2. Dunn, R. A. and R. W. Henley. 1985. Nematode control for commercial nursery crops. Fla. Coop. Extension Serv. Nematology Plant Protection Pointer NPPP-22.
3. Janick, J., R. W. Schery, F. W. Woods, and V. W. Ruttan. 1969. Plant science: an introduction to world crops. W. H. Freeman and Co. San Francisco.
4. Overman, A. J. and J. P. Jones. 1986. Soil solarization, reaction, and fumigation effects on double-cropped tomato under full-bed mulch. Proc. Fla. State Hort. Soc. 99:315-318.
5. Raymundo, S. A. and J. Alcazar. 1986. Increasing efficiency of soil solarization in controlling root-knot nematodes by using two layers of plastic mulch. J. Nematol. 18:628.
6. Sasser, J. N., and C. Cameron-Carter. 1982. Root-knot nematodes (*Meloidogyne* spp.): Identification, morphological and physiological variation, host range, ecology, and control, p. 21-31. In: R. D. Riggs (ed). Nematology in the southern region of the United States. Southern Coop. Series Bull. 276.
7. Slack, D. A. and R. D. Riggs. 1982. The bud and leaf nematodes, p. 180-181. In: R. D. Riggs (ed). Nematology in the southern region of the United States. Southern Coop. Series Bull. 276.
8. Stapleton, J. J., and J. E. DeVay. 1984. Thermal components of soil solarization as related to changes in soil and root microflora and increased plant growth response. Phytopath. 74:255-259.
9. Stapleton, J. J., B. Lear, and J. E. Devay. 1987. Effect of combining soil solarization with certain nematicides on target and nontarget organisms and plant groth. Ann. Appl. Nematol. 1:107-112.
10. Thomason, I. J., S. D. Van Gundy, and H. E. McKinney. 1960. Thermotherapy for root knot nematodes, *Meloidogyne* spp., of sweetpotato and tarragon propagating stocks. Plant Disease Reporter 44:354-358.

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PROPAGATION TECHNIQUES FOR FIVE ENDANGERED SAND SCRUB SPECIES

NANCY J. BISSETT
The Natives, 453-C Champane Road
Davenport, Florida 33837

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Abstract. **Several seed and cutting propagation techniques were tested for *Prunus geniculata* Harper, *Warea carteri* Small, *Warea amplexifolia* (Nutt.) Small, *Dicerandra cornutissima* Huck, and *Dicerandra immaculata* Lakela. All five are listed as federally endangered and are endemic to parts of central Florida's sandhills or sand scrub. *Prunus geniculata* germinated best after a period of cold moist stratification. Both warea's, which are annuals, germinated easily from seed, but are susceptible to damping-off fungi and phytotoxicity from pesticides. Cuttings of *D. cornutissima* taken in July and treated with a weak hormone solution developed stronger root systems than those not treated. Cuttings treated similarly for *D. immaculata* showed no significant difference when treated with hormone. Both species showed little difference from December cuttings.**

The major threat to Florida's endagered plant species is loss of habitat caused largely by human development and a secondary threat is collection from the wild. Though preservation of habitat is the most critical concern, another alleviation of the problem is to bring these plants into cultivation in a manner in which a wide range of the genetic diversity of each species is retained. The Center for Plant Conservation, a national organization with member gardens throughout the country (2), as well as many private nurseries have been working on propagation techniques.

Bok Tower Gardens, a member of the Center for Plant Conservation, has sought to bring many rare and endangered species from central Florida's sand pine scrub and sandhill into cultivation. The sand pine scrub community is most frequently found on white sand that is acid and excessively well-drained. Characteristic plants include sand pine, several scrub oaks, rusty lyonia, saw palmetto, scrub palmetto, prickly pear, rosemary, several subshrub mints, and buckwheats. Many species, including 4 of the 5 described here, are endemic to central Florida's scrub (1, 3).

The sandhill typically occurs on rolling hills of deep yellow well-drained acid sands with a dominant vegetation of turkey oak and longleaf pine with a grassy and herbaceous understory. In this form it is a fire-based community with fires occuring every 2 to 5 years. Where fire is excluded more shrubby species are found. Most sandhill communities have been converted to citrus groves and residential developments. *Warea amplexifolia* is among those species endemic to the sandhill (1, 3).

All five species have been listed as endangered by the U.S. Fish and Wildlife Service. Both *Prunus geniculata* and *Warea amplexifolia* exist in the natural areas at Bok Tower Gardens. All five are found only in central Florida.

Propagation of these plants to increase chances of survival is encouraged, but propagation material should be taken from previously propagated plants if at all possible. To collect seeds and cuttings from the wild, owner permission is required and both the Florida Division of Plant Industry and the U.S. Fish and Wildlife Service should be consulted.

