Propagation, Production, and Landscape Evaluation of Native Wildflowers in West, Central and South Florida, 2010
Condensed Progress Report

1. Project Investigators

Sandra B. Wilson, Professor
Department of Environmental Horticulture
Indian River Research and Education Center
University of Florida
2199 South Rock Road
Fort Pierce, FL 34945
sbwilson@ufl.edu

Hector Perez, Assistant Professor
Department of Environmental Horticulture
PO Box 110670
University of Florida
Gainesville, FL 32611
heperez@ufl.edu

Mack Thetford, Associate Professor
Department of Environmental Horticulture
West Florida Research and Education Center
University of Florida
5988 Highway 90, Building 4900
Milton, FL 32572
thetford@ufl.edu

2. Project Description (intent, goals, objective)

A team of 3 UF faculty with specialized research and education expertise in plant propagation were funded by The Florida Wildflower Foundation with the overall objective of introducing new or underutilized native plants into our nursery and landscape industry. We selected ten native wildflower species to study using the following criteria: (1) plants have high ornamental potential for consumer demand and successful marketing and distribution, (2) plants have a functional value for dune stabilization or restoration, wildlife cover, or wildlife food source, (3) plants have been identified by native growers as good research candidates for improved germination, rooting or establishment, (4) plants are native to areas associated with natural ecosystems near one or more of the investigators research sites with known sources for permit approval and collection. See Table 1 for plant list. Specific objectives were to:

- evaluate the most optimal method of propagating selected native wildflowers that have ornamental potential but are underutilized in the landscape.

- improve plant quality by assessing container production practices such as media composition, irrigation frequency, fertilization, plant number per pot, and pruning.

- evaluate plant establishment and performance in west, central and south Florida landscapes.

3. Research progress at each site

Fort Pierce

Collection sites were identified for all ten species, collection permits were acquired, GPS coordinates were recorded, and seeds were collected when appropriate (Table 2; Figure 2; Figure 3). Steve Woodmansee (Biologist, The Institute for Regional Conservation, Miami, FL), Kari Ruder (Owner, Naturewise Plants, Cocoa, FL), and Nancy Bissett (Owner, The Natives, Davenport, FL) were contacted

to assist with identification/collection in south/central Florida. Detailed digital photos were taken of each species to illustrate plant form, flower, and seed structure (Figure 1). Seeds were air dried, cleaned, and counted. Seeds with visible damage were discarded. A subsample of seeds (2 reps of 100) were subjected to pre-germination viability tetrazolium tests (for methods see Table 3). An additional 400 seeds (4 reps of 100) were germinated in petri dishes at 20 C and an 8-hr photoperiod, unless otherwise indicated (Table 3). Un-germinated seeds were tested for viability to calculate percent dormancy (Table 4). To generate a containerized population for field trials, an additional subsample of seeds (100) were sown in propagation half flats filled with Fafard Superfine Germinating Mix for 28 days.

Additional germination studies were performed using scarified (18 M acetic acid, 5 min) and non- scarified seed (*Callisia ornata*, *Chrysoma pauciflosculosa*, *Dalea feayi*, *Heliotropium curassavicum*, *Licania michauxii*, *Polygonella macrophylla*, *Polygonella polygama*, *Polygonella robusta*) placed in petri-dishes within incubators set at 20/10, 25/15, 30/20 and 35/25 C and a 12 hr photoperiod. Results are presented in Table 5. Unscarified *C. pauciflosculosa* had greatest germination (37.5%) at 20/10 ^{o}C. Seeds were not subjected to acid treatments. *D. feayi* had greatest germination (71%) when acid scarified and incubated at 25/15. Less than 3.5% of unscarified seeds germinated, regardless of temperature. *H. curassavicum* also had greatest germination (56.5%) at 25/15 ^{o}C, if not scarified. For *Licania michauxii*, seed viability was 84% with 82% germination. At 20/10 ^{o}C only 21% of seeds germinated, however at 30/20 ^{o}C 50% of seeds germinated under controlled conditions. Acid scarification degraded the embryo and was detrimental to germination. Greatest germination of *P. macrophylla*, *P. polygama* and *P. robusta* was achieved at 20/10 ^{o}C. Higher temperatures decreased germination of each species. Scarification decreased germination of *P. polygama* and *P. robusta*, but improved germination of *P. macrophylla*, regardless of temperature.

Cuttings of all species (except *P. macrophylla* and *C. pauciflosculosa*, which are only native to west FL) were collected (Table 6) and shipped to Milton for vegetative propagation experiments.

Each species was evaluated in landscape trials located in north, central and south FL. At each site, raised beds were prepared with landscape fabric and drip irrigation. Initial soil samples were analyzed and presented in Table 7. Seeds of each species were sown in cells and the finished plugs were transplanted into 1 gal pots with soilless media. Finished plants were distributed to GNV and Milton and planted July 14 2009 at all 3 sites. Plants were arranged in a completely randomized block design with 3 plants replicated in 3 blocks (Figure 6). At planting, initial growth index and visual quality assessments were recorded. Each month, visual quality and flowering were recorded. Visual quality was based on a scale of 1-5, where 1= Very poor quality - Not acceptable, severe leaf necrosis or yellowing, not marketable, dead or almost dead; 2= Poor quality - Not acceptable, sparse/uneven form, leaf yellowing, unhealthy appearance, not marketable; 3= Fair quality - marginally acceptable, somewhat desirable form and color, moderately healthy; 4= Good quality - very acceptable, minor flaws, nice color without yellowing, good form, healthy and vigorous, marketable; and 5= Excellent - Perfect condition, premium color and form, extremely healthy and vigorous, very marketable. Flowering was based on a scale of 1-5, where 1= No flowers or flower buds; 2= Flower buds visible, no open flowers; 3= One to several open flowers; 4= Many open flowers, average to good flowering; and 5= Abundant flowering, possible peak bloom. Results are shown for vegetatively propagated plants from April 2009 to April 2010 in Fig. 4. Results are shown for seed propagated plants from July 2009 to April 2010 in Fig.5. The trials are still in progress, but the graphs clearly show flower impact, flower longevity, visual quality, and cold hardiness of wildflowers among sites.

