Nursery Production of *Uniola paniculata* (southern seaoats)

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Introduction

Uniola paniculata (southern seaoats) is the dominant foredune building grass from southeastern Virginia along the Atlantic and Gulf coasts to eastern Mexico. This perennial grass has been used extensively to build artificial dunes and stabilize existing dunes. With the increased shoreline damage by tropical storms on the eastern seaboard in the last few years, the need for beach restoration also has increased. Vegetative propagation for dune restoration in beach sand is expensive, and young plants are subjected to extreme environmental factors which can result in poor plant establishment and growth. Direct seeding in the dunes is ineffective because of seed dormancy-viability and movement of sand which affects planting depth.

Unlike many grasses, seaoats is not a prolific seed producer. Therefore, the primary natural method of reproduction in the dune habitat is through vegetative means. Buds are formed around the stem base, and the formation angle of the buds determine whether a shoot or lignified rhizome develops. Acutely angled buds become tillers and right angled buds become rhizomes. Internodal potions of the rhizomes decay leaving the nodal regions with associated culms to root and become new plants. As sand is deposited around the base of the plant, these rhizomes establish roots in dune sand.

The dune habitat found along the coastal regions of the Southeast lacks sufficient nutrients for optimal growth. Commercial nurseries in the Southeast commonly use pine bark-sand media, which is also nutrient-deficient. Nurseries attempt to maintain adequate nutrition by using quick-release granular fertilizer, controlled-release fertilizer or fertilizer injected into irrigation water, alone or in combinations. Macronutrient fertilizers commonly are applied to sumulate plant growth and increase vegetative cover in dune plantings.

Production of seeded *Uniola paniculata* in commercial nurseries would increase availability of plants for dune restoration. The objectives of this research were to 1) enhance germination of freshly harvested seed,2) investigate the effect of planting depth within containers to simulate the dune environment, where the base of the plant is buried, and 3) determine an optimum nutrition program for *Uniola paniculata* grown in pine bark-sand media for nursery production.

Materials and methods

Seed germination. Mature *Uniola paniculata* panicles were harvested from the Jekyll Island, Ga., area 15 Sept.1993 in cooperation with the Jekyll Island Authority. The spikelets were rubbed over a screen to remove the chafe, and the seeds were collected. Harvested seeds were stored dry at 40 F for 30 days. Before treatments all seed were soaked for 30 min in a 30% bleach solution as a surface sterilant. Seed treatments included 24h soak in 100 or 500 ppm gibberillic acid (GA_4) or distilled water. Scarificaton also was applied to the seeds across all GA_4 Treatments. Seeds were scarified using 600-grit sandpaper and gently rubbing the seeds between fingers. A scarified only and non-treated control also were included.

Seeds were planted in 40-cell trays using a standard nursery seed propagation media of 1:peat moss: 1 perlite (by volume) and germinated in a shadehouse at Carolina Nurseries, Moncks Corner, S.C. Preplant fertilization for all treatments included incorporation of 9 lb/yd3 18N-2.6P-9.9K Osmocote and 9 lb/ yd3 14-7-7 granular fertilizer. A preplant drench of Banrot at 8 lb/100 gal was applied. Seed were planted 1 inch deep with two seeds per cell.

The 40-cell trays were irrigated by mist for 5 min initially followed by mist every 16 min for 8 sec during the first 10 days and then every 32 min for 8 sec for the remainder of the study. The study was started on 17 Nov. 1993 and concluded 20 Dec. 1993. On 20 Dec. 1993, germination percentages were determined for the seed treatments.

A follow-up study was conducted in a glass greenhouse at Clemson University. Seeds collected at Jekyll Island and stored at 4C for 136 days were planted in a peat-based medium, Fafard 3B. Two planting depths were studied, 0.5 and 1 inch. Seeds were given preplant treatments consisting of a control and 24-h soaks in distilled water, 100 ppm gibberillic acid (GA_4), and 7 mM and 14 mM thiourea. There were four replications of each seed treatment x planting depth combination with five cells per replicate. On 8 Feb 1994, before planting, all seeds were disinfected by immersing in 30% bleach solution for 30 min. and the medium was drenched with Banrot at 8 lb/100 gal. The seeds were planted in a 200 cell plug tray with two seeds per cell with mist. Bottom heat was provided at a constant temperature of 25C. The studywas begun 9 Feb. 1994 and terminated 9 Mar. 1994.

