Salt Tolerance of *Panicum virgatum* and *Spartina pectinata*

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Rationale

- Lignocellulosic biomass grown as a biofuels feedstock shows great potential in meeting the federal mandate for cellulosic biofuels
- Biomass needs to be grown on marginal or degraded land unable to support row crop production to avoid potential competition with food and feed crops
- Salt tolerances for corn (*Zea mays*) and soybean (*Glycine max*) are 1.7 and 5.0 dS/m, respectively (Tanji and Kielen, 2003)
- Biomass crops able to tolerate saline conditions would be able to fill an important niche in the bioeconomy

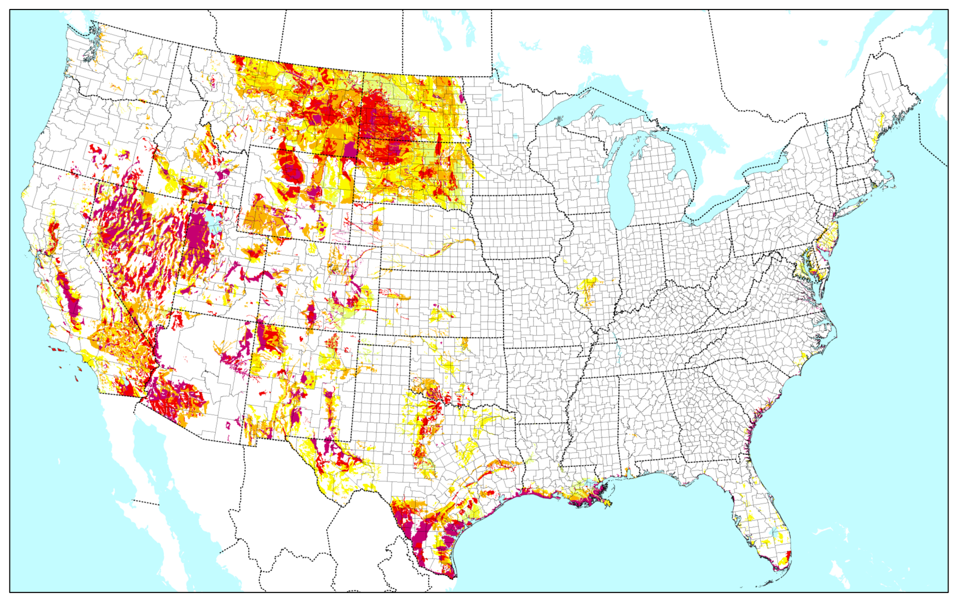

Figure 1. Salt-affected soils in the U.S. (Kartesz, 2011).

Research Goals

- Identify species and cultivars of candidate perennial grasses that will germinate under moderate and high salt levels
- Determine effects of various levels of sodicity and salinity on biomass growth characteristics of select perennial grass species and cultivars

Methods and Materials

- Both studies performed in the greenhouse
- Salt treatments included a control (pure water) and a factorial of two levels of salinity (5 and 10 dS/m) and sodicity
  - Salts used – $MgSO_4$, $CaCl_2$ and NaCl – were added in a 1:1.7:2.5 ratio respectively for low sodicity treatments and a 1:2.5:7 ratio for high sodicity
- Data analyzed in SAS, MIXED procedure

Table 1. Interpretation of electrical conductivity. (Millar, 2003)

EC (dS/m)	Salt rank	Interpretation
0-2	Low	Very little injury to plants
2-4	Moderate	Sensitive plants may suffer
4-8	High	Non-salt tolerant plants will suffer
8-16	Excessive	Only salt-tolerant vegetation will grow
16+	Very Excessive	Very few plants will grow

Methods and Materials (cont'd)

Germination

- Cultivars studied:
  - Switchgrass (*Panicum virgatum*) 'Cave-in-Rock', 'Alamo' and 'Kanlow'
  - Prairie cordgrass (*Spartina pectinata*) 'Red River' and wild types 17-109, 17-102, PCG-109, 19-106, 20-102
- Experiment conducted as a randomized complete block design with salt treatment as blocks, 4 replications, repeated twice
- Seeds treated with fungicide (Apron Maxx), planted in pure silica at 3 mm depth, 20 seeds per 13.3 cm^2 cell, 24 cells per flat, covered with a dome
- Watered from below with respective solutions, temperatures maintained at 30° C for 16 h (day), and 20° C for 8 h (night)
- Germination counts taken every 2 days for 21 days, final height measured

Biomass Growth

- Cultivars studied: switchgrass 'Cave-in-Rock' and 'Kanlow'; prairie cordgrass 'Red River', 17-109 and 17-102
- Experiment conducted as a randomized complete block design, 4 replications
- Plants of each population were grown under the previously described salt regimes and harvested after most control plants had reached anthesis
- Height, number of tillers, number of internodes, and dry weight measured