A phenology study was conducted for *Licania* on Sept 17 2009. *Licania* fruit was collected (9-4-09, Martin County) and soaked in water overnight. Mesocarp tissue was partially removed using a hose, and seed was placed on screen to dry for 48 hr. Seed was shipped to Gainesville and Milton. Dillon half flats were filled with sand. 40 seed were placed in each flat subjected to 2 treatments (buried or

partially buried) at each of 3 sites (Fort Pierce, Gainesville, Milton). There were 20 seeds per treatment replicated 5 times (in flats). Flats were watered, covered with wire mesh to prevent predation, and placed on a bench outside in full sun. Plants were watered once or twice per week only if a natural rainfall event did not occur. Germination was checked once a week as indicated by cotyledon emergence; existing radicle emergence was documented in December, prior to freezing temperatures. Radicle emergence was noted in Milton prior to winter. Regardless of partial or full burial treatment, no cotyledon emergence was noted at any site. This experiment is still in progress, however it is suspected that seeds have decayed.

A containerized media study was conducted on 23 Sept 2010. Coastalplain honeycombhead (*Balduina angustifolia*), Florida scrub roseling (*Callisa ornata*), bush goldenrod (*Chrysoma pauciflosculosa*), Godfrey's goldenaster (*Chrysopsis godfreyi*), Feay's prairieclover (*Dalea feayi*), gopher apple (*Licania michauxii*), largeleaf jointweed (*Polygonella macrophylla*), October flower (*Polygonella polygama*), and largeflower jointweed (*Polygonella robusta*) were transplanted into containers filled with one of four commercially available media (Table 11). Atlas 3000 is composed of 40% peat, 50% pine bark, and 10% coarse sand. Atlas 7000 is a mix typically used for native palms that is composed of 40% peat, 30% coarse sand, and 20% cypress dust. Fafard 3B, a more readily available medium, is composed of 45% peat, 25% pine bark, 10% vermiculite, and 20% perlite. Metro Mix 300, a favored medium amongst native growers, is composed of 15% peat, 35% pine bark, 35% vermiculite, 10% perlite, and 5% bark ash. Physical and chemical properties of the four media ranged from 48-76% moisture content, 3.3-5% air filled porosity, 60-68% total porosity, 55-61% container capacity, 0.13-0.55 $g \cdot cm^3$ bulk density, 0.33-1.3 $g \cdot cm^3$ particle density, 5.8-6.9 pH, 0.09-0.79 mmhos·cm electrical conductivity (EC), and 2.9-14.5 $meq \cdot 100g^{-1}$ cation exchange capacity (CEC) (Table 12-13). Plant growth is being measured every month. Finished 1-gal plants of each treatment and species will be transferred to the field in a randomized complete block design and evaluated for landscape performance in the Spring.

Gainesville

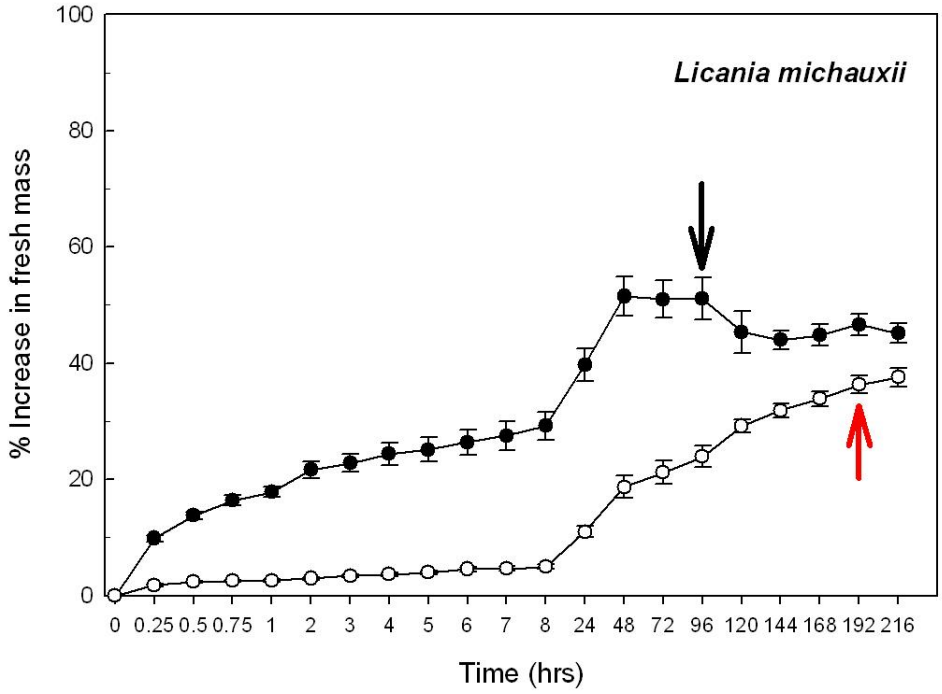
Balduina angustifolia. Initial germination of Coastalplain honeycomb was conducted on 3/31/08 with seeds collected on 2/09/08 from Scrub Oak Preserve, Martin County. Pre-germination TZ was not carried out due to limited number of seeds. The following treatments were used: 33/24, 29/19, 27/15, and 22/11^{o}C light and dark which represent Florida's day/night temperatures. Four replications using 12 seeds/rep were used. The experiment was carried out for 4 wks and the data for dark treatments was collected at the end of the four weeks. No germination was observed at higher temperatures, 33/24 and 29/19 under light regime, or in any temperature in the dark. Results showed very low germination percentages at lower temperatures under light, 27/15 (2%) and 22/11 (4%), and 27/15 dark (2%). Post-TZ results of 6% viability confirmed low seed viability due mainly to empty seeds, and black/mushy embryos. Seeds are likely to have been collected before they matured. Cold stratification of 75 seeds each at 4^{o}C for 4 and 8 wks were initiated on March 31, 2008. Seeds were placed in petri dishes with blue blotter papers to germinate on a heating mat at 25^{o}C (=77^{o}F) on the lab bench. Lights were left on during the day and turned off at night.

An experiment to measure germination timing under natural conditions was expected to start with seeds collected in December 2009-January 2010. This germination phenology experiment will consist of three treatments: seeds sown on the soil surface; seeds partially buried in the soil, and seeds buried 2 cm in the soil profile. Environmental conditions such as air temperature, relative humidity, soil temperature, and soil moisture will be recorded to determine the effects of these variables on germination. Germination counts will occur on a weekly basis. Several sites were visited but substantial quantities of seed were not found. New sites with better populations are being identified.

