NRCS 2010 Conservation Proposal

Propagation of Salt Flats Plant Species and Conservation Barrier Demonstration

Final Report

Salicornia bigelovii (Torr)

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Initial Material Collection:

Seed, cuttings and division plant materials were collected from Playa Sucia, Cabo Rojo (17.951596, -67.192706) on October 12, 2010 with the assistance of NRCS Edwin Mas, Plant Materials/Grazinglands Specialist. All plant materials were collected in the one location except *Sporobolus pyramidatus* and *Spartina piztens* which were collected further south. Two additional trips were required to gather *Salicornia* seeds after the initial ones germinated but did not develop due to the lack of salt water fertilization.

Nursery Plant Production:

All propagation was performed at Plantas de Puerto Rico, Cayey (Carr 715 Km 5.0 Bo Cercadillo, Cayey) additional pictures of the propagation can be seen at:
https://picasaweb.google.com/jachong/NurseryProduction

The following is a per plant account of its propagation requirements:

Notes: 3 cuttings per cell / 72 cell tray size / 12 wk production (4 wks root initials). Irrigated with fertilizer or reconstituted sea salt water.

Batis maritima (L.)

When propagated by cuttings *Batis* is a non-vigorous slow growing plant. This slow growth and development suggest this plant has a higher optimal temperature requirement than the provided during the propagation period. This is one of the hardest plants we propagated as it requires specific dry, but turgid cuttings conditions to strike root. Strike root is the commercial term when cuttings first develop the initial roots. Three cuttings per cell, one inch long with at least two nodes, are planted into 72 cell trays for roots to appear after six weeks the cuttings must be maintained hydrated, but not wet, wet cuttings rot easily. The cuttings require another six weeks to fill the cells. Hence no continuous misting should be used when propagating these plants, additionally these plants prefer to be propagated in sand or very porous commercial mix (peat moss). Similar to *Sporobolus virginicus*, but with less vigor, the *Batis* plants are kept as mother plants grow tall and bend its stems 'run' extending over the ground or trays rooting themselves into the sand. This allows aerial cuttings to be propagated once these are rooted. However, commercially cutting propagation is preferred as these can be set to the same size and finish the same time.

Paspalum vaginatum (Swartz)

Paspalum is propagated by cuttings and/or runners. However cutting propagation is the commercial way of propagating it using at least 3 cuts per cell. The cuttings are aggressive and vigorous, these grow on any substrate (peat moss, Promix, sand). *Paspalum* tolerates irrigation with salty water and responds very well to fertilizer applications. From all plants we tested it is the easiest plant to propagate and grow. It strikes root within 14 days and fills a 72 tray cell in six weeks, after which produces runners. It requires pruning after eight weeks.

Notes: 3 cuttings per cell / 72 cell tray size / 6 wk production (2 wk root initials). Irrigated with fertilizer or reconstituted sea salt water to 10 oz / 5 gal of water.

Paspalum vaginatum trays the easiest plant to propagate from all plants tested, number one in production capacity, growth and development.

Notes: Seed propagated 48 cell tray / 6-7 wks total growth (1 wk germination). Must be irrigated with reconstituted sea salt water (2oz / gal of water).

Salicornia bigelovii (Torr)

