Effect of Water Depth on Texas Wild Rice Germination and Growth

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Introduction

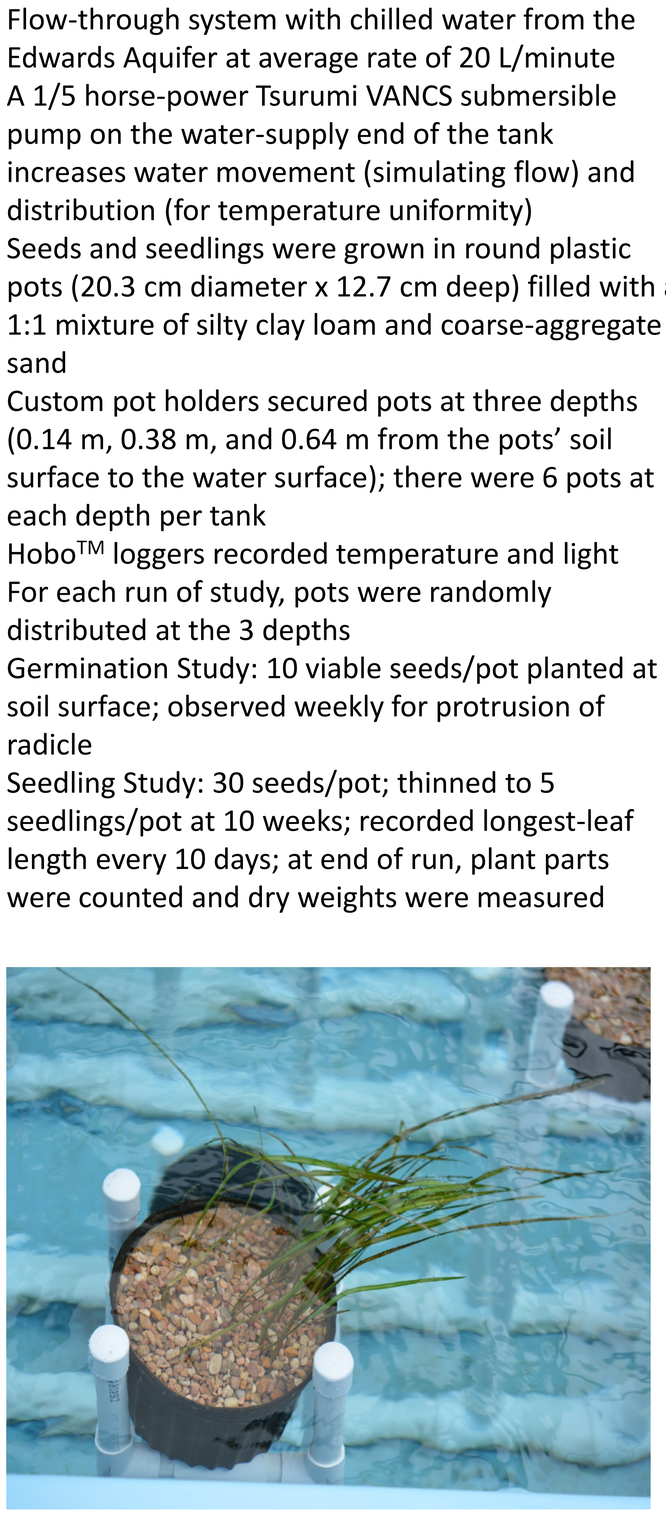
Zizania texana, listed as federally endangered, is an aquatic grass restricted to the first 3.2 km of the spring-fed, thermally constant San Marcos River in San Marcos, TX. It grows at all river depths (from 0 to > 4 m), being submergent in faster flows and emergent in slower water. Sexual reproduction in the species was not observed regularly until the mid-1990s. It is currently propagated from seed at the U.S. Fish and Wildlife Service's San Marcos Aquatic Resources Center for transplantation into restoration sites within its natural range. Understanding conditions that favor establishment of *Z. texana* propagules will facilitate more effective conservation and restoration of the species.