Chrysoma pauciflosculosa. Initial germination of Woody goldenrod was conducted on 4/07/08 with seeds collected on 12/06/07 at Pensacola Beach, FL. Pre-germ test on plump and skinny seeds were 15% and 9%, respectively. We used 25 seeds per replication for a total of 4 reps for each treatment. Under light, very low germination percentages of 1% in 33/24, 29/19 and 22/11^{o}C; 4% at 27/15 were obtained. Only 1% germination was observed in 22/11^{o}C dark. There was no germination at all for the skinny seeds. Average post-TZ of 9% and 1.6% was obtained for plump and skinny seeds, respectively. Cold stratification of 100 seeds each at 4^{o}C for 4 and 8 wks on plump and skinny seeds were initiated on 4/02/08. Seeds were submitted to germination tests at the conclusion of the stratification period; however, no germination was observed after 4 weeks of incubation. In a later study, fresh seeds were collected November 2009 from several sites (Table 2), cleaned, and subjected to viability and germination tests. Seed viability was 51% with only 13% germination after 14 days. However, we found that woody goldenrod prefers cooler temperatures to germinate, as germination increased from 1.5% at 35/25 ^{o}C to 37.5% at 20/10 ^{o}C after 28 days.

***Licania michauxii*.** Initial germination and imbibition tests were conducted on Gopher Apple. Fruits were collected from a native stand in Jonathan Dickinson State Park on 08-21-08 and tested within 4 weeks of collection. Non-scarified seeds and fruits (seeds + endocarp) were placed in 35 mL of water and fresh mass determined at regular intervals. After 10 days, fruits and seeds increased in fresh mass by about 45 and 30% respectively, suggesting that imbibition occurs, but slowly. Slow imbibition may be the result of water penetrating through the large seeds. Regardless of slow imbibition, all viable seeds germinated by day 10. No physical dormancy is present in seeds of *L. michauxii*.

Germination of seeds was tested at four simulated seasonal temperature regimes in the light and dark. Endocarps were removed with a boning knife. Seeds were treated with ferti-lome Halt systemic fungicide (3 tsp/gal) for 30 min and air dried prior to placement in petridishes filled with play sand. Five replicates of nine seeds were used for each treatment combination. After 4 weeks under alternating light, germination was 96.7 ± 3.3 (mean ± SE), 74.3 ± 6.9, 62.1 ± 17.6, and 53.5 ± 11.6% at alternating temperatures of 33/24, 29/19, 27/15, and 22/11°C, respectively. Interestingly, germination after 4 weeks ranged from 86 to 93% at all temperature regimes in the dark. Such high germination percentages, over a variety of simulated environmental conditions, suggest that fresh seeds are non-dormant upon shedding. Furthermore, the germination response seems to be promoted at higher temperatures in the light. The interaction of germination temperature and illumination needs to been explored further.



Increase in fresh mass of *Licania michauxii* endocarps with seeds (solid circles) and seeds without endocarps (open circles). Black and red arrows denote endocarp sloughing and onset of germination, respectively. All viable seeds had germinated at 216 h of imbibition. Remaining seeds had rotted from within at this time. No germination was observed for endocarps.

	% Germination ± (SE)		Mean time to complete germination in weeks ± (SE)
Season	Light	Dark	Light
Winter (22/11°C)	53.5 (11.6)	93.3 (4.4)	3.8 (0.1)a
Spring (27/15°C)	62.1 (17.6)	86.0 (6.5)	2.4 (0.1)b
Fall (29/19°C)	88.3 (5.3)	74.3 (6.9)	2.9 (0.2)b
Summer (33/24°C)	96.7 (3.3)	92.2 (4.8)	1.4 (0.1)c

Initial germination of *Licania michauxii* seeds (endocarp removed) tested under simulated Florida seasonal temperatures and 12 h alternating light or darkness for 28 d. Seeds were collected on 8/21/08 from Jonathan Dickinson State Park and tested for initial germination beginning on 9/11/08.

Polygonella polygama and ***Polygonella robusta***. Octoberflower seed were collected from a native stand in Wauchula, Florida and Largeflower jointweed from Hobe Sound, Florida. Before germination tests began, seed viability was examined using the Triphenyltetrazolium chloride (TZ) test. A germination test was conducted by incubating seeds at simulated seasonal temperatures. The 12-hr alternating temperatures represented seasonal conditions throughout Florida (22/11°C, 27/15°C, 29/19°C, and 33/24^{o}C). Four replicates (n = 25) received the light treatment while an additional four replicates were incubated in the dark. After four weeks, un-germinated seed were tested for viability. Pre-germination viability was fairly high (65%) in *P. polygama* compared to a lower *P. robusta* (47%). Highest germination of 15% (*P. polygama*) and 58% (*P. robusta*) was achieved at 22/11.

To measure the permeability of the seed coat, an imbibition test was done using mechanically scarified and non-scarified treatments. Increases in fresh mass were calculated over a 48 hr period using the formula $W_i = [(W_i - W_n)/ W_n] \times 100$, where W_i and W_n are the masses of imbibed and non-imbibed tissues (T_0), respectively. A completely randomized design was used for this study. Results showed a steady increase in weight in both species, indicating a regular uptake in water for both nicked and not nicked seeds (Figure A).

To further investigate potential physical dormancy of the fruit or seed coat, a light microscopy study was used. The seeds were sectioned using a microtome and stained with Toluidine Blue. To investigate the potential of an underdeveloped embryo (morphological dormancy), longitudinal sections were taken. The images of (n = 10) seeds were measured to determine the seed:embryo ratio. To further investigate occurrence of physical dormancy, seed coats were sectioned and examined for the presence of thickened or lignified walls. Palisade layers of macrosclerids or osteosclerids were not observed. Seed coats were one to two cells thick. Together, these two experiments indicate a lack of dormancy imposed by the seed coat. Morphological dormancy was examined also using light microscopy. Both *P. polygama* and *P. robusta* had embryo:seed ratios of 0.9:1.0 indicating that the seed embryo was fully developed and morphological dormancy does not exist (Figure B).

The presence of physiological dormancy was investigated using gibberellic acid (GA_3). This study was carried out using four (n = 25) replicates with GA_3 solutions of 0, 1, 10, 100, or 1000ppm for 24 hr. All were incubated at 22/11^{o}C with a 12-hr photoperiod. Data was collected once a week for four weeks. When the seeds were treated with 1000ppm of GA_3 the total germination percentage was highest for both species (*P. polygama* = 26% and *P. robusta* = 53%) (Figure C).

A "Move-Along" experiment was used to determine the extent to which seeds require warm- or cold-stratification. Treatments consisted of four control chambers set to 22/11, 27/15, 29/19, or 33/24°C and a summer and winter move-along. Throughout one year, temperatures were adjusted as follows to represent changes in seasonal temperatures in the move-along chambers. Germination data was collected once per week. Results show that germination increased significantly when warm stratified first before being placed in cooler temperatures (Figure D).

