Role of Postharvest Removal of Stubble and Fall Regrowth on Seed Yield of Grasses

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Agriculture and Agri-Food Canada (AAFC) is the center of grass seed research and development in Saskatchewan. Most of the breeding development and agronomic research for grass seed production in Saskatchewan has been conducted by AAFC. Farmers also possess a wealth of practical experience. The Saskatchewan Forage Council has secured three years of funding through the Canada-Saskatchewan Green Plan Agreement to compile a survey and literature review of this knowledge and initiate research with new technologies which may improve seed yields.

During the past summer, research focused on stubble and regrowth management of established grass seed fields. Five trials were set up during the fall of 1994 on established grass stands in north-eastern Saskatchewan. The locations, grass species and age of the stands were as follows:

Location	Grass Species	Age of Stand at Renovation
Nipawin	Creeping red fescue	1st seed crop
Pontrilas	Meadow bromegrass	1st seed crop
Tisdale	Smooth bromegrass	4th seed crop
Tisdale	Meadow bromegrass	4th seed crop
Star City	Dahurian wild ryegrass	2nd seed crop

The experiment was a split plot design with four rates of nitrogen (0, 30, 60, and 90 kg N/ha) as main plots and five types of post harvest management as subplots. The post-harvest treatments included:

1) leaving the stubble intact at swathing height (20 - 25 cm),

2) mowing the stubble and regrowth as short as possible with a flail mower and removing the material by hand raking,

3) spraying the stubble and regrowth with Gramoxone (paraquat) at 1.1 kg/ha in 550 1/ha of water and burning after 1 week,

4) mowing the stubble and regrowth as short as possible with a flail mower, removing the material by hand raking, and tilling with an Aerway implement,

5) mowing the stubble and regrowth as short as possible with a flail mower and burning the area after one week of drying.

The data collected from each of the sites included counts of tillers, seed heads, silvertop heads per square meter, as well as seed yield per square meter. Drought affected two of the sites severely such that harvest of the seed would not be viable. The Dahurian wild ryerass field showed signs of drought stress, but late June rains revived the crop and a small, but respectable yield was harvested. The creeping red fescue and meadow bromegrass experiments located close to Nipawin escaped the drought which affected the region just north of Tisdale.

I. Effect of residue management on growth and seed yield of grasses

A. Creeping red fescue

Spring tiller counts could not be completed on creeping red fescue because of the high number of tillers and irregular clumpy nature of the stand. The importance of fall regrowth to develop tillers suitable for induction of seed production is indicated by seed head density (Table 2). Paraquat applied to desiccate the grass in late August killed the tillers and almost eliminated seed head production. A lower rate of paraquat or an early morning application may have reduced this injury. The density of seed heads was highest for the clip and rake treatment as well as the clip, rake, and Aerway treatment. The clip / rake and clip / rake / Aerway treatments had equal seed yields (Table 6). Seed yields on the clip and burn plots were not different from the control plot where the fall regrowth was not removed. The seed yield on the clip / burn treatment may have been reduced by the poor quality of the burn. The data indicates, however, that good clipping is superior to poor burning. To the contrary, some Oregon data shows that a crop with mechanical removal or mulching of straw residues produces only 70% of the seed yield of burned fields. None of the renovation treatments had a significant effect on silvertop at this site.

B. Meadow bromegrass

Spring tiller densities on the three treatments which were clipped were higher by 10-25% on the younger 'stand and by 50-65% on the older stand (Table 1). Older stands have a higher tiller density. Regrowth management of the young stand had a dramatic effect on the seed head density (Table 2), whereas the effects were smaller at the older site. The relative ratings of the residue treatments were similar. More seed heads were found on the clip / rake treatment at both sites. The Aerway treatment hurt seed head production on the older site while the spray-burn treatment was less damaging to the older stand than the younger stand. Seed head density at the younger site was reduced on the spray-burn treatment to about 15% of the clip-rake treatment.

The density of silvertop heads was not significantly different on the younger stand, and the differences on the older stand were a reflection of the total number of seed heads present (Table 3). The younger stand showed lower percentages of silvertop for the residue management treatments than the control, but there were no differences at the older site (Table 4).

The percentage of fertile tillers on the older plot were only 510% of those from the younger stand (Table 5). The highest seed yield on the younger stand was on the three clipped treatments (Table 6). On the older site, all four residue management approaches yielded equal quantities of seed. The benefit of the Aerway may be largely water infiltration, especially for older stands and the drought may have limited the response of this treatment.

C. **Smooth bromegrass**

The fall residue management had no effect on spring tiller counts (Table 1), but the seed head densities for the three clip treatments were superior to the control (Table 2). Silvertop levels were low in all treatments (Table 3). Seed yields were not improved over the control by any of the treatments (Table 6). Gramoxone reduced seed yields by a greater proportion than the reduction in percentage of fertile tillers. There was some visual evidence that the Aerway treatment may have stimulated some seed head production, but the head counts did not reflect that observation. Drought may have reduced the potential for improved yield from the Aerway treatment.

