Comparison of Root Development of Zoysiagrass Cultivars and Experimental Genotypes for Drought Avoidance Traits

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Zoysiagrass genotypes with maximum root extension and enhanced rooting across depths suggest better traits for drought avoidance

SUMMARY

- PROBLEM: Turfgrass species, including zoysiagrass, need to develop drought resistance mechanisms due to increasing water limitations. Root development is crucial for water uptake.
- BACKGROUND: New zoysiagrass cultivars show promising drought tolerance, but detailed study is needed on their root systems and shoot-to-root ratio (SRR).
- OBJECTIVE: To evaluate root characteristics and SRR in zoysiagrass genotypes and their contribution to drought avoidance.

MATERIALS AND METHODS

- STUDY DESIGNS:
  - Two experiments (2023 and 2024) in a controlled greenhouse setting.
  - 12 zoysiagrass genotypes, grown in polyvinyl chloride tubes filled with calcined clay.
  - Maximum measurements of root length and weekly shoot quality rating on a 1-9 scale (1= poor; 6= minimally acceptable; 9= optimum best).
  - WinRHIZO image analysis of root length, and root volume at depths 0-10, 10-20, 20-30, 30-60 and 60-90 cm.
  - Mowed at 1-inch and collected clippings.
  - Irrigated lightly and frequently, and lightly and infrequenctly.
- GENOTYPES: Meyer, Emerald, Zeon, Innovation, Chisholm, Gateway, KSUZ 1201, DALZ 1701, DALZ 1702, DALZ 1808, DALZ 1311, and FAES 1319.

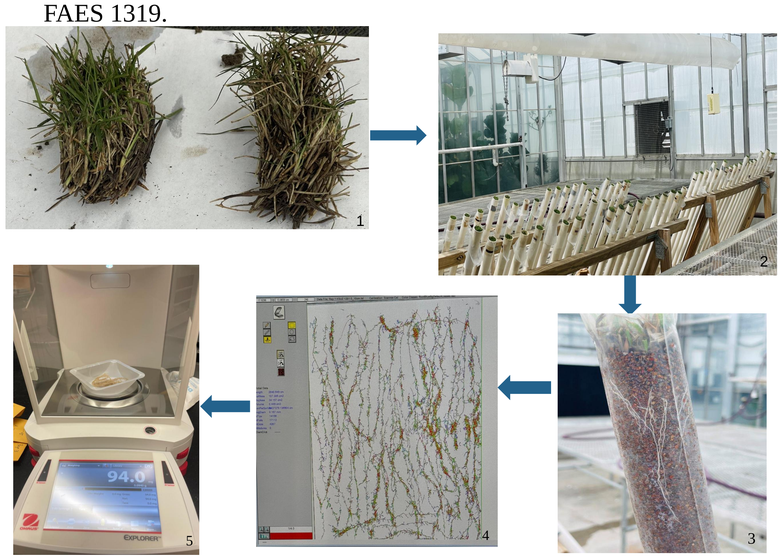

Figure 1. (1) washed and trimmed plugs before planting in PVC pipes; (2) PVCs resting at 20º angle for easy rooting identification; (3) Weekly data collected on maximum root length; (4) Root morphology as visualized using WinRHIZO software; (5) Measurement of zoysiagrass root dry mass

RESULTS

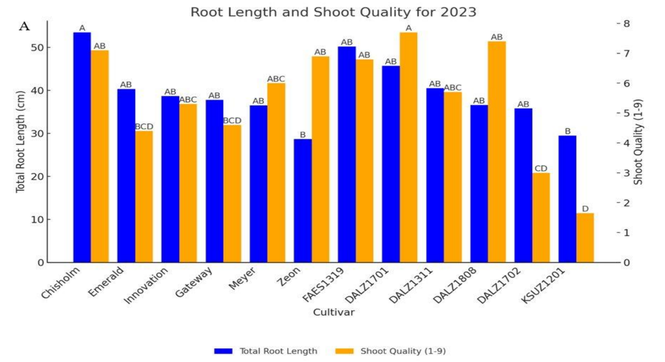

Figure 2. Relationship between total root length and shoot quality of zoysiagrass genotypes for 2023 (A) and 2024 (B). Total root length was defined as the average of root lengths across replications. letters above each blue bar indicate a significant difference ($P < 0.05$).

