RESIDUE MANAGEMENT AND STAND AGE DOES NOT AFFECT SEED QUALITY IN GRASS SEED CROPS

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Introduction. Field burning has been an important residue management practice in cool-season grass seed crops. Historically, residue burning has been justified on the basis of disease control, weed control, and stimulation of seed yield. Public concern over air quality has necessitated the identification of alternative residue management practices. Furthermore, recent research has established that agronomically feasible alternatives to field burning exist for all species grown in the region except for creeping red fescue. Seed growers have largely adopted field burning alternatives but many still believe that these practices may reduce seed quality. One concern has been that seed quality will progressively decline as crop stands age in the absence of field burning. The objective of our investigation was to determine how alternative post-harvest residue management techniques and stand age affect seed quality in cool-season perennial grasses.

Methods. On-farm residue management trials were conducted between 1992 and 1997 in 26 commercial seed production fields throughout Oregon. Species, cultivars, and duration of residue management trials are listed in Table 1. Residue management treatments included: (i) flail chopping with no straw removal (Straw), (ii) removal of straw by baling with or without further management of stubble (Bale), (iii) removal of straw by baling, followed by propane burning (Propane), and (iv) open-field burning (Burn). The treatments were evaluated in each of the following species included: perennial ryegrass (Straw, Bale, Propane); tall fescue (Straw, Bale); Chewings fescue (Straw, Bale, Propane, Burn); Kentucky bluegrass (Straw, Bale, Burn); orchardgrass (Straw, Bale); creeping red fescue (Bale, Propane, Burn); and dryland bentgrass (Bale, Propane, Burn). Residue management treatments were conducted in each of the seed fields after the first seed harvest and ending when the field was removed from production. Fertilizer and herbicide applications were uniformly made across all residue treatment plots and at application timings and rates standard for each grass seed crop species.

Field plots were harvested with a farm-scale swather and windrows remained in the field until the seed dried. Dried windrows were combined with farm-scale combines equipped with pickup header attachments. Subsamples (1164) were taken by using a sampling tube from the harvested seed for seed quality analysis. Seed germination and purity tests were conducted according to rules of the Association of Official Seed Analysts. Seed samples were also examined for contamination by ergot sclerotia, and blind seed disease.

Results. There were no interactions between stand age and residue management technique evident for any of the species tested in our trials. This finding refutes one of the major concerns of seed producers that field burning alternatives would not only lower seed quality but that this problem would be exacerbated in aging stands. The incidence and severity of ergot and blind seed diseases in the 1164 harvested seed samples also were not related to residue management or stand age (data not shown). Control of ergot and blind seed has been attributed to field burning in grass seed crops, and has long been used as a justification for the use of field burning as a management practice in grass seed production.

Pure seed percentage in perennial ryegrass was reduced in 3rd- and 4th-year stands, and other crop percentage was higher in 4th-year stands (Table 2). Inert matter was increased in 3rd-year stands. Stand age had no effect on weed seed contamination. Seed germination tended to be lower in 2nd-year stands and was reduced in 3rd-year stands. Residue management practices had no effect on seed purity and germination in perennial ryegrass (Table 2). No straw removal tended to increase the incidence of rough bluegrass (*Poa trivialis*) seed contamination in perennial ryegrass but these increases were not statistically significant. The straw mulch also suppressed weeds thereby reducing contamination by annual bluegrass (*P. annua*) and annual ryegrass seeds in perennial ryegrass seed.

Fourth-year stands of tall fescue had significantly greater levels of pure seed and pure seed levels were somewhat greater in 5th-year stands than in other stand ages (Table 3). Other crop seed contamination was greatest in 5th-year stands. Inert matter levels were high in 2nd- and 3rd - year stands, low in 4th -year stands, and intermediate levels were recorded in 5th-year stands. Weed seed levels were unaffected by age of stand. Seed germination tended to be higher in 4th- and 5th-year stands. No effect of residue management technique was evident in seed purity and seed germination results (Table 3).

Pure seed percentage levels were reduced and inert matter levels increased in 3rd-year stands of Chewings fescue (Table 4). Increased inert matter was responsible for the loss in seed purity. The reduction in seed purity in 3rd-year stands of Chewings fescue was accompanied by a reduction in seed germination. The cause of reduced seed germination was unknown as seed weight was not affected by management without straw removal (data not shown).

