NARROW ROWS AND RESIDUE MANAGEMENT INCREASE SEED YIELD OF THREE TURFGRASSES

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ABSTRACT
Trials were seeded in 1993 at Saskatoon SK and Brooks AB, Canada and assessed in 1994 and 1995 to examine the impact of residue management, row spacing and seeding rate on seed yields of Kentucky bluegrass, creeping bentgrass, and creeping red fescue, with the focus primarily on Kentucky bluegrass. The highest, most consistent yields were achieved in the first production year, and yields were generally highest at narrow (20 - 40 cm) row spacings at that time. Without aggressive residue management such as burning or close mowing (scalping), yield of all three species declined dramatically in the second harvest year (less pronounced at wide row spacing). Aggressive management consistently produced higher yields than mowing or baling, but even the best yields were lower than those in the first harvest. Seeding rate did not have a consistent effect on Kentucky bluegrass seed yield, and residue management did not affect the incidence of silvertop.

KEYWORDS
Burning, clipping, turfgrass, seed production, row spacing, *Poa*, *Festuca*, *Agrostis*

ACRONYMS
Kentucky bluegrass (KBG), creeping bentgrass (CBG), creeping red fescue (CRF)

INTRODUCTION
High land values and increasingly stringent controls of open-field burning are combining to push the North American turfgrass seed production business out of its traditional center in the Pacific Northwest of the USA. Seed of cool-season turfgrasses can be produced under irrigation on the Canadian prairies, seed companies are interested in expanding their contract production acreage, and producers view turfgrass seed as a potentially high value crop under irrigation, but agronomic packages specific to this region are needed before seed production is practical. Studies to determine the optimum row spacing and residue management practices for the region were undertaken in Saskatchewan and Alberta in 1993.

MATERIAL AND METHODS
At Saskatoon SK in 1993, KBG (*Poa pratensis* L.) cv Dormie, CBG (*Agrostis palustris* Huds.) cv National, and CRF (*Festuca rubra* L.) cv Boreal, were seeded on a clay-loam soil at 1 kg live seed ha^{-1} for KBG and CRF, and 2 kg/ha for CBG. The trial design was a 5 replicate split plot, with grass species as the main plots and inter-row spacings (20 and 40 cm) as the subplots. Each subplot was 22 x 3.6 m. Overhead irrigation was applied as required. After harvest in 1994, each main plot was divided into three residue management subplots set out across the row spacing subplots, and three treatments: 1) mowed to 10 cm, 2) scalped to 2.5 cm and clippings removed, or 3) burned, were applied in late August. The treatments were reapplied in 1995. The plots were fertilized (20 kg ha^{-1} of N as 34-0-0) following the residue management treatments, with additional fertilizer (80 - 100 kg of N as 34-0-0) applied in mid-October, prior to freeze-up. Insect and disease pests, and the incidence of silvertop (white, sterile seed heads on green, healthy stems), were monitored from 1994 to 1996. Most of the plants in the CBG plots did not survive the winter of 1994-95, and two of the five CBG plots were subsequently abandoned due to encroachment of grassy weeds. In 1995 and 1996, individual tillers (50 per plot in 1995, 25 in 1996) were tagged with plastic markers in early spring; in 1995 the growth stage of each tiller was assessed. The tagged plants were examined again prior to harvest to determine their fate (vegetative, reproductive, with silvertop, dead).

At Brooks AB in 1993, a trial to examine the impact of seeding rate (100 to 400 seeds m^{-1} of row) and row spacing (20, 40 and 60 cm) on KBG cv. Abbey was seeded on a silt-loam soil in a 4 replicate split plot design, with row spacing as main plots and seeding rate as subplots. Seeding rate and row spacing combinations resulted in seed applications of 0.5 to 6.0 kg/ha. Each subplot was 2.4 x 5.3 m. Overhead sprinkler irrigation was applied as required. The plots were fertilized with 100 kg ha^{-1} N as 34-0-0 in mid-September 1994 and 150 kg in late October 1995. After harvest in 1994, the stand did not dry down enough to be burned, so it was mowed and plant residue was removed. In 1995, the test was burned after harvest. Results from two replicates were not included in the analysis in 1995 because of uneven irrigation distribution. In another trial at Brooks, the impact of residue management was assessed in a 4 replicate randomized complete block trial seeded to KBG cv Abbey in 1993 at 2 kg of seed ha^{-1} with 20 cm inter-row spacing. Plot size, irrigation and fertilization were the same as for the seeding rate test. Residue management treatments compared burning, baling, or leaving the residue on the field.

RESULTS AND DISCUSSION
At Saskatoon, seed yields for all species were excellent in 1994, with means of 310, 1260, and 700 kg/ha for CBG, CRF, and KBG, respectively. In 1995, CBG suffered severe winter injury and seed yield was very poor (10 kg/ha), CRF yield was low (230 kg/ha, reason unknown), and KBG yield was similar to 1994 (680 kg/ha). Seed yield was higher (P - 0.05) at 20 cm row spacings than at 40 cm over all species in 1994 (790 vs. 750 kg/ha) and 1995 (370 vs. 340 kg/ha). Post-harvest residue treatment in 1994 did not affect plant growth stage in 1995 (data not shown). However, over all three grass species, burning and scalping increased the subsequent percentage of tillers that produced seed heads, reduced the incidence of dead tillers, and increased yield relative to mowing (Table 1, Fig. 1). Yield of KBG in burn and scalp treatments in an adjacent trial over three years were also consistently higher (P - 0.05) than in mowing treatments (BDG & JJS, unpublished). Silvertop levels were low, and they were not affected by residue management. Incidence was lower (P - 0.05) in CBG (3%) than in CRF (10%) or KBG (9%) in 1994-95. Grass plant bugs, primarily *Trigonotylus* spp., were the predominant insect species present. Cottony snow mold (*Coprinus psychromorbidus)* was moderately severe in one replicate in the spring of 1996, but had no effect on seed yield.

In the rate x spacing trial at Brooks, seeding rate had no consistent effect on seed yield (data not shown). Seed yield in 1994 was higher (P - 0.05) in the 40 cm row spacing (1170 kg/ha) than 20 cm (990 kg/ha) or 60 cm (930 kg/ha). Yields in 1995 were substantially lower than in 1994 (550 vs. 1030 kg/ha), but were highest at the widest row spacing (370 kg/ha at 20 cm, 550 at 40 and 740 at 60 cm). This may be because there was no burn after harvest in 1994. In the residue management trial, yield in the first production year (1994) was excellent (mean 1040 kg/ha). In 1995, the study showed the

same trends as at Saskatoon; yield was high when residue was burned (760 kg/ha), lower when mowed and baled off (620 kg/ha), and lowest (510 kg/ha) when residue was left on the field (Fig. 1).

The highest, most consistent yields in these trials were achieved in the first production year. Without residue management, yield declined dramatically in subsequent years. Aggressive management, such as burning or scalping, consistently produced higher yields than mowing or baling, but even the best yields in subsequent years were lower than those in the first harvest. Wide row spacing appears to require less management after the first harvest that the narrow spacings, but is very prone to weed invasion. These trials will be continued for one more year, but our results to date suggest that growers in the prairie region of Canada should strive to maximize yields in the first harvest year by seeding without a companion crop at narrow (20-40 cm) row spacings to ensure maximum returns, and that residue management treatments such as burning or very close mowing be used to maintain yields in subsequent crops.

Table 1
Impact of post-harvest residue management in 1994 on the fate of tillers and seed yield of three species of grasses in 1995 at Saskatoon, SK (n=5). Seeded in 1993.

Residue Treatment	% Seed Heads	% Vegetative Heads	% Dead Tillers	Yield (kg/ha)
Kentucky bluegrass				
- Scalp	55 a	25 a	13 b	690 a
- Burn	59 a	23 a	13 b	710 a
- Mow	50 a	17 a	24 a	620 a
Creeping red fescue				
- Scalp	23 a	59 a	16 a	270 a
- Burn	22 a	61 a	16 a	250 a
- Mow	14 b	65 a	19 a	140 b
Creeping bentrgrass				
- Scalp	27 a	42 b	30 b	17 a
- Burn	11 b	49 b	40 a	10 ab
- Mow	6 b	62 a	32 b	3 b
Mean				
- Scalp	29 a	42 a	17 a	380 a
- Burn	27 a	43 a	20 a	370 a
- Mow	21 b	45 a	23 b	300 b

Values for each species in a column followed by the same letter are not different at *P* - 0.05, based on Duncan's multiple range test.

Figure 1
Impact of post-harvest residue management treatment in 1994 on seed yield (kg ha^{-1}) of Kentucky bluegrass (KBG) and creeping red fescue (CRF) in 1995 at Saskatoon, SK (n = 5) and Brooks, AB (n = 2). Seeded in 1993.