Managing Saline Areas with forages

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Risk for Soil Salinity in Prairie Landscapes According to Land Use in the 1996 Census

Risk Classes
- Low
- Moderate
- High
- Water
- Not Rated

Winnipeg
January, 1999
Is it Salinity?

- Saline soils
  - Normal pH,
  - High concentrations of soluble salts (NaCl, CaSO₄),
  - Forms salt when precipitates out of solution
  - Could be Na, K, Ca, Mg based.

- Sodic soils
  - Often called alkali or gumbo soils
  - High pH (>8.5)
  - High portions of sodium, not necessarily salt;
  - High concentrations of Na relative to Ca & Mg =

Structural problems – 4 D
Where are Saline soils?

- Areas where:
  - Water table within 2 meters of soil surface.
  - Excess ground water builds up in recharge area,
  - Groundwater is flows laterally,
  - Flow dissolves and transports soluble salts,
  - Water evaporates at discharge area.
Ground Water Flow and Soil Salinity

- Recharge Area:
  - Permeable Layer
  - Excess Water
  - Infiltration
  - Deep Percolation

- Lateral Water Movement

- Discharge Area:
  - Evapotranspiration

- Water Table

- Saline seep
  - Salt particles
Forage Placement for Reducing Saline Problems

Deep Rooted Perennial Forages

60-180 ft buffer strip, deep rooted, salt tolerant

Surface Drainage

Tile Drainage
Methodology for choosing forages

1. List forages adapted to your environment
2. Determine purpose of forage (yield, cover)
3. Cross reference use with adaptation
4. You’ll end up with a list of 1 to 4 species
Forage Adaptation

Seedbed Preparation
Increasingly, forage growers are successfully establishing forage stands without tillage. Benefits of zero-tillage forage establishment are:
- lower costs and labour
- better seedbed moisture conservation
- emerging crop is protected by standing stubble from drying-out and sandblasting.
If seeding into an existing forage stand:
- apply one litre per acre glyphosate to reduce competition
- apply fertilizer according to soil test recommendations
If conventional tillage practices are being used, prepare a fine, firm, shallow seed bed.

### Legumes

<table>
<thead>
<tr>
<th>Forage</th>
<th>Use</th>
<th>Longevity</th>
<th>Winter Hardiness</th>
<th>Drought Tolerance</th>
<th>Flooding Tolerance</th>
<th>Salinity Tolerance</th>
<th>Alkalinity Tolerance</th>
<th>Acidity Tolerance</th>
<th>Preferred Climate and Growing Conditions</th>
<th>Growth Period</th>
<th>Positive Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>Hay &amp; Pasture</td>
<td>Long</td>
<td>Good</td>
<td>Good</td>
<td>Low</td>
<td>Low to Moderate</td>
<td>Moderate to high</td>
<td>Low</td>
<td>Widely adapted to most Manitoba soils but will not tolerate areas that have periodic flooding.</td>
<td>Spring - Fall</td>
<td>Easy to establish. High yields. Rapid regrowth. Highest nutrition of all forages.</td>
</tr>
<tr>
<td>Alkali Clover</td>
<td>Hay &amp; Pasture</td>
<td>Short</td>
<td>Fair</td>
<td>Poor</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Prefers low-lying moist areas.</td>
<td>Spring</td>
<td>Easy to establish. Tolerant to poor drainage and acidic soils.</td>
</tr>
<tr>
<td>Birdsfoot Trefol</td>
<td>Pasture</td>
<td>Long</td>
<td>Good</td>
<td>Moderate</td>
<td>High</td>
<td>Low</td>
<td>Moderate to high</td>
<td>Moderate</td>
<td>Prefers moist areas.</td>
<td>Spring</td>
<td>Non bloating - resists seedling. Feed value similar to alfalfa.</td>
</tr>
<tr>
<td>Cicer Milicheli</td>
<td>Pasture</td>
<td>Long</td>
<td>Good</td>
<td>Moderate to High</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Widely adapted but exhibits its creeping habit best on more coarse textured soils.</td>
<td>Spring - Fall</td>
<td>Non bloating. Hardier than alfalfa. Very aggressive once established.</td>
</tr>
<tr>
<td>Red Clover</td>
<td>Hay &amp; Pasture</td>
<td>Short 2-3 years</td>
<td>Poor</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Best suited to humid areas with moderate temperatures.</td>
<td>Spring</td>
<td>Easy to establish. Tolerates wetter and more acidic soils than alfalfa.</td>
</tr>
<tr>
<td>Sainfoin</td>
<td>Pasture</td>
<td>Long</td>
<td>Fair</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Moderate</td>
<td>Best on brown and dark brown soil areas. Yields poorly in very dry areas. Grows well on thin grassy soils.</td>
<td>Spring - Summer</td>
<td>Non bloating. More drought and cold tolerant than alfalfa.</td>
</tr>
<tr>
<td>Sweet Clover</td>
<td>Hay &amp; Pasture</td>
<td>2 years</td>
<td>Good</td>
<td>Moderate to High</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Especially productive on well-drained fertile soils.</td>
<td>Spring of second year</td>
<td>Widely adapted. Good for soil drainage improvement.</td>
</tr>
<tr>
<td>White Clover</td>
<td>Pasture</td>
<td>Short to long</td>
<td>Good</td>
<td>Poor</td>
<td>Low to Moderate</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Prefers well drained silt loams to clay soils that have a constant supply of moisture.</td>
<td>Spring - Fall</td>
<td>Will reseed. Resistant to grazing with good regrowth. Excellent quality, especially during mid-summer heat.</td>
</tr>
</tbody>
</table>

