RESIDUE MANAGEMENT AND ESTABLISHMENT SYSTEMS FOR ANNUAL RYEGRASS SEED PRODUCTION

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ABSTRACT
Two on-farm trials were established in 1994 to investigate low cost crop residue management and seeding practices in two cultivars of annual ryegrass (*Lolium multiflorum* Lam.) grown for seed production in Oregon's Willamette Valley. Sites varied by soil type and drainage. Stand density was greater in no-till and volunteer established plots at both locations, but straw removal by baling had no effect on stand density. Fertile tiller number and seed yield was reduced in drill sown plots in TAM-90 (poorly drained site); also, fertile tiller number was fewer where no straw removal preceded no-till or volunteer establishment. No difference in spring tillering characteristics or seed yield was observed in Gulf (better drained site).

KEYWORDS
Seed yield, tillering, seeding rate, no-till, yield components

INTRODUCTION

Much of Oregon's annual ryegrass seed production acreage has been in a continuous annual production cycle based on open field burning followed by no-till drilling to establish the subsequent crop (Young and Mellbye, 1995). Recent restrictions on open field burning have resulted in less than one-third of the annual ryegrass acreage being burned. The most common nonthermal residue management strategy currently used by annual ryegrass growers is flail chopping and plowing under the crop residue before conventional preparation of a seed bed for the next crop.

Other crop establishment strategies, however, are evolving. These nonthermal management options include: (i) removing the straw by baling and seeding into the stubble by no-tillage methods, and (ii) producing a new seed crop with seed lost from the previous crop (volunteering) without any straw removal. The producer's objective in choosing either option is to cut the production costs over standard seed bed preparation (Mellbye *et al*., 1995).

Volunteer cropping with total straw residue remaining on the soil surface is not without problems. Growers perceive that volunteered stands produce lower seed yields than drilled stands, although no scientific comparisons have been made.

The objectives of our study were to determine the effects of crop residue management and seeding practices on establishment, growth, development, and yield of subsequent annual ryegrass seed crops.

PROCEDURE

Two on-farm sites near Halsey, OR were selected for field scale experiments using grower-owned, commercial size farm equipment. Two cultivars of annual ryegrass were evaluated, one at each site. At one on-farm site, Gulf annual ryegrass was grown on a tiled, Woodburn silt loam soil (moderately well drained). At the other on-farm site TAM-90 annual ryegrass was grown on a Dayton silt loam soil (poorly drained).

In July-August, 1994 straw was baled and removed from half the plots at both sites. The remaining straw was flailed twice. The baled plots were flailed once to keep stubble height consistent in all treatments. Straw samples were taken following baling and flailing to assess the amount of straw that remained in the baled and full straw plots. Following straw management, conventionally tilled treatments were plowed and worked into a seed bed at both sites.

Both sites were drilled with the same no-till drill. This drill seeded 17 kg ha^{-1} in 25 cm rows and also band-applied 135 kg ha^{-1} (broadcast equivalent) of ammonium phosphate-sulfate fertilizer (16-20-0) in the drilled row. The drill was used to apply only fertilizer in volunteer plots, to permit uniform fertilizer application over all treatments. Seeding dates were September 8 and September 15, 1994, for TAM-90 and Gulf respectively.

The experimental design was a randomized split block design, where each site has three main treatments: (i) plow and conventional drill, (ii) no-till drill, and (iii) volunteer. Each main plot treatment was split; straw baled and removed on one half and straw flailed and left on the soil surface on the other half. In total, six treatments were arranged in three replications at each site.

Plot size was 7.6 x 122 m for Gulf and 6.7 x 182 m for TAM-90, which allowed plots to be harvested with the growersí swathers and combines. A weigh wagon was 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 the seed laboratory purity results.