Management of straw without removal reduced percentage of pure seed in Chewings fescue (Table 4). This reduction in seed purity resulted from increased inert matter when straw was managed without removal. However, field burning did not improve seed purity levels in Chewings fescue. Germination percentage of seed produced without straw removal was lower than other management practices, including field burning.

Seed purity and seed germination were not influenced by age of stand nor by residue management practices in Kentucky bluegrass (Table 5), orchardgrass (Table 6), creeping red fescue (Table 7), and dryland bentgrass (Table 8).

Our results demonstrate that cool-season perennial grass seed crops can be produced using field burning alternatives without loss in seed purity or in seed germination. Straw management without removal (Straw) in Chewings fescue increased purity problems and caused reduced seed germination. Bale and propane based management approaches always produced seed purity and seed germination levels equivalent to burning.

Our trials did not reveal a consistent trend in seed germination level as the crop stands aged for any of the species tested. Seed purity was lower in older stands of perennial ryegrass but tended to be higher in older stands of tall fescue. Seed purity was not consistently related to age of crop stand in the other species evaluated in our trials. Reduced seed purity was often accompanied by increased inert matter and sometimes by lower seed germination.

Table 1. Species, cultivar, and duration of on-farm residue management trials in cool-season grass seed crops. All trials were initiated after the first seed harvest in each field. The number of seed quality tests represent the number of samples submitted for individual seed germination and purity tests (total = 1164 germination and purity tests).

Species	Cultivar	Duration (harvest years)	Number of seed germination, seed purity tests performed
Kentucky bluegrass	Abbey	3	45
	Bristol	3	45
	Baron	3	54
Chewings fescue	Banner	4	45
	Barnica	3	45
	Jamestown II	3	36
Tall fescue	Rebel Jr. (Glaser site)	4	60
	Rebel Jr. (Wilfong site)	3	45
	Rebel II	3	45
	Anthem	3	45
	Crewcut	3	45
	Barlexas	2	30
	Titan II	2	30
Creeping red fescue	Pennlawn	3	45
	Shademaster	1	18
	Hector	2	36
Perennial ryegrass	Pennfine	3	54
	Pennant	3	54
	Yorktown III	2	36
	Linn	2	36
	Manhattan IIE	3	63
	Oasis	3	54
	Affinity	2	42
	Cutter	2	36
Orchardgrass	Elsie	3	45
Dryland bentgrass	Highland	5	75

Table 2. Influence of stand age and residue management on seed quality in perennial ryegrass.

Stand age	Purity: Pure seed	Other crop	Inert matter	Weed seed	Germination
(Year)	---------- (%) ----------				
2nd	95.6 b⊥	1.3 a	3.0 a	0.1 a	92.1 ab
3rd	92.7 a	1.6 a	5.4 b	0.2 a	90.6 a
4th	93.5 a	3.7 b	2.7 a	0.1 a	93.9 b
Residue management					
Straw	93.8 a	2.0 a	3.9 a	0.1 a	91.6 a
Bale	94.2 a	1.9 a	3.8 a	0.1 a	92.4 a
Propane	94.1 a	1.6 a	4.1 a	0.1 a	91.3 a

⊥Means in columns within stand age and residue management followed by the same letter are not different by Fisher=s protected LSD values (*P* = 0.05).

Table 3. Effect of stand age and residue management technique on seed quality in tall fescue..

Stand age	Purity: Pure seed	Other crop	Inert matter	Weed seed	Germination
(Year)	---------- (%) ----------				
2nd	95.4 a⊥	0.2 a	4.3 b	0.0 a	89.9 a
3rd	94.9 a	0.3 a	4.8 b	0.1 a	90.6 a
4th	98.4 b	0.2 a	1.2 a	0.2 a	94.5 b
5th	95.9 ab	2.2 b	1.9 ab	0.0 a	91.5 ab
Residue management					
Straw	95.9 a	0.4 a	3.7 a	0.1 a	91.4 a
Bale	96.1 a	0.3 a	3.5 a	0.1 a	91.4 a

⊥Means in columns within stand age and residue management followed by the same letter are not different by Fisher=s protected LSD values (*P* = 0.05).

Table 4. Effect of stand age and residue management practices on seed quality in Chewings fescue.

