



Salinity Tolerance of Native Plants and Soil Amendment Potential for Reclamation

Jean-Marie Sobze



Project Context

- Produced water spilled on two industrial sites
- Remediation measure:
 - Excavation of contaminated soils.
- Problem: Exposure of naturally saline sub-soil



Purpose

- Conduct greenhouse studies to evaluate local trees and shrubs tolerance to soil salinity.
- Examine the impact of propagules deployment methods: Seedlings vs. Seeds
- Assess soil amendment effect.



Vs.



Method

- Seeds collected from the same seed zone as the spill site
- Soils originated from remediated sites
- Soil Preparation
 - Treatment with a mixed solution of MgSO_4 , CaCl_2 , and Na_2SO_4 . Soil aged for at least Two weeks.
- Salinity levels: 4,6, 9, 12 dS/m
 - Control: Non-disturbed soil from surrounding forest

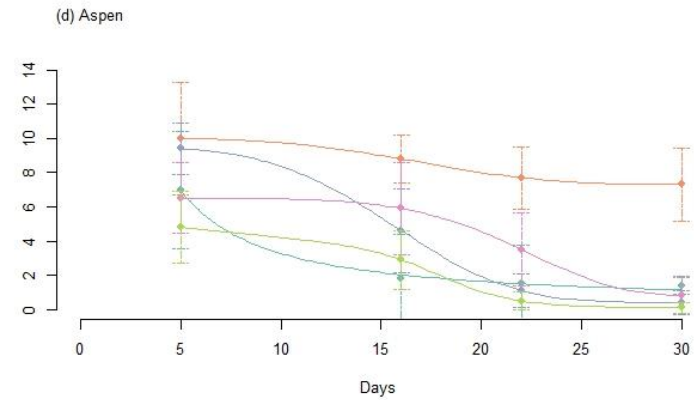
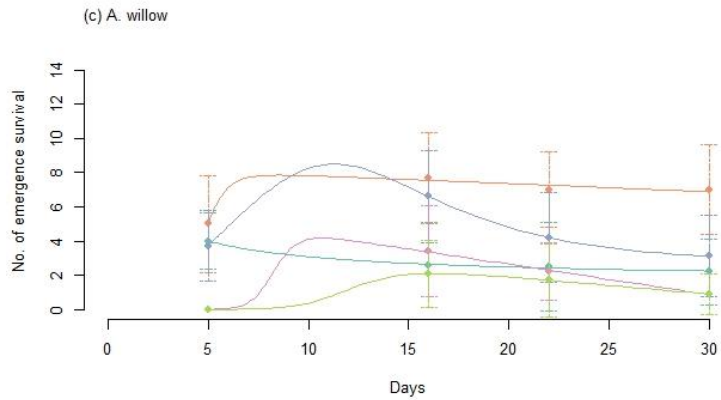
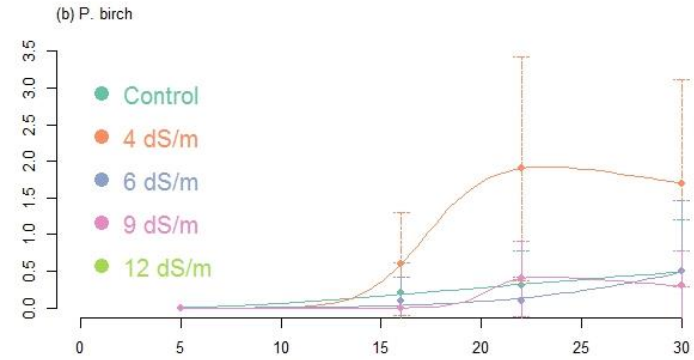
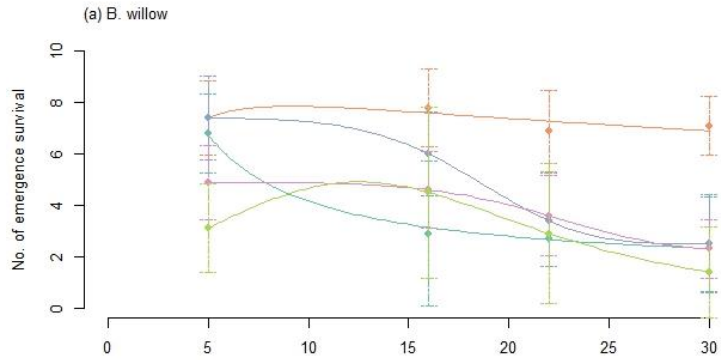


Experiments

- Seeding
 - Stratified seeds were directly sowed on treated and control soils.
- Transplant
 - Seedlings grown with nursery peat mix were transplanted (in treated and control soils (hot and cold planting)
- Amendments
 - Zeolites
 - Bio-char
 - T-Caron