Planting depth. Well rooted seed-grown liners of *Uniola particulata* were planted in a 4 pine bark: 1 sand (by volume) media on 15 Mar.1994 at Carolina Nurseries into full 1-gal and 3-gal tree containers. The liners were placed in the containers with the crown either even with the surface of the media or 4 inches below the media surface. Liners were planted in the 3 gal containers with the crown also 4 inches below the media surface. The bottom of the deeply planted liners were either on the bottom of the 1 gal container or 8 inches above the container bottom for the 3 gal container. Treatments were arranged in a RCBD with five blocks per container treatment. The plants were topdressed with 16 g of 18-3-6 + Mg Osmocote Custom Blend and grown outside. Irrigation was applied using overhead sprinklers following normal nursery practice of 0.5" of water per day.

On 6 July 1994, the study was terminated. Shoots and roots were collected and dried and dry weight determination of both shoot and root tissue and root:shoot ratio were determined.

Nutrition. Well rooted seedgrown liners of *Uniola paniculata* were planted in a 4 pine bark : 1 sand (by volume) media on 15 Mar. 94. The plants were planted with the crowns even with the top of the media in trade 1-gal (2.8-liter) containers. Fertilizers were applied at standardized rates of nitrogen, 1.5 or 3 lb N/yd3 on 5 Apr. 1994. The containers were topdressed with the following nursery fertilizer formulations: 1) 14-7-7 with micronutrients granular quick release formulation (16 or 32 g/container), 2) 18-3-6 with micronutrients (Osmocote Custom Blend) slow release (13 or 25 g/container),3) 16-7-12 without micronuarients (Osmocote slow release) (14 or 28 g/ container), or 4) STEP micronutrients 2 lb/yd3 STEP (3 g/container). The control was not topdressed with additional fertilizer, however it did receive the normal nursery practice of twice weekly fertilizer-injected irrigation with 0.5" water/day.

Results and Discussion

Seed germination. Seeds soaked in 100 ppm GA_4 had the highest germination percentage 21 days after treatment (DAT) (Table 1). At 21 DAT the emerged seedlings from the 100 ppm GA4 treatment were judged to be most desirable. Seedlings from the 500 ppm GA4 treatment were twisted, caused by excessive cell elongation. Scarified seeds were observed to have had swelling equivalent to treatments that received soaking treatments only; however, scarification was not necessary to promote germination and resulted in germination no better than the control.

In the follow-up study there was no difference in the germination rates of any of the treatments (data not shown). The germination rate of the 100 ppm GA_4 soak was lower than previously observed. Thiourea did not improve the germination percentage, although it has been used effectively by other researchers to stimulate germination of seeds that require a moistchilling treatment.

Earlier researchers found that as storage time increased germination decreased, showing either increased dormancy or decreased viability and that storage time is an important consideration. Soaking in 100ppm GA_4 increased and accelerated germination of freshly harvested seed, and as storage time increased, germination rate was reduced. Our data supports the use of a GA4 soak. It appears that *Uniola paniculata* has a short span of seed viability in storage and that seed dormancy was not the cause of poor germination.

Planting depth. Planting depth had a significant influence on shoot growth (Table 2). Plants grown with the crown even with the media surface in 1 gal or deep in 3 gal containers had higher shoot weights than plants grown deep in 1 gal containers. Root dry weight was also affected by planting depth, the plants grown deep had the lowest root weight. Root to shoot ratios were similar between the planting depths. However, plants grown in the 1 gal containers, regardless of planting depth, had root/shoot ratios almost twice as high as the plants grown in the 3 gal containers.

Although the root/shoot ratios of the plants grown in 1 gal containers were similar, there were differences in the weights of the dried shoot and root. The reason for these differences can be related back to the planting depth. Plants grown in the bottom of these containers are exposed to a perched water table or zone of media saturation. The media in containers remains wet under a regime of regular irrigation such as would be followed in a commercial nursery in the Southeast. Thus, seaoats don't tolerage excessively wet conditions.

Nutrition. Levels of tissue nutrients were similar were similar in many cases (Table 3). However, there were significant effects on shoot dry weights due to fertilizer rate. The control treatment and the low N rates had higher shoot weights compared to the high N rates for each formulation (Table 3). As N rate increased to 3 lb/ yd3, however the amount of shoot biomass decreased for all three fertilizer formulations. The micronutrient-only treatment also resulted in lower shoot weight.