### Tame Grasses

<table>
<thead>
<tr>
<th>Forage</th>
<th>Use</th>
<th>Longevity</th>
<th>Winter Hardiness</th>
<th>Drought Tolerance</th>
<th>Flooding Tolerance</th>
<th>Salinity Tolerance</th>
<th>Alkalinity Tolerance</th>
<th>Acidity Tolerance</th>
<th>Preferred Climate and Growing Conditions</th>
<th>Growth Period</th>
<th>Positive Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altai Wild Ryegrass</td>
<td>Pasture</td>
<td>Long</td>
<td>Excellent</td>
<td>High</td>
<td>Low</td>
<td>Very High</td>
<td>Moderate to high</td>
<td>Low</td>
<td>Grasses best on soils of medium to high fertility and grasses best with adequate moisture.</td>
<td>Early Spring - Mid Summer</td>
<td>Retains nutritional value late into fall/winter. Suitable for extended grazing season. Sustained growth.</td>
</tr>
<tr>
<td>Creeping Foxtail</td>
<td>Pasture</td>
<td>Long</td>
<td>Good</td>
<td>Low</td>
<td>High</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Adapted to areas where canary grass grows well and soil moisture is continually available.</td>
<td>Early Spring - Fall</td>
<td>Spreads rapidly once it is established. Suitable for erosion control.</td>
</tr>
<tr>
<td>Creeping Red Fescue</td>
<td>Pasture &amp; Lawn</td>
<td>Long</td>
<td>Excellent</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Does best in high rainfall areas. Will grow in wide range of soil types.</td>
<td>Spring - Fall</td>
<td>Tolerates close grazing. Grows well late summer to freeze up and retains quality.</td>
</tr>
<tr>
<td>Crested Wheatgrass</td>
<td>Hay &amp; Pasture</td>
<td>Long</td>
<td>Excellent</td>
<td>Moderate to High</td>
<td>Low</td>
<td>Low</td>
<td>Moderate to high</td>
<td>Low</td>
<td>Adapted to dry areas with good soils but will also establish on lighter grass.</td>
<td>Early Spring</td>
<td>Tolerates close grazing and trampling.</td>
</tr>
<tr>
<td>Dahurian Wild Ryegrass</td>
<td>Pasture</td>
<td>Short</td>
<td>Good</td>
<td>Moderate</td>
<td>High</td>
<td>Low</td>
<td>Moderate</td>
<td>Low</td>
<td>Adapted to all soil zones.</td>
<td>Spring - Fall</td>
<td>Highly competitive and quick to establish.</td>
</tr>
<tr>
<td>Intermediate Wheatgrass</td>
<td>Hay &amp; Pasture</td>
<td>Short to Medium</td>
<td>Good</td>
<td>Moderate to High</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>A wide range of soils that are well drained with ample moisture.</td>
<td>Late Spring - Mid Summer</td>
<td>Easy to establish. Good hay grass with alfalfa. Cut yields of Crested WG &amp; Smooth Bromegrass.</td>
</tr>
<tr>
<td>Kentucky Blue Grass</td>
<td>Hay &amp; Pasture &amp; Lawn</td>
<td>Long</td>
<td>Excellent</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
<td>Moderate</td>
<td>Low</td>
<td>Grows in most soils.</td>
<td>Spring - Fall</td>
<td>Tolerates close and frequent defoliation. Useful in erosion control.</td>
</tr>
<tr>
<td>Meadow Grass</td>
<td>Hay &amp; Pasture</td>
<td>Long</td>
<td>Good</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Grows well on most soils where Smooth Bromegrass does well.</td>
<td>Early Spring - Late Summer</td>
<td>Very palatable. Good regrowth after grazing or cutting.</td>
</tr>
</tbody>
</table>

### Seeding

Seeded shallow (1/4 to 1 inch) into a firm seed bed. Seed at 1/4 inch for small seeded forage such as timothy, on heavy soils. Seed up to 1 inch for larger seeded forages such as intermediate wheatgrass, or alfalfa on lighter soils.

