ROLE OF ROOT SYSTEMS IN THE PRODUCTIVITY OF GRASS SEED CROPS

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Introduction. Little is known about the role of root and rhizome systems in the persistence and long-term productivity of grass seed production fields. The influence of management practices, environment, and plant stand density on these vital plant organs remains to be discovered. The objectives of our study were to: (i) determine how burning promotes seed yields in creeping red fescue by comparative analysis of the root and rhizome systems of burned and non-burned plants and to (ii) determine how stand density and stand age impact root system development of bunch-type (perennial ryegrass, Chewings fescue, and tall fescue) and creeping-type (creeping red fescue) grass seed crops. The following article reports results from the first year of a three-year research project.

Progress. Crop residue management affected late fall root production in a 3-year old commercial field of Hector creeping red fescue (Figure 1). Root biomass density near the soil surface was significantly greater when the crop was burned than when stubble and straw were mechanically removed. This may help explain why seed yields are generally higher with burning than with nonthermal methods in creeping red fescue. Low stubble height and high stubble height reduced seed yield by 4% and 12%, respectively, compared with burning. Increased stubble removal (low stubble) improved both shallow root production and seed yield. No differences in root biomass density were observed among residue management methods in deeper portions of the soil profile. High stubble caused the greatest rhizome production in late fall (158 g/m^3), followed by field burning (129 g/m^3) and low stubble resulted in the fewest rhizomes (70 g/m^3). Low stubble height likely depleted carbohydrate storage in the stubble resulting in lower rhizome production.

Experimental trials at the Hyslop Oregon State University Research Farm involve a rhizome-forming red fescue cultivar (Shademaster) and is contrasted against a cultivar that produces few rhizomes (Seabreeze) and Chewings fescue (SR5100), which produce no rhizomes. The trials were sown in May 1997 and residue management operations were conducted in July 1998. Three stubble treatments were used to differentiate root, rhizome, shoot, and seed yield responses: (i) no stubble removal, (ii) complete mechanical removal of stubble, and (iii) removal of stubble by burning. Results will be reported in future articles.

Additional trials were sown in 1997 at Hyslop Farm to learn how stand density and stand age impacts root system development of bunch-type and creeping type grass seed crops. Four different stand densities were evaluated: 15-, 30-, 45-, and 60-cm (6-, 12-, 18-, and 24-inch) row spacings.

Late fall root biomass density in first-year stands was affected by row spacing in Cutter perennial ryegrass and LRF 983 tall fescue, but not in SR5100 Chewings fescue, and Shademaster and Seabreeze creeping red fescue (Table 1). Root biomass density was generally greater when crops were sown in narrow row spacings than in wider row spacings. Differences in root biomass density attributable to row spacing were greatest for the shallow portions of the soil profile, whereas differences were least in the deepest portion of the profile sampled (Figure 2). Root biomass density declined rapidly with increasing distance from the crop row (Figure 3).

Shoot biomass production was affected by row spacing in Cutter perennial ryegrass, SR5100 Chewings fescue and in Seabreeze creeping red fescue, but not in Shademaster creeping red fescue and in LRF 983 tall fescue (Table 2). Shoot production was greatest in 15-cm rows.

Fertile tiller production was greater in narrow rows than wide rows in Shademaster creeping red fescue and in Cutter perennial ryegrass (Table 3). Row spacing had no effect on fertile tiller production in Seabreeze slender red fescue, SR 5100 Chewings fescue, and LRF 983 tall fescue.

Row spacing had no effect on seed yield in tall fescue (Table 4). Seed yield tended to be higher in 30-cm rows in creeping red fescue and Chewings fescue. Slender red fescue and perennial ryegrass sown in 15- and 30-cm rows produced greater seed yields than when sown in 45- and 60-cm rows.

These trials will continue for two additional seasons to determine whether roots play a role in stand persistence and in the stand-age related decline in seed yield.

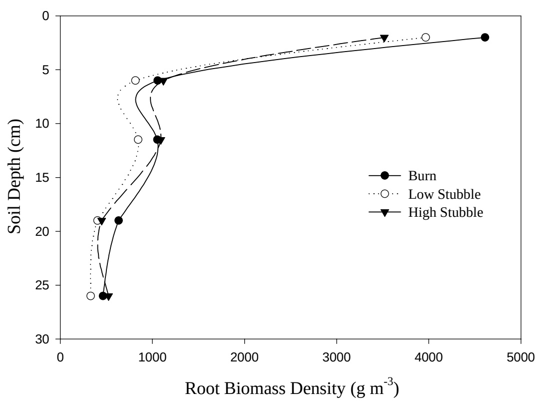

Figure 1. Effect of residue management on root biomass density and distribution in Hector creeping red fescue.