Experiments were conducted to determine if *P. polygama* and *P. robusta* can be propagated by cuttings. Softwood cuttings (approximately 10 cm long) of *P. polygama* were collected in Haney Creek Preserve (South Florida) on August 28, 2008. Softwood cuttings (approximately 10 cm long) of *P. robusta* were collected from two sites; Jonathan Dickinson State Park (South Florida) on July 21, 2008 and Fort Cooper State Park (Central Florida) on July 30, 2008. Cuttings were quick dipped in the following 1-Naphthaleneacetic acid (NAA) and indole-3-butyric acid (IBA) auxin treatments:

IBA Concentration (ppm)	NAA Concentration (ppm)		
	0	250	500
0	0 , 0	0 , 250	0 , 500
500	500 , 0	500 , 250	500 , 500
1000	1000 , 0	1000 , 250	1000 , 500

For the first 2 weeks, cuttings received overhead mist at 8 sec every 10 min. From 3-6 weeks (3-8 weeks for *P. polygama*) cuttings received overhead mist for 5 sec every 20 min. Rooting data were collected after 6 weeks (*P. robusta*) or 8 weeks (*P. polygama*). Rooting was assessed using 4 factors: percent rooting, number of roots, longest root length, and a visual root quality rating (rooting index). The scale for rooting index was 1= dead, 2= alive without roots, 3= light rooting, 4= medium rooting, 5= heavy rooting that when pulled from the cell holds onto media and remains intact. The experiment was arranged in a randomized complete block design with 6 cuttings per treatment replicated 5 times. Data were analyzed using SAS (2000) and significant means separated using Duncan's multiple range test at $\alpha = 0.05$.

Up to 80% rooting and a 3.6 root index was achieved from *P. robusta* cuttings collected from the south FL site and treated with 500:1000 ppm NAA:IBA (Figure F). Higher auxin concentrations of 1000:1000 NAA:IBA or 1000:2000 NAA:IBA decreased percent rooting as compared to 500:1000 NAA:IBA, but were not significantly different from the other treatments. When *P. robusta* cuttings were collected from the central FL site, only 3 to 27% rooting was achieved, regardless of treatment. Cuttings from each site were collected within a week of each other using similar criteria, thus emphasizing the impact location can have on rooting success. For *P. polygama*, up to 63% rooting was achieved when cuttings were treated with 500:2000 NAA:IBA (Figure E). However, this was not significantly greater than the untreated controls (53% rooting). It is possible that 2000 ppm IBA was not a high enough concentration to improve rooting.

Figure A. Imbibition rates as described by increase of fresh mass of *Polygonella polygama* (top) seeds when nicked (open circles) and not (solid circles) as compared to *Polygonella robusta* (bottom) seeds when nicked (open circles) and not (solid circles) kept at constant incubation of 27^{o}C.

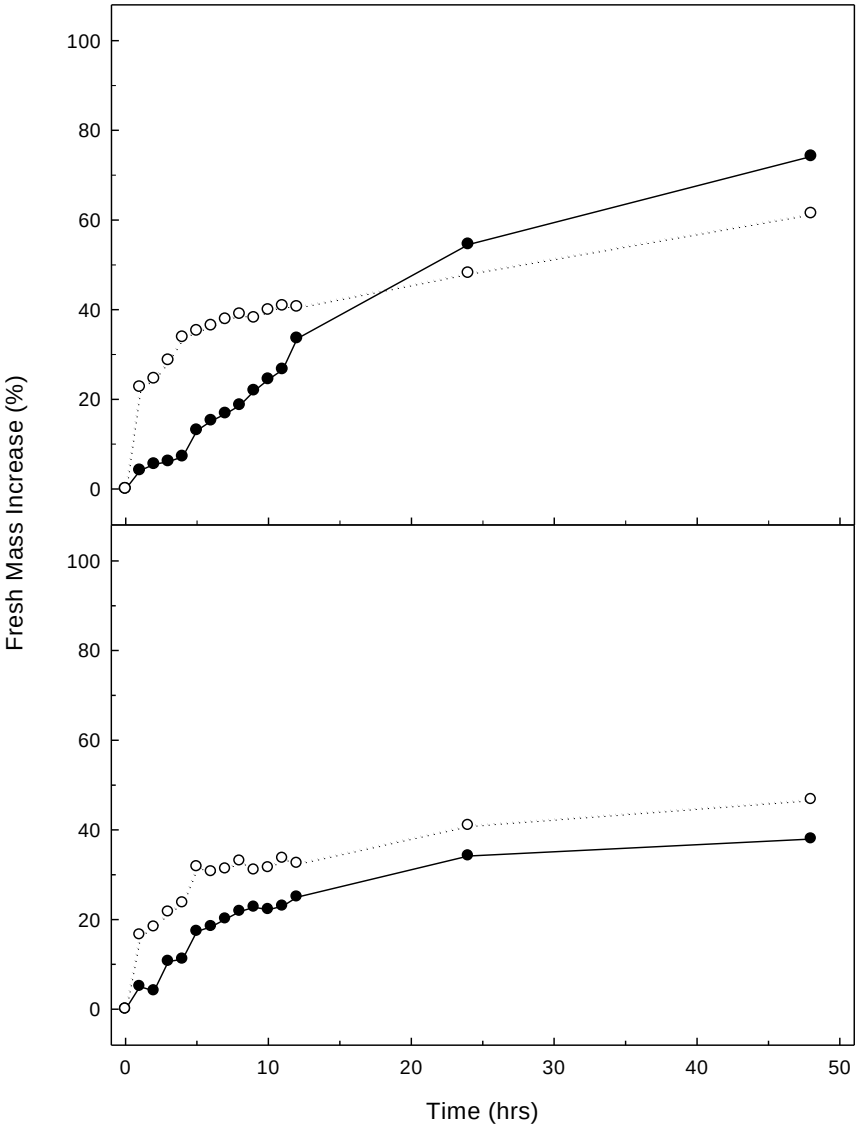


Figure B. The photos taken here represent the typical a) embryo to seed ratio and b) seed and fruit coat and in *Polygonella polygama.*