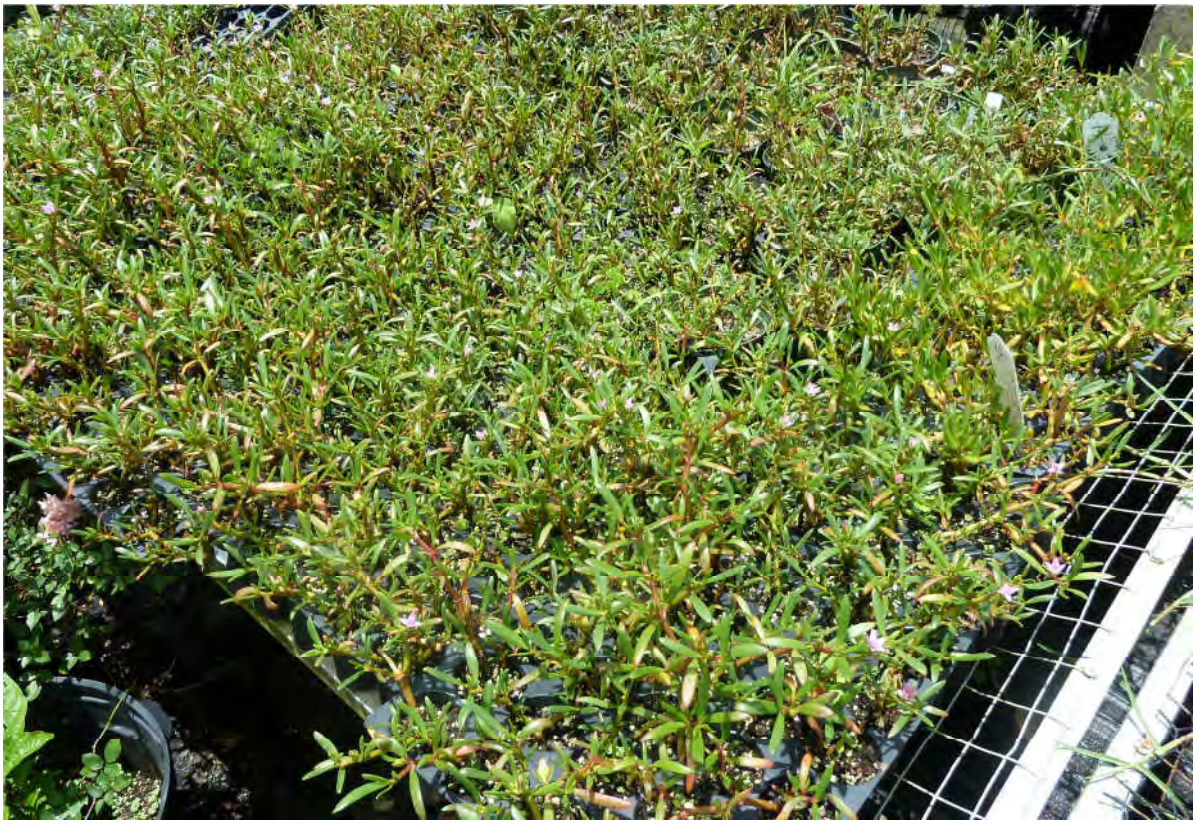
Featured in the cover of this report this is the only plant we tested that should be commercially propagated by seed. This shallow root plant was propagated in 48 tray cells 2" deep and 1.5" wide. It does not require sea water to germinate, but it requires sea water to grow and develop after germination. These plants were irrigated twice weekly with 10oz of reconstituted sea salts in 5 gallons of water (2oz/gal). Once established it grows fast, but its growth can be affected by rain. It can be produced in beach sand or mixed sand with peat moss with a 1:1 ratio. Multiple seeds should be sprinkled on top of the trays to cover the trays. Taking a week to germinate and reaching a height of 2" after six weeks. Leaf-stem cuttings did not provide to be commercially reliable. Additional studies of these plants are recommended as it has multiple uses. However it must me noted that less than 1% oil by weight could be extracted from the foliage/stem of these plants when using a hexane liquid to liquid extraction method. When this as done the plants were not in flower.

Germinating (left) and growing (right) of Salicornia in 48 cell tray size. Seed production is the best method of propagation.

Sessuvium portulacastrum (L.)

Propagated by cuttings an easy, adaptable to root plant. Two week lead time to strike root, six weeks to finish in tray planted in a 72 tray 3.5" deep liner 1.5" wide. This is the second easiest plant to propagate only after *P. vaginatum*. Requires pinching (removal of apical meristems) of cuttings to stimulate branching after 30 days from sticking. Must plant at least 3 cuttings per cell to fill in cell. It takes 6 weeks from cutting to be rooted and finished.

Notes: 3 cuttings per cell / 72 cell tray / 6 wk production (2 wks root initials). Irrigated with fertilizer or sea salt reconstituted water to 20 mS/cm.



Sessuvium 72 cell trays after 6 weeks from cutting, stick and rooting. -

Spartina patens

This plant **requires** the establishment of mother plants, which can be a slow process. The plants require at least three months to fully establish as mother plants in one gallon containers. Once established the mother plant yields runners and can be divided and planted into 6” pots taking another three months to establish. This is a very elegant tall plant with strong leaves and roots, that when establish can create strong barriers, however it does take a long time to grow it, when compared to the other plants.

