KIKA DE LA GARZA PLANT MATERIALS CENTER
3409 NORTH FM 1355 KINGSVILLE, TEXAS 78363
PHONE/FAX: 361-595-1313

September 12, 2007

Zapata County
Soil & Water Conservation District
1825 Stop 18B
Zapata, Texas 78076

Enclosed is a progress report on the work we have done so far to address revegetation of saline impacted sites in Zapata County.

If you have any questions concerning the progress report, the study approach, or any other item of concern, please get back to me.

Sincerely,

John Lloyd-Reilley
Manager

enc: July 2007 Progress Report

USDA NRCS

E. “Kika” de la Garza Plant Materials Center

Saline Revegetation Trials
Zapata County

Progress Report
July 2007

We conducted a salinity workshop in July of 2006 with about 20 people in attendance from both NRCS and SWCD (Attachment A - Meeting Agenda) . In 2006, our graduate student, LeeRoy Rock, presented results from our research. He presented a poster in San Antonio titled “Erosion Control/ Water Quality Improvement on Saline Agricultural land” (Attachment B – Poster). He also gave an oral presentation in December of 2006 at the 4th International Symposium on Seed Transplants and Stand Establishment of Horticultural Crops entitled “Screening South Texas Native Plant Seedlings for Salinity Tolerance” (Attachment C & D – Talk Abstract). Updates on the project were submitted for inclusion in the 2005-2006 edition of Caesar Kleberg Wildlife Research Institute’s *Current Research* (Attachments E, F,& G).

We have finished both the seed germination and seedling evaluations. LeeRoy is now statistically analyzing the data and should have results soon.

We established a field salinity monitor on the Jose Dodier Ranch (Attachment H – Pictures of Monitoring Site). We will continue to take data at this site for another two years in order to establish a salinity seasonal profile.

We seeded four field sites in Zapata County in the fall of 2006. The seed mixture was bristlegrass, windmillgrass, big sacaton, and coated Arizona cottontop and two-flowered trichloris. The field sites had spotty establishment. Some areas looked very good (likely due to better soil types) but overall you could not call it successful. We will continue to monitor these sites for establishment and spread.

Additional work planned under this project is a big sacaton hedge to be planted in the fall of 2007.

Attachment A – Meeting Agenda

Salinity Workshop

Thursday (7/20/2006)

Sources and Causes (Ramiro/Dunn)	9:00-10:00 am
Inventory and Assessment (Ramiro/Dunn)	10:00-10:30 am
Break	10:30-10:45 am
Survey and Monitoring - Dataloggers (Nelson)	10:45-12:30 am
Lunch	
Survey and Monitoring – EM-38 (Morgan)	1:00- 3:30 pm

Friday (7/21/2006)

Survey and Monitoring – EM-38 –continued	9:00-12:00 am
Lunch	12:00- 1:00 pm
Management & Remediation (Moore/Reilley)	1:00- 3:00 pm

Erosion Control/Water Quality Improvement on Saline Agricultural Land (Saline Site Revegetation Trials)

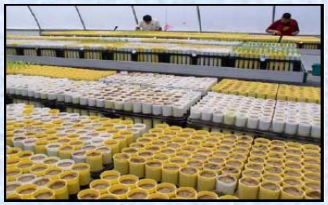
LeeRoy Rock*, Shad D. Nelson, and John L. Reilley

Texas A&M Univ.-Kingsville, USDA-NRCS "Kika" de la Garza Plant Materials Center

3409 N. FM 1355, Kingsville, Texas 78363, lrock454@hotmail.com; shad.nelson@tamuk.edu

OBJECTIVES

In order to solve erosion problems and increase the productivity on saline impact range sited in Zapata County and other areas in the South Texas region, it is critical to know the tolerance of plant species to varying levels of salt. This assessment is necessary for seed germination and at the young seedlings stage