Seed Emergence and Survival



Bebb's Willow: Seed Emergence and growth on Organic Soils



Control



4 dS/m



6 dS/m



9 dS/m



Control



4 dS/m



6 dS/m

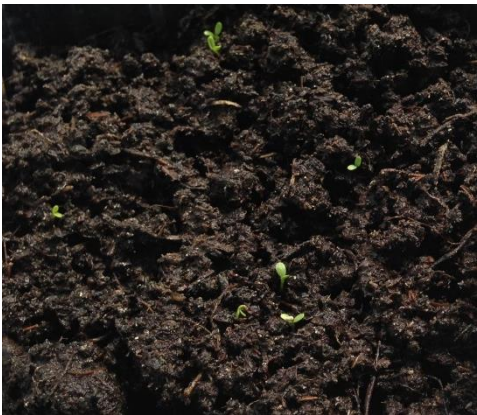


9 dS/m

Autumn Willow: Seed Emergence and growth on Organic Soils



Control



4 dS/m



6 dS/m



9 dS/m



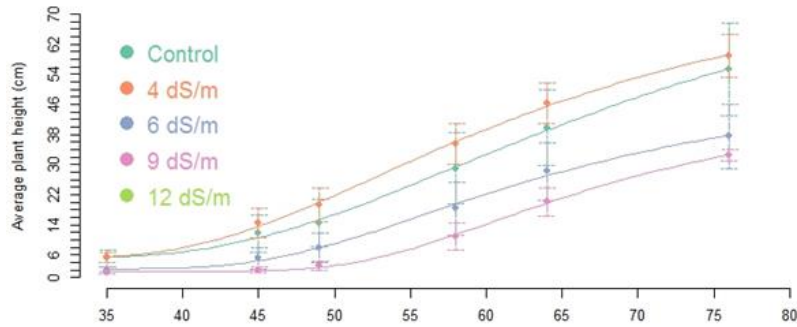
6 dS/m

4 dS/m

