United States Department of Agriculture

Natural Resources Conservation Service

USDA-NRCS Cape May Plant Materials Center

Advancing the Science of Coastal Ecosystem Restoration

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Direct Seeding of Smooth Cordgrass for Tidal Shoreline/Marsh Stabilization

In a collaborative project between US Army Corps of Engineers (USACE) - New York District, the National Park Service (NPS) Gateway National Recreation Area Jamaica Bay Unit, the USDA-NRCS New Jersey Plant Materials Center (NJPMC), and several nonprofit organizations, a large-scale marsh island restoration project was conducted from 2006-2012. The USACE constructed and planted extensive marsh shorelines and interior areas with smooth cordgrass (*Spartina alterniflora*) among other tidal marsh species. The NJPMC developed seed collection guidelines, seed cleaning and storage technology, and low marsh seeding specifications. Seeding trials in dredged sand material helped develop recommended seeding rates and methods for direct seeding smooth cordgrass in a sandy substrate. Results showed that smooth cordgrass could be successfully direct seeded at a rate of 10 lbs/ac in the upper ⅓ of the tidal range elevation at low energy sites without a buffer or at high energy sites with an established vegetative buffer at a lower elevation. Well established seeded areas exhibited similar plant densities and cover as vegetatively planted areas within two growing seasons.

Approximate Marsh Island Acres Restored

Elders East 40
Elders West 40
Yellow Bar Hassock....45
Black Wall 20
Rulers Bar 10

Above: Maps of the locations of the marsh islands restored and Jamaica Bay area.

Project Accomplishments

- Plant Technology Development
  - Collecting, cleaning, and storing seed of tidal marsh species
  - Direct seeding trials of smooth cordgrass in a dredged sand medium
  - Development of a "deep" planting plug that allows for quick rooting at high energy sites
- Over 150 Acres of Marsh Islands Restored
  - Over 600 lbs of smooth cordgrass seed collected and cleaned
  - Over 1.2 million plants (smooth cordgrass, saltgrass (*Distichlis spicata*), saltmeadow cordgrass (*Spartina patens*) propagated and planted

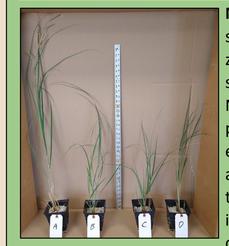
Top (left to right): NJPMC employee harvesting smooth cordgrass seed; aerial view of island during restoration project; drill calibration trials for direct seeding.
Middle (left to right): Cleaned smooth cordgrass seed; Manhattan skyline viewed from Jamaica Bay Unit; direct seeded site (83 DAP; 1929 GDD Base 50°F*).
Bottom (left to right): "Deep" rooted planting plug; greenhouse propagated smooth cordgrass seedlings; direct seeded site (428 DAP; 3816 GDD Base 50°F*).

*Growing degree days (GDD) calculated using http://climatesmartfarming.org/tools/csf-growing-degree-day-calculator/

Wetland Plants Salinity Tolerance Screening

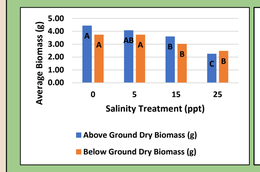
NJPMC staff conducted trials to standardize protocol for greenhouse salinity tolerance trials using a set of four automated hydroponic ebb and flow systems to subject plants to treatments of flooding with solutions of varying salinity concentrations. Preliminary trials used Southampton Germplasm prairie cordgrass (*Spartina pectinata*) as the subject with plans to repeat the same trials testing other Plant Materials Program conservation plant releases such as Timber switchgrass, High Tide switchgrass, 'Meadowcrest' gamagrass, and three varieties of saltmeadow cordgrass: 'Avalon', 'Flageo', and 'Sharp'. The primary goal of these trials is to guide plant recommendations for use on marginal farmland to mitigate the impacts of saltwater intrusion due to climate change, but findings could be applicable for living shoreline restoration projects as well.

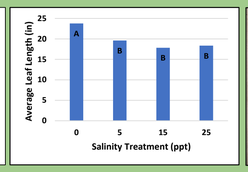
Objective: to examine the degree of physiological effects to Southampton Germplasm prairie cordgrass resulting from varying levels of salinity treatments (0, 5, 15, and 25 ppt) in a hydroponic growth system.



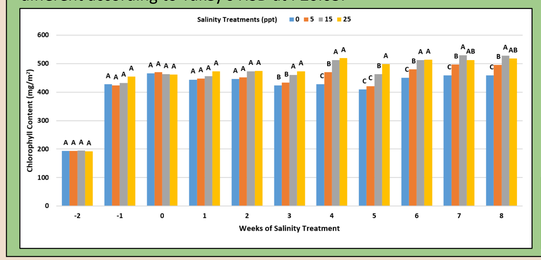
Above: After salinity treatments, a clear visual distinction could be drawn between fresh (A) and salinity treatments.
A = 0, B = 5, C = 15, D = 25 ppt

Materials and Methods: The salinity range was selected to mimic levels of estuaries and transitional zones in the Mid-Atlantic coastal region. Plants were sourced from production fields established at the NJPMC in 2009. Similar sized propagules were planted in quart containers in perlite and trimmed to equal height. Plants were irrigated twice daily. After a two-week acclimatization period, salinity treatments were initiated and increased incrementally by 5 ppt per week. Treatments continued for eight weeks. Plants were photographed weekly to document visual indications of plant stress. Weekly plant survival and chlorophyll content measurements were recorded during the study. After salinity treatments concluded, leaf length and biomass measurements were recorded.





