Advancing Seeding Technologies of Smooth Cordgrass for Tidal Marsh

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Partners in Developing New Plant Sciences for the Tidal Marsh Restoration

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Cape May Plant Materials Center
Literature Review
Direct Seeding *Spartina alterniflora* (smooth cordgrass)

- Limited trials done on seeding *Spartina alterniflora*
  - North Carolina State-Drs. Woodhouse, Seneca, and Broome (1970’s)
  - Galveston Bay -surface broadcast seeding with airboats. (1990’s)
    - USDA-NRCS, TX Critical Area Planting Job Sheet (2010)
      - Seeding *Spartina alterniflora*, Scott Alford.
  - Louisiana State University-Working with improved seeding genotypes/aerial seeding. (2008)
Challenges with *Spartina alterniflora* seed

- Wild harvest by hand at **optimum** time before shatter.
- Low natural germination percentage (10-30%).
- Cold, wet storage requirements. Limited shelf life.
- Difficulty getting wet stored seed to flow through a seeder/seed drill. Carrier must be used.
- Proper depth/placement of seed to prevent seed movement/washing away.
Seed Ripeness

Five to six weeks from flowering to seed maturity
Seed Harvest - Sickles/Machetes

Inter-Agency Partnership
Seed Storage/Handling

- Harvested seed after-ripened on concrete floor with fans for air flow.
- Seed was then feed through an agricultural combine.
- Final stage through seed clippers.
Equipment Settings for Cleaning Seed of Smooth Cordgrass (*Spartina alterniflora*).

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**Abstract**

The purpose of this project was to determine the most efficient and yet affordable process by which to clean seed of smooth cordgrass.

Smooth cordgrass is a dominant warm season grass occupying the inter-tidal zone of estuarine plant communities. Large scale harvesting, processing and cleaning of Spartina seed has been limited to hand processes to ensure high levels of viable seed harvested.

*The USDA NRCS Cape May Plant Materials Center is the first known facility to utilize an agricultural combine for large scale seed cleaning equipment that resulted in hundreds of pounds of viable seed. This information will serve to advance the cost effectiveness of large scale estuary conservation.*

**Materials and Methods:**

Building for after ripening of seed, combine, 62-D three Screen separator, germplasm storage at 1-2°Celsius, and 25 ppt salt water.

**Results and Discussion:**

Though many settings combine settings were experimented with the following settings yielded the cleanest and least damaged seed.

Fan Speed: 9

Cylinder Speed: 7

Concave: 12

Air Inlet: Full-Open

Adjustable Sieves: 15 mm

The 62-D three screen separator performed best at the following settings:

Hopper Roller Opening: 2/3rd Open

Air Deflector Board: 1/4" Open

Fan Speed: 900 RPM

Top Screen: #24

Middle Screen: Slotted 6/64th by 3/4"

Bottom Screen: 1/25th covered with paper.

Adjustable Speed: 1/2 Turn open

Seed Discharge Door: Closed

Top and Bottom Fan Balancer: Air Flow Ribbon Balanced

**Summary:**

Cost effective seed cleaning of the coastal halophyte smooth cordgrass can be accomplished. Due to the purchase costs associated with the machinery mentioned, a propagator will need to carefully examine available labor rates, the quantity of seed that will be processed and the cost of equipping their operation with similar machinery.

**Equipment Manufacturer Disclaimer:**

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Seed Storage

Salt Water: 25 ppt. flushed every ten days. 
¼ cup Clorox per 25 gallons.
Seed Storage: 38 degrees F.
Typically, wild collected seed was bagged and allowed to “ferment” for a few months. Plants started in seeding trays to produce plugs. (10%-30% germination rates)

Our seed cleaning/handling process has produced germination rates of 75%-85%. Allows for successful direct seeding.
Plant Propagation

Takes 3-4 mo. from seed germination to marketable plant.
Plant Propagation

Deep plugs cost- $1.00

Quart pots produced- $3.00/container

1.5 foot plant spacing:

Plugs- $29,040/ac.
Qt. Pots- $87,000/ac.
Seeding vs Vegetative Planting

- Advantages of plugs
  - quicker stabilization under high energy conditions. Quart sized pots used in highest energy shoreline fringe
  - Plants more resistant to waterfowl “plucking” if planted by mid-July.
Seeding vs Vegetative Planting

Advantages of Seeding

- reduced planting costs, more mechanized
- Cover more area less time
- Seed is cheaper than plugs.