Conclusions

Uniola paniculata has the potential to become a widely grown nursery plant in the Southeast. Seeds should be planted soon after harvest in the fall to ensure highest germination percentages of these seeds. A GA_4 preplant soak of the seeds will help more rapid and uniform germination.

Typically on the dunes, the crowns of *U. paniculata* become buried by drifting sand, however, burying the crown of *U. paniculata* in 1 gal containers reduced the shoot and root weight of the plant due to the increased moisture in the bottom of the containers. Reducing the frequency and amount of irrigation would be helpful in encouraging maximum growth.

Finally, *U. paniculata* does not respond like most plants grown in containers to increased nutrient inputs. High fertilization rates, whether granular or controlled release, dramatically reduced the shoot weight of the plant. Nutrient inputs should be maintained at a minimum.

The results of these experiments suggest that, through proper management, *U. paniculata* potentially could be a successful crop for nurseries to grow.

Table I. Germination percentages of *Uniola paniculata* seeds as affected by preplant seed treatment.

Untreated control	24 b
100 ppm GA4 soak	56 a
500 ppm GA4 soak	40 ab
Distilled water soak	28 b
Scarification	24 b
Scarificafion + 100 ppm GA4 soak	16 b
Scarificafion + 500 ppm GA4 soak	8 c
Scarification + Distilled water soak	24 b

Column means with the same letter are not different based on P = 0.05.

Table 2. Shoot dry weight, root dry weight, and root/shoot ratio of *Uniola panioulata* grown under different planting depths in a 4 pine bark :1 sand (by volume) media.

Depth treatment	Shoot dry wt (g)	Root dry wt (g)	Root/shoot ratio
1 gal (Crown even with media surface)	157 a	24.2 a	0.15 a
1 gal (Crown 10 cm below media surface)	106 b	14.3 b	0.15 a
3 gal (Crown 10 cm below media surface)	144 a	12.2 b	0.08 a

Column means with the same letter are not different based on P = 0.05.

Table 3. Results of tissue analysis[z] and shoot dry weight of container-grown *Uniola paniculata* treated with various fertilizer formulations at standardized rates of 1.5 or 3 lb N/yd^3 in a 4 pine bark : 1 sand (by volume) media.

Fertilizer	g/container	Wt (g)	N	P	K	Ca	Mg	Fe	Mn	Cu	Zn
Control	---[y]	60.4 ab[x]	1.47 c	1.10 b	1.20 c	0.33 ab	0.12 ab	54.2 bc	31.0 c	3.2 bc	9.2 b
14-7-7	16.2	61.2 ab	1.67 ab	0.13 ab	1.39 bc	0.34 ab	0.13 ab	62.2 ab	47.0 ab	4.2 a	13.6 ab
14-7-7	32.4	30.5 c	1.55 bc	0.11 b	1.25 c	0.28 b	0.11 b	59.0 ab	55.6 a	3.4 abc	10.8 ab
16-7-12	14.2	79.9 a	1.45 c	0.10 b	1.33 cd	0.37 ab	0.16 a	55.2 bc	39.6 bc	3.6 ab	12.8 ab
16-7-12	28.4	24.7 c	1.69 ab	0.16 a	1.36 bcd	0.50 a	0.16 a	67.2 a	37.8 bc	4.0 ab	18.0 a
18-3-6	12.6	77.5 a	1.77 a	0.12 ab	1.51 a	0.30 b	0.14 ab	56.2 bc	35.4 bc	2.6 c	12.6 ab
18-3-6	25.2	48.5 ab	1.80 a	0.13 ab	1.45 ab	0.28 b	0.15 ab	59.2 ab	53.0 a	3.8 ab	17.0 a
Micros	3.0	34.5 c	1.44 c	0.11 b	1.32 cd	0.24 b	0.11 b	48.2 c	36.4 bc	3.2 bc	11.8 ab

[z]Results expressed as percentage for macronutrients (N, P, K, Ca, Mg) and ppm for micronutnents (Fe, Mn, Cu. Zn).

[y]The control was not topdressed with additional fertilizer, however did receive the normal nursery practice of twice weekly fertilizer-injected irrigation water.

[x]Treatments analyzed using mean separation. Column means with the same letter are not different based on P = 0.05 using least significant difference (LSD).