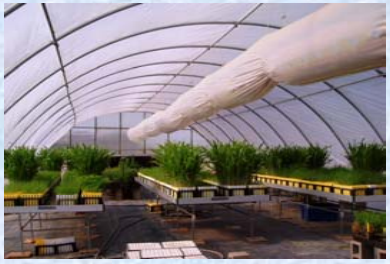


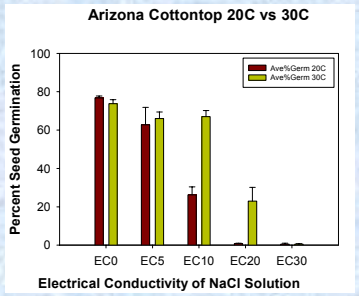
ABSTRACT

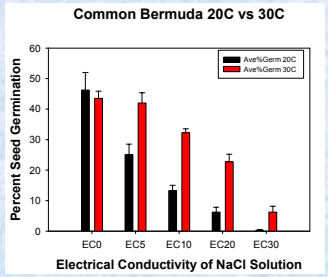
An estimated 600 thousand acres of South Texas are affected by alkaline and saline soil conditions. Natural mineralization, but mostly past oilfield activity, has been a culprit to the increase in soil salinity. High soil salt concentrations lead to the depletion of vegetated areas, especially if the ratio of Na ions exceeds other minerals found in the soil. The loss of vegetation exposes the soil to erosion thus, soil structure and fertility deteriorates over time. Therefore, establishment of vegetation in saline sites by direct seeding of saline sites poses a challenge. The high concentration of dissolved salt in the soils, in particular Na ions, hinders seed germination. Temperature and soil moisture also interact with salinity, producing a significant but highly variable environmental window for seed germination. Therefore, both seed germination and young seedling responses to varying salinity levels needs to be determined. The study focuses on 21 plant species in response to saline and alkaline conditions in a controlled greenhouse environment as well as testing two saline-affected sites; one in Zapata County and another in Kleberg County, Texas over the course of a year.

Materials & Methods

Starting in June of 2005, LeeRoy Rock, a student at Texas A&M Kingsville, began seed germination trials at the Plant Material Center (PMC.) Tests were done on 21 plant species. These trials were performed using a Hoffman "Controlled Environment Chamber". The first trial was run at 5 salinity levels; 0, EC-5, EC-10, EC-20, EC-30 at a constant temperature of 68˚F with 12 hrs light /12 hrs of dark. The second trial was run in the same manner as above, but with constant temperature of 86 ˚F. Germination was recorded at 2-day intervals for 28 days. Seeds were placed in covered clear plastic boxes on blotter paper underlain by a layer of creped cellulose. The substrate was moistened with 100 ml of treatment solution and remoistened when necessary. Each treatment was conducted 4 times with 100 seeds per box. Green house testing consists of a set-up of 3 ebb-flow tables to handle watering at an EC of 0, 10, and 20. Nine species have been selected and seeded into 36 trays each holding 98 cone shape containers. This has been randomly replicated four times in each of the 3 salinity treatments. Once the plants reach the 3-leaf stage these plants will be subjected to the salinity treatments. Importance of how salt levels will change in the soil over time so, data-logging equipment for soil moisture and electrical conductivity will also be used to measure salinity changes over time.

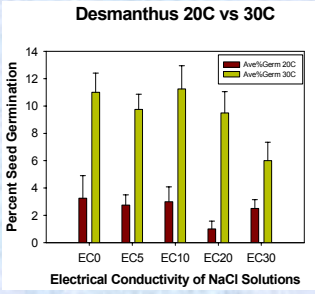


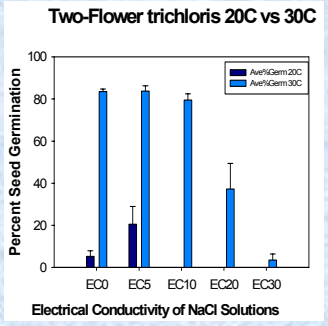


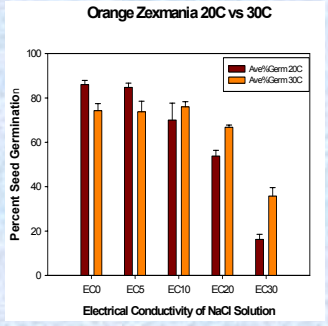


RESULTS

Most of the species germinated better under the higher temperatures even when the salinity levels were high. Six plant species responded better than the other tested species at salt levels with an EC of 20 or greater. These were bundleflower (Desmanthus virgatus), orange zexmenia(Zexmenia hispida) and sorghum with greater than 30 %germination at temperatures at 86˚ F and two-floweredtrichloris (Chloris crinita), Arizona cotton top (Digiteria californica) and Bermudagrass with greater than 20 %germination at temperatures at 86˚F. Data from the saline irrigation reviled species that tolerated high salinity levels while soil moisture was maintained. After the final harvest saturate paste extract been collected for this phase of the experiment.







