Characterization of Grass Root Systems

M.A. HUSSEY AND S. SIMECEK

Summary

Six warm-season grass species were compared in a greenhouse study for selected rooting characteristics. A wide range of variation was observed between species for rooting depth as well as total root length. Rhodesgrass was observed to have the greatest rooting depth of all species investigated. Preliminary evaluation of root elongation data indicates that this character may be related to ease of establishment across species.

Introduction

A major objective of grass breeding programs in Texas is to "enhance the establishment, persistence, and en-

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vironmental stress tolerance of adapted species." Since stand establishment problems (low seeding vigor) and moisture stress are two factors which act simultaneously to limit the success of forage species, a need exists to develop selection techniques which will enable plant breeders to develop stress tolerant genotypes.

Previous research has indicated that increased seed weight within a species is one method of improving seedling vigor and successful stand establishment (2). Research with Agropyron spp. has also suggested that rooting depth and root elongation rate may also be related to successful establishment (3). More recent work involving Old World Bluestems has indicated that small differences in rooting depth or root distribution may greatly influence the drought resistance of a species (1).

In order to develop techniques which will facilitate selection for stress tolerance in warm-season grasses, a study was initiated to study grass root systems. The objective of this study was to compare buffelgrass, kleingrass, two Old World Bluestem cultivars, Laurisagrass, and rhodesgrass for rooting depth, total root length, and shoot to root ratio.

Procedures

Six commonly utilized grass species were evaluated in a greenhouse experiment (Table 1). The study was conducted by transplanting seedlings (3 to 5 tillers) into polyethylene tubes (5.0 cm X 200 cm) containing fritted clay (>10 mm). The tubes were inserted into PVC pipe and insulated to maintain a root zone temperature of less than 35°C. Individual tubes were fitted with an automatic watering system to facilitate daily watering and weekly fertilization (macro- and micronutrient).

On a weekly basis, the polyethylene tubes were raised from the PVC pipe and the depth of the fastest growing roots marked. All tubes were harvested when the first visible root reached the bottom of the tube (5 weeks).

The experiment was harvested by removing the polyethylene tubes from the PVC pipe. The tubes were slit vertically and washed free of the fritted clay to facilitate the removal of the entire root system. Two replications were fixed immediately in 70 percent ethyl alcohol, while four replications were dried at 60°C for 48 hours for dry matter determination. Total root length was determined using a Comair automatic root length scanner with two scans being made per sample.

TABLE 1. CULTIVARS UTILIZED IN THE EVALUATION OF WARM-SEASON GRASS ROOT SYSTEMS

Genus and Species	Cultivars
1. Bothrichloa ishaemum	WW-Spar
2. Bothrichloa caucasian	Caucasian
3. Cenchrus ciliaris (buffelgrass)	Common Llano Nueces 409704 409704 OT
4. Chloris gayana (rhodesgrass)	Bell Hunter Pioneer
5. Panicum coloratum (kleingrass)	Selection 75
6. Penniseteum orientale (Laurisagrass)	Laurisagrass

Results and Discussion

Mean rooting depth, total root length, and shoot to root ratio for the study is shown in Table 2. In general, rhodesgrass was found to have the longest root system of the six species investigated. However, observations under field conditions indicate that there is little difference in the mean rooting depth of rhodesgrass and buffelgrass (4).

For buffelgrass, the mean rooting depth reported for Common, Llano, and Nueces is similiar to those values reported in previous studies. The introductions 409704 and 409704 OT were significantly different from the results obtained for the commercial cultivars (Table 2), and were more similiar in rooting habit to Laurisagrass.

While little difference was observed for rooting depth between WW-Spar and Caucasian Bluestem, there was a significant difference in total root length (21.6 m vs. 11.8 m). This is similar to data from Oklahoma which suggests that there is little difference in rooting depth between the two species, but that WW-Spar has more roots deeper in the soil profile (1).

In general, the species which were observed in this study to have deep root systems (rhodesgrass, buffelgrass, kleingrass) are easier to establish than are the species with shallow root systems (Caucasian, Laurisagrass, WW-Spar). Future efforts will be directed toward determining the potential of root system modification for characters in the improvement of warm-season perennial grasses.

TABLE 2. MEAN ROOTING DEPTH, TOTAL ROOT LENGTH, AND SHOOT/ROOT RATIO OF SIX WARM SEASON SPECIES

Species	Rooting Depth	Total Root Length	Shoot/ Root
1. Rhodesgrass	176	110.0	2.10
2. Buffelgrass	146	41.7	2.40
3. Kleingrass	146	45.2	2.10
4. Laurisagrass	87	30.7	1.70
5. WW-Spar	69	21.6	2.40
6. Caucasian	71	11.8	1.80
PI 409704	85	22.9	2.50
409704 OT	129	29.9	2.60

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