### Spring Seeding

The best time to seed forages is in the early spring, as soon as field conditions permit. The cool, moist conditions of early spring are most favourable for germination and growth of both grasses and legumes. The moist conditions also allow a shallow seeding depth, which is very important for quick establishment of the forage crop.

### Summer Seeding

If there is adequate moisture, forages can be seeded from late July to mid-August. During this period, grasses experience a higher rate of success. Legumes require a longer growing period to ensure winter survival, therefore, summer seeding is not recommended.

### Dormant

Use dormant (conventional seeding). Dormant seeding is done when the grass will germinate if seeded in the summer. Dormant seeding is used in areas where the temperatures are colder over the winter.

### Cover Crops

Cover crops are often used for their ability to reduce erosion, especially if established as green feed to provide a small yield.
### Relative Tolerance of Crops and Weeds to Salt

dS/m = deciSiemens / meter

<table>
<thead>
<tr>
<th>Salt Tolerance Level (dS/m)</th>
<th>Forages</th>
<th>Speed of Forage Establishment</th>
<th>Weed/Crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High (&gt;16)</td>
<td>Tall Wheatgrass</td>
<td>Slow</td>
<td>Red Samphire Sea Blight</td>
</tr>
<tr>
<td></td>
<td>Beardless Wild-rye</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>High (16)</td>
<td>Slender Wheatgrass</td>
<td>Fast</td>
<td>Kochia Foxtail Barley Russian Thistle</td>
</tr>
<tr>
<td></td>
<td>Alai Wild-rye</td>
<td>Slow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Russian Wild-rye</td>
<td>Slow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Western Wheatgrass</td>
<td>Slow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tall Fescue</td>
<td>Fast</td>
<td></td>
</tr>
<tr>
<td>Moderate (8)</td>
<td>Alfalfa</td>
<td>Fast</td>
<td>Barley Wheat</td>
</tr>
<tr>
<td></td>
<td>Sweetclover</td>
<td>Medium</td>
<td>Fall Rye Oats</td>
</tr>
<tr>
<td></td>
<td>Birdsfoot Trefoil</td>
<td>Slow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bromegrass</td>
<td>Slow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meadow Fescue</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crested WG</td>
<td>Fast</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intermediate WG</td>
<td>Fast</td>
<td></td>
</tr>
<tr>
<td>Low Tolerance (4)</td>
<td>Timothy</td>
<td>Fast</td>
<td>Canola Soybeans</td>
</tr>
<tr>
<td></td>
<td>Alsike Clover</td>
<td>Fast</td>
<td>Beans</td>
</tr>
<tr>
<td></td>
<td>Red Clover</td>
<td>Fast</td>
<td>Corn</td>
</tr>
<tr>
<td></td>
<td>White Clover</td>
<td>Fast</td>
<td>Flax, Peas, SF</td>
</tr>
</tbody>
</table>
CMCDC – Winkler site, June 11, 2008

- potatoes (just over 50% emergence)
- alfalfa (just emerging)
- corn (4 leaf)
- beans (1st trifoliolate)
- barley (3-4 leaf)
- sunflowers (2nd leaf)
- canola (2 leaf)
**Seeding:** 2009 direct spring seeding with Bourgault coulter drill  
**Weed Control:** fall glyphosate (2008)  
**Crop:** Barley  
**Soil:** very saline  
**Result:** poor catch b/c of wet conditions
New varieties

• **Green Wheatgrass** (*Elymus hoffmannii*)
  - Origin: Turkey
  - Salt tolerant, palatable & some rhizomes

• AC Saltlander (SPARC):
  - Invasive??
  - Downy Brome?

• **NewHy**
  - Quackgrass x Bluebunch
  - \([Elytrigia repens \times Pseudoroegneria sp]\)
  - Agricultural Research Service Laboratory, Utah.

