Turfgrass rooting depth under optimal conditions

Landon Bunderson
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ABSTRACT

Root depth of turfgrasses is important in nutrient acquisition and drought resistance. Four grasses; *Poa pratensis* (Kentucky bluegrass), *Bouteloua gracilis* (blue grama), *Festuca ovina* (sheep fescue), and *Pascopyrum smithii* (western wheatgrass) were grown in a greenhouse with automated watering with a full nutrient solution for 63 days in 45 cm columns filled with Turface to evaluate root growth potential. Western wheatgrass and blue grama roots reached 45 cm in 45 days. Kentucky bluegrass roots had lengths of 37 cm in each of the 2 columns and sheep fescue had an average of 33.5 cm. Grasses with the deepest roots had the highest fresh and dry mass.

INTRODUCTION

Roots are the main method of nutrition acquisition for plants. The ability to acquire these nutrients is affected by the size and shape of roots. In turfgrasses, as in many plants, the depth of the roots can affect fertilization intervals and watering intervals. Plants with longer roots have a better ability to reach nutrients and water below the topsoil. Often turfgrasses develop shallow roots because of unfavorable soil conditions (compaction, water-logging) and poor management and therefore need a lot of water and fertilizer. If the root depths in this experiment had significantly deeper roots than in the field, an argument might be made for finding new maintenance techniques for these turfs.

KENTUCKY BLUEGRASS: Wu (1985) placed Kentucky bluegrass in the “medium” root depth range (20-46 cm) for turfgrasses. Wu (1985) cited differences in irrigation and

soil type for differences within species. Erusha et al. (2002) found that Kentucky bluegrass reached a depth of 21 cm after eight weeks in washed silica sand. Erusha et al. (2002) also found that Kentucky bluegrass reached 60 cm in a hydroponics system after 10 weeks (plus the eight weeks in the sand). Weaver (1926) reported that Kentucky bluegrass roots in deep moist subsoils have been found at depths of 1.5 to 2.1 meters. It would seem that Weaver (1926) is referring to depths in non-irrigated, range situations. Nevertheless, Kentucky bluegrass can reach such depths. Erusha et al's. (2002) study of 18 weeks would not support the hypothesis that Kentucky bluegrass will reach a depth of 45 cm inches in 2 months.

BLUE GRAMA: Ares (1976) created a window that was 80 cm for viewing roots in soil. He did not explain why, but he only reported blue grama depths from 0- 45 cm, which must be where the bulk of the roots were. Lee et al. (1994) stated that 80% of blue grama roots were at 50 cm or less which supports my assumption about Ares. Both Ares (1976) and Lee et al. (1994) looked at existing grasses the age of these plant was not stated. Maximum root depth was 90-100 cm. Soil was sandy loam and sandy clay loam.

SHEEP FESCUE: Weaver (1926) reported that a study on sheep fescue grown for one season in clay loam underlaid at 15-35 cm deep with a gravely clay, the roots were very abundant at 30 cm and that a few roots extended to 69 cm. Fry et al. (2004) stated that sheep fescue has excellent drought tolerance. Fry et al. (2004) reported that turfgrasses with deep root systems, low ET rates, and ability to adjust osmotically to stress have shown to be drought tolerant. Sheep fescue has narrow leaves that would help slow ET, but one would assume that to have excellent drought tolerance it must also be able to

form deep roots. It would seem that the study reported by Weaver (1926) might have found roots abundant at depths beyond 30 cm if it not been for the gravely clay.

WESTERN WHEATGRASS: Weaver (1926) stated that western wheatgrass roots can reach depths from 1.2 feet to over 2.4 meters. Very little has been written on western wheatgrass and root depth.

Hypotheses:

1) Kentucky bluegrass roots will be less than 45 cm after 2 months.

2) Blue grama roots will be at least 45 cm after 2 months.

3) Sheep fescue roots will be at least 45 cm after 2 months.

4) Western wheatgrass roots will be at least 45 cm after 2 months.

MATERIALS AND METHODS

Four grasses *Poa pratensis* (Kentucky bluegrass), *Bouteloua gracilis* (blue grama), *Festuca ovina* (sheep fescue), and *Pascopyrum smithii* (western wheatgrass) were chosen from a larger experiment on low water turfgrasses. On September 21, 2005 the grasses were direct seeded into 7.5 cm diameter PVC tubes cut to 45 cm long in a greenhouse. The media was Turface (providing for constant oxygen availability and an easily penetrated substrate, it also allowed for easy removal from roots) with finer Turface in the top 10 mm and a fine layer of vermiculite on top of that to keep the seeds moist while germinating. Columns were automatically watered with a complete nutrient solution (Hydrosol 1:200 dilution N = 1.8 mM P = 0.75 mM K = 2.7 mM) at 20 times per day and 20 seconds each time. Supplemental HPS lighting was used to increase the daily PPF integral. The photoperiod was 16-h. Grasses were thinned to approximately 15 seedlings

per tube, 3 weeks after planting. All plants were trimmed to 10 cm (4") once a week, grass clippings were weighed immediately for fresh weight and a week later for dry weight. Grasses were removed from tubes on November 21, 2005, 61 days after planting.