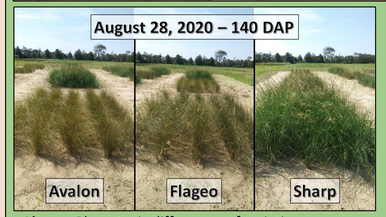
Above: Results of biomass and leaf length measurements. Averages followed by the same letter are not significantly different according to Tukey's HSD at P≤0.05.
Above Right: Average planting propagule size.
Below: Results of chlorophyll concentration measurements. Averages followed by the same letter within the same treatment week are not significantly different according to Tukey's HSD at P≤0.05.



Time lapse video of salinity treatment impacts.

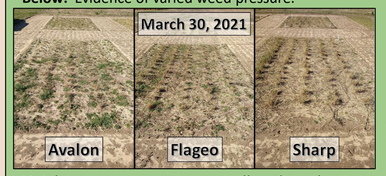
Salt Meadow Cordgrass Variety Performance Study

The effects of climate change have impacted plant communities and those impacts will likely become more prominent if the effects of climate change become more pronounced. Adaptations of certain plant species or specific genotypes of species may make them better suited for survival and reproduction in geographic areas outside of their widely, historically accepted native habitat. Taking this into consideration, NJPMC staff initiated a study to examine the performance of a local genotype ('Avalon') and two more southern genotypes ('Flageo' and 'Sharp') of saltmeadow cordgrass (*Spartina patens*) varieties.



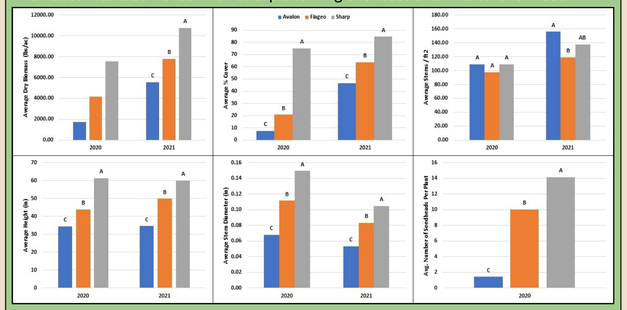
Above: Phenotypic differences of varieties were readily apparent during the establishment year.
Below: Evidence of varied weed pressure.

The primary objective of this study is to compare the biomass production and forage quality of three saltmeadow cordgrass varieties to provide a mitigation option for agricultural production on land that has been impacted by saltwater intrusion due to climate change.



Preliminary data collected during the establishment year (2020) and first year data (2021) have shown statistically significant differences between varieties for multiple criteria.

Height, percent coverage, seedhead production, vegetative barrier criteria (stem diameter and stem counts), and biomass production data were collected. Although strictly observational, a clear difference in weed pressure between varieties was also noted with Sharp showing the least and Avalon the most.

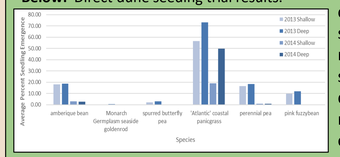


Above: Results of preliminary (2020) and first year (2021) data. Averages followed by the same letter are not significantly different according to Tukey's HSD at P≤0.05.

Improving Plant Diversity in Living Shoreline Plantings

While grasses and grass-like plants provide the primary stabilization functions for living shorelines, increasing plant biodiversity by including adapted flowering forbs and wildflowers would provide additional beneficial ecosystem services. Flowering forbs such as seaside goldenrod, amberique-bean, and the obligate wetland plant, Virginia saltmarsh mallow, are additional species that have undergone evaluation for direct seeding applications and/or integration into shoreline plantings as containerized plants.

Above: Seaside goldenrod in peak bloom.
Below: Direct dune seeding trial results.



Seaside Goldenrod (*Solidago sempervirens*)

Monarch Germplasm seaside goldenrod is a source-identified composite germplasm released by the NJPMC in 2010 for dune stabilization, increased plant diversity of dune restoration projects, and wildlife services. The standard practice for establishment is by means of vegetative propagules. Dune seeding trials conducted by the NJPMC were conducted to determine if direct seeding was a viable alternative method of establishment. Poor seedling emergence results suggested direct seeding should not be recommended as a reliable means of establishment.

Amberique-Bean (*Strophostyles helvola*)

Amberique bean is an annual, native legume with a trailing vine growth habit. As an early pioneer species, it is ideally adapted for the shifting topography of sandy coastal dunes and often volunteers along roadsides, at edges of salt marshes, in open fields, throughout sparse woodlands or forest clearings, and disturbed areas. It could be used for conservation applications; however commercial availability is lacking. The NJPMC is developing a composite germplasm conservation release to remedy this need. NJPMC staff conducted trials to select for beneficial traits (root length, seed production, seed longevity, etc.), examine establishment and harvest methods, and evaluate applicability to address conservation concerns.

Right: Direct dune seeding amberique bean.
Below: Virginia saltmarsh mallow in bloom.

Virginia Saltmarsh Mallow (*Kosteletzkya virginica*)

Virginia saltmarsh mallow is an herbaceous, flowering perennial with a lengthy bloom period. Its showy deep pink to lightly pink hued white flowers provide value for a range of wildlife species; high oil content seeds make the mature fruit an energy rich food source for migratory birds and small mammals while flowers provide an ample pollen and nectar source for insects and the ruby-throated hummingbird. It is salt tolerant and commonly occurs on the coastal plains in marshes, swamps, and along the edges of wetlands. The NJPMC is developing a conservation release selected for salinity tolerance and length of bloom period.