Not seeded  AC Saltlander
## Perennial Forages For Saline, Flooded and Peat Soils

<table>
<thead>
<tr>
<th>Forage Variety</th>
<th>Occurrence of visible surface salts (salinity rating) 1</th>
<th>Tolerates Flooding 2-5 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Almost Always</td>
<td>Frequently</td>
</tr>
<tr>
<td>Green WG (AC Salt)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tall Wheatgrass</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hybrid WG (NewHy)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Russian Wild Rye</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Slender WG</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Intermediate WG</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Tall fescue</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Smooth Bromegrass</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Awned Wheatgrass</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Creeping Foxtail</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Northern WG</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Western WG</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Orchard Grass</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Alfalfa</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Timothy</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

(Based on Test Results from Canada Salt Tolerance Lab, Swift Current)
Establishing A Saline Stand

- Establish when land can still support barley
- Seed early spring if possible (April-early May)
  - Cool, moist conditions are an advantage
- Seed shallow (1/2” to 3/4”)
- Double seeding rates.
- Control perennial weeds prior to seeding
- Seed bed free of clods
- Consider “top up” seeding in existing stands
  - Some success
Establishing A Saline Stand

• Don’t use mixes geared designed for yield
• Staples: TF, SWG, TWG,
  – Add others based on price/availability.
  – Alfalfa establishes on fringes - contains the area.
    • Increased leaf:stem
  – Native grasses used when price low and available.
    • (Green Needle Grass, Big Blue Stem, Little Blue Stem – moderately tolerant, and longer lived.
• Moisture & weed control more influential than tillage.

• Production is always reduced, even with tolerant species.
  – Expect delayed emergence and maturity
Always plant a mix

- **Hay**
  - 5 lb tall WG, 5 lb slender WG, 3 lb alfalfa, 3 lb/ac sweet clover
  - 5 lb tall fescue, 3 lb alfalfa, 3 lb sweet clover

- **Pasture**
  - 4 lb creeping foxtail, 2 lbc slender WG,
  - 2 lb alfalfa, 2 lb sweet clover, 2 lb birdsfoot trefoil
  - 4 lb tall fescue, 2 lb slender WG, 2 lb creeping foxtail,
  - 1 lb/ac alfalfa, 2 lb sweet clover, 1 lb/ac birdsfoot trefoil
**Seeding**: 2008 direct spring seed, old native hay, Haybuster – no till.

**Weed Control**: none

**Crop**: Ducks Unlimited Mix

**Soil**: 3.46 EC (dS/m)

**Result**: poor catch

Excess moisture Jun/Jul/Aug/Sept 2008

DU Mix – 11 lb/ac
42% tall WG,
10% slender WG,
25% TF,
11% S. Clover,
12% alfalfa
Seeding: 2008 spring tillage, broadcast, harrowed.
Weed Control: none
Crop: Ducks Unlimited Mix
Soil: 3.54 EC (dS/m)
Result: excellent catch
Excess moisture Jun/Jul/Aug/Sept 2008

DU Mix – 11 lb/ac
42% tall WG,
10% slender WG,
25% TF,
11% S. Clover,
12% alfalfa
Summary

1. Reduce summer fallow to reduce evaporation
2. Improve drainage
   • lower the water table; promote leaching of salts
3. Seed high moisture using forages in recharge areas.
4. Seed salt tolerant forages in discharge areas.
   • Note: Crops will not root into the water table.
5. Use manure & crop residues to add SOM.
   • SOM won’t cure salinity - it improves water infiltration, water holding capacity and tilth of the soil.
   • Apply 20-30 tons/acre of solid manure every 3-4 years.
6. Deep tillage??
   – Not in saline soils. Consider zero till.
     • can bring salts to the surface.
   – May improve sodic soils
     • break up hardpan, improve infiltration, Conduct field investigation first.

7. Seed early and shallow.
   – Crop tolerance to salinity is influenced by stage of growth.

8. Use recommended fertilizers.
Relative salt index for several fertilizers.

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>Salt index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium nitrate</td>
<td>100</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>116</td>
</tr>
<tr>
<td>Ammonium nitrate</td>
<td>105</td>
</tr>
<tr>
<td>Urea</td>
<td>75</td>
</tr>
<tr>
<td>Potassium nitrate</td>
<td>74</td>
</tr>
<tr>
<td>Ammonium sulfate</td>
<td>69</td>
</tr>
<tr>
<td>Calcium nitrate</td>
<td>53</td>
</tr>
<tr>
<td>Magnesium sulfate</td>
<td>44</td>
</tr>
<tr>
<td>Diammonium phosphate</td>
<td>34</td>
</tr>
<tr>
<td>Concentrated superphosphate</td>
<td>10</td>
</tr>
<tr>
<td>Gypsum</td>
<td>5</td>
</tr>
</tbody>
</table>

http://aggie-horticulture.tamu.edu/GREENHOUSE/NURSERY/guides/ghhdbk/salts.html

Texas A&M University
9. There are no quick fixes (chemicals, soil conditioners, etc).
Thank-you

• References
  • https://extension.usu.edu/files/publications/publication/AG-SO-03.pdf
  • http://www.gov.mb.ca/agriculture/soilwater/soilmgmt/fsm01s00.html