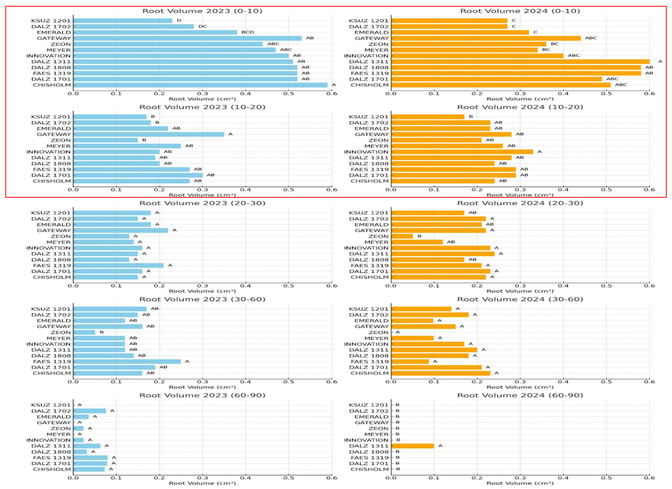

Figure 3. Genotype comparison of root volume in 2023 and 2024 across depth. Letters on each bar indicate significant differences ($P \leq 0.05$).

RESULTS

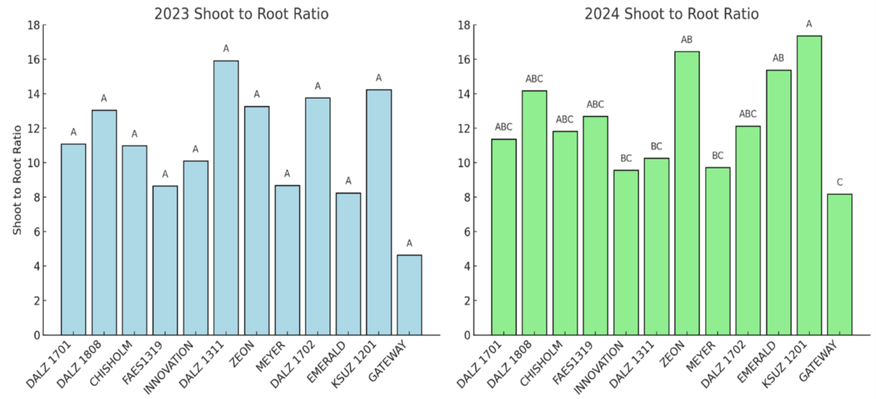

Figure 4. Shoot-to-root ratio. This was determined by dividing the combination of total clipping and shoot mass throughout the study period by total root mass across depths. Letters on each green bar indicate significant differences in 2024 ($P = 0.0004$).

DISCUSSION

- Root length and volume were highest in the upper 10 cm of the soil profile, with substantial declines at deeper depths.
- Deeper-rooted genotypes like Chisholm, FAES 1319, and some others, are better suited for drought conditions, while shallower-rooted genotypes like Zeon and KSUZ 1201 may not perform well under water-limited conditions.
- Genotypes with extensive root systems had higher shoot quality ratings, expressing positive relationship between root development and overall turf quality.
- Genotypes with higher SRR like Zeon and KSUZ 1201 prioritized shoot growth over root development and may perform better in environments with abundant water but may struggle under drought stress.

CONCLUSION

- The study gives an understanding of the rooting characteristics of the 12 genotypes that were evaluated for drought avoidance traits.
- The significant differences in root traits among genotypes show the importance of selecting cultivars based on maximum rooting depth and lengths across each level to enhance drought avoidance.
- These results can inform breeding programs aimed at improving drought resilience in turfgrass, especially in regions with frequent water limitations.

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