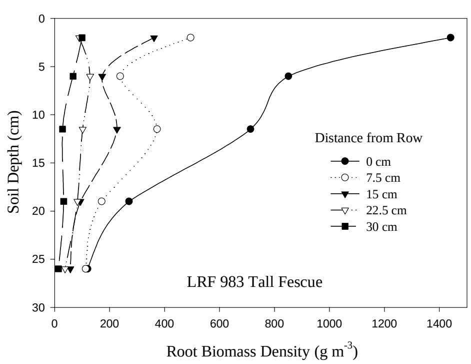

Figure 2. Root biomass density and distribution responses to crop row spacing in LRF 983 tall fescue.

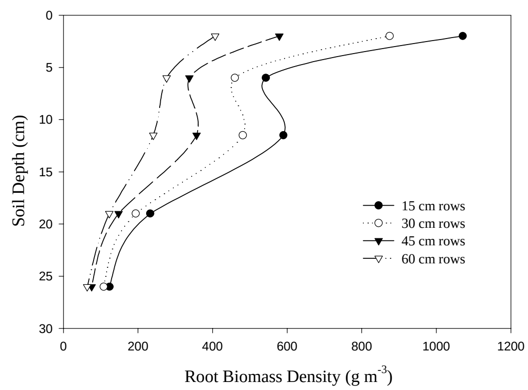

Figure 3. Effect of distance from crop row on root biomass density and distribution on LRF 983 tall fescue.

Table 1. Effect of row spacing on autumn root biomass density in grass seed crops. Root biomass densities are averaged over soil depths and sampling distance from crop row.

Grass seed crop	Row spacing (cm) 15	30	45	60
	(g/m^3)			
Shademaster creeping red fescue	702 aH	1005 a	532 a	491 a
Seabreeze slender red fescue	630 a	598 a	523 a	489 a
SR5100 Chewings fescue	837 a	837 a	497 a	246 a
LRF 983 tall fescue	359 c	296 bc	210 ab	156 a
Cutter perennial ryegrass	1166 b	1090 b	636 a	452 a

HMeans in rows followed by the same letter are not different.

Table 2. Effect of row spacing on autumn shoot biomass in grass seed crops.

Grass seed crop	Row spacing (cm) 15	30	45	60
	(g/m^3)			
Shademaster creeping red fescue	397 aH	339 a	293 a	279 a
Seabreeze slender red fescue	372 b	213 a	287 ab	244 a
SR5100 Chewings fescue	485 b	263 a	179 a	145 a
LRF 983 tall fescue	588 a	482 a	497 a	330 a
Cutter perennial ryegrass	354 b	325 b	125 a	147 a

HMeans in rows followed by the same letter are not different.

Table 3. Effect of row spacing on fertile tiller production in grass seed crops.

Grass seed crop	Row spacing (cm) 15	30	45	60
	(no./sq. ft.)			
Shademaster creeping red fescue	284 bH	249 ab	178 a	201 a
Seabreeze slender red fescue	457 a	372 a	273 a	274 a
SR5100 Chewings fescue	347 a	291 a	242 a	213 a
LRF 983 tall fescue	85 a	95 a	82 a	76 a
Cutter perennial ryegrass	284 bc	323 c	208 a	223 ab

HMeans in rows followed by the same letter are not different.

Table 4. Effect of row spacing on seed yield in grass seed crops.

Grass seed crop	Row spacing (cm)			
	15	30	45	60
	---------- (lb/a) ----------			
Shademaster creeping red fescue	712 abH	823 c	755 b	693 a
Seabreeze slender red fescue	637 b	664 b	546 a	570 a
SR5100 Chewings fescue	1074 ab	1205 b	996 a	1007 a
LRF 983 tall fescue	1212 a	1461 a	1176 a	1504 a
Cutter perennial ryegrass	1434 b	1523 b	1143 a	1037 a

HMeans in rows followed by the same letter are not different.