Stand age	Purity: Pure seed	Purity: Other crop	Purity: Inert matter	Purity: Weed seed	Germination
(Year)	(%)				
2nd	91.7 b⊥	0.0 a	8.4 a	0.0 a	88.8 b
3rd	83.9 a	0.0 a	15.9 b	0.1 a	79.3 a
4th	93.5 b	0.0 a	6.5 a	0.0 a	89.2 b
Residue management					
Straw	83.9 a	0.0 a	17.1 b	0.0 a	76.0 a
Bale	90.4 b	0.0 a	9.4 a	0.1 a	86.4 b
Propane	91.4 b	0.0 a	8.5 a	0.1 a	88.5 b
Burn	89.9 b	0.0 a	10.0 a	0.0 a	86.6 b

⊥Means in columns within stand age and residue management followed by the same letter are not different by Fisher=s protected LSD values (*P* = 0.05).

Table 5. Effect of stand age and residue management technique on seed quality in Kentucky bluegrass.

Stand age	Purity: Pure seed	Purity: Other crop	Purity: Inert matter	Purity: Weed seed	Germination
(Year)	(%)				
2nd	90.9 a⊥	0.0 a	9.3 a	0.0 a	88.0 a
3rd	91.6 a	0.0 a	8.4 a	0.0 a	82.4 a
4th	88.1 a	0.0 a	11.9 a	0.0 a	85.8 a
Residue management					
Straw	87.3 a	0.0 a	12.7 a	0.0 a	83.7 a
Bale	90.6 a	0.0 a	9.4 a	0.0 a	85.7 a
Burn	91.3 a	0.0 a	8.8 a	0.0 a	86.0 a

⊥Means in columns within stand age and residue management followed by the same letter are not different by Fisher=s protected LSD values (*P* = 0.05).

Table 6. Effect of stand age and residue management technique on seed quality in orchardgrass.

Stand age	Purity				Germination
	Pure seed	Other crop	Inert matter	Weed seed	
(Year)	---------- (%) ----------				
2nd	92.5 a⊥	1.0 a	6.6 a	0.0 a	95.0 a
3rd	94.0 a	0.1 a	6.1 a	0.0 a	94.5 a
4th	96.2 a	0.5 a	3.5 a	0.0 a	96.0 a
Residue management					
Straw	94.2 a	0.4 a	5.4 a	0.0 a	95.3 a
Bale	94.2 a	0.5 a	5.3 a	0.0 a	95.0 a

⊥Means in columns within stand age and residue management followed by the same letter are not different by Fisher=s protected LSD values (*P* = 0.05).

Table 7. Effect of stand age and residue management practices on seed quality in creeping red fescue.

Stand age	Purity				Germination
	Pure seed	Other crop	Inert matter	Weed seed	
(Year)	---------- (%) ----------				
2nd	93.1 a ⊥	0.0 a	6.9 a	0.0 a	85.8 a
3rd	91.2 a	0.0 a	8.9 a	0.1 a	87.4 a
4th	95.3 a	0.0 a	4.7 a	0.0 a	89.0 a
Residue management					
Bale	93.5 a	0.0 a	6.4 a	0.1 a	88.0 a
Propane	91.6 a	0.0 a	8.5 a	0.0 a	87.7 a
Burn	93.0 a	0.0 a	7.1 a	0.0 a	86.0 a

⊥Means in columns within stand age and residue management followed by the same letter are not different by Fisher=s protected LSD values (*P* = 0.05).

Table 8. Effect of stand age and residue management practices on seed quality in dryland bentgrass.

Stand age	Purity				Germination
	Pure seed	Other crop	Inert matter	Weed seed	
(Year)	------ (%) ------				
2nd	95.2 a⊥	0.0 a	5.0 a	0.0 a	94.7 a
3rd	97.6 a	0.0 a	2.4 a	0.0 a	91.7 a
4th	96.0 a	0.0 a	4.1 a	0.0 a	93.7 a
5th	98.2 a	0.0 a	1.8 a	0.0 a	95.0 a
6th	93.9 a	0.0 a	5.9 a	0.1 a	93.0 a
Residue management					
Bale	96.2 a	0.0 a	3.7 a	0.0 a	94.0 a
Propane	95.9 a	0.0 a	4.1 a	0.0 a	93.8 a
Burn	96.4 a	0.0 a	3.7 a	0.1 a	93.0 a

⊥Means in columns within stand age and residue management followed by the same letter are not different by Fisher=s protected LSD values (P = 0.05).