D. Dahurian wild rvegrass

The Dahurian wild ryegrass **stand had very** poor spring vigour as it entered its third seed production year. Tiller counts were completed two weeks later than the other sites because of the slow growth in spring. Tiller density was highest in the control as well as the clip / rake treatment (Table 1). Seed head density was equal for four of the treatments (Table 2). The spray-burn treatment reduced seed head density by up to 65%. Dahurian wild ryegrass is resistant to the causal agent of silver-top (Table 3). Dahurian wild ryegrass recovered from injury by paraquat more effectively than meadow bromegrass according to the differences in percentage of fertile tillers (Table 5). Seed yield was lowest for the spray-burn treatment (Table 6). The control, clip-rake, and clip-burn had equal seed yields.

Table 1: The effect of late summer straw and regrowth management on spring tiller counts (#/sq.m.)

Species	LSD (0.05)	Control	Clip	S/Burn	Aerwav	C/Burn
Meadow bromegrass - new	128	894 b	1482 d	662 a	1319 c	1370 cd
Dahurian wild ryegrass	98	550 c	552 c	174 a	385 b	353 b
Smooth bromegrass	NS	594	605	587	593	612
Meadow bromegrass - old	127	1492 b	1826 d	1175 a	1674 c	1592 bc

Table 2: The effect of late summer straw and regrowth management on seed head density (#/sq.m.)

Species	LSD (.05)	Control	clip	S/Burn	Aerwav	C/Burn
Creeping red fescue	146	785 b	958 c	9 a	959 c	826 bc
Meadow bromegrass - new	72	315 b	580 c	80 a	568 c	525 c
Dahurian wild ryegrass	21	95 b	88 b	33 a	76 b	77 b
Smooth bromegrass	17	106 ab	126 c	90 a	120 bc	124 c
Meadow bromegrass - old	22	25 a	82 c	67 bc	48 b	72 c

Table 3: The effect of late summer straw and regrowth management on silvertop incidence (# of heads/sq.m.)

Species	LSD (.05)	Control	Clip	S/Burn	Aerwav	C/Burn
Creeping red fescue	7	22 b	22 b	0 a	20 b	22 b
Meadow bromegrass - new	13	31 b	44 b	2 a	30 b	34 b
Dahurian wild ryegrass	NS	0	0	0	0	0
Smooth bromegrass	NS	1	1	1	1	1
Meadow bromegrass - old	5	10 a	25 c	22 c	17 b	23 c

Table 4: The effect of late summer straw and regrowth management on silvertop incidence (% of seed heads)

Species	LSD (.05)	Control	Clip	S/Burn	Aerwav	C/Burn
Creeping red fescue	NS	3.0	2.2	4.2	2.1	2.7
Meadow bromegrass - new	2.4	10.1 d	7.5 b	3.1 a	5.1 ab	7.0 b
Dahurian wild ryegrass	NS	0	0	0	0	0
Smooth bromegrass	NS	0.6	0.7	0.7	0.6	0.7
Meadow bromegrass - old	NS	42	32	33	34	33

Table 5: The effect of late summer straw and regrowth management on % of fertile tillers

Snecies	LSD (.05)	Control	Clip	S/Burn	Aerwav	C/Burn
Meadow bromegrass - new	7.1	36.7 b	39.4 bc	12.2 a	44.1 c	39.1 bc
Dahurian wild ryegrass	6.2	17.7 ab	15.6 a	27.3 c	20.5 ab	24.0 c
Smooth bromegrass	2.9	17.7 ab	20.8 c	15.4 a	19.9 bc	20.2 bc
Meadow bromegrass - old	1.4	1.6 a	4.5 c	5.8 c	2.8 ab	4.5 c

Table 6: The effect of late summer straw and regrowth management on seed yield (kg/ha)

Snecies	LSD (0.05)	Control	Clip	S/Burn	Aerwav	C/Burn
Creeping red fescue	109	553 b	676 c	93 a	683 c	532 b
Meadow bromegrass - new	118	465 a	880 b	355 a	876 b	820 b
Dahurian wild ryegrass	67	327 c	339 c	148 a	249 b	352 c
Smooth bromegrass	12	32 b	29 b	16 a	34 b	27 ab
Meadow bromegrass - old	18	22 a	66 b	63 b	62 b	64 b

II. Effect of nitrogen on growth and seed vield of grasses

A. Creeping red fescue

The seed head density of creeping red fescue was not significantly affected by nitrogen fertilization, but nitrogen did increase the seed yield according to the linear contrast. No significant differences were observed for the incidence of silvertop at varying levels of nitrogen application.

