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Evaluating constructed wetlands for beneficial use of saline-sodic water

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Abstract Text:

Changes in agricultural practices, and irrigation strategies combined with natural processes, have led to increased salinization of soil and water resources worldwide. Coal bed methane (CBM) development in the Powder River Basin of Montana and Wyoming results in the co-production of large volumes of sodic and moderately saline discharge water, and represents a potential source of salinization of soil and water resources.

Study objective was evaluation of constructed wetlands as a tool for CBM product water management. This was accomplished by assessing seasonal water use, biomass production and water use efficiencies (WUE) of three plant communities. Native species establish hydrologically distinct communities in former ephemeral channels now running with CBM product water, and nine species of those cataloged were selected and segregated into three communities. Closed-system wetland cells were constructed and each community was assigned to four of these cells, i.e., lysimeters. Chemistry of the supply water was sodic and moderately saline, typical of northern portions of the Powder River Basin where low to moderate electrical conductivities and high sodium adsorption ratios are common.

Plant community dynamics have been the most interesting aspect of this study. Establishment was very good for seven of the nine species, but over the course of the study we have seem a marked change in community composition. American bulrush and Common cattail had very sparse growth in year one but have not come back at all in subsequent years. Although Inland saltgrass was conspicuously absent during the first three years of the study, in year four it has exhibited surprisingly vigorous growth – perhaps salinity levels have become sufficiently elevated. Canada Wildrye, Streambank wheatgrass and Creeping spikerush had robust growth in the first two years but growth was hampered in year three and no growth has been observed in year four. Again, this may be a function of elevated salinity and/or sodicity. Prairie cordgrass established quickly and has exhibited vigorous growth each year of the study. Maritime bulrush had a hard time getting established but by year three was doing quite well and is one of the only plants to come back in year four.

Results indicate that constructed wetlands planted with native, salt tolerant species have potential to utilize substantial volumes of CBM product water while remaining robust and viable. However, care must be taken in species selection as some are good colonizers, some make better long-term residents and others will remain dormant until salinity and/or sodicity levels become elevated. Observed increases in soil SAR could be the result of preferential plant uptake of Ca and Mg ions and/or little to no water infiltrating into the soil profile, while increases in soil EC could be due to evapoconcentration of salts (especially sodium) on soil surface. i.e. more water evaporating than infiltrating through. Evapoconcentration of salts could lead to adverse soil salinity and sodicity conditions with respect to long-term impoundment, viability and reclamation with high clay content soils being more susceptible than non-clay soils to degradation of physical properties when seasonally irrigated with saline-sodic water.

Impact Statement:

Constructed wetlands composed of native halophytic or salt tolerant plant species have potential to utilize saline-sodic water while remaining viable. However, evapoconcentration of salts could lead to adverse

soil salinity and sodicity conditions with respect to long-term impoundment, viability and reclamation, especially in high clay content soils.