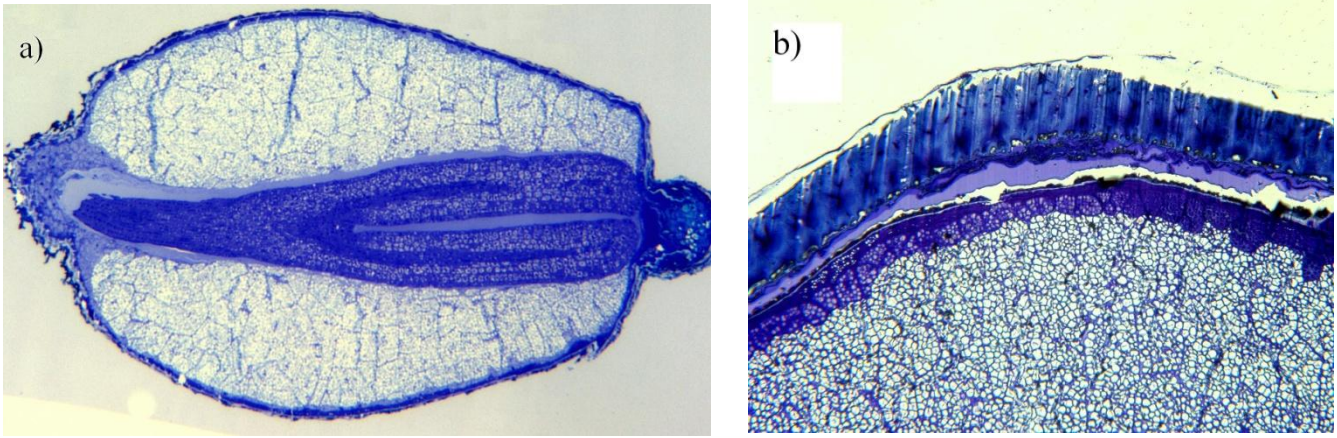


Figure C. Germination of *P. polygama* (top) and *P. robusta* (bottom) seeds after soaking for 24 hours in varying concentrations of GA_3 and subsequent incubation at the constant temperature of 22/11^{o}C. Treatments were 0 ppm GA_3 (filled circles), 1 ppm (open circles), 10 ppm (filled triangles), 100 ppm (open triangles), and 1000 ppm (filled squares). Standard error represents the variation over the four replicates.

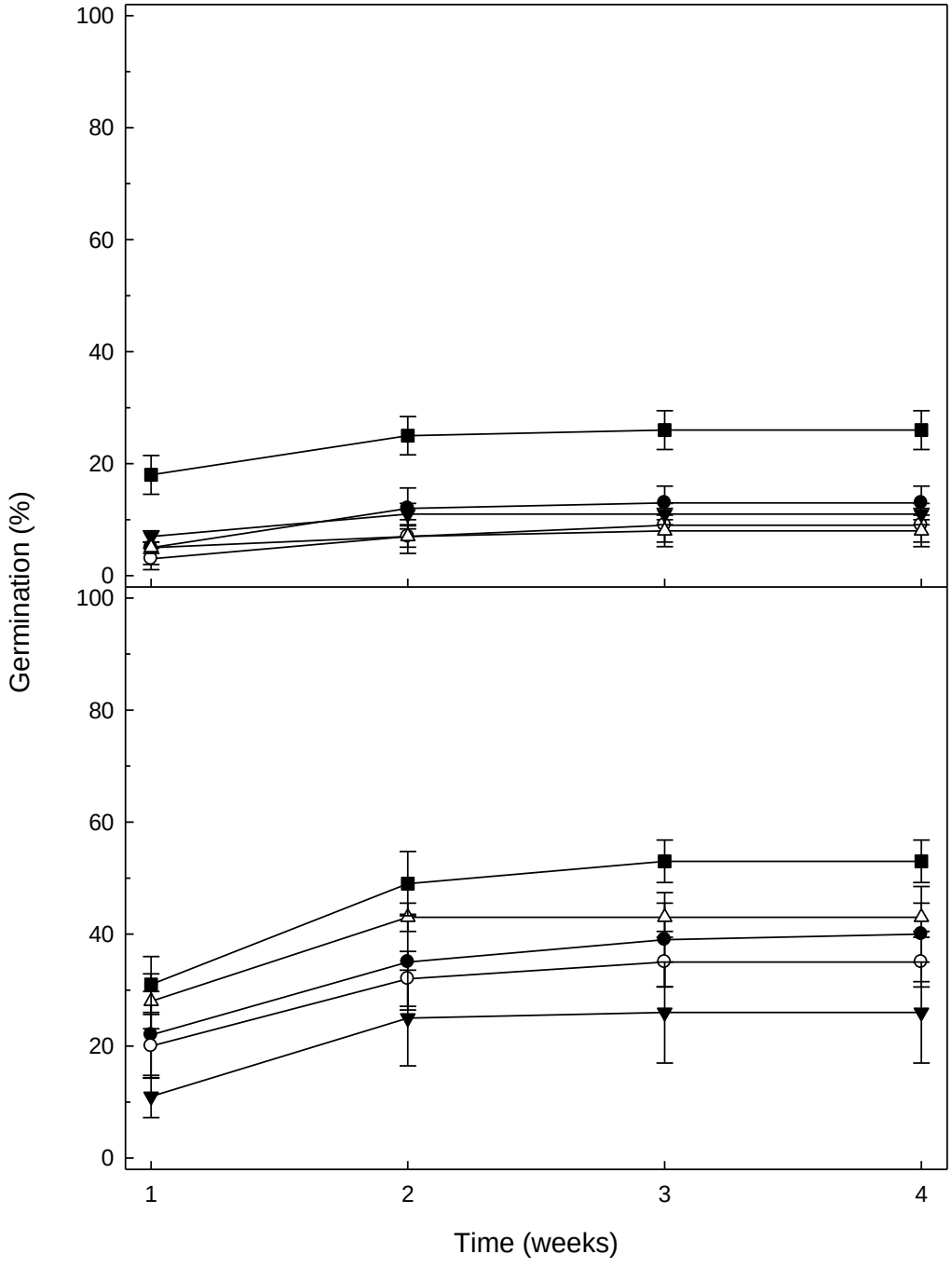


Figure D. Germination of *P. polygama* and *P. robusta* seed germinated at 4 temperatures, or subjected to seasonal fluctuations where Summer= 33/24 (12wks)+ 29/19 (4wks)+ 27/15 (4wks)+ 22/11 (12wks), and Winter= 22/11 (12wks)+ 27/15 (4wks)+ 29/19 (4wks)+ 33/24 (12wks) .