B. Meadow bromearass

Spring tiller density, silvertop frequency and percentage of fertile tillers were not affected by nitrogen application. The seed yield at the older site responded to the nitrogen application in spite of the drought conditions. The newer site responded to nitrogen but was only significant at the 10% significance level when analyzed for the linear contrast.

C. Smooth bromegrass

Spring tiller and seed head density were both increased by higher rates of nitrogen application. Although the percentage of fertile tillers also increased, these effects did not support a significant increase in seed yield. The level of silvertop was not influenced by nitrogen application.

D. Dahurian wild ryegrass

Spring tiller density was increased by nitrogen application, but head density, seed yield and percentage of fertile tillers were not affected by nitrogen application.

Table 7: The effect of nitrogen rate (kg N/ha) on spring tiller density (/sq.m.)

Species	LSD 1.05)	O N	30 N	60 N	90 N
Meadow bromegrass - new	NS	1075	1137	1142	1228
Dahurian wild ryegrass	54	339 a	437 b	397 b	437 b
Smooth bromegrass	52	550 a	628 b	588 ab	627 b
Meadow bromegrass - old	NS	1709	1604	1506	1388

Table 8: The effect of nitrogen rate (kg N/ha) on seed head density (# / sq.m.)

Species	LSD (.05)	O N	30 N	60 N	90 N
Creeping red fescue	NS	646	607	768	808
Meadow bromegrass - new	NS	393	411	453	397
Dahurian wild ryegrass	NS	69	79	62	85
Smooth bromegrass	12	72 a	119 b	122 b	139 c
Meadow bromegrass - old	NS	44	77	49	59

Table 9: The effect of nitrogen rate (kg N/ha) on silvertop incidence (# of seed heads/ sq.m.)

Species	LSD (.05)	O N	30 N	60 N	90 N
Creeping red fescue	NS	15	14	15	26
Meadow bromegrass - new	NS	27	24	32	30
Dahurian wild ryegrass	NS	0	0	0	0
Smooth bromegrass	NS	0.65	0.70	0.35	1.10
Meadow bromegrass - old	NS	14	23	17	23

Table 10: The effect of nitrogen rate (kg N/ha) on silvertop incidence (% of seed heads)

Species	LSD (.05)	**O N**	30 N	60 N	**90 N**
Creeping red fescue	NS	3.4	2.1	1.6	4.3
Meadow bromegrass - new	NS	5.9	5.8	7.4	7.3
Dahurian wild ryegrass	NS	0	0	0	0
Smooth bromegrass	NS	0.87	0.65	0.31	0.76
Meadow bromegrass - old	NS	31	35	35	37

Table 11: The effect of nitrogen rate on percentage of fertile tillers

Species	LSD (.05)	O N	30 N	60 N	90 N
Meadow bromegrass - new	NS	36	33	38	31
Dahurian wild ryegrass	NS	22	20	19	23
Smooth bromegrass	2.9	13 a	19 b	21 b	22 b
Meadow bromegrass - old	NS	2.5	4.9	3.3	3.9

Table 12: The effect of nitrogen rate (kg N/ha) on seed yield (kg/ha)

Species	LSD (.05)	O N	30 N	60 N	90 N
Creeping red fescue	NS[1]	429	442	560	599
Meadow bromegrass - new	NS[2]	630	696	696	696
Dahurian wild ryegrass	NS	251	276	264	342
Smooth bromegrass	NS	22	25	28	34
Meadow bromegrass - old	25	32 a	47 a	57 ab	78 b

1 - Significant at 0.05% when using contrasts
2 - Significant at 0.10% when using contrasts

Conclusion:

Residue management of straw and regrowth in the fall is important for maximum seed yields of grasses. Spring tiller counts were the highest for the clip treatment at the four sites where tiller counts were possible. Seed head density also followed this trend. Seed yields were the highest for the clip treatment with the exception of Dahurian wild ryegrass which showed no increase in seed yield by fall clipping. The paraquat spray treatment reduced seed yields at all sites except the older meadow bromegrass stand. The Aerway treatment showed no increase in seed yield in addition to clipping and raking, but did hurt seed yields of the shallow rooted Dahurian wild ryegrass. Fall clipping of regrowth is essential for species with vigorous regrowth following seed harvest.

The impact of nitrogen fertilization on seed yield was less than anticipated. The dry spring may have been the main factor reducing seed yield responses to nitrogen at all sites. Responses to nitrogen fertilization may also be limited, however, by the inclusion of grass in annual cropping systems. The perennial grass may be able to extract nitrogen which is beyond the reach of annual crops. Yet yield responses ranging from 40% for creeping red fescue to 140% for meadow bromegrass were observed from the application of 90 kg N/ha.

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