Notes: 3 month mother plants in gallon containers or larger plant divisions finish in 3 month total in 4-6” containers. Irrigation can be fertilize or reconstituted sea salt water.

Spartina divisions from mother plants and it’s established in 4” pots

Sporobolus virginicus (L.) (left)
Sporobolus pyramidatus (L.) (right)

These plants can be propagated by seed however stem basal cuttings are the best mode of commercial propagation as seed germination is limited to about 5%. These plants require the establishment of mother plants (6" to gal pots or trays) for three months. Once established these plants grow fast. Plants then to flower during longer days and plants stay 'dormant' or grow little during winter time. S. virginicus is a larger more vigorous plant, whereas S. pyramidatus is smaller but has been shown to grow fast once established.

3 month mother plant in 6" container / 2-3 cuttings per cell / 72 cell trays / 6 wks total plant production (2 wk root initials)

Sporobolus virginicus (L.)

Sporobolus pyramidatus (L.)

Sporobolus virginicus (L.) growing and rooting itself with runners over a tray from where plants can be separated.

Field Plantings:

Summary

Plant propagation for these species is not the only aim when these are going to be transplanted to harsh conditions. In addition to plant propagation plants must be pre-treated with salt water or reconstituted sea water from sea salt (2oz/gal) and irrigated with this water with every irrigation to condition the plants to this environment. In addition to this plants are preferably planted just prior to the start of the raining season otherwise these must be irrigated, which in these locations can be difficult.

Initial test planting

A total of four plantings were performed three in Cabo Rojo and one in Ponce. Additionally more than 200 plants were donated to the Cabo Rojo National Wildlife Refuge for planting by volunteers and students. On April 21, 2011 an initial planting of 150 plants of *Paspalum vaginatum* and *Sessuvium portulacarum* were tested at the “Refugio de Vida Silvestre” (RVS) located at 18° 0'16.63"N and 67° 9'50.72"W. The plants were propagated in 50 trays of 1.5” deep and 1” wide cells and 72 tray cell size 3.5” deep 2” top wide. The initial planting was performed to observe plant requirements for establishment. Out of the 150 plants only about 26 survived after 60 days. Although the surviving plants, all *Paspalum*, were not in good shape and were not capable of buffering erosion at that time, these were established. There seem to be several factors affecting plant establishment 1) meeting the watering care needs after the planting 2) soil quality at the planting location and 3) plant preparation prior to planting.

Paspalum plants planted about one per foot square on April 21, 2011, Cabo Rojo between the fresh and saline waterlines.

The RVS is a good location for planting as it is under the direction of DRNA and it is where fresh water meets the saline water having a topography ideal for testing. The RVS topography has been planned and maintained by the US Army Corps of Engineers. These plantings were specifically 1) between the fresh water and the upper part of the saline waterline (pictured above) and 2) within the saline waterline. Surviving Paspalum plants were all in between the fresh and saline waterlines all other plants died and where within the saline waterline. The major concern for plant survival at that time was that plants did not received proper amount of water for plant establishment, hence a water pump was acquired to provide additional water. Additional pictures can be seen at:

https://picasaweb.google.com/jachong/Apr212011Jun302011PlantTestFollowUp

Main 1700 plant planting

On July 3, 2011 a preliminary visit to RVS in Cabo Rojo took place to look at the area to be planted. It was a rainy day which allowed us see part of the water movement within the RVS. On July 7, 2011 more than 1700 salt plant species were planted in the RVS in three distinct locations 1) in the fresh waterline just above the saline waterline 2) in fresh waterline spillway inside the saline waterline and 3) within the saline waterline.

Picture showing planting inside the saline waterline as it can be noted saline plant species already grow in this area.