RESULTS

Figure 3 root depth of grasses in cm

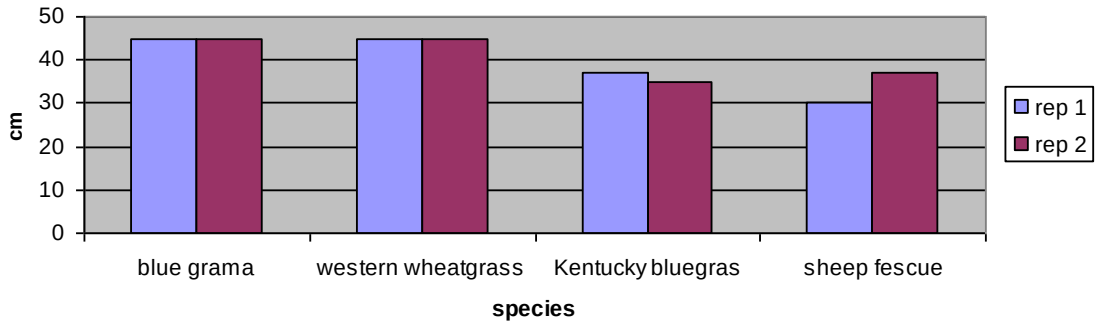
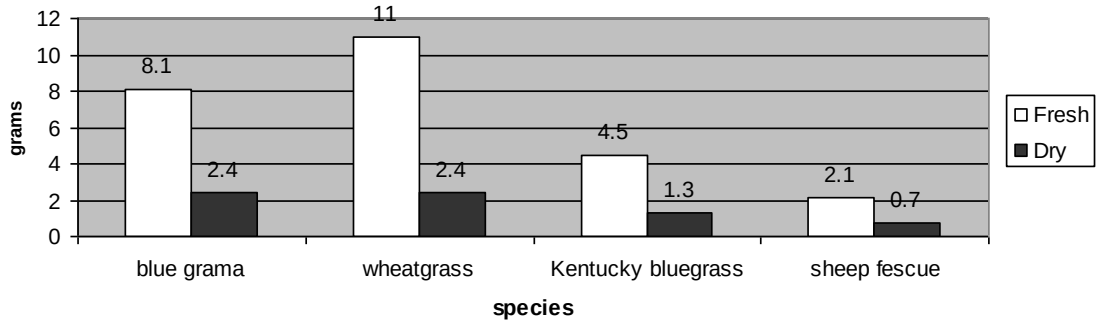


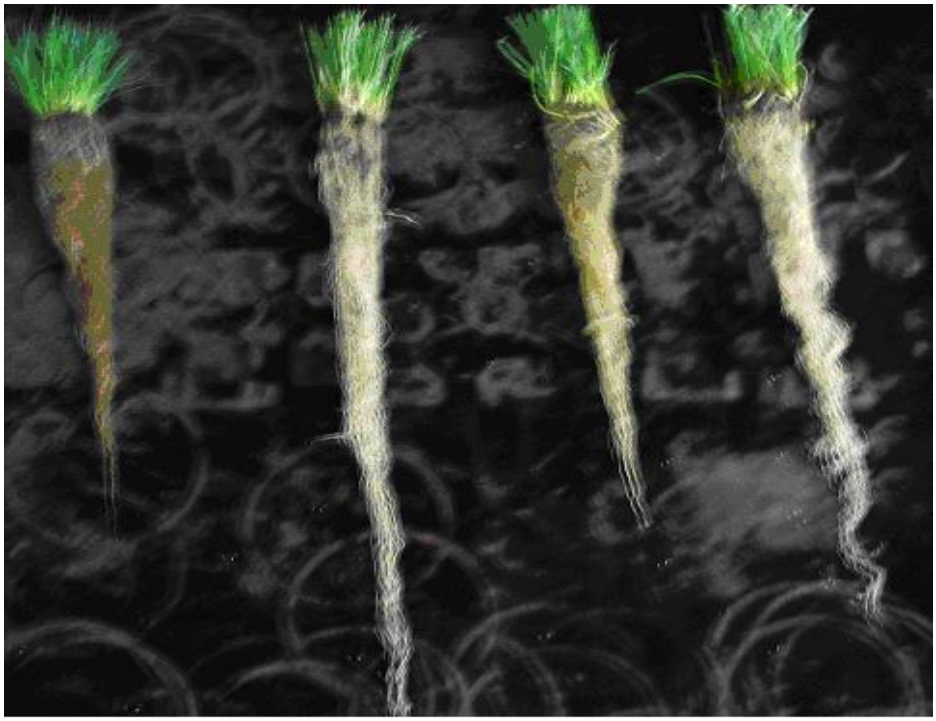
Figure 1 Total clipping weights, fresh and dry in grams