Objective

This study was conducted to determine how water depth may influence seed germination and early growth of *Z. texana*. Data will help inform protocols for *ex situ* propagation, restoration-site selection, and management of river habitats to promote natural dispersal.

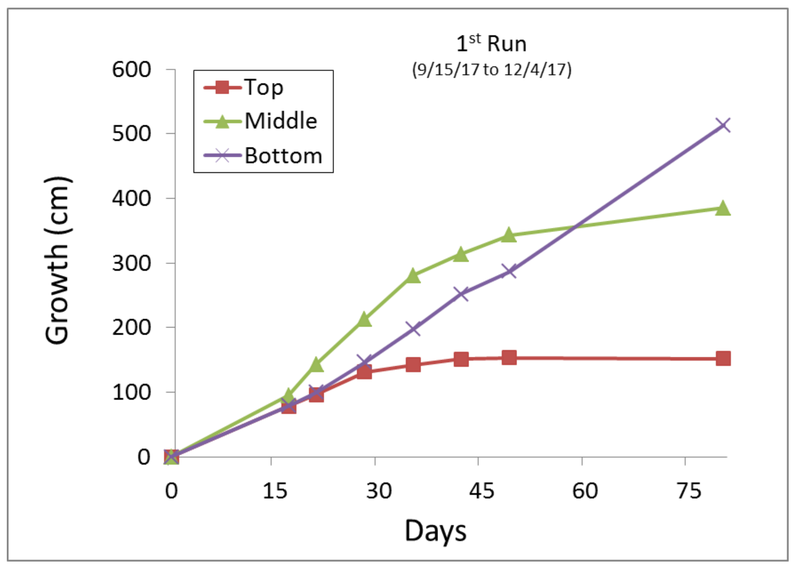
Methods

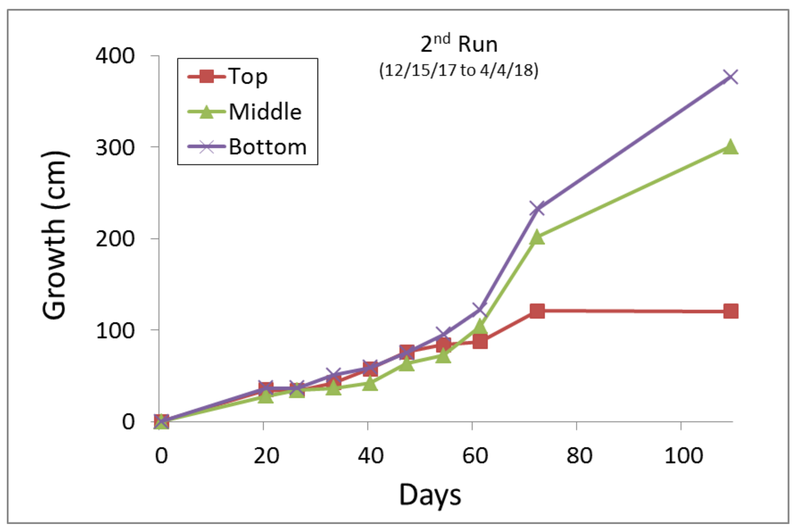
- 2,430 L (642-gal.) fiberglass tanks measuring 0.9 m wide x 3.0 m long x 0.9 m deep
- Flow-through system with chilled water from the Edwards Aquifer at average rate of 20 L/minute
- A 1/5 horse-power Tsurumi VANCS submersible pump on the water-supply end of the tank increases water movement (simulating flow) and distribution (for temperature uniformity)
- Seeds and seedlings were grown in round plastic pots (20.3 cm diameter x 12.7 cm deep) filled with a 1:1 mixture of silty clay loam and coarse-aggregate sand
- Custom pot holders secured pots at three depths (0.14 m, 0.38 m, and 0.64 m from the pots' soil surface to the water surface); there were 6 pots at each depth per tank
- Hobo™ loggers recorded temperature and light
- For each run of study, pots were randomly distributed at the 3 depths
- Germination Study: 10 viable seeds/pot planted at soil surface; observed weekly for protrusion of radicle
- Seedling Study: 30 seeds/pot; thinned to 5 seedlings/pot at 10 weeks; recorded longest-leaf length every 10 days; at end of run, plant parts were counted and dry weights were measured