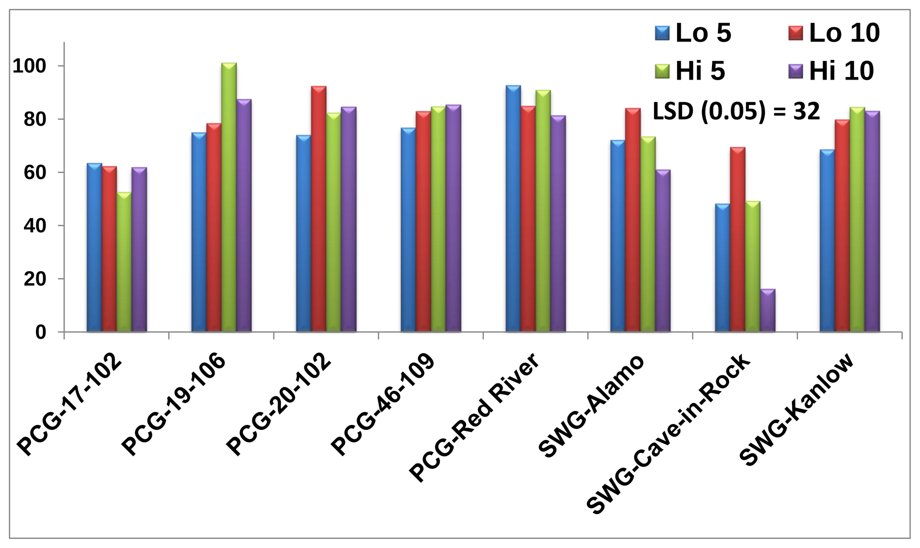

Figure 2. Effect of varying levels of sodicity and salinity on seed germination as a percentage of the control treatment.

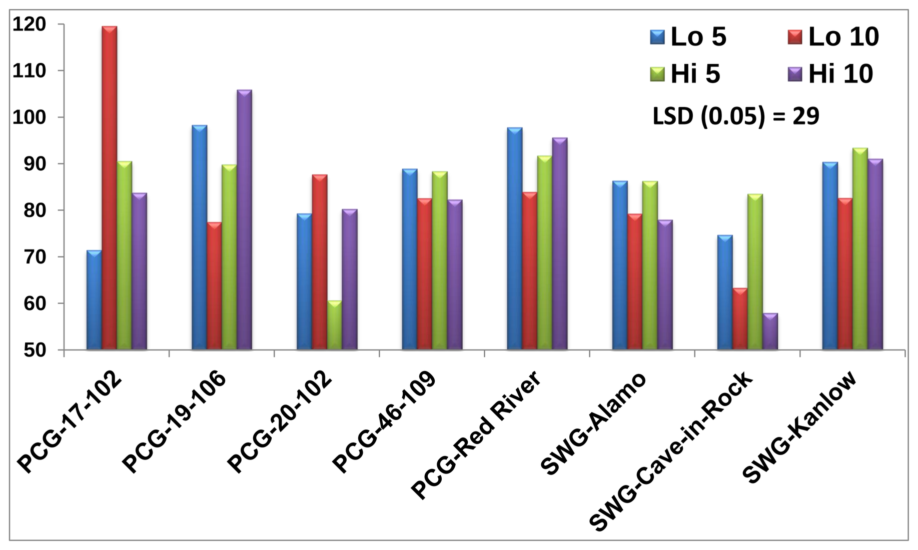

Figure 3. Effect of varying levels of sodicity and salinity on seedling height as a percentage of the control treatment.

Results

Germination

- Germination was not statistically lower than the control for most cultivars with all salt treatments (Fig. 2)
  - Germination was significantly reduced for all salt treatments with prairie cordgrass 17-102 and 'Cave-in-Rock' switchgrass
- Seedling heights were generally not significantly affected by salt treatments (Fig. 3)
  - 'Cave-in-Rock' was stunted at higher salinity levels
  - Prairie cordgrass 17-102 and 20-102 heights were reduced at a lower salinity level – likely due to random variability within seeds

Biomass Growth

- Sodicity was not significant but dry weight, height and tiller number were negatively impacted by salinity (Fig. 4, 5 & 6)
- 'Kanlow' had the highest yields at each salinity level
- 'Cave-in-Rock' yield was reduced 77% at EC 10 compared with the control
- Prairie cordgrass populations showed similar responses to salinity with 57% yield reduction on average for EC 10 treatments compared with the controls
- Height responses were nearly flat, but tiller number was significantly decreased
- 'Cave-in-Rock' had 73% fewer tillers in the EC 10 treatments than in the control

