POST-HARVEST RESIDUE MANAGEMENT FOR FINE FESCUE SEED CROPS IN OREGON

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ABSTRACT
On-farm trials were conducted from 1992 to 1995 to investigate the efficacy of alternative post-harvest residue management practices for production of fine-leaf fescue seed crops, creeping red fescue (*Festuca rubra* L.) and Chewings fescue (*F. rubra* L. ssp. *commutata* Gaud.). Seed yield and seed quality were maintained in Chewings fescue seed crops without burning when residue management techniques removed most of the straw and stubble remaining after harvest. Seed yield was reduced to unacceptable levels by all nonthermal management practices in creeping red fescue.

KEYWORDS
Seed yield, seed quality, tiller development

INTRODUCTION
Open-field burning of grass seed crop straw and stubble is an important management tool in Oregon. However, health and aesthetic concerns associated with the smoke produced by burning has prompted research to identify alternative practices for fine-leaf fescue seed crops, creeping red fescue and Chewings fescue. Stubble management without straw removal did not consistently improve first-year seed yield in creeping red fescue (Meijer and Vreeke, 1988). Residue management did not affect second-year seed yield in creeping red fescue, but third-year seed yields were greatest when the straw and stubble were burned (Canode and Law, 1978). Among nonthermal treatments, straw and stubble removal improved seed yield over straw removal alone. Burning did not improve seed yield of Chewings fescue over thorough removal of straw and stubble during a three-year period (Young et al., 1984).

The objective of our study was to determine the influence of residue management practices on crop regrowth, seed yield and seed quality of fine fescue seed crops in Oregon.

METHODS
The research was conducted in commercial seed production fields of creeping red fescue and Chewings fescue. Residue management strategies examined at the on-farm sites included: (i) removal of straw by baling (Bale), (ii) baling, followed by flail chopping stubble (Flail), (iii) baling and flailing, followed by residue removal with a needle-nose rake (Rake), (iv) baling, followed by removal of the residue by vacuum-sweeper (Vacuum), (v) flail-chopping straw and stubble three times with no removal (Flail 3X), (vi) baling, followed by incineration of straw and stubble by propane burner (Propane), and (vii) open-field burning (Burn). Residue management operations were conducted in 1992, 1993, and 1994 after the first, second, and third seed harvests in each field, respectively. Straw remaining in the field and the height of stubble after nonthermal treatment was measured.

Fall regrowth characteristics were measured on samples taken in fall 1992, 1993, and 1994. Fertile and spring vegetative tiller numbers were also determined at each site. Plots were harvested with the growers' swathers and combines. Weigh wagons were used to determine the bulk seed weight harvested from each plot. Clean seed yield was calculated from percent cleanout values obtained from the bulk seed and from seed laboratory purity results. Seed germination and purity values were determined by the Oregon State University Seed Laboratory.

The experimental design in each trial was a randomized block with three replications. Each residue management plot was 6.7 m by 122 m. Residue management effects were tested by analysis of variance.

RESULTS AND DISCUSSION
Baling removed 75 to 82% of the straw remaining after harvest. Stubble height was reduced by the Flail treatment, but no additional straw was removed. The Rake treatment removed more than half the straw remaining after baling (82 to 90% removal). Vacuum was the most effective treatment for removing straw (91 to 98% removal) and for reducing stubble height.

There was a marked tendency for fall tiller height to be taller in treatments that did not thoroughly remove straw and stubble (Table 1). Since increased quantities of straw and greater stubble height were present in Flail 3X, Bale, and Flail treatments, shading may have reduced the quality of the light environment at the level of the plant crown and in turn, may have caused the etiolation of fall tillers (Chastain and Grabe, 1988). Tiller number was not affected by residue treatment in Chewings fescue. Burn and Propane treatments produced the greatest proportion of large tillers basal diameter tillers but did not affect overall tiller number in creeping red fescue. Tiller leaf number was not influenced by residue management.