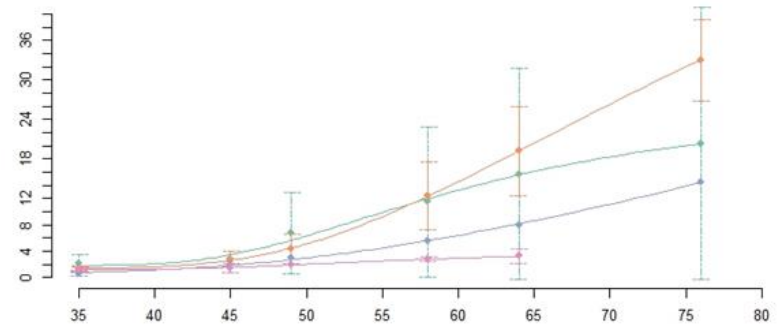
Control

Early Establishment: Shoot Growth

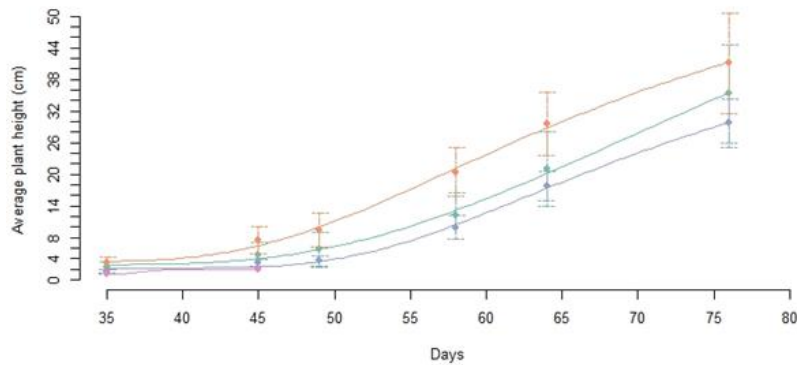
(a) B. willow



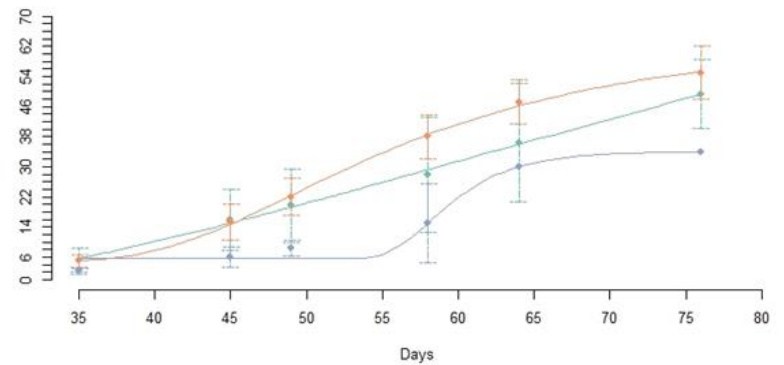
(b) P. birch



(c) A. willow



(d) Aspen



Roots Development - Autumn Willow



Control

4 dS/m

6 dS/m

Root Development - Bebb's Willow



Control

4 dS/m

6 dS/m

9 dS/m

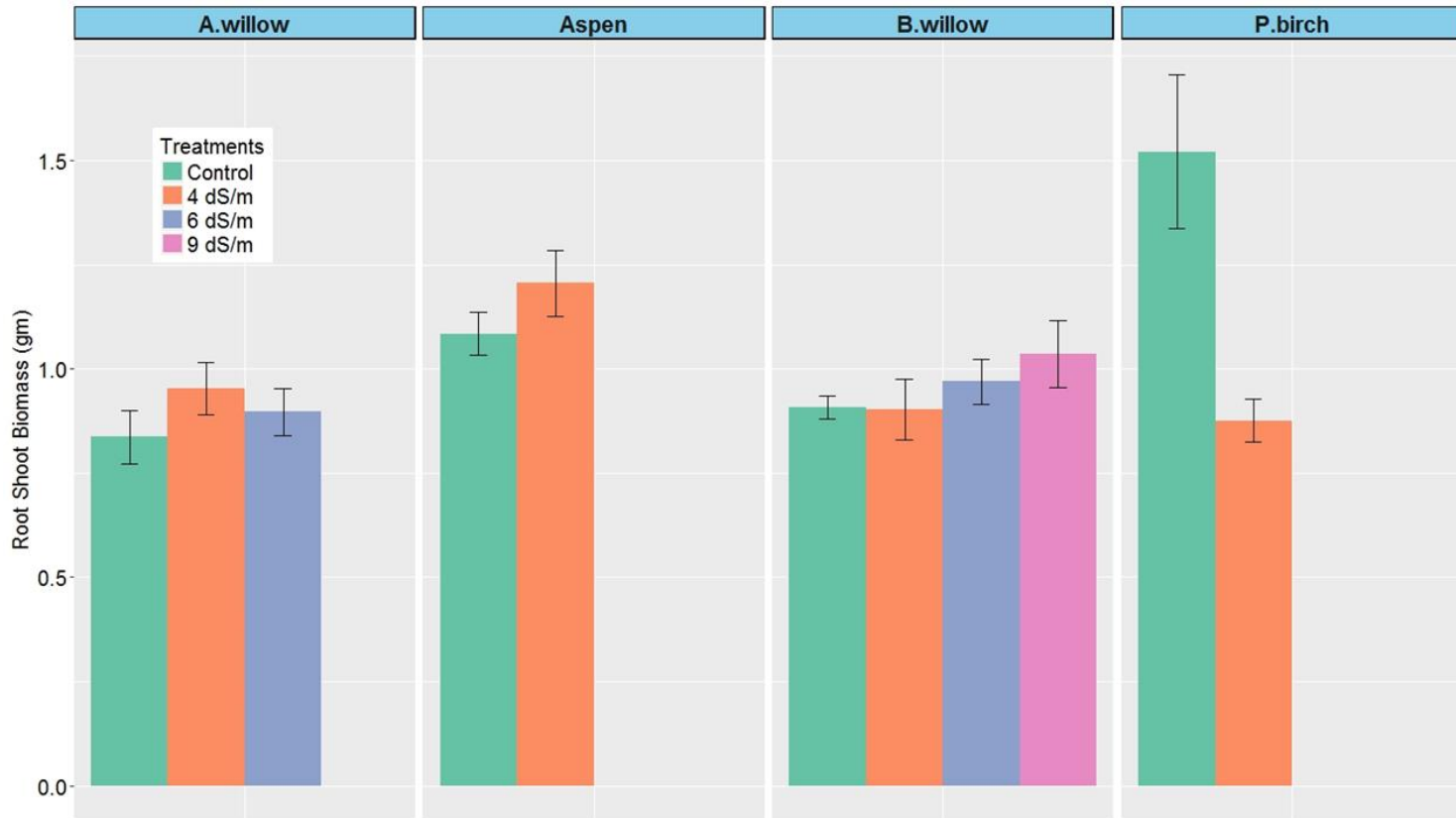