ISHS

4th International Symposium on Seed, Transplant and Stand Establishment of Horticultural Crops

TRANSLATING SEED AND SEEDLING PHYSIOLOGY INTO TECHNOLOGY
DECEMBER 3-6, 2006 •• SAN ANTONIO, TEXAS

July 20, 2006

Drs. LeeRoy Rock, Shad Nelson and John Lloyd-Reilleyr
Dept. of Agronomy & Resource Sciences, Texas A&M University-Kingsville
USDA-NRCS Kika da la Garza Plant Materials Center, Kingsville

Thanks for submitting an abstract for the 4th *ISHS International and 8th National Symposium on Seed, Transplant and Stand Establishment of Horticultural Crops, "Translating seed and seedling physiology into technology".*

Title: **Screening South Texas Native Plant Seedlings for Salinity Tolerance**

Authors: **LeeRoy Rock[1*], Shad D. Nelson[1] and John Lloyd-Reilley[2]**

Presentation: **Oral**

Abstracts will be revised by the Scientific Committee and you will be informed of acceptance as an oral or poster via e-mail before the early registration deadline 30 August, 2006.

Visit our Symposium website http://sest2006symposium.tamu.edu/index.php which reports updated information pertaining the event, including tentative program, abstract submission, registration, deadlines and hotel reservation.

Please, note that December still attracts many tourists and other Conventions in San Antonio. Therefore, we recommend to proceed at your earliest possible convenience with the reservation of your accommodation.

We look forward to seeing you and your colleagues at the SEST 2006 SYMPOSIUM.

Sincerely,

Daniel I. Leskovar
Convener SEST 2006 Symposium

Professor, Vegetable Physiology - Horticulture
Texas Agricultural Experiment Station, Texas A&M University
1619 Garner Field Rd.
Uvalde, TX 78801
Ph: (830)278-9151 x. 140
Email: d-leskovar@tamu.edu

Screening South Texas Native Plant Seedlings for Salinity Tolerance

LeeRoy Rock[1*], Shad D. Nelson[1] and John Lloyd-Reilley[2]

[1]Dept. of Agronomy & Resource Sciences, MSC 228, Texas A&M University-Kingsville, Kingsville, TX; lrock454@hotmail.com, shad.nelson@tamuk.edu
[2]USDA-NRCS Kika da la Garza Plant Materials Center, Kingsville, TX; John.Reilley@tx.usda.gov

Over 243,000 hectares of South Texas land is affected by saline soil conditions. Weathering of parent materials and minerals contribute to soil salinity, but other factors such as wind erosion, atmospheric precipitation and coastal breezes carry salt inland across South Texas. Elevated levels of these soluble salts restrict plant establishment of native species in Texas. To establish these plants onto saline and alkaline sites both seed germination and young seedling response to varying salinity levels requires further investigation. The objective of this study focused on evaluating seed germination and stand establishment of 21 native and introduced plant species to elevated saline conditions. Seed germination to increasing salt levels was evaluated in diurnal and temperature-controlled seed germination chambers and seedling stand development monitored under greenhouse setting. Seed germination trials were run in NaCl at an EC of 0, 5, 10, 20, 30 dS m^{-1} at 20 and 30°C. Several native species demonstrated an interaction between salinity tolerance and temperature increase. Seedling stand salinity tolerance was evaluated using sea salt solutions at 0, 15, and 30 dS m^{-1} and plant survival over a 4 month period, May-Aug 2006. Plant species that exhibited salinity tolerance may help improve the revegetation strategies for salt-affected soils. Results from this study will assist future seed and seedling establishment programs along disturb Texas roadsides and soils.

Attachment E

Seed Germination Responses to Varying Levels of Salinity

LeeRoy Rock, John Lloyd-Reilley and Shad D. Nelson

In order to solve erosion problems and increase productivity on saline impacted range sites in South Texas, it is critical to know the tolerance of plant species to varying levels of salt. Soluble salts such as sodium ions (Na^+) delay seed germination by decreasing the soil water potential, or cause salt ion entry to the seed embryo causing toxicity. The objective of this study is to evaluate the seed germination responses of both Texas native and introduced grasses and forbs to varying levels of salinity.

A Hoffman germination chamber was used to test twenty one species of grasses and forbs. These plants were selected to determine germination potential under salinity stress using solutions of sodium chloride at electrical conductivity (E.C.) levels of 0, 5, 10, 20, and 30 dS/m. Seeds were tested at temperatures ranging from 60°F to 86°F. Light conditions alternated between 12 hours each of light and dark. Percent live seed from each seed source was determined by tetrazolium chloride testing.