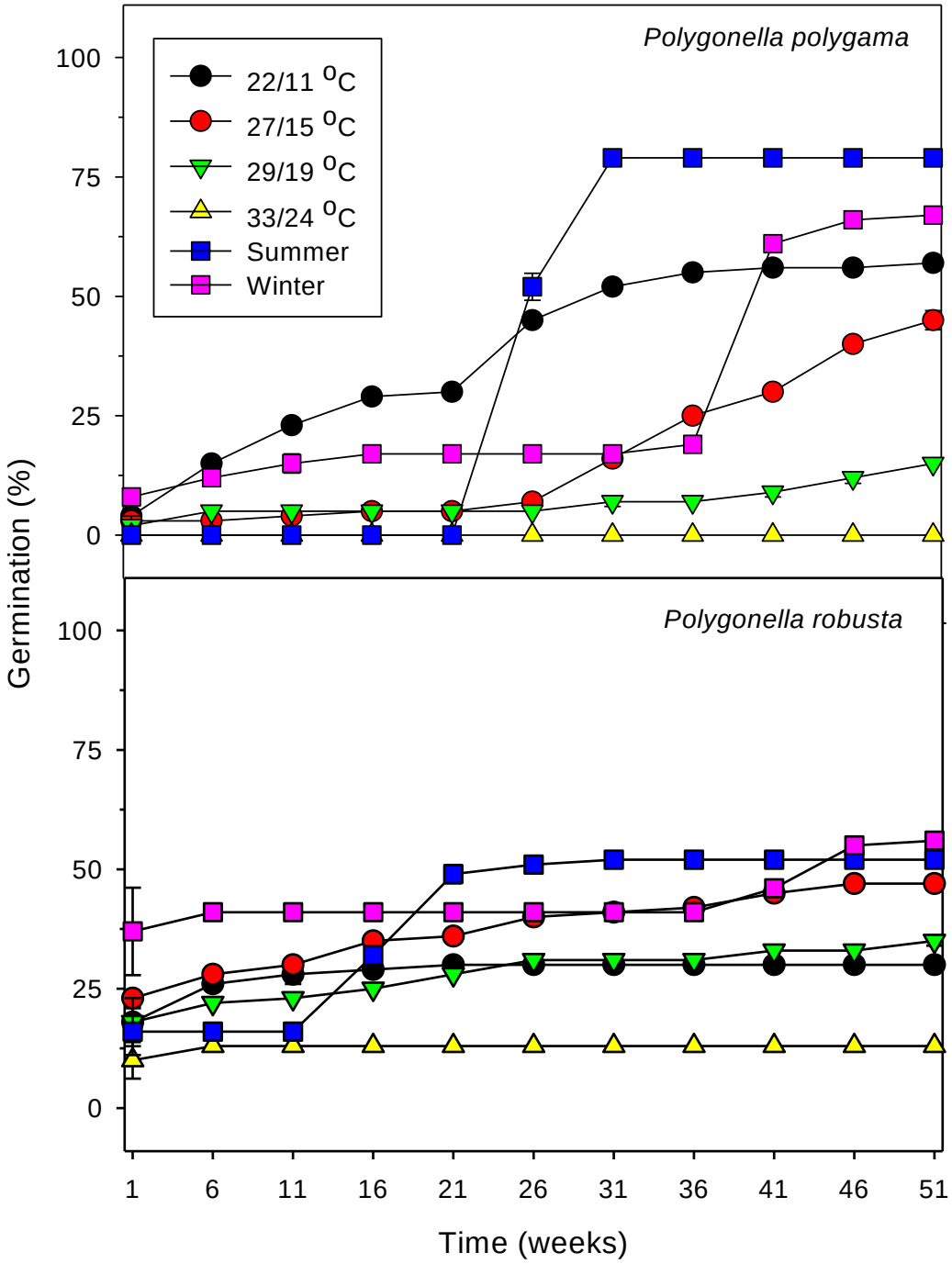


Figure E. Effects of K-IBA and K-NAA treatments on rooting softwood cuttings of October flower (*Polygonella polygama*) collected from central (top) or south (bottom) Florida populations. Data presented as means ± standard error.

Site	Treatment	Root index (scale 1-5)	Rooting (%)	Root number	Root length (cm)
Central	0 IBA, 0 NAA	2.0 ± 0.1	30.0 ± 6.2	3.3 ± 1.1	2.2 ± 0.3
Central	500 IBA, 0 NAA	2.6 ± 0.2	60.0 ± 11.3	3.6 ± 0.2	4.0 ± 1.0
Central	1000 IBA, 0 NAA	2.2 ± 0.1	43.3 ± 8.5	4.2 ± 0.3	5.2 ± 0.3
Central	0 IBA, 250 NAA	1.9 ± 0.2	36.7 ± 9.7	2.6 ± 0.5	4.6 ± 0.8
Central	500 IBA, 250 NAA	1.8 ± 0.2	26.7 ± 11.3	2.3 ± 0.1	4.2 ± 1.6
Central	1000 IBA, 250	2.4 ± 0.3	46.7 ± 16.2	3.6 ± 0.5	4.4 ± 0.3
Central	0 IBA, 500 NAA	2.5 ± 0.1	56.7 ± 4.1	3.2 ± 0.4	3.8 ± 0.6
Central	500 IBA, 500 NAA	2.3 ± 0.3	50.0 ± 15.8	3.3 ± 1.8	3.0 ± 0.5
Central	1000 IBA, 500	2.1 ± 0.4	43.3 ± 17.2	2.8 ± 0.4	4.9 ± 0.8
South	0 IBA, 0 NAA	2.7 ± 0.3	53.3 ± 9.7	3.8 ± 0.7	2.6 ± 0.6
South	500 IBA, 0 NAA	2.8 ± 0.4	60.0 ± 13.5	4.0 ± 0.7	3.7 ± 0.5
South	1000 IBA, 0 NAA	2.2 ± 0.1	40.0 ± 6.7	4.1 ± 1.0	2.7 ± 0.5
South	0 IBA, 250 NAA	1.8 ± 0.2	26.7 ± 11.3	4.0 ± 0.8	4.8 ± 0.7
South	500 IBA, 250 NAA	2.6 ± 0.3	50.0 ± 13.9	4.1 ± 0.8	2.7 ± 0.4
South	1000 IBA, 250	2.5 ± 0.2	63.3 ± 9.7	4.2 ± 0.2	4.5 ± 0.5
South	0 IBA, 500 NAA	2.6 ± 0.3	50.0 ± 9.1	4.1 ± 0.7	2.8 ± 0.6
South	500 IBA, 500 NAA	2.4 ± 0.2	56.7 ± 8.5	4.6 ± 0.8	3.4 ± 0.7
South	1000 IBA, 500 NAA	2.8 ± 0.2	60.0 ± 12.5	5.1 ± 0.7	2.9 ± 0.5
Site		*	NS	*	NS
NAA		NS	NS	NS	NS
Site × NAA		NS	NS	NS	NS
IBA		NS	NS	NS	NS
Site × IBA		NS	NS	NS	NS
IBA × NAA		*	NS	NS	NS
Site × IBA × NAA		NS	NS	NS	NS