***Z. texana* Seedlings at the Top Depth within One of the Study Tanks**

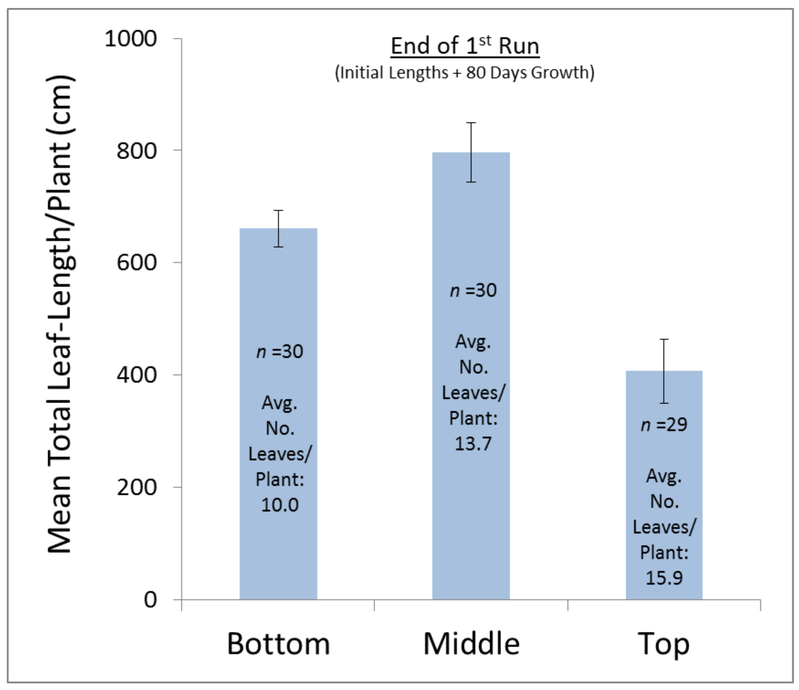
Increased Growth Rate at Lower Depths

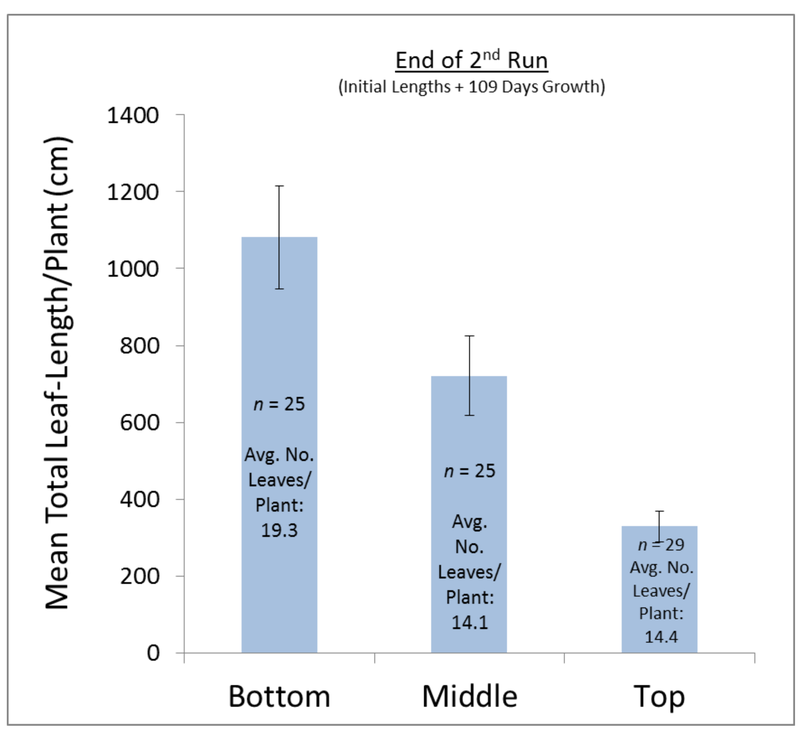




Greater Overall Leaf Growth at Lower Depths

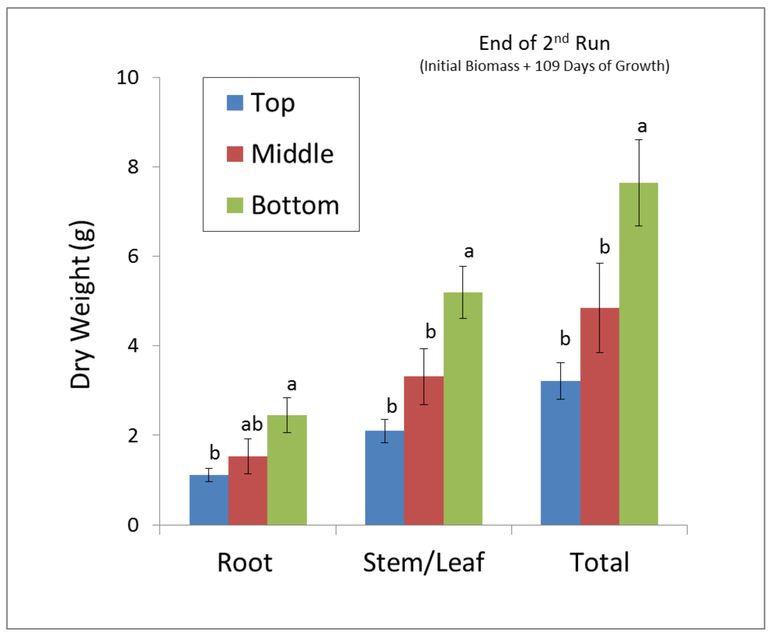
* significant difference among all depths/run (P<0.05; 1-way ANOVA, Tukey Test)





Higher Biomass with Increased Depth

*different letters within a group indicate significant difference
($P < 0.05$; one-way ANOVA, Tukey Test)



Results

Temperature/Light

- Temperature ranged from 18.2 to 22.1°C, equally among depths and tanks
- Average daytime light intensity ranged from 260.5 to 313.6 lumens/ft² and from 93.8 to 102.9 lumens/ft² at top and bottom depths, respectively

Germination

- Tested within four separate groups of seeds, collected at different times of year and stored for varying time periods of between 0 and 183 days
- Germinability was between 14.7 and 91.7% and mean germination time ranged from 2.5 to 54.2 days
- No significant difference among depths ($P > 0.05$; one-way ANOVA)

Seedling Growth

- Trend toward higher growth rate with increased depth
- Significantly greater total leaf lengths in deeper plants
- Significantly greater stem/leaf and total biomass among all depths; root biomass significantly greater between top and bottom depths

Discussion

- Germination did not appear to be impacted by water depth under experimental conditions at depths tested
- Greater depth down to 0.6 m led to increased leaf/stem growth; this is possibly due to:
  - increased carbon uptake due to greater water velocity contacting leaf surface in deeper water
  - partitioning of energy to leaves/stems at expense of roots in deeper plants
  - more space available for leaf growth as depth increases (i.e., leaf growth is limited by the air – water-surface interface)
- Especially in clearer water, seedling establishment is probably aided by increased water depth up to a certain threshold
- More research is needed to explore potential energy partitioning, particularly with varying water turbidity

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