Table 2. Growth of sea oats (*Unicola paniculata*) in 25-cm diameter containers as influenced by potting medium composition.

Medium[z]	Average size index (N = 15)[yx]				Number of culms	
	April 30	June 18	July 16	August 13	April 23	August 27
s:uc (1:3)	44.6 a[t]	59.2 d	102.6 d	150.1 d[x]	2.3 a	29.1 d
s:uc (1:1)	46.0 a	79.7 bcd	133.6 bc	177.9 abcd[w]	2.4 a	37.8 bcd
s:uc (3:1)	42.5 a	104.8 ab	156.7 a	189.1 abc	2.2 a	35.3 cd
s:uc (0:1)	52.0 a	65.2 cd	130.2 bc	163.0 cd[v]	2.5 a	35.6 cd
s:sc (1:3)	44.4 a	84.2 bcd	131.1 bc	172.3 bcd	2.7 a	39.7 bcd
s:sc (1:1)	50.4 a	98.6 ab	157.1 a	190.9 ab	3.0 a	51.7 ab
s:sc (3:1)	44.2 a	115.6 a	165.2 a	196.5 ab	3.3 a	48.9 abc
s:sc (0:1)	46.1 a	91.2 abc	148.9 ab	183.6 abc[u]	2.7 a	42.5 bcd
HM_a	46.6 a	100.1 ab	161.7 a	205.7 a	2.6 a	58.6 a
HM_b	37.1 a	66.4 cd	115.6 cd	162.7 cd	2.7 a	33.7 d

[z]s = beach sand; uc = unscreened sewage sludge compost; sc = screened sewage sludge compost; HM_a = commercially available horticultural medium composed of peat:vermiculite:perlite:sand:composted pine bark (Metromix 300®; ratio of ingredients not released by manufacturer); HM_b = sawdust:muck ("Florida peat"):sand (5:3:2, by volume).
[y]Size index = height + [(Diam 1 + Diam 2)/2].
[t]Mean separation within columns by the Tukey test (HSD), 5% level.
[x]Mortality: 1 of 15.
[w]Mortality: 3 of 15.
[v]Mortality: 5 of 15.
[u]Mortality: 2 of 15.

to $26.75/m^3$ (1) with an average price of approximately $5.35/m^3$. Potting mixes using sewage sludge compost may prove to be an economical method of raising selected nursery plants for growers.

In general, 3 potting mixes showed significant differences in growth and culm production for sea oats. Other work in this area should include investigating the optimum potting mix component ratios for these materials and also evaluating the optimum growing time for sea oats for a variety of container sizes.

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GERMINATION OF NANDINA DOMESTICA SEED AS INFLUENCED BY GA_3 AND STRATIFICATION[1]

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Abstract. **Delayed germination of** Nandina domestica **Thunb. seed is the result of rudimentary embryo. Although seeds ripen in late winter, germination does not occur until the next fall. Treatments of 1000 ppm GA_3 for 24 and 48 hr and alternating cold-warm (4-30°C) moist stratification for 6 and 12 weeks, resulted in erratic and poor germination. Cold-warm/warm-cold and warm stratification alone had little effect. Cold stratification for 6 and 12 weeks without GA_3 pretreatment improved germination. Seeds of** N. domestica **when stored at 3-5°C remain viable and will germinate uniformly and rapidly in spring.**

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Nandina domestica, commonly known as nandina; heavenly bamboo; or sacred bamboo, is a monogeneric, monotypic taxon, in Nandinaceae (7, 10). It is frequently used as a landscape plant in north-central Florida but is cold hardy to Zone 6 (2). A slow growing plant that may reach a height of 2 m, it has bright green tri-pinnately compound leaves, which change to a red-bronze color from winter through early spring. Several erect panicles of numerous creamy-white flowers appear in August and September and are followed by masses of bright red berries in fall. Nandina is most attractive when planted in groups. Two cultivars exist; one with white berries (*N. domestica* 'Alba') and a compact dwarf form (*N. domestica* 'Atropurpurea Nana'), with consistently red leaves, often used for foundation plantings.

A consensus in most horticultural manuals is that *Nandina* can be propagated by cuttings as well as seed. The cuttings are extremely slow to root and seeds do not germinate until mid to late fall regardless of planting time (2, 4, 5). In the only known research work on propagation of nandina seeds, Afansiev (1), using a number of treat-

Table 1. Germination of *Nandina domestica* Thunb. (Treatments on the left column were followed by treatments on top, except where indicated by "a").