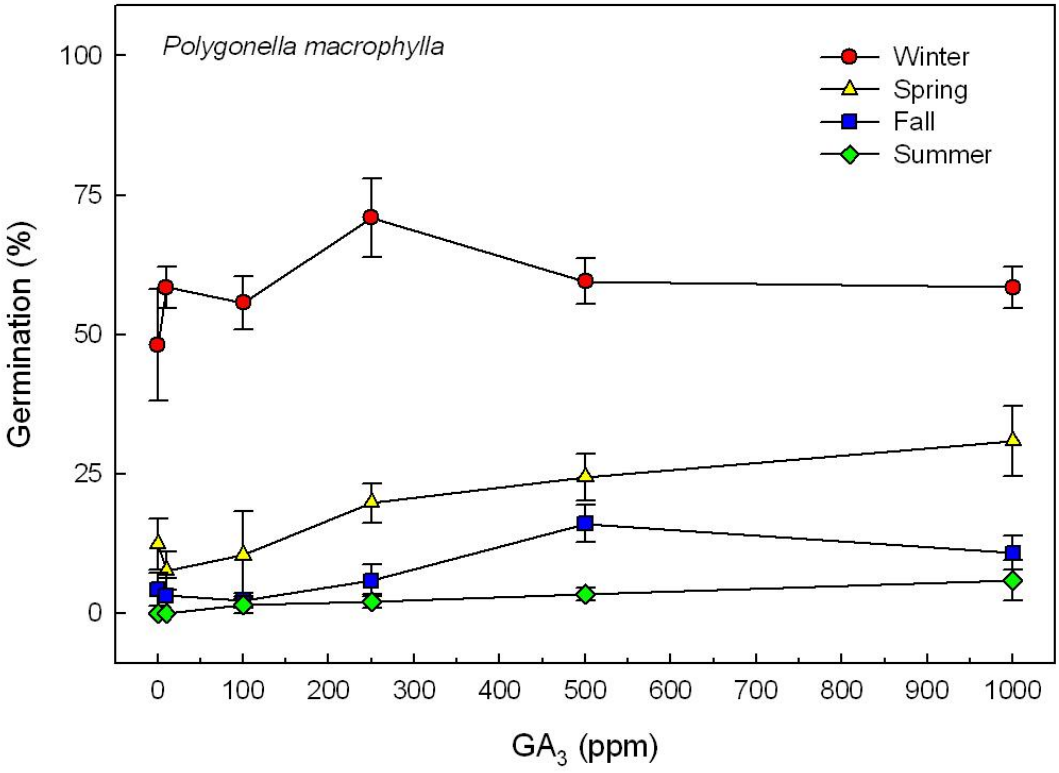
Non-significant (NS) at $\propto$=0.05 (*), 0.01 (**), or 0.001 (***).

Figure F. Effects of K-IBA and K-NAA treatments on rooting softwood cuttings of Sandhill wireweed (*Polygonella robusta*) collected from central (top) or south (bottom) Florida populations. Data presented as means ± standard error.

Site	Treatment	Root index (scale 1-5)	Rooting (%)	Root number	Root length (cm)
Central	0 IBA, 0 NAA	3.0 ± 0.5	56.7 ± 19.4	8.9 ± 1.7	6.3 ± 1.7
Central	500 IBA, 0 NAA	3.0 ± 0.3	60.0 ± 12.5	7.7 ± 0.9	7.3 ± 1.7
Central	1000 IBA, 0 NAA	3.3 ± 0.3	76.7 ± 11.3	7.6 ± 1.0	7.9 ± 1.4
Central	0 IBA, 250 NAA	2.9 ± 0.2	66.7 ± 5.3	6.2 ± 0.7	6.1 ± 2.2
Central	500 IBA, 250 NAA	2.8 ± 0.4	60.0 ± 15.5	7.5 ± 1.6	8.2 ± 1.9
Central	1000 IBA, 250	2.8 ± 0.6	53.3 ± 17.8	9.6 ± 1.7	8.3 ± 1.0
Central	0 IBA, 500 NAA	1.6 ± 0.4	20.0 ± 12.3	5.8 ± 2.4	2.9 ± 0.7
Central	500 IBA, 500 NAA	2.7 ± 0.5	53.3 ± 13.3	7.7 ± 0.8	6.1 ± 0.8
Central	1000 IBA, 500	2.9 ± 0.2	63.3 ± 9.7	7.3 ± 0.4	8.1 ± 1.0
South	0 IBA, 0 NAA	2.8 ± 0.3	50.0 ± 11.8	7.4 ± 1.7	2.3 ±1.1
South	500 IBA, 0 NAA	2.1 ± 0.2	13.3 ± 8.2	3.0 ± 0.0	1.7 ± 0.8
South	1000 IBA, 0 NAA	2.1 ± 0.1	16.7 ± 5.3	4.1 ± 0.5	4.4 ± 0.6
South	0 IBA, 250 NAA	2.1 ± 0.1	10.0 ± 6.7	5.0 ± 0.0	10.1 ± 0.3
South	500 IBA, 250 NAA	3.6 ± 0.3	80.0 ± 6.2	8.5 ± 1.4	6.9 ± 0.8
South	1000 IBA, 250	2.9 ± 0.4	50.0 ± 14.9	10.9 ± 2.0	4.8 ± 0.5
South	0 IBA, 500 NAA	2.9 ± 0.2	53.3 ± 6.2	6.4 ± 1.2	6.8 ± 1.9
South	500 IBA, 500 NAA	2.4 ± 0.4	23.3 ± 16.3	9.4 ± 4.3	7.6 ± 0.2
South	1000 IBA, 500 NAA	2.3 ± 0.2	23.3 ± 11.3	9.2 ± 1.6	4.2 ± 1.3
Site		NS	***	*	NS
NAA		NS	NS	NS	*
Site × NAA		*	NS	*	*
IBA		NS	NS	NS	NS
Site × IBA		NS	NS	NS	*
IBA × NAA		NS	*	*	NS
Site × IBA × NAA		**	***	NS	NS