**ESSENTIAL
TO ALBERTA**

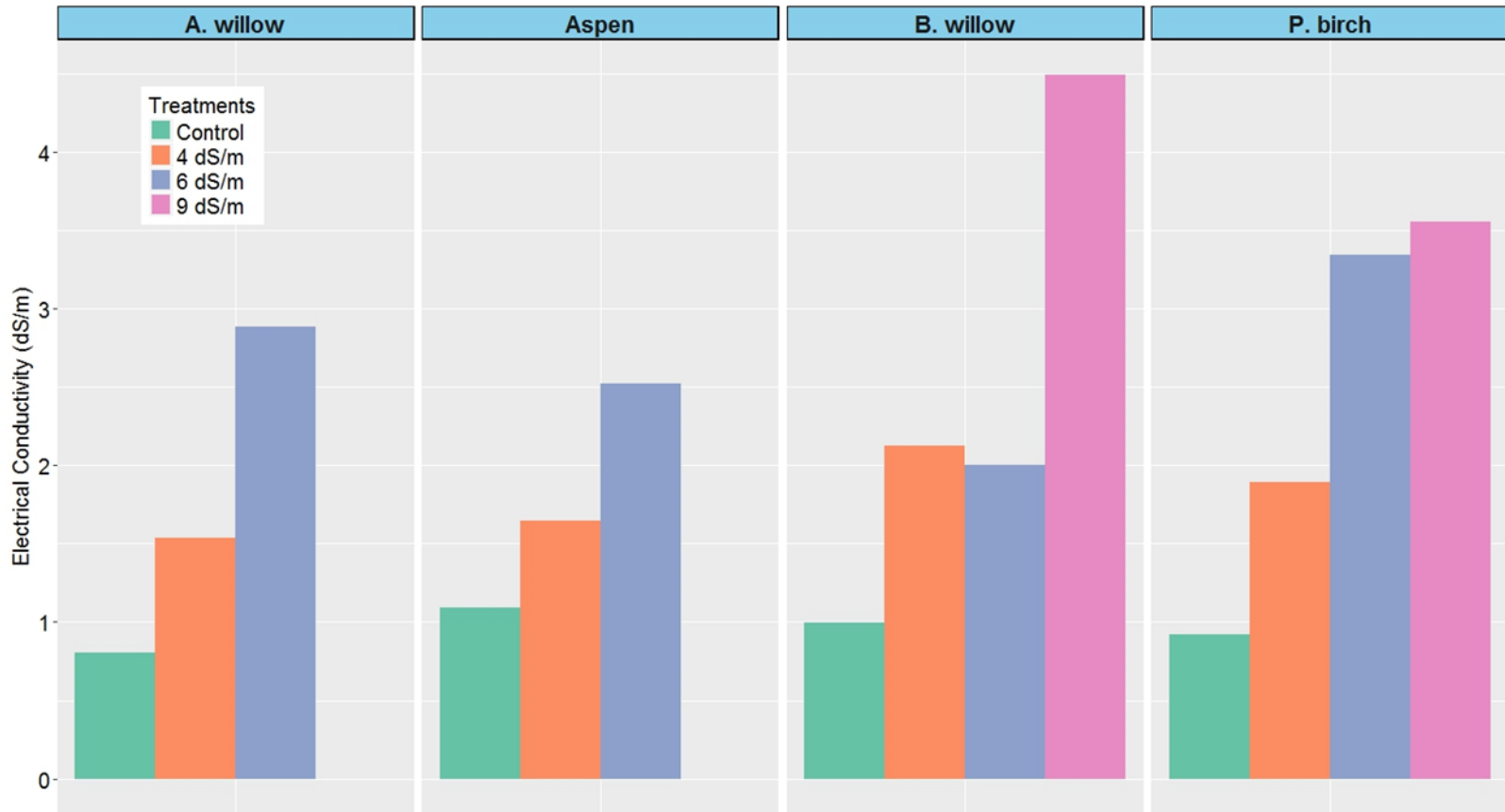


Early Establishment: Root-Shoot Ratio

Low root-shoot ratio for all species in all treatments



EC at the End of Experiment



Seedling Transplant - Mineral Saline Soil

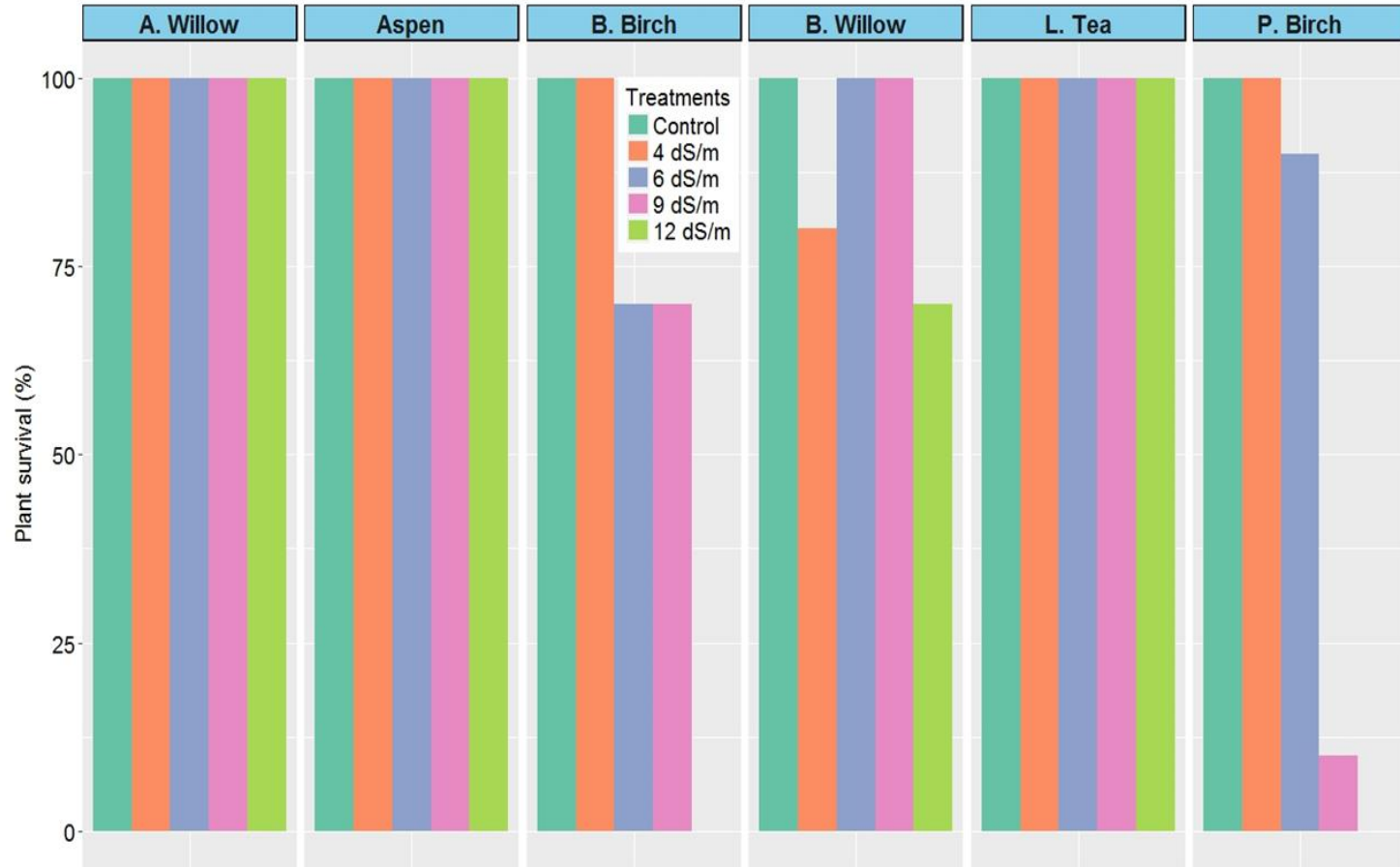


Survivorship of 5 Species

Plant were considered alive when they had a green stem.

