Screening for Salt Tolerance in Native and Exotic Shrub Willow

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INTRODUCTION

- A growing desire worldwide for a secure and environmentally-friendly energy source has fueled interest in purpose-grown feedstock for bioenergy production.
- Given concerns over converting agronomic food crops into fuel crops for bioenergy production, a tremendous opportunity exists to develop non-consumable woody crops as a bioenergy feedstock. The ability to grow woody crops on marginal land that is deemed unsuitable for annual crop production would be an added benefit.
- Salinity is a significant agronomic problem across the Canadian prairies, with an estimated 1.6 million ha of saline soils in Saskatchewan alone. The potential exists to utilize and reclaim these marginal lands by growing short-rotation intensive culture willow (*Salix* spp.) plantations. However, apart from limited anecdotal information, no empirical work has been done to examine the salt tolerance of different willow clones.

OBJECTIVE

- Determine the salt tolerance of numerous native and exotic willow clones for their potential use in willow plantations to be established on salt-affected lands.

MATERIALS & METHODS

- Kettlehut Association loam soils were collected from a catena, influenced by toe-slope salinity, containing high concentrations of sulfate salts (Fig. 1a). The soils were blended (Fig. 1b) to achieve four salinity levels: non-saline to very slightly saline (0.8 and 3.6 dS/m), slightly saline (5.0 dS/m), and moderately saline (8.0 dS/m).
- Plant material of 37 different willow clones (Table 1) was collected from one-year-old stools in the spring of 2009, sectioned into 15 cm cuttings, and planted in pots.
- Above- and below-ground growth parameters were measured after 60 days (Fig. 1c).

Figure 1. Collecting soil along a saline hillslope catena near Central Butte, SK (a), blending air-dried soils to achieve desired salinity levels (0.8, 3.6, 5.0, and 8.0 dS/m) (b), and assessing willow growth after 60 days (c).

Table 1. Selected shrub willow (*Salix* spp.) clones screened for salt tolerance

Clone	Species	Sex	Clone	Species	Sex
(1) Allegany	*S. purpurea*	F	*(20) Saratoga*	*S. purpurea x S. miyabeana*	F
(2) Alpha	*S. viminalis*	F	*(21) Saskatoon D3*	*S. discolor*	?
(3) Canastota	*S. sachalinensis x S. miyabeana*	M	*(22) Saskatoon E3*	*S. eriocephala*	?
(4) Charlie	*S. alba x S. glatfelteri*	?	*(23) Sherburne*	*S. sachalinensis x S. miyabeana*	F
(5) Cicero	*S. sachalinensis x S. miyabeana*	F	*(24) SV1*	*S. dasyclados*	F
(6) Fabius	*S. viminalis x S. miyabeana*	F	*(25) SX-61*	*S. sachalinensis*	F
(7) Fish Creek	*S. purpurea*	M	*(26) SX-64*	*S. miyabeana*	M
(8) Hotel	*S. purpurea*	?	*(27) Taberg*	*S. viminalis x S. miyabeana*	F
(9) India	*S. dasyclados*	M	*(28) Truxton*	*S. viminalis x S. miyabeana*	F
(10) Juliet	*S. eriocephala*	?	*(29) Tully Champion*	*S. viminalis x S. miyabeana*	F
(11) Marcy	*S. sachalinensis x S. miyabeana*	F	*(30) Verona*	*S. viminalis x S. miyabeana*	F
(12) Millbrook	*S. purpurea x S. miyabeana*	F	*(31) 94001*	*S. purpurea*	M
(13) Oneida	*S. purpurea x S. miyabeana*	M	*(32) 00X-026-082*	*S. eriocephala*	M
(14) Oneonta	*S. purpurea x S. miyabeana*	M	*(33) 00X-032-094*	*S. eriocephala*	?
(15) Onondaga	*S. purpurea*	M	*(34) 01X-268-015*	*S. viminalis x (S. sachalinensis x S. miyabeana)*	?
(16) Otisco	*S. viminalis x S. miyabeana*	F	*(35) 9837-77*	*S. eriocephala*	F
(17) Owasco	*S. viminalis x S. miyabeana*	F	*(36) 9882-041*	*S. purpurea*	F
(18) S25	*S. eriocephala*	F	*(37) 99208-038*	*S. viminalis x S. miyabeana*	F
(19) S365	*S. caprea*	F			

RESULTS

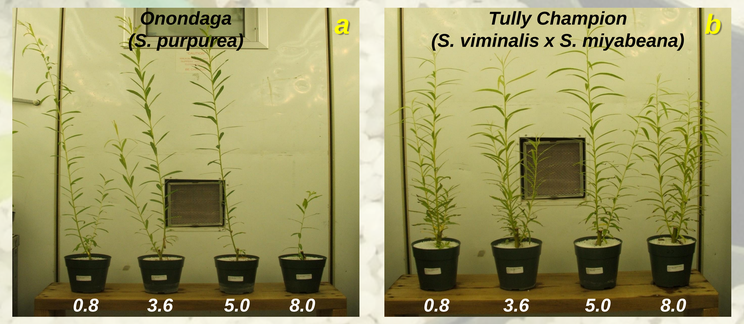

Figure 2. The effect of increasing soil salinity (dS/m) on above-ground growth of relatively salt intolerant (a) and tolerant (b) willow clones after 60 days.

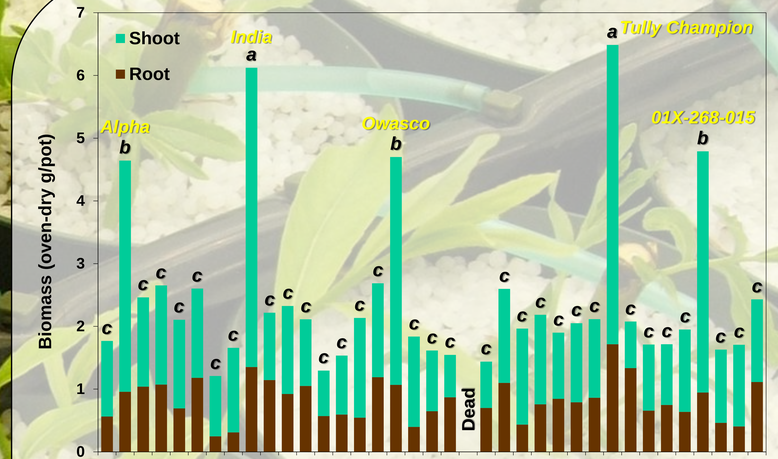

Figure 3. Biomass of different native and exotic shrub willow clones grown for 60 days in moderately saline (8.0 dS/m) soil. See Table 1 for clone identification. For shoot biomass, bars with the same letters are not significantly different (P >0.05) using LSD.

DISCUSSION & CONCLUSIONS

- Most willow clones tested in this study were able to tolerate slightly saline conditions (≤ 5.0 dS/m). In addition, several clones (Alpha, India, Owasco, Tully Champion, and 01X-268-015) showed no reduction in growth with moderate salinity (≤ 8.0 dS/m).
- Establishing purpose-grown willow plantations with salt tolerant clones provides utility for otherwise non-productive land, thereby avoiding the displacement of arable land from food production.
- Further research in the field is required to validate the differences in salt tolerance of willow clones observed in this growth chamber study.

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