CLIPPING INTENSITY IMPACTS ON ROOT MASS VARIATION OF COOL SEASON GRASSES

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ABSTRACT

Seasonal changes in grass root and mat weight density were documented under different cutting managements. Kentucky bluegrass (*Poa pratensis* L.) and tall fescue (*Festuca arundinacea* Schreb.) received one annual cut, twice yearly forage harvest, and mown turf treatments. Orchardgrass (*Dactylis glomerata* L.) received one annual and twice yearly cutting treatments. Soil cores were collected to a 15 cm depth and divided into 7.5 cm increments. Roots and mat were recovered, washed, dried and weighed. Differences in years, seasons, species, treatments, and soil depth significantly influenced total root weight density and fine root density. With all species and treatments, new root growth was very heavy in spring, ceased at the beginning of summer, and resumed in the fall. Differences in the seasons, grass species, and cutting treatments significantly influenced mat weight density. The amount of roots present, cycles of growth and senescence, and subsequent root:soil interactions all have seasonal differences.

KEYWORDS

Grasses, mat weight density, root weight density, seasonal.

INTRODUCTION

Studies looking at seasonal grass root growth report heaviest root growth during spring, a summer cessation, and fall renewal (Garwood 1967, Stetson 1994). Forage and turfgrass studies have found 89-94% of the root mass in the top 15 cm of the soil profile (Gist and Smith 1948, Murphy et al. 1994).

The purpose of this study was to observe (i) seasonal changes in root density (ii) mowing treatment effects and (iii) species responses to mowing.

MATERIALS AND METHODS

Three cool season grass species were sampled from established plots at the University of Rhode Island, Kingston, Rhode Island. The soils were in the Enfield series. Orchardgrass (*Dactylis glomerata*), Kentucky bluegrass (*Poa pratensis*), and tall fescue (*Festuca arundinacea*) plots were split and randomly assigned a one-cut (CRP) and twice-cut (forage) treatment. Kentucky bluegrass and tall fescue turf plots were regularly mown. Samples were taken 25 times over two years while the ground was not frozen.

Soil cores were collected and handled according to methods described by Boehm (1979). Four randomly chosen replicate 5 cm diameter core samples from each of the eight plots were taken to a 15.0 cm depth. Verdure was removed in the field. Samples were refrigerated and processed within 24-48 hours.

After removing the mat layer, the roots were washed free of soil in a hydropnuematic elutriation system using 930 um primary and 410 um secondary sieve at 1.05 kg cm^{-2} of air pressure and 4.22-5.63 kg cm^{-2} of water pressure for 8 minutes (Smucker, McBurney, and Srivastava, 1982). Small, fine roots were delivered into the sieves. Larger, heavier roots remained in the elutriation chamber. Mat samples were handwashed. Roots and mat were dried at 65^{o} C for 48 hours and weighed. Root and mat weight densities were calculated as mass divided by sample volume. The analysis of variance was performed using the SAS General Linear Models procedure (SAS Institute, Inc., 1985).

RESULTS AND DISCUSSION

Total root (TRWD), fine root (FRWD), and large root weight densities (LRWD) were significantly different between years, seasons, species, and soil depths. TRWD and FRWD were also affected by treatment. Tall fescue TRWD and LRWD decreased and Kentucky bluegrass increased in surface samples under turf conditions. FRWD was reduced in Kentucky bluegrass turf. The fine to large root ratio was smaller under frequently mown turf compared to other treatments. Annual differences were attributed to the 1992 growing season being cooler and wetter than the 30 year average; the 1993 season was warmer and drier. Differences in mat weight density (MWD) were attributed to season, species, and treatment.

Seasonal fluctuation in grass root weight density was similar to previously reported data (Garwood 1967, Williams 1969). All treatments and species had vigorous root growth in early spring. By mid June new growth had ceased and the roots matured. New roots were not seen until fall. New root growth in samples taken just before the ground froze indicated that these grasses were extremely active underground. Fall root regrowth of the turf treatment occurred later than in the forage and CRP cutting treatments.

Statistical analysis indicated that the effect of cutting treatment, grass species, and the interaction of species and cutting in each horizon for TRWD, FRWD, LRWD, and MWD was unique for each year and season (Table 1). Species and treatment influences on TRWD occurred in both upper and lower horizons. Species and interaction effects on TRWD were common. Grass species and their reaction to cutting influenced LRWD in the top horizon. In the lower horizon cutting treatment, grass species, and their interaction had equal incidences. Species and treatment influenced FRWD almost equally in both horizons. Interaction effects were more frequent in the bottom horizon.

Mat was measured as an integral sample component. It had different species characteristics and included dead and live shoots, crowns, stems, and roots. MWD fluctuated with season, species and cutting treatments as did roots (Table 1).

In summation, season most strongly influenced the fluctuation of grass root mass density and mat density. They were also influenced by species, cutting frequency, and the interaction of these. The influence on root mass density varied annually depending on environmental conditions such as temperature and soil moisture. Annual weather differences did not affect mat density.

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Table 1
Analysis of variance of the influence of grass species (SPEC) and cutting treatments (TRT) by season, depth, and year on total root weight density (TRWD), large root weight density (LRWD), fine root weight density (FRWD), and mat weight density (MWD).

Year	Season	Depth	SPEC	TRT	SPEC X TRT
		TRWD			
92	spring	0-7.5 cm	NS	NS	**
		7.5-15 cm	NS	**	*
92	summer	0-7.5 cm	NS	*	NS
		7.5-15 cm	NS	NS	*
92	fall	0-7.5 cm	*	**	**
		7.5-15 cm	**	NS	**
93	spring	0-7.5 cm	***	NS	**
		7.5-15 cm	***	*	***
93	summer	0-7.5 cm	**	NS	NS
		7.5-15 cm	***	*	***
93	fall	0-7.5 cm	***	**	NS
		7.5-15 cm	***	NS	***
		LRWD			
92	spring	0-7.5 cm	NS	*	**
		7.5-15 cm	NS	NS	NS
92	summer	0-7.5 cm	NS	NS	NS
		7.5-15 cm	NS	NS	NS
92	fall	0-7.5 cm	NS	NS	**
		7.5-15 cm	NS	***	***
93	spring	0-7.5 cm	***	NS	NS
		7.5-15 cm	***	***	***
93	summer	0-7.5 cm	**	NS	NS
		7.5-15 cm	***	***	***
93	fall	0-7.5 cm	***	NS	NS
		7.5-15 cm	***	NS	*
		FRWD			
92	spring	0-7.5 cm	*	NS	.
		7.5-15 cm	NS	**	.
92	summer	0-7.5 cm	*	***	NS
		7.5-15 cm	NS	**	NS
92	fall	0-7.5 cm	***	***	NS
		7.5-15 cm	***	***	*
93	spring	0-7.5 cm	*	NS	**
		7.5-15 cm	**	*	***
93	summer	0-7.5 cm	NS	NS	NS
		7.5-15 cm	NS	NS	NS
93	fall	0-7.5 cm	NS	***	NS
		7.5-15 cm	*	NS	*
		MWD			
92	spring		*	*	NS
	summer		***	***	*
	fall		*	***	***
93	spring		**	***	*
	summer		***	***	***
	fall		**	*	**

*, **, *** Significant at the 0.05. 0.01, and 0.001 probability levels, respectively.