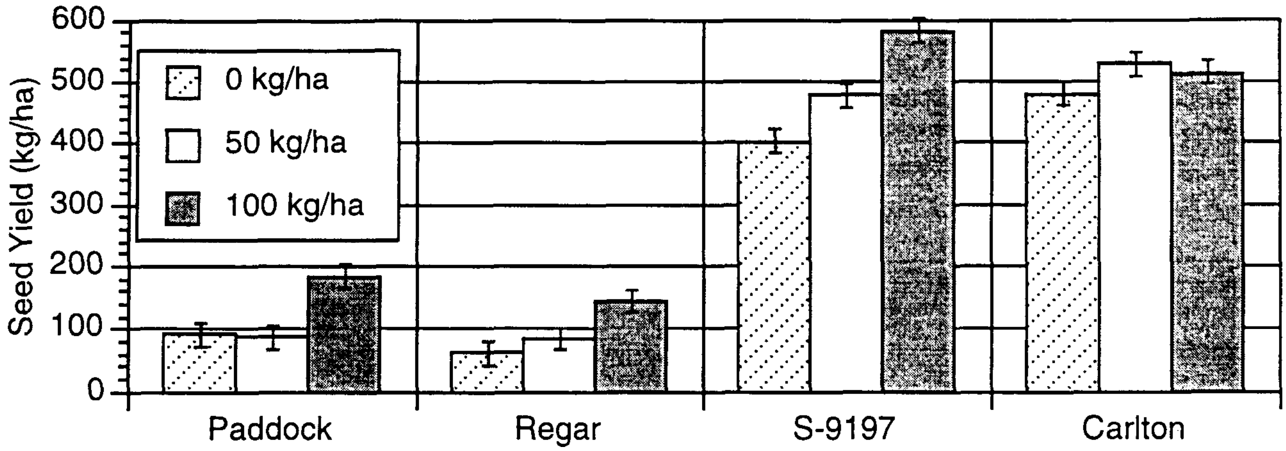

Figure 4. The effect of nitrogen fertilization on bromegrass seed yield at Outlook, 1997.

At Outlook, nitrogen application tended to increase seed yield of meadow bromegrass while at Saskatoon the addition of nitrogen reduced seed yield slightly (Fig. 4 &5). Too much nitrogen, or nitrogen applied too late can stimulate vegetative growth that competes with reproductive tillers.

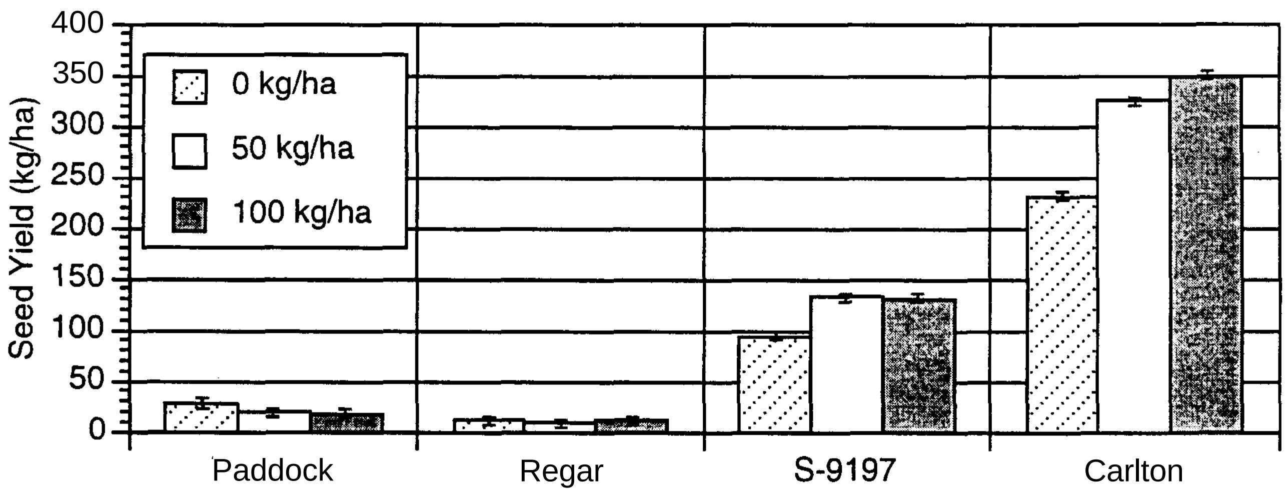

Figure 5. The effect of nitrogen fertilization on bromegrass seed yield at Saskatoon, 1997.

Comparing meadow bromegrass to smooth bromegrass or hybrid bromegrass, we found that in 1997, meadow bromegrass produced 50-60% as many heads as either of the other species. At the same time, the meadow bromegrass cultivars produced only 23-30% of the seed yield of smooth or hybrid bromegrass. This can be explained, at least in part, by the fact that the meadow bromegrass had 3.5 times the level of silver-top in S-9197 and 4.5 times the level of silver-top in smooth bromegrass. These comparisons point to two strategies for increasing meadow bromegrass seed yield: 1) controlling silvertop to capitalize on the existing yield potential, and 2) increasing yield potential by increasing the proportion of tillers that are reproductive.

The only factor in these trials that had a consistent significant impact on silvertop was genetic background (Table 2). Residue removal reduced silvertop incidence, particularly in the meadow bromegrass cultivars, but the levels were still unacceptably high (50% at Saskatoon, 30% at Outlook). However, silvertop can be controlled with insecticides (Chang et al. 1997).

Table 2. Silvertop incidence (%) in bromegrass at Saskatoon and Outlook in 1997 (n=12 S.E=. 11.02)

	Silvertop (%)	
	Saskatoon	Outlook
Paddock	62	32
Regar	56	42
s-9197	19	9
Carlton	14	7

Residue removal increased head density (Table 3). Timing was especially important in meadow bromegrass cultivars although there was no significant interaction between species/variety and residue removal treatment. Residue removal after harvest and in October produced the greatest head density.

Table 3. The effect of residue removal on bromegrass head density in 1997 (n=24, S.E.=83).

Residue removal	Head density (#/m^2)
None	114
After harvest	380
October	266
After harvest + October	395

Nitrogen fertilization also increased head density regardless of location and residue removal treatment (Table 4). All species and varieties responded in the same manner.

Table 4. The effect of nitrogen fertilization on bromegrass head density in 1997 (n=32, S.E.=78).

Nitrogen (kg/ha)	Head density (#/m^2)
0	217
50	303
100	347

In conclusion, field studies have shown that timely residue removal and nitrogen fertilization can increase meadow bromegrass seed yields at least for 1 year even under higher than normal plant density. These practices also improve smooth bromegrass and hybrid bromegrass seed yield. Further improvements in seed yield are likely to occur with the use of an insecticide to control silver-top.

References

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