Both western wheatgrass reps reached 45 cm in 45 days. Blue grama also reached 45 cm in 45 days in both reps. Contrary to what was predicted, sheep fescue only reached 30 cm and 37 cm after 63 days. Kentucky bluegrass reached a depth of 37 cm in both reps after 63 days. Total fresh and dry weights are shown in figure 1. Data were analyzed using SAS PROC GLM method. P-value for differences between grasses was highly

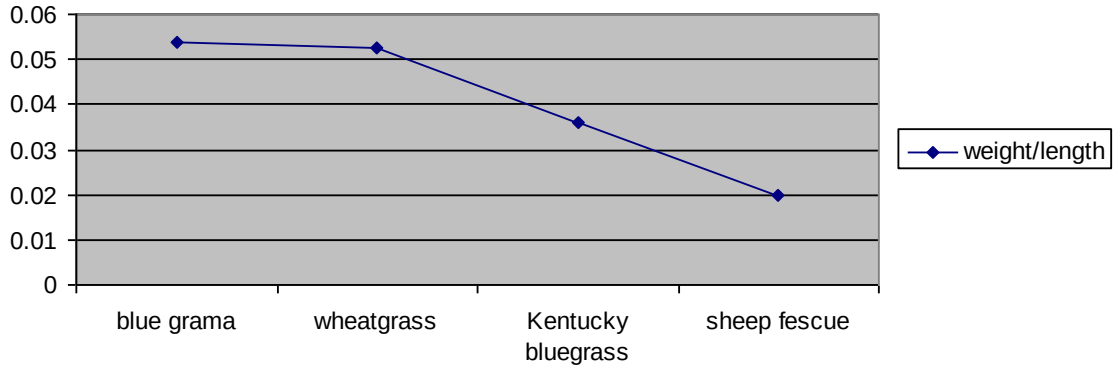
significant (<0.0001). There was a significant difference between all grasses for the fresh weight. For dry weight there was no significant difference between blue grama and western wheatgrass, but Kentucky bluegrass and sheep fescue were different from each other and western wheatgrass and blue grama. The species with the highest yield had the highest root depth. Sheep fescue had the shallowest roots and the lowest yield. Root length was analyzed using SAS PROC GLM, but did not fit the assumptions of normality, and therefore no assumptions could be drawn.

Rep 1 sheep fescue blue grama Kentucky bluegrass western wheatgrass



Rep 2 sheep fescue blue grama Kentucky bluegrass western wheatgrass

Figure 4 dry weight/length



DISCUSSION

Yield and depth were correlated (Figure 4). Similar to what Wu (1985) described, Kentucky bluegrass was able to grow roots in the range of 20-46 cm (Figure 3). As expected, western wheatgrass and blue grama reached the 45 cm depth. Sheep fescue reached depths of only 30 and 37 cm. This was a surprise, it seems that either sheep

fescue has slow growing roots or its drought resistance is due to other factors such as narrow leaves.

SUGGESTIONS FOR FUTURE RESEARCH

I would like to continue this kind of research in the future. One thing that I would like to do is have longer columns for the western wheatgrass and the blue grama. I would like to do different clipping heights and intervals to see if that affects overall root depth. This kind of information could be highly relevant for establishing deep roots, especially in species that are just now being evaluated for turf. In my research for my thesis there are mixes like sheep fescue and western wheatgrass. They have different characteristics individually when grown together than when grown separately. The different characteristics could be due, in part, to root depths being different when they are grown together. I would like to grow the two in the same column and evaluate how they grow together compared to separately. This would be easy in mixes like sheep fescue and western wheatgrass because the roots are different colors. Another experiment I would like to try is Kentucky bluegrass grown in turface compared to Kentucky bluegrass grown in sand and other media. This would help us draw conclusions about how large of a role mechanical impedance plays in root depth for Kentucky bluegrass.

LITERATURE CITED

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