Glyphosate herbicide (0.66 kg a.i. ha^{-1}) was applied one week after seeding to no-till plots for the control of volunteer seedlings that had germinated on the soil surface. This technique, known as a "sprout spray," can be effective in controlling stand density when there is a "sprout" of volunteer seedlings before the crop emerges. Absence of early fall rains limited soil moisture and reduced the effectiveness of this practice in 1994. Treatment with ethofumesate herbicide was broadcast at 1.7 kg a.i. ha^{-1} in mid-November to all plots. The growers' normal fertilizer management (150-157 kg N ha^{-1} in early April) was also broadcast applied to all plots.

In January 1995, plants were removed from a 10 x 25 cm area and counted to determine the actual stand density established. In addition, plant biomass was dried and weighed. The stands were evaluated again in June (near peak anthesis) by sampling a 25 x 25 cm area from which fertile and vegetative tiller numbers were determined, as well as subsamples to determine spikelet and floret number per inflorescence. Yield assessment was determined by swathing through the center of each plot (June 29 and July 3 in Gulf and TAM-90, respectively). Combine harvest was completed on July 27 and August 4 in Gulf and TAM-90, respectively.

RESULTS AND DISCUSSION

Stand density was significantly greater in no-till and volunteer established plots in both cultivars (Tables 1 and 2). No-till established plots had a slightly greater density over volunteer established plots suggesting that no benefit resulted from the "sprout spray" treatment. Dry weight per seedling was inversely related to stand density, thus, at lower densities individual seedlings were larger in size. Nevertheless, total above-ground dry weight of seedlings from the drill seeded stand was less than the biomass in the no-till or volunteer stands. Straw removal (baling) had no effect on stand density or above ground dry weight.

Straw removal did affect total tiller population at maturity in TAM-90 (Table 1). Regardless of stand density, a high percentage (70 - 79%) of the stand was comprised of fertile tillers. Fertile tiller number in TAM-90 was significantly higher in both no-till and volunteer established stands where straw was baled and removed (data not shown). Fertile tiller number was not affected by straw management in drill sown plots. No significant effect on spring tiller production was observed in Gulf.

Seed yield was significantly lower in the drill sown plots in TAM-90 (Table 1) but no significant difference in seed yield was observed in Gulf (Table 2). It is likely that differences in soil drainage characteristics and cultivars at these two sites could explain the different results observed. Percent cleanout was slightly higher in TAM-90 where the full straw load was left on the field, and in Gulf cleanout was greater in the no-till and volunteer treatments. These field treatments will be maintained for two additional crop years; thus, our first-year results should not be used to establish conclusive recommendations.

REFERENCES

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Table 1
Effect of establishment cropping system on performance of TAM 90 annual ryegrass.

Cropping System	Seedling[1] number	Above-ground dry weight[1] per seedling	per unit area	Harvest index	Cleanout	Seed yield
	(no. m^{-2})	(mg seedling^{-1})	(g m^{-2})	(%)	(%)	(kg ha^{-1})
Sowing method						
Drill	1926 a*	38 b	5 a	21	1.6	2486 a*
No-till	12299 b	12 a	12 b	25	1.5	2810 b
Volunteer	10900 b	15 a	13 b	26	1.4	2920 b
Residue removal						
Bale	8242	24	10	23	1.4 a	2518
No removal	8511	19	11	25	1.6 b	2735

1Data collected in January 1995.
*Means in columns followed by the same letter are not significantly different by Fisherís protected LSD values (p=0.05).

Table 2
Effect of establishment cropping system on performance of Gulf annual ryegrass.

Cropping System	Seedling[1] number	Above-ground dry weight[1] per seedling	per unit area	Harvest index	Cleanout	Seed yield
	(no. m^{-2})	(mg seedling^{-1})	(g m^{-2})	(%)	(%)	(kg ha^{-1})
Sowing method						
Drill	4110 a*	23	7 a	26	3.1 a*	2910
No-till	19852 b	13	18 b	28	3.8 b	2714
Volunteer	16624 b	15	19 b	27	3.7 b	2530
Residue removal						
Bale	15742	16	14	28	3.6	2717
No removal	11309	18	15	26	3.5	2718

[1]Data collected in January 1995.
*Means in columns followed by the same letter are not significantly different by Fisherís protected LSD values (p=0.05).