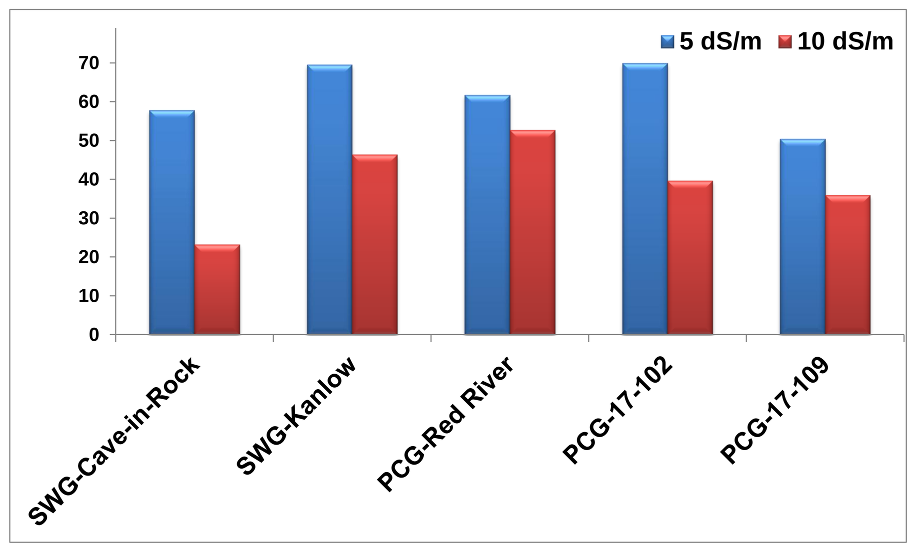

Figure 4. Effect of increasing salinity on biomass yield (as a % of Control) of switchgrass and prairie cordgrass.

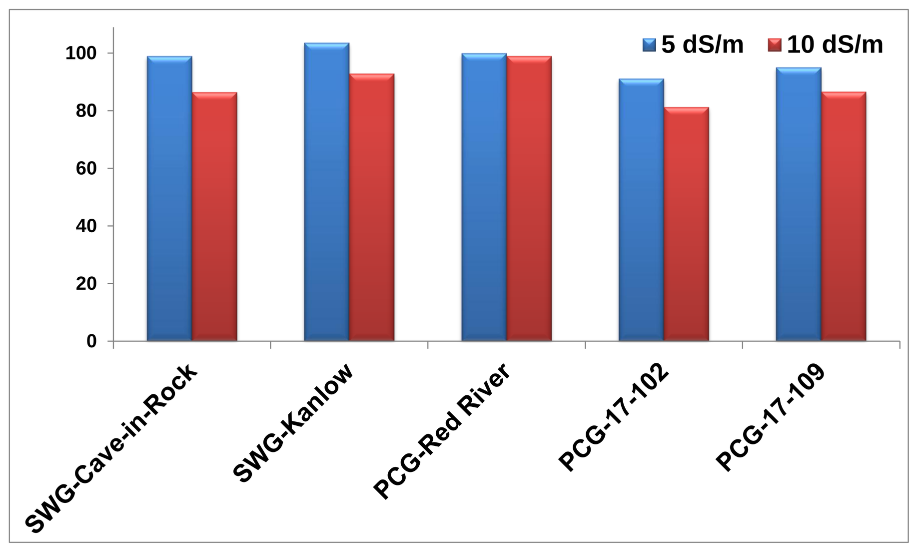

Figure 5. Effect of increasing salinity on plant height (as a % of Control) of switchgrass and prairie cordgrass.

Results (cont'd)

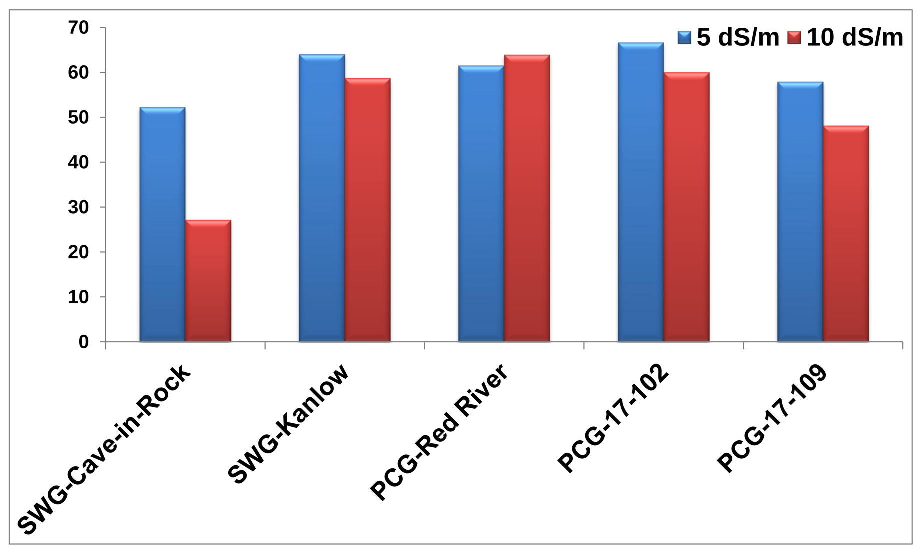

Figure 6. Effect of increasing salinity on tiller number (as a % of Control) of switchgrass and prairie cordgrass.

Conclusions

- Most cultivars of both switchgrass and prairie cordgrass exhibited good germination levels and early seedling growth under salt regimes examined
- Biomass yields are reduced with increasing levels of salinity, mostly due to reduced tillering
- 'Kanlow' shows potential for high biomass yields on salt-affected lands, particularly in the southern half of the U.S.
- Prairie cordgrass may prove beneficial in the northern half of the U.S. and on land with "excessive" salt

References

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