Picture showing *Paspalum* planting above the spillway on the fresh waterline. This planting allows the filtering of sediments coming in fresh water from upland. Additional pictures can be seen at: https://picasaweb.google.com/jachong/Jul72011Planting1700

A follow up trip on July 14, 2011 showed that in general all plants planted just above the saline waterline in the fresh waterline and in the fresh waterline spillway survived and all plants planted within the saline waterline died. Additional pictures can be seen at:

https://picasaweb.google.com/jachong/Jul142011Followup

Although a water pump was left at RVS office it was not required as there was almost daily rain between the planting and the follow up day. This planting was a little disappointing due to all plants dying within the saline waterline, even though salt plant species grow at the same location. Water available by rain during those days suggests that plants did have all water needs met, suggesting that the plants itself could not resist the saline conditions of the area and/or that the soil characteristics were anaerobic. These clues provided information for us to modify the plant growing conditions at the nursery to acclimatize the plants better prior to bring these to the field. Hence it is not only important to propagate these plants like traditional plants are propagated, but to acclimatize these plants *prior* to planting these in high saline conditions.

Additional recommendations learned from these plantings are that these plants are good to mitigate areas that have been affected by erosion, or require erosion control, or as part of the mitigation plan when engineered works are establish, ie. water canals, ditches among others. These plants are good to be established mitigation controls where human intervention has taken place recently and/or natural plants have not yet colonize the area. The use of compost to aid in the establishment of these plants should be considered when possible.

A final visit to this location on January 12, 2012 demonstrated that the majority of the plants had perish or had not grown as expected. This to our view this occurred due to two reasons, plants in the saline level died due to anaerobic conditions, which local living plants have been able to overcome. Some plants in the water spill and fresh water side survived, but were eaten by cows and additional plants in the fresh area although alive would require more irrigation. Plantings must occur in August, September and October for Cabo Rojo for the most rainfall.

Second planting 750 plants Ponce

Plants were acclimatized at the nursery prior to planting with every irrigation containing reconstituted sea salt water (2oz of sea salt per gallon of water). This second planting (750 plants) was at a private Ponce beach located at 17°58'9.65"N and 66°35'21.56"W next to the Costa Caribe Gulf and Country Club on October 21, 2011. One of the owners of the 800 acre

Prior to planting about 15 feet from sea water

farm Mr. Fernando Collazo kindly provided access to the area for the planting. We wanted to test the plants in different conditions, when compared to the RVS location the areas soil is very sandy and plants where and could only be irrigated with sea water or rainfall. Mr. Fernando's property assistant pledge to water the plants until establishment.

Paspalum plants planted about 2 plants per square foot.

Additional pictures can be seen at the following link: https://picasaweb.google.com/jachong/PoncePlanting

Ponce Follow up

After planting th

Plants after about two months from planting

The plants planted in Ponce had great success of establishment when compared to the plants planted at Cabo Rojo. These plants were planted closed together and directly on sandy soil. Fewer varieties, where planted in Ponce, including *Paspalum*, *Sessuvium*, *Spartina* and few *S. virginicus*. *Paspalum* plants did plant well everywhere, a few plants were out rooted and died, but overall they survived. During planting the natural vegetation was green, as the plants we planted, and after two months due to decreasing rains the natural vegetation is brown similar to our planted plants (see pictures right). We planted in Ponce as close as 2 to 8 feet from the sea water. Plants that receive water from the strong waves are greener and doing better than the other plants. This indicates that they were not as tender as other plants and that the pre-treatment at the nursery (2oz sea salt/gal with every irrigation) was appropriate. *Sessuvium* plants did suffer more when outside of the sea water zone.

Area prior to planting

Area after planting -

Area after planting

Area after two months from planting

The establishment of a flat tray of *Paspalum* at Ponce demonstrated the best method of plant establishment in the sand.

Runners (black arrows) of Paspalum plants growing from the buffer zone out towards the water. Meaning that the buffer zone is expanding and debris accumulation (blue arrow) within the buffer zone.

The fourth planting

A fourth planting was performed at Playa Sucia (July 14, 2011) including *Salicornia* and *Paspalum* plants. *Salicornia* plants did not survive the planting similar to the plantings in RVS. However at the time of the follow up many *Salicornia* new plants were starting to grow in the area were the *Salicornia* plantings were planted. This can either indicate that the planted plants did provide some seed although it looked like these had not flowered at the time of the planting or that indigenous seed sprouted in the area. The best method for these plants to be 'spread' into the land seems to be by the spreading of the seed and not necessarily by the plating of the plants, unless these are to be cultured. Some of the Paspalum plants survived in the area.