Treatments	Percent germination						
	Control	Cold Strat.[z] (6 wk)	Cold Strat. (12 wk)	Warm Strat.[w] (6 wk)	Warm Strat. (12 wk)	GA_3, 1000 ppm (24 hr)	GA_3, 1000 ppm (48 hr)
Control	31.66 ± 6.43[a]	—	—	—	—	—	—
Cold Strat. (6 wk)	—	69.33 ± 8.08[a]	—	34.66 ± 19.86	—	—	—
Cold Strat. (12 wk)	—	—	63.00 ± 12.53[a]	—	—	—	—
Warm Strat. (6 wk)	—	14.33 ± 10.12	—	2.00 ± 1.0[a]	—	—	—
Warm Strat. (12 wk)	—	—	—	—	0.00[a]	—	—
GA_3, 1000 ppm (24 hr)	—	28.66 ± 2.08	31.00 ± 6.11	9.00 ± 6.56	0.33 ± 0.58	19.33 ± 4.73[a]	—
GA_3, 1000 ppm (48 hr)	—	20.66 ± 2.08	28.66 ± 11.59	2.66 ± 1.53	0.00	—	17.66 ± 1.53[a]

[z]Cold stratification at 4°C.
[w]Warm stratification at 30°C.

ments (cold stratification; different planting times through the year; and application of sugar, vitamin B_1, hydrogen peroxide, potassium permanganate, or forced oxygen), concluded that stratification neither hastened the development of the embryo nor improved germination and that irrespective of the length of stratification (or lack of it), germination took place in October, November, and Decmber.' He further stated that all other treatments were equally ineffective and in all cases germination was delayed by a month.

This paper reports the results of warm and/or cold stratification as well as GA_3 treatment for various periods of time to hasten embryo development and regulate germination time.

Materials and Methods

Current year's seeds were obtained from Mr. Alan Shapiro of San Felasco Nursery, Gainesville, FL in April of 1983. These were soaked in water for 24 hr, cleaned, treated with 15% Clorox (NaOCl) solution to prevent fungal infection, and subsequently allowed to dry. Three replications of 100 seeds each were factorially moist or dry stratified in cold (4°C) and warm (30°C) for 0, 6, or 12 weeks. Another group of seeds was treated with GA_3 at 1000 ppm for 24 or 48 hr and moist stratified in warm (30°C) or cold (4°C) for 0, 6, or 12 weeks. Control replications were planted on May 1, and treated replications on June 10 and August 1, respectively. Planting medium consisted of 1:1 mixture of terralite and vermiculite. All containers were randomly placed in a propagation greenhouse (27-29°C day + 16-18°C night) under intermittent mist. Germination rate was observed weekly but the final germination count was made on December 15. One group each of dry-cold and dry-warm stratified seeds were planted on February 20, 1984 and germination count was made 4 weeks later, on March 19, 1984.

Results and Discussion

From the data in Table 1, it is evident that neither GA_3 nor warm (moist or dry) stratification resulted in better germination than control. Moist and dry cold stratification, however, appear to be equally effective in improving germination percentage and regulating germination time. Cold stratified seeds planted in February had the highest number (78%) and shortest germination time of 3 weeks.

The embryo in nandina is in early stages of development when the seeds appear mature. This was noted by Lubbock (8) and Afansiev (1) and is herewith confirmed. Further development of the rudimentary embryo, which is formed after flowering in August and September and during fruit enlargement in winter months, is arrested during the ensuing spring and summer seasons. Growth is resumed once again in early fall and germination occurs later in that season. Thus, 2 cold periods are required for continuation of embryo growth; the first occurs during the first winter when the fruit is still attached to the plant and the second in fall. The cold period that activates the enzymes necessary for the resumption of embryo development (3, 6, 9) is apparently relatively short. No significant differences were observed between 6 and 12 weeks (63% and 69%, respectively) of cold stratification. Seeds stratified for 12 weeks, however, germinated rapidly and uniformly as compared with 6 weeks. The untreated control seeds, which were planted May 1, did not begin germination until late October and had a final germination of 31% on December 15.

GA_3, which some presume to substitute for cold requirement (3, 6, 9), appeared to have a negative effect, particularly when seeds were warm stratified. The concentration of GA_3 may have been too high, resulting in some damage.

In a number of seeds examined, the embryo appeared to have aborted. This may explain the less than 100% maximum germination (69.33% in 12 week cold stratified seeds). Since it is not possible to examine every seed for presence or absence of an embryo, it is conceivable that a certain percentage of seeds were inviable.

The practical implications of this study are that seeds cleaned and stored at low temperatures and planted in spring germinate rapidly and uniformly and the resulting seedlings have the distinct advantage of a long uninterrupted growing season.

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