Many plants on saline soils had death tops.

All species had survivors on soil with 9 dS/m or lower



Seedlings Performance



12 dS/m 9 dS/m 6 dS/m 4 dS/m control

Paper birch



N. control 4 dS/m 6 dS/m 9 dS/m 12 dS/m

Bog birch

Seedlings Performance



12 dS/m 9 dS/m 6 dS/m 4 dS/m . control

Bebb's willow



12 dS/m 9 dS/m 6 dS/m 4 dS/m . control

Autumn willow

Seedlings Performance



12 dS/m 9 dS/m 6 dS/m 4 dS/m . Control

Labrador Tea



N. control 4 dS/m 6 dS/m 9 dS/m 12 dS/m

Aspen

Root Development - Bog Birch



Nat control



4 dS/m



6 dS/m



9 dS/m



12 dS/m

Root Development - Labrador Tea



Nat control



4 ds/m



6 dS/m



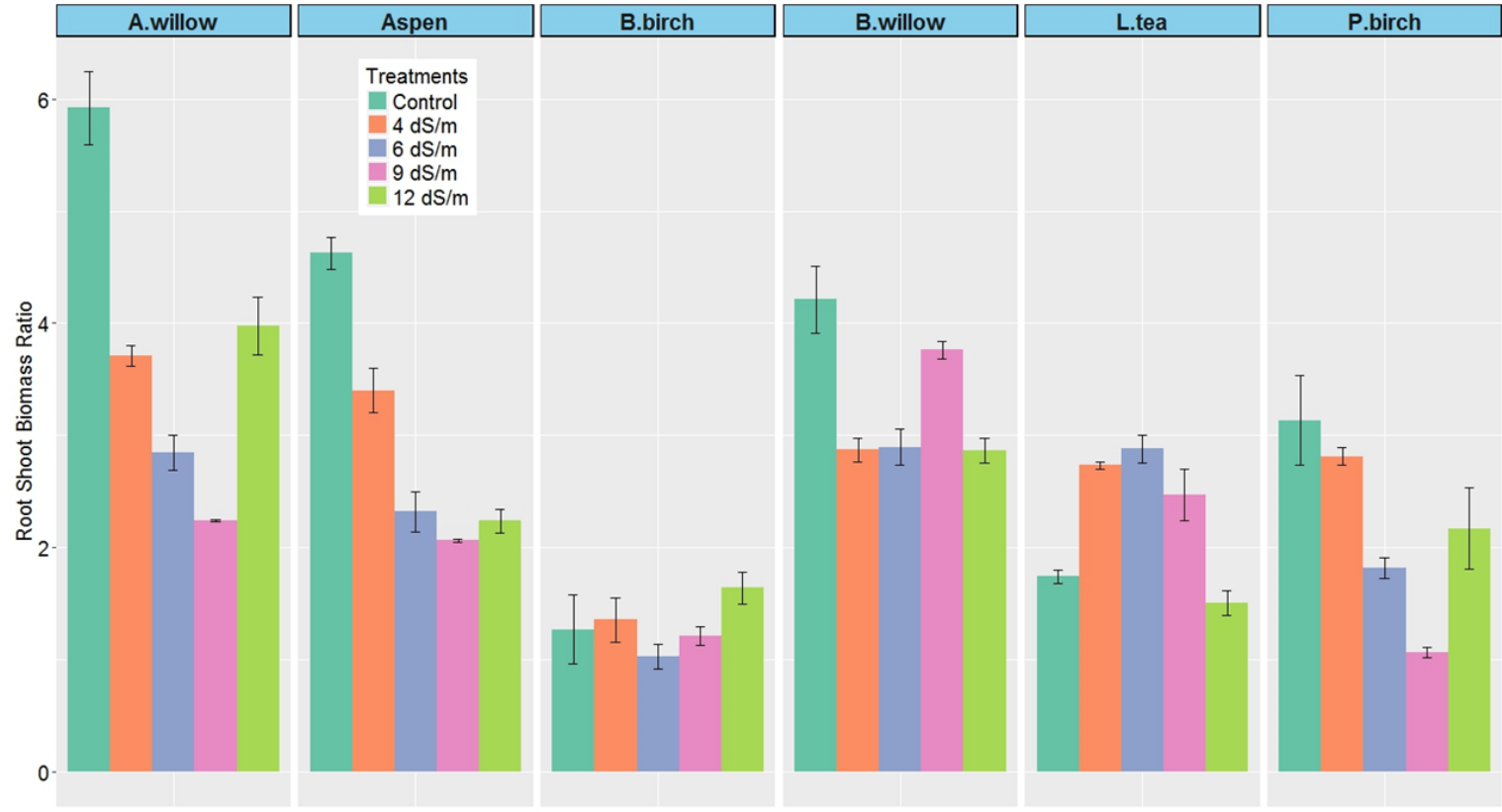
9 dS/m



12 dS/m

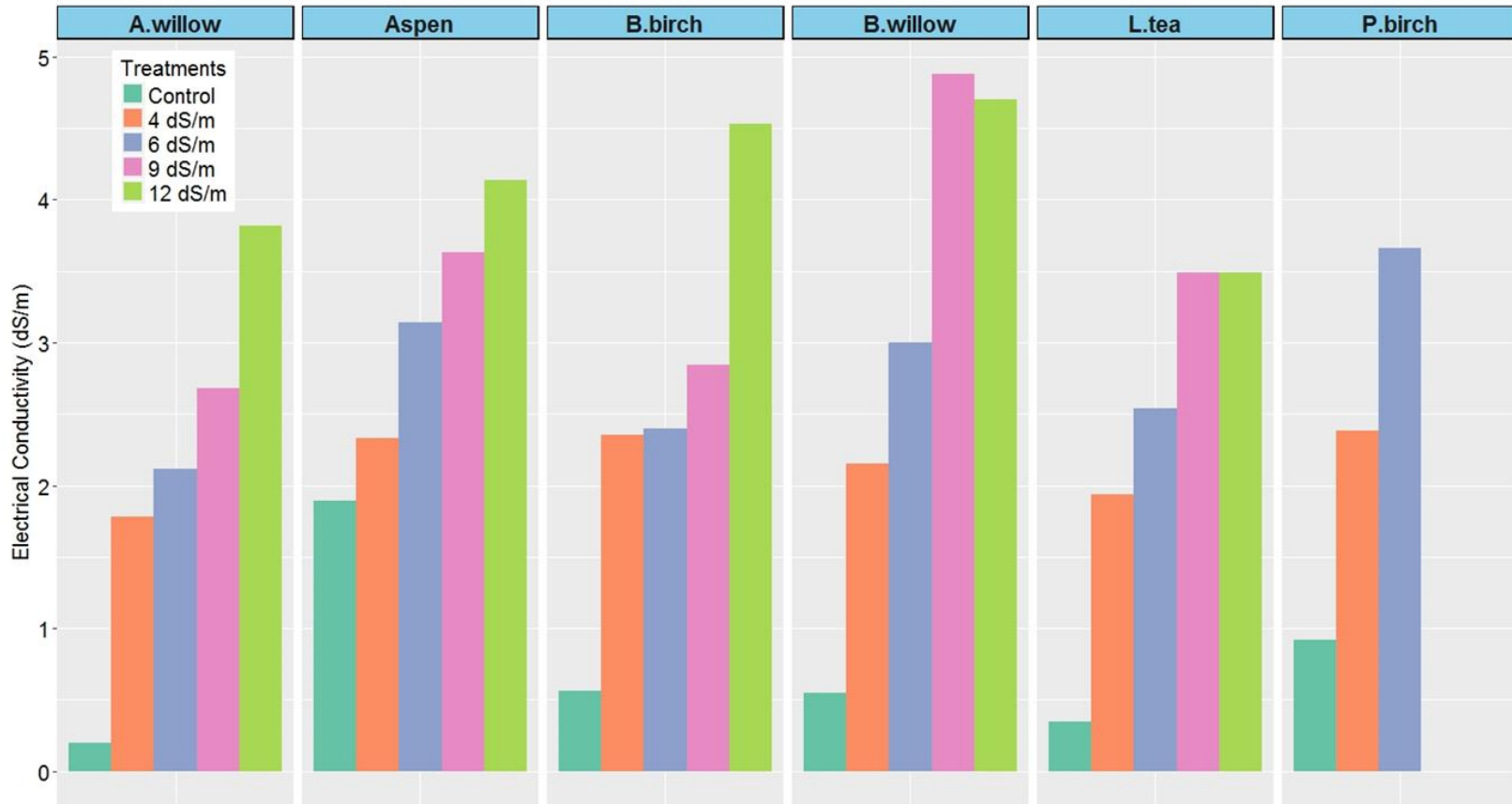
Root-Shoot Ratio

All species had good root-shoot ratio except of bog birch.