The percent of seed germination observed over 28 days varied among seed species, salinity treatment, and temperature. Statistical analysis will be conducted on the results of these tests to determine treatment significance. Results from this study will provide important information on seed germination characteristics, which should improve revegetation efforts on saline impacted sites of South Texas.

Cooperative funding was provided by the USDA Natural Resources Conservation Service and the Zapata County Soil and Water Conservation District.

Attachment F

Screening South Texas Plant Seedlings for Salinity Tolerance

LeeRoy Rock, John Lloyd-Reilley and Shad D. Nelson

Over 600,000 acres of South Texas land is affected by saline soil conditions. Land with sparse vegetation and severe erosion are often found to have accumulated salts within the soil. Weathering of parent material releases soluble salt ions such as Na^{+}, Cl^{-}, Ca^{2+}, Mg^{2+}, SO_4^{2+}, and HCO_3^{-} that contribute to soil salinity. Elevated levels of these soluble salts restrict plant establishment in some areas South Texas. To better establish plants on saline and alkaline sites, young seedling responses to varying salinity levels requires further investigation.

The objective of this greenhouse study focused on evaluating seedling responses of 21 native and introduced plant species to elevated saline conditions. Three ebb-flow tables were set to water at one of three levels of sea salt solutions: 0, 15, and 30 dS/m. Plants were seeded in 98 conetainers per tray and then the trays were randomly placed on the tables with 4 replicates per species per table. Plant survival and biomass production were evaluated over a 4 month period during May-Aug 2006 and March-July 2007.

Once the data from this study is analyzed it should give us critical information on the plant species that exhibit the most salinity tolerance. These species may have the best chances for establishment on salt-affected soils. Results from this study will assist in the restoration of soils affected by salinity and provide important vegetative cover over areas prone to erosion.

Cooperative funding was provided by the USDA Natural Resources Conservation Service and the Zapata County Soil and Water Conservation District.

Attachment G

Variations in Salinity for Soils in Zapata County

LeeRoy Rock, John Lloyd-Reilley and Shad D. Nelson

Zapata County, an arid environment located in the south-west region of southern Texas, has mild winters and hot dry summers. Summer temperatures can exceed over 100˚ F with highly variable rainfall year to year. Average annual rainfall is 19 inches for Zapata County. However, rains are seldom evenly spread throughout the year, leading to extended periods of drought. Less than 1% of the county is considered prime farmland as the majority of the soils contain highly soluble salts that prevent vegetation establishment. In order to develop successful revegetation strategies on these difficult sites, it is important to know how the varying temperature and rainfall of the different seasons will effect salt levels in the soil. Therefore, the objective of this study is to establish a monitoring station in Zapata County to daily record soil moisture, temperature conditions, and salinity levels.

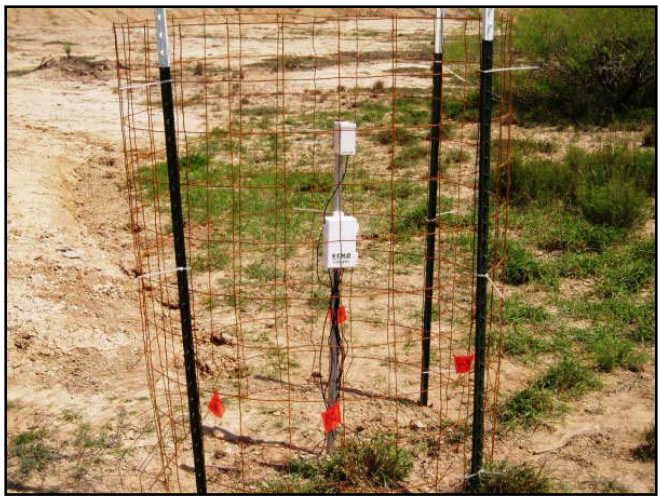
A one-quarter acre field site in Zapata County has been selected for monitoring. Soils in this area vary in salinity with electrical conductivity values ranging from 1 to 45 dS/m. Due to the presence of highly soluble salts, the research site has limited vegetation and severe erosion. Four soil salinity sensors, a rain gauge, and data logging equipment (Decagon Devices Inc.™) have been set-up at the study site to observe soil salinity level changes in response to seasonal rainfall distribution. This going study is expected to continue into 2008.

The results from this study should improve revegetation efforts by attempting to match changing soil conditions with saline adapted plant material.

Cooperative funding was provided by the USDA Natural Resources Conservation Service and the Zapata County Soil and Water Conservation District.

Attachment H

June 2006 – Setup



September 2006

February 2007