



Abstract

Coal bed methane extraction produces a by-product wastewater, a usable water source. This could be useful in areas where water availability is low. The objective of this project is to determine survivability and plant biomass of forage species irrigated with saline waters. Screening for salt tolerant forage species would allow more extensive use of saline water supplies. A germination screening was conducted to determine survivability and early plant biomass of sixteen different forage species. These species were irrigated with water qualities that were chosen to represent conditions of water surface supplies that could result from coal bed methane development (saline-sodic water). A short list was determined based on survivability and biomass. Selected plant species were placed in a field scale demo. These forage species are flood irrigated with saline water supplies. With the selected forage species from this project and methods which coal bed methane water can be used in conjunction with management practices, the impact of coal bed methane (CBM) water can be minimized. This could result in an enhanced growing condition for forage production.

Research Objectives

- Determine survivability and early plant biomass production sixteen different forage species
- Irrigate with water qualities that were chosen to represent conditions of water surface supplies that could result from coal bed methane (CBM) development.
- Define a short list of species that are in a long-term experiment to assess (forage) biomass production potential utilizing CBM x surface water mixes
- Field scale demo

Methods Phase I:

- 3 replication randomized block design, each replication received one of the three water treatments and sixteen forage species.
- Water treatments were applied for five day intervals, discarded and replaced with a new 100L stock solution.
- Water reached a predetermined level during each irrigation cycle
- Each 100 L stock solution contained 500 mL of nutrients.
- Harvest was conducted after a 5 week period.
- Planting medium was sand.

Methods Phase II:

- 3 replication randomized block design, each pot within a replication received one of the two water treatments (CBM, saline-sodic), and eight forage species.
- Pot within a pot (outside pot filled with gravel and covered with weed barrier).
- Planting medium was sand.

- 8 pot within a pot, each contained one of the 8 forage species.

- Irrigated with saline-sodic water.
- Planting medium was clay.

- Harvest was conducted after a five month grow out.

Methods Phase III:

- Field scale demonstration
- Selected forage species that displayed tolerance to saline-sodic water in phase I, and phase II.

Field plots:

Hayes Ranch, flood irrigation from Tongue River in Birney, Montana
 Gay Ranch, flood irrigated from Powder River in Broadus, Montana
 Horticulture Farm Montana State University, flood irrigated with simulated CBM water.

Water Treatments (simulated)	EC (Electrical conductivity)	SAR (sodium adsorption ratio)
Powder River Water	EC 2.5 mmhos/cm	SAR 4
CBM Discharge Water	EC 3.5 mmhos/cm	SAR 12
Saline-sodic Water	EC 8 mmhos/cm	SAR 23

Phase I:

Species Used in Screening for Salt Tolerance:

- | | |
|--------------------------|---|
| •Corn | <i>Zea mays</i> |
| •Altai | <i>Elymus angustus</i> |
| •Tall Wheatgrass | <i>Agropyron elongatum</i> |
| •Crested Wheatgrass | <i>Agropyron cristatum</i> |
| •Kochia | <i>Kochia scorparia</i> |
| •Sorghum | <i>Bicolor (L.) moench</i> |
| •Intermediate Wheatgrass | <i>Agropyron intermedium</i> |
| •Newly Wheatgrass | <i>Elyrtigia repens x Pseudoroegneria spicata</i> |
| •Tall Fescue | <i>Festuca arundinacea</i> |
| •Palute Orchardgrass | <i>Dactylis glomerata L.</i> |
| •Slender Wheatgrass | <i>Agropyron trachycaulum</i> |
| •Perennial Ryegrass | <i>Lolium perennal</i> |
| •Valier | <i>Hordeum valier</i> |
| •Sugarbeets | <i>Beta vulgaris L.</i> |
| •Hi Mag Tall Fescue | <i>Festuca arundinacea hi mag</i> |
| •2nd Gen. Alfalfa | <i>Medicago sativa</i> |