Final Soil Electrical Conductivity

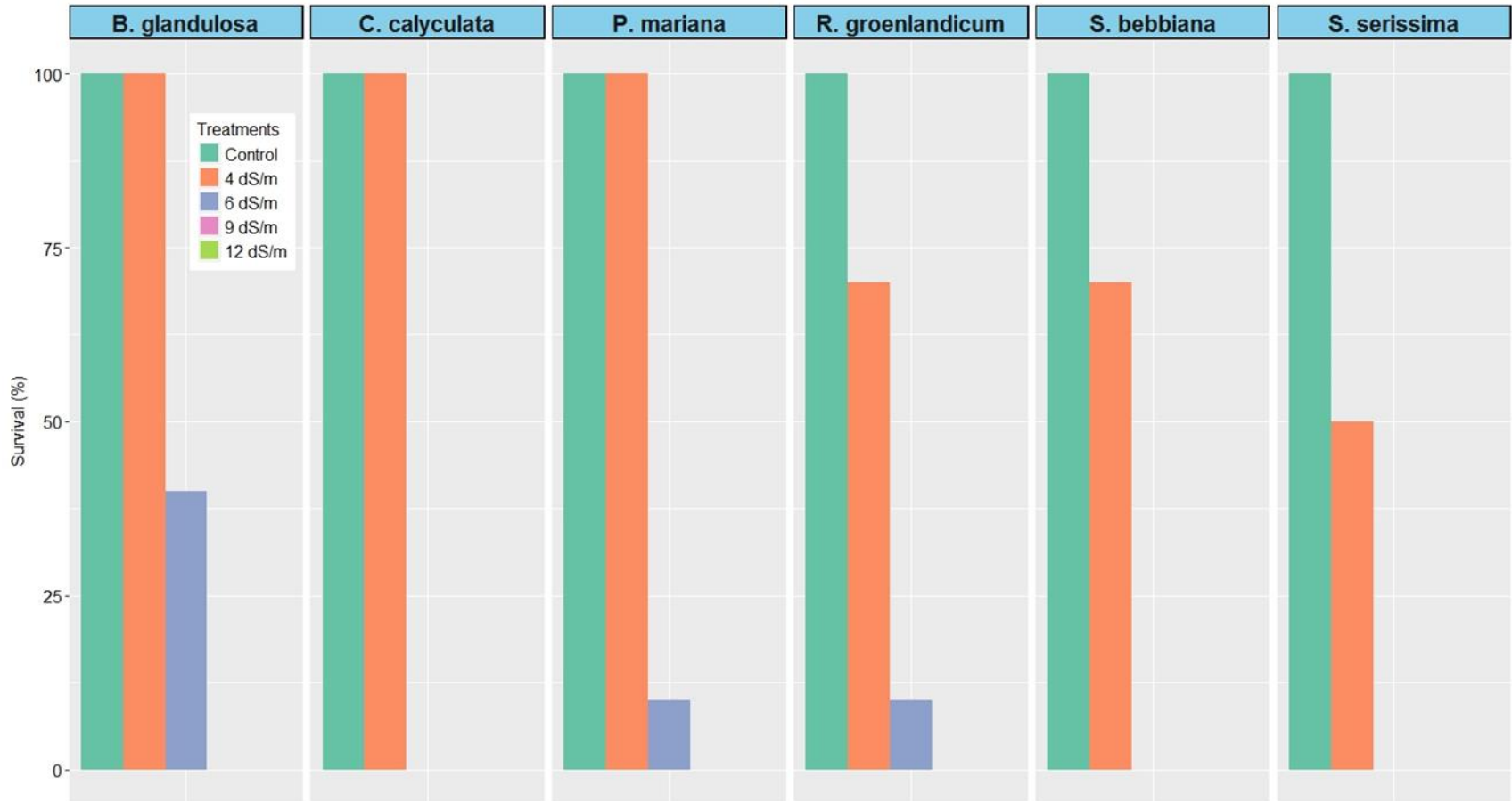
The Final soil salinity decreased in all treatments