10 seeds/sq. ft. requires 435,600 seeds/ac. At $0.01/seed, the cost of seed for 1 acre would be approximately $4360.
Seeding Methods

- **Broadcast** - use of airplane or fan boats to distribute seed on mud flats.
  - Limitations - surface application, uneven distribution of seed
  - Advantages - Aerial planting offers speed (7 seconds/acre) ease and the versatility of getting into remote areas inaccessible by land vehicles or boats.

- **Drill seeding** – using a mechanized equipment method to place seed at a specified depth in rows.
  - Limitations - need substrate that will support heavy equipment.
  - Advantages – more efficient, improved seed-soil contact for better establishment.
Case Studies

- Jamaica Bay, NY Marsh Island Restoration (USACOE-New York District)
  - Spartina alterniflora drill seeded on dredged sand.

- USFWS-Prime Hook Wildlife, Delaware
  - Spartina alterniflora, Spartina patens and barnyardgrass (cover crop) was aerially seeded.
Jamaica Bay, New York
Dredged sand pumped and graded
Graded area before seeding/planting
Direct Seeding Technology for Marsh Establishment

Carrier: Non-clumping (cheap) cat litter at 3:1 by weight.
Low Energy Site
High Energy site conditions

- 25 foot planted buffer of quart pots -Spartina alterniflora.
- Planting in Median tidal range elevation.
High Energy Site
Low Energy Site-Seeding-Seeded May 2007

Sept. 2007

July 2008
High Energy Site Seeding

September 07

July 08
ACOE-Yellow Bar Project
32 acres drill seeded 2012
Kasco Versa Seed Drill

Trial planting with a seed drill in the wetland pit at the Cape May Plant Materials Center.
Seed Drill Preparation/Calibration
Jamaica Bay-Yellow Bar Island
Spartina alterniflora seeding-after 1 growing season
Yellow Bar Seeding

First Growing Season - 2012

Second growing season
Spartina alterniflora and additional tidal marsh species were harvested and cleaned through the Bureau of Land Management (BLM) Seeds of Success Program. (2015)

1,000 acres seeded aerially in June 2016. Each plane load covered 50-100 acres.

Cover crop used was barnyard grass (Echinocloa crusgalli) seeded at 10 pounds/ac. over the entire area. This was also the carrier seed used to for the Spartina alterniflora (seeded at 1-2 lbs./ac.) and Spartina patens which were seeded in appropriate zones depending on elevation.
Aerial Seeding Preparation

Adding carrier seed

Mixing with auger
Prime Hook-aerial seeding

Loading plane

Final mix-hopper
June 2016 Seeding
Prime Hook NWR-aerial seeding

June 2016

October 2016
Lessons Learned

- High quality seed, properly stored and handled is necessary for seeding success.

- Drill seeding is a viable option in coarse-textured (sand) dredge materials with lower energy environments. Most effective in the upper 1/3 elevation of the tidal range.

- In higher energy sites, plant a 50-70 foot shoreline fringe buffer with vegetative material (plugs).
Lessons Learned

- Plant density from seeding can take up to 3 growing seasons to equal second growing season density from vegetative plugs. (1 year delay in complete establishment).

- Drill seeding in high organic (muck) soils is not possible. Broadcast seeding generally has a range of results from poor-good depending on site conditions, but in many cases is the only option. Use of good quality seed is necessary.
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