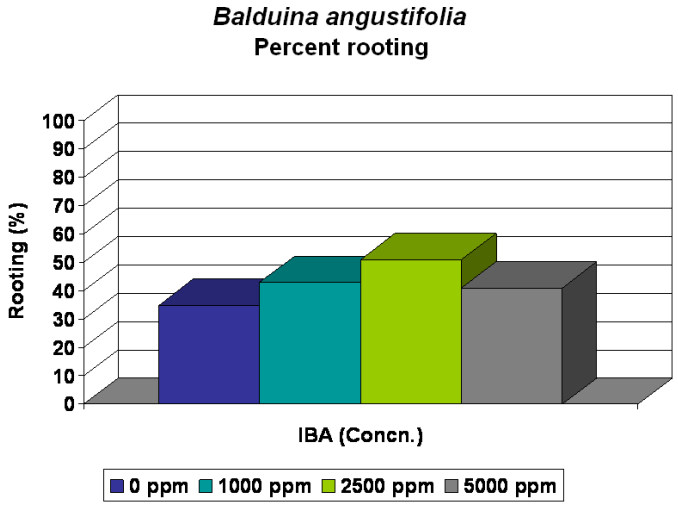
Non-significant (NS) at $\propto$=0.05 (*), 0.01 (**), or 0.001 (***).

Figure G. ***Polygonella macrophylla***. Large-leaved jointweed seed were collected from a native stand in Big Lagoon State Park, Florida on 11/12/08 and tested for germination starting on 1/14/09. The germination test was conducted by incubating seeds (first exposed to varying concentrations of GA_3 for 24 hr) at simulated seasonal temperatures. The 12-hr alternating temperatures represented seasonal conditions throughout Florida (22/11°C, 27/15°C, 29/19°C, and 33/24°C). Highest germination (up to 70%) was achieved at 22/11, regardless of GA concentration. Application of GA only nominally improved germination at each temperature.

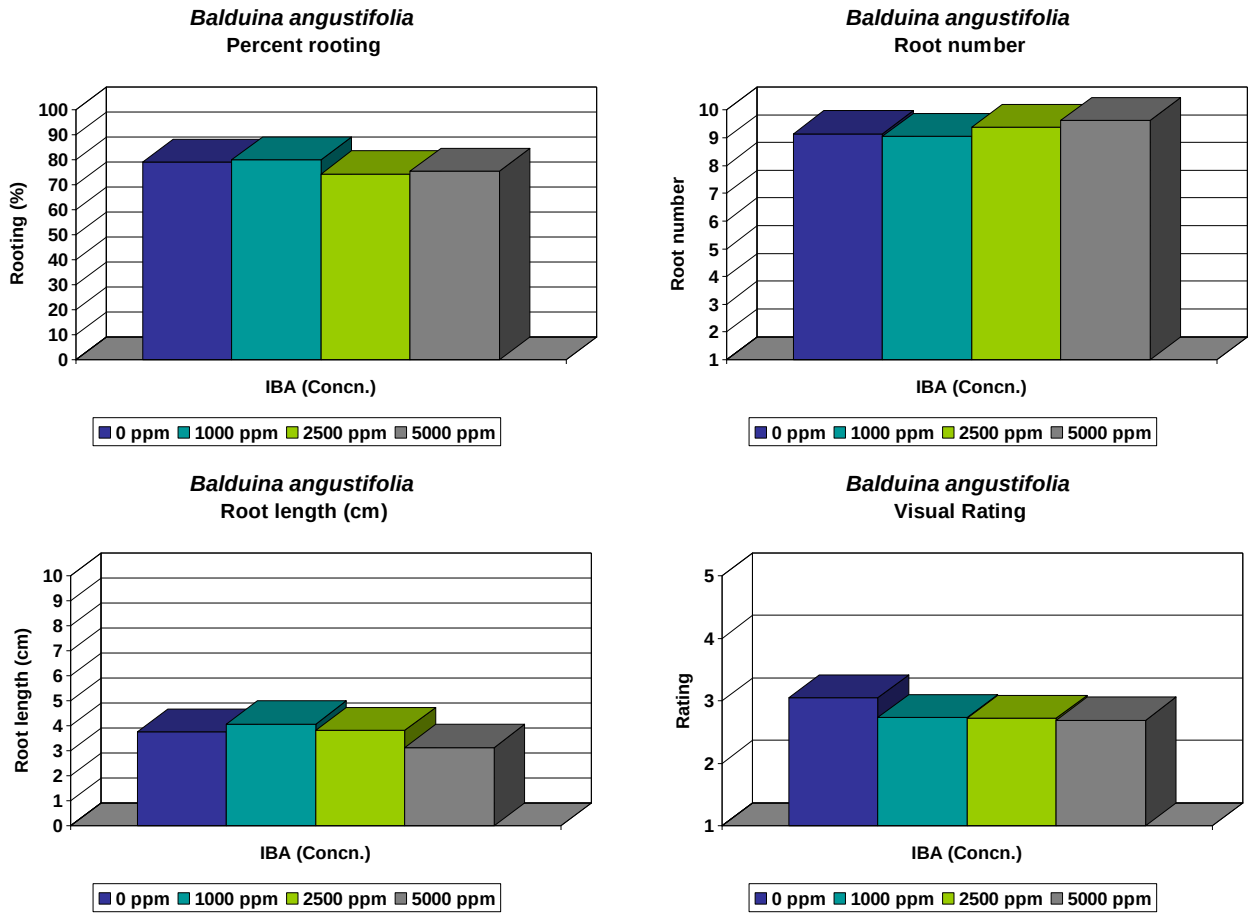


Milton

Balduina angustifolia. Cuttings were collected in Central Florida in the Green Swamp area on June 18, 2008. There was considerable stem and foliage damage from heat stress during the shipping process. The top left figure demonstrates a healthy cutting and the top right figure represents a cutting suffering from heat stress. All cuttings were cut in half and the top portion of heat stressed cuttings discarded (see bottom left figure). Cuttings were segregated by cutting type (blocks). The basal portion of each cutting (1 cm) was treated with IBA (0, 1000, 2500, or 5000 ppm). On July 28, 2008 (approx. 5 weeks after sticking) cuttings were evaluated for rooting (see bottom right figure). Given the poor nature of the cuttings we could not be sure the results were reflective of the shipping conditions or the treatments. We stuck them anyway to learn how they may respond to the propagation environment; no additional data were collected on these plants.