Analyses

- Post germination soil analyzed for electrical conductivity (salinity), SAR (sodium adsorption ratio), base cations (Na, Ca, and Mg), pH, bicarbonates
- Species x water quality combination determined
- Determined germination and survivability

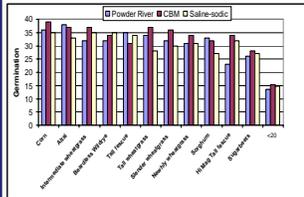


Figure 1. Germination of sixteen forage species

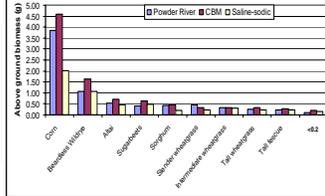


Figure 2. Above ground biomass of sixteen forage species

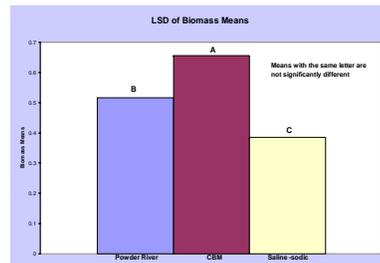


Figure 3. LSD of germination x water treatment

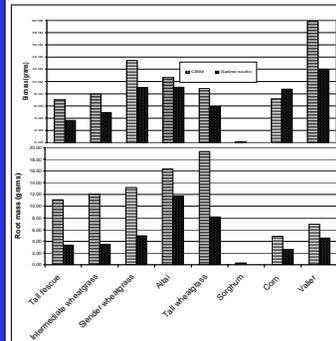
Phase II:

Species Used for "The Short List": Phase II

- | | |
|-------------------------|-------------------------------|
| Corn | <i>Zea mays</i> |
| Tall fescue | <i>Festuca arundinacea</i> |
| Intermediate wheatgrass | <i>Agropyron intermedium</i> |
| Slender wheatgrass | <i>Agropyron trachycaulum</i> |
| Altai wildrye | <i>Elymus angustus</i> |
| Tall wheatgrass | <i>Agropyron elongatum</i> |
| Valier barley | <i>Hordeum valier</i> |
| Sorghum | <i>Bicolor (L.) moench</i> |

Analyses

- Post germination soil analyzed for electrical conductivity (salinity), SAR (sodium adsorption ratio), base cations (Na, Ca, and Mg), pH, and bicarbonates
- Species x water quality combination determined
- Determined germination and survivability
- Plant tissue analyses



Figures 4 & 5. Above ground biomass and root mass of species grown in sand irrigated with CBM and saline-sodic water treatments

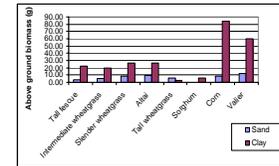


Figure 6. Above ground biomass of species grown in sand and above ground biomass of species grown in clay, both irrigated with saline-sodic water treatments

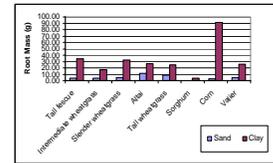


Figure 7. Root mass of species grown in sand and root mass of species grown in clay, both irrigated with saline-sodic water treatments

Phase III:

Species for Field Scale Demonstration: Phase III

- | | |
|----------------------------|-------------------------------|
| Corn | <i>Zea mays</i> |
| Tall fescue | <i>Festuca arundinacea</i> |
| Intermediate wheatgrass | <i>Agropyron intermedium</i> |
| Slender wheatgrass | <i>Agropyron trachycaulum</i> |
| Altai wildrye | <i>Elymus angustus</i> |
| Tall wheatgrass | <i>Agropyron elongatum</i> |
| Valier barley | <i>Hordeum valier</i> |
| Harrington barley | <i>Hordeum harrington</i> |
| Maritime (seacoast) barley | |
| Hays barley | MT 981060 |
| Saltbush | <i>Atriplex aptera</i> |

Demonstration at Montana State Horticulture Farm (experimental design)



Hayes Ranch: Plot on Tongue River



Gay Ranch: Plot on the Powder River