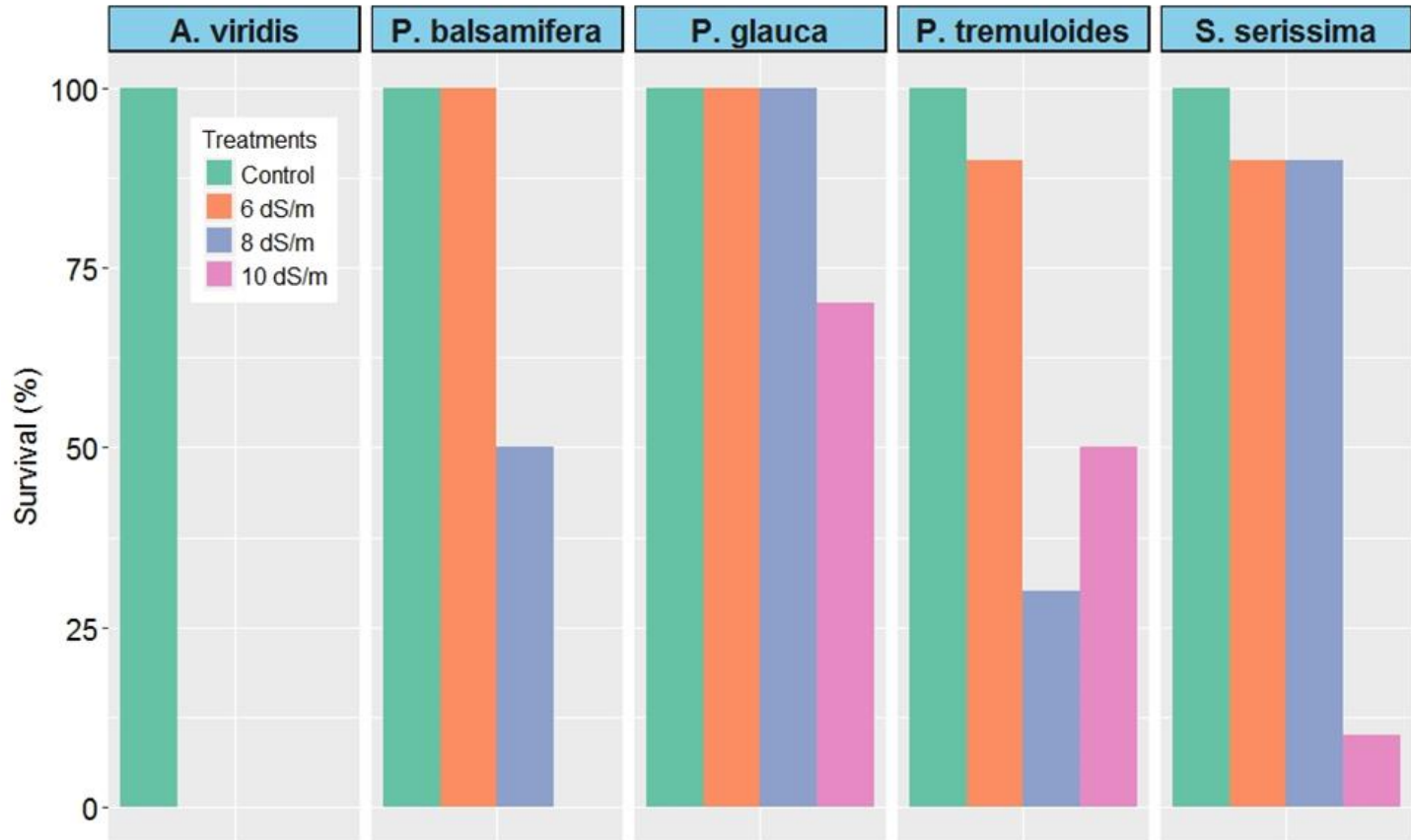
Salinity Tolerance of Dormant Seedlings

Transplant of peatland and upland species from cold storage

Survival of Peatland Species on Peat Medium (Cold Transplant)



Survival of Upland Species (Cold Transplant)



Amended Saline Soil

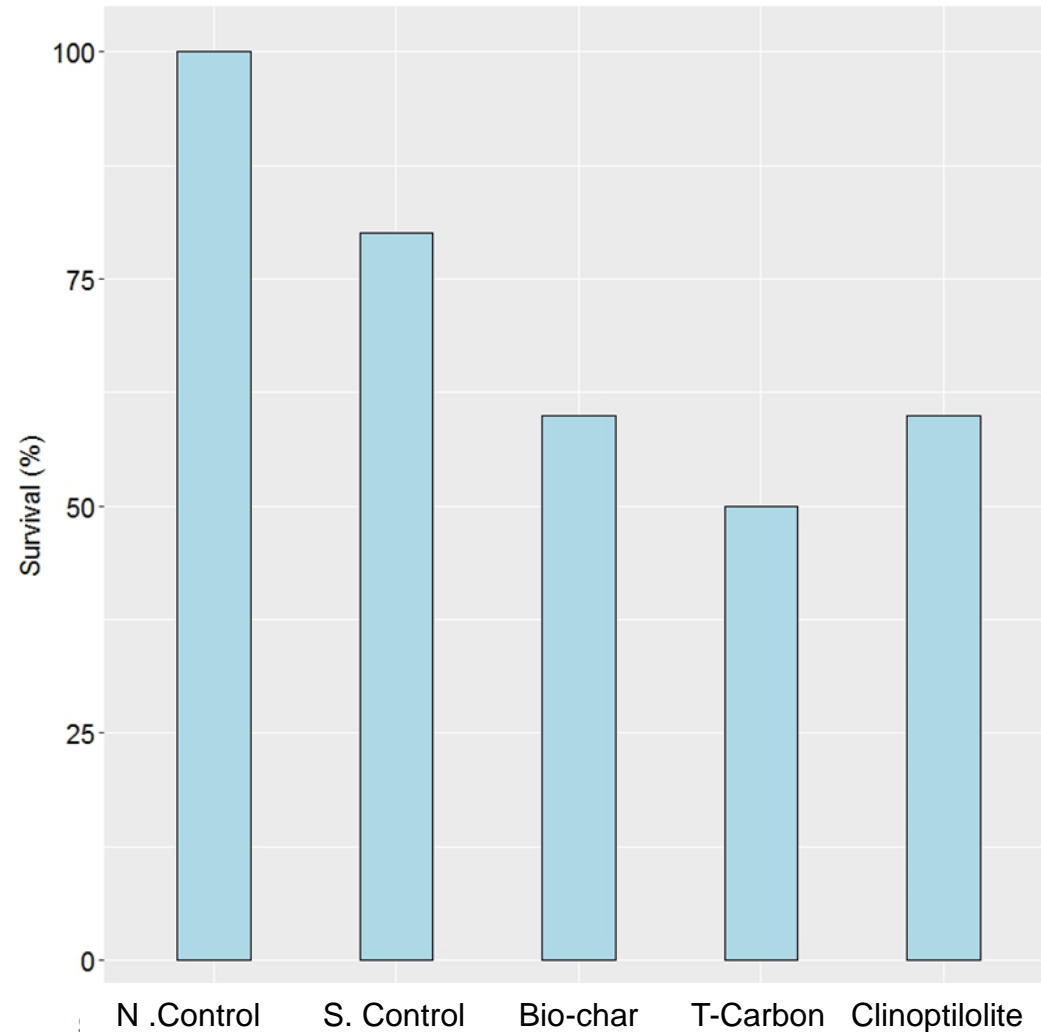
Soil Salinity: 9dS/m

Species: Aspen

Amendment:

- Clinoptilolite
- Bio-char
- T-Carbon (Char)

- Application rate: 10% by volume



Conclusion

- None of the species germinated and grew at 12dS/m.
- Bebb's willow performed better from seed than other species.
- The survivorship was higher from transplanted seedlings than from seeds.
- Paper birch and green alder were the least salinity tolerant species.
- Aspen seedlings showed better performance across all treatments than other species.
- Hot-transplanted seedlings performed better than the cold-planted ones.
- Soil amendment did not improve plant survival on saline soil.

Acknowledgement

Ryan O'Neill
Bhupesh Khadka



BRI research team



Summer students

ZMM[®] CANADA MINERALS CORP. 