Prunus geniculata

Prunus geniculata, scrub plum, of the Rosaceae is a heavily branched shrub averaging 3 feet tall with strongly zigzag twigs, deciduous leaves, white five petalled blooms in spring and sweet, juicy reddish plums that are born in April. It occurs in scrub and sandhill ecosystems in Lake, Polk and Highlands Counties.

Both seed and cutting propagation were attempted. Cuttings taken mid-June failed because of a leaf disease in the mist bed. Some callousing and a few roots had formed and this method should be tried again. Hormone treatments did not appear to help or hurt. Since *P. geniculata* is not a vigorous shrub, it is suggested that cuttings be taken from young shrubs or those that have regenerated after fire of after having been cut back.

This project was supported by Bok Tower Gardens as a member of the Center for Plant Conservation.

Seed was collected in April and cleaned June 8 using a blender and flotation. Seed that floated was separated out. One lot was sown immediately as well as the seed lot that floated. Another lot was sown after drying 2½ weeks and another lot was stratified at that point for 2 months and then sown. A final lot was sown without cleaning.

Some of the seed was eaten from the seed trays by varmints, thus distorting results. None of the seed that floated germinated. Stratifying the seed vastly increased germination, though not all germinated seed grew after sowing. Uncleaned seed germinated more slowly and continued to germinate after the mid-October potting. A sand mix of 2 parts sand and 1 part styrofoam in the seed trays produced more vigorous root systems and less seedling death than a standard potting soil (Table 1).

Warea carteri

Warea carteri, Carter's mustard, of the Brassicaceae (mustard family) is a single-stemmed annual 2 to 3 feet tall whose flowering clusters resemble the garden flower cleome or spider flower. Simple, alternate leaves 1/2 inch long diminish in size upward on the stem. Each plant produces many racemes of white four-petalled flowers maturing to downward curved seed pods 2 inches long and slender, thus resembling a many legged spider. It had been known from Dade County rock pinelands and scrub but is now known in only a few locations in Brevard, Polk, and Highlands Counties in scrub and scrubby flatwoods. A site does not consistently produce a population each year.

Seed was collected from a site with 48 plants at harvest time on November 26. Some plants died before bearing seed. An estimated 1/6 of the total seed or 13,000 seed were collected. This means approximately 78,000 seed were produced from the 48 plants or 1625 seed per plant. One grain equaled 169 seed (1 ounce equals 437.5 grains.) Four trays with a sand styrofoam mix were sown with 6 grains or approximately 1000 seed each on December 9. By December 17 the seed had begun to germinate. On December 30 seed germination averaged 188 per tray. Metalaxyl was sprayed to prevent damping off. By February 20 diazinon was sprayed on half of the plants because of aphids and the plants showed evidence of phytotoxicity but they did recover.

Warea amplexifolia

Warea amplexifolia, Clasping warea also of the Brassicaceae, is similar to *W. carteri* though showier with large lavender flowering clusters and slightly glaucous auriculate-clasping leaves. It is known from only a few locations in Lake and Polk Counties, including Bok Tower, on longleaf pine and turkey oak sandhills.

The seed was collected at the end of November and cleaned using a blender and winnowing. One grain equaled 466 seed. Seed was sown as in *Warea carteri* on December 9. By December 14 seed had begun to germinate. On December 30 seed germination in trays of 1000 averaged 200. The seedlings were showing signs of damping off and metalaxyl was sprayed. The fungicide seemed to control damping off but seedlings and potted plants continued to die even though seed trays and potted plants were kept separated throughout the greenhouse. Plants that were eventually delivered to Bok Tower gardens of both species of *Warea* succumbed to insect and disease despite pesticide control efforts.

Dicerandra cornutissima

Dicerandra cornutissima, Longspurred balm, of the Lamiaceae (mint famiy) is a half woody, half herbaceous plant one foot tall with narrow, 3/4 inch long leaves of a very strongly minty odor and abundant purple-rose flowers on erect flowering shoots in fall. In the winter when the flowering shoots have died away it is a small mounded mat of bright green leaves. This dicerandra is only found on a few-square miles in Marion County on yellow sand scrub. It has reseeded abundantly on road cuts in residential developments.

Seed propagation was attempted from seed collected mid-December with no germination. Seed propagation has been successful for Robin Huck with seed collected earlier in the season. (Robin Huck, South Merritt Island, Florida, personal communication)

Cuttings were taken July 1 from 58 parent plants. The cuttings from each parent plant were kept in a separate bag and assigned a number so that eventually only one clone from at least 50 different parent plants would be placed in the garden for greater genetic variability. The cuttings from each bag were divided into 2 groups. One group was treated with Roottone, a commercial talc prep-

Table 1. *Prunus geniculata,* scrub plum seed propagation.

Tray	Collected	Clean	Dry	Stratified	Sown	Soil Mix	Varmint trouble	Sank or Floated	Sown	If stratified geminated when sown	Not germinated when sown	Potted	Potted
1.	4-86	6-8-86	—	—	6-9-86	Peat	yes	S	200	—	—	10-14-86	12
2.	4-86	6-8-86	—	—	6-9-86	peat	yes	F	51	—	—	—	0
3.	4-86	6-8-86	6-25-86	—	6-25-86	sand	some	S	150	—	—	10-14-86	15
4.	4-86	6-8-86	6-22-86	(6-22-86-8-25-86)	8-25-86	peat	no	S	144	100	44	10-14-86	32/59
Additional seed collection, not part of Center for Plant Conservation collection													
5.	4-19-86	6-8-86	—	—	6-9-86	peat	yes	S	100	—	—	10-14-86	13
6.	4-19-86	6-8-86	—	—	6-9-86	peat	yes	F	100	—	—	10-14-86	1
7.	4-19-86	6-8-86	6-25-86	—	6-25-86	sand	some	S	100	—	—	10-14-86	11
8.	4-19-86	6-8-86	6-22-86	(6-22-86-8-25-86)	8-25-86	peat	no	S	105	59	46	10-14-86	44
9.	4-86	no	—	(6-22-86-8-25-86)	8-25-86	peat	no	—	57	2	55	10-14-86	1

Table 2. *Dicerandra cornutissima,* longspurred balm, vegetative propagation with Roottone rooting hormone.

Treatment	No. rooted after 59 days	% rooted after 59 days	Total no. alive after 162 days	% alive after 162 days
No hormone applied (N=268)	134	50.0	19	3.5
Hormone applied (N=281	238	84.7		

Table 3. *Dicerandra immaculata,* Lakela's mint, vegetative propagation with roottone rooting hormone.

Treatment	No. rooted after 67 days	% rooted after 67 days	Total no. alive after 158 days	% alive after 158 days
No hormone applied (N=420)	284	67.6	68	7.9
Hormone applied (N=437	293	67.0		

aration hormone, and the other was not. The trays were placed in an open mist bed with minimum mist needed to keep foliage wet. Only 30 of the 58 parent plant cuttings were examined, and of these untreated cuttings rooted less than 50% whereas hormone treated cuttings rooted 84.7%. The cuttings treated with hormone also had more new growth and the roots were generally longer and more abundant. This was a visual evaluation only. Within one week after potting the cuttings most of the plants had died. There was no apparent cause other than stress from disturbing the root system by taking from a common rooting tray (Table 2).

Cuttings were again taken on December 12. At this time of year seeding was almost finished and the plants exhibited much new fresh growth. Cuttings were taken from 64 parent plants with 12 cuttings taken per plant. Plants were again divided and treated as above and placed 2 each to a 3½ inch pot. No root examination was done however 70% of those treated with hormone and 72% of those not treated formed new plants and were established from the growing containers to the garden without loss.

Dicerandra immaculata

Dicerandra immaculata, Lakela's mint, is another small subshrub mint that has a mounded form 15 inches high. The spotless lavender flowers are larger and showier than *D. cornutissima,* and also occur on erect stems in fall. This plant also has a strong mint odor and is so showy it would make an excellent garden plant. It is found only in an area 1/2 mile by 3 miles in the Vero Beach area in sand scrub ecosystems.

Seed propagation was attempted as for *D. cornutissima* and again there was no germination.

Cuttings were taken July 4 from 60 individual plants with 16 cuttings each and were treated as for *D. cornutissima,* including Roottone. On September 10 the cuttings were examined and potted on to quart containers. There was no significant difference in the rooting between hormone treated and not treated or in the quality or quantity of the root systems. Within a couple of weeks of transplanting most of the plants had died. Again no cause seemed apparent except disturbance of the root system from transplanting (Table 3).

Cuttings were taken again on December 22. Good cuttings were fairly easily obtained from new basal growth though it was not as dense or as vigorous as those obtained from *D. cornutissima.* Approximately 12 cuttings were taken from each of 61 parent plants and similarly divided and half treated with hormone. The cuttings were placed 2 to a pot in 3½ inch pots filled with 2 parts sand and 1 part styrofoam mix. Roots were not examined, however 53% of those treated with hormone and 47% of those not treated formed new plants and were established in the gardens.

Literature Cited

1. Duever, L. C. 1983. Natural communities of Florida's inland sand ridges. The Palmetto 3(3):1-3.
2. Shaw, Jonathan A. 1985. Preserving Florida's and the Nation's endangered plants. Proc. Fla. State Hort. Soc. 98:314-316.
3. U.S. Dept. Agr. Soil Conservation Service. Twenty-six ecological communities of Florida.