Fertile tiller production in Barnica Chewings fescue was increased in proportion to the thoroughness of straw removal and stubble height reduction. Residue management did not affect fertile tiller number in Banner Chewings fescue. Burning in creeping red fescue consistently caused high fertile tiller production, whereas Propane and nonthermal treatments usually reduced fertile tiller number.

All nonthermal residue management treatments produced seed yields that were inferior to open-field burning in creeping red fescue except the Vacuum treatment in the second seed harvest (Table 2). Propane burning produced seed yields that were equivalent to burning in the second and fourth seed harvests. Nonthermal residue treatments resulted in seed yields in creeping red fescue that were not acceptable over the entire duration of our study. Pumphrey (1965) reported that seed yields in creeping red fescue were not different from burning in three of four experiments when straw and stubble were completely removed. Meijer and Vreeke (1988) could not detect a relationship between fall tiller production and first-year seed yield in creeping red fescue. In our study, fall tiller height and basal diameter, and fertile tiller production were linked to successful seed production in creeping red fescue.

Among Chewings fescue seed crops, seed yields of Banner were not influenced by residue management method (Table 2), but seed yields of Barnica were low when managed without straw removal (Flail 3X). Seed yields attained by Rake and Vacuum methods were equivalent to field burning while somewhat lower yields were observed with the Bale treatment. Since the numbers of tillers produced in fall were not related to seed yield in Chewings fescue, it is possible that the environment in which the tillers are formed may play a role in determining seed yield.

Germination was not influenced by thoroughness of straw and stubble removal. For most treatments, seed purity was not affected by residue management practices; however, purity was sometimes lessened in the Flail 3X treatment. This was usually due to an increase in inert matter and was sometimes accompanied by increased percent cleanout. Nonthermal treatments other than the Vacuum treatment tended to increase the presence of weed seed in Chewings fescue.

Seed growers need to be aware that failure to remove any straw from fine fescue fields can reduce seed yield and purity. At present, we recommend that post-harvest residues in creeping red fescue be managed with open-field burning and that nonthermal practices can be utilized in Chewings fescue when most straw and stubble is removed.

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Table 1. Effect of residue management practices on fall tiller height (cm) in chewings and creeping red fescue seed production fields.

	Chewings fescue						
	Barnica		Banner			Pennlawn creeping red fescue	
Treatment	1992	1993	1992	1993	1994	1992	1993
Flail 3X	18 c†	14 c	—-	—-	—-	—-	—-
Bale	14 b	9 ab	—-	—-	—-	—-	—-
Flail	—-	—-	9 c	8	15 c	13	10 c
Rake	13 ab	10 b	8 bc	8	15 c	11	8 ab
Vacuum	15 bc	7a	6 a	7	12 b	10	8 ab
Propane	—-	—-	6 a	8	13 bc	10	9 b
Burn	10 a	9 ab	7 ab	8	11 a	10	7 a

†Means in columns followed by the same letter are not different by Fisher's Protected LSD values ($P = 0.05$)

Table 2.
Seed yield (kg/ha) response of fine fescue seed crops to residue management practices.

		Chewings fescue		
Seed harvest	Treatment	Barnica	Banner	Pennlawn creeping red fescue
Second	Flail 3X	897 a†	—-	—-
	Bale	1043 ab	—-	—-
	Flail	—-	1201	777 a
	Rake	1081 b	1204	803 a
	Vacuum	1156 b	1110	1024 b
	Propane	—-	1167	981 b
	Burn	1144 b	1184	1146 b
Third	Flail 3X	375 a	—-	—-
	Bale	671 b	—-	—-
	Flail	—-	687	609 a
	Rake	716 bc	680	591 a
	Vacuum	834 c	750	558 a
	Propane	—-	778	607 a
	Burn	839 c	700	842 b
Fourth	Flail 3X	319 a	—-	—-
	Bale	704 b	—-	—-
	Flail	—-	460	590 a
	Rake	730 b	414	534 a
	Vacuum	782 b	398	531 a
	Propane	—-	304	647 ab
	Burn	940 b	382	781 b

†Means in columns followed by the same letter are not different by Fisher's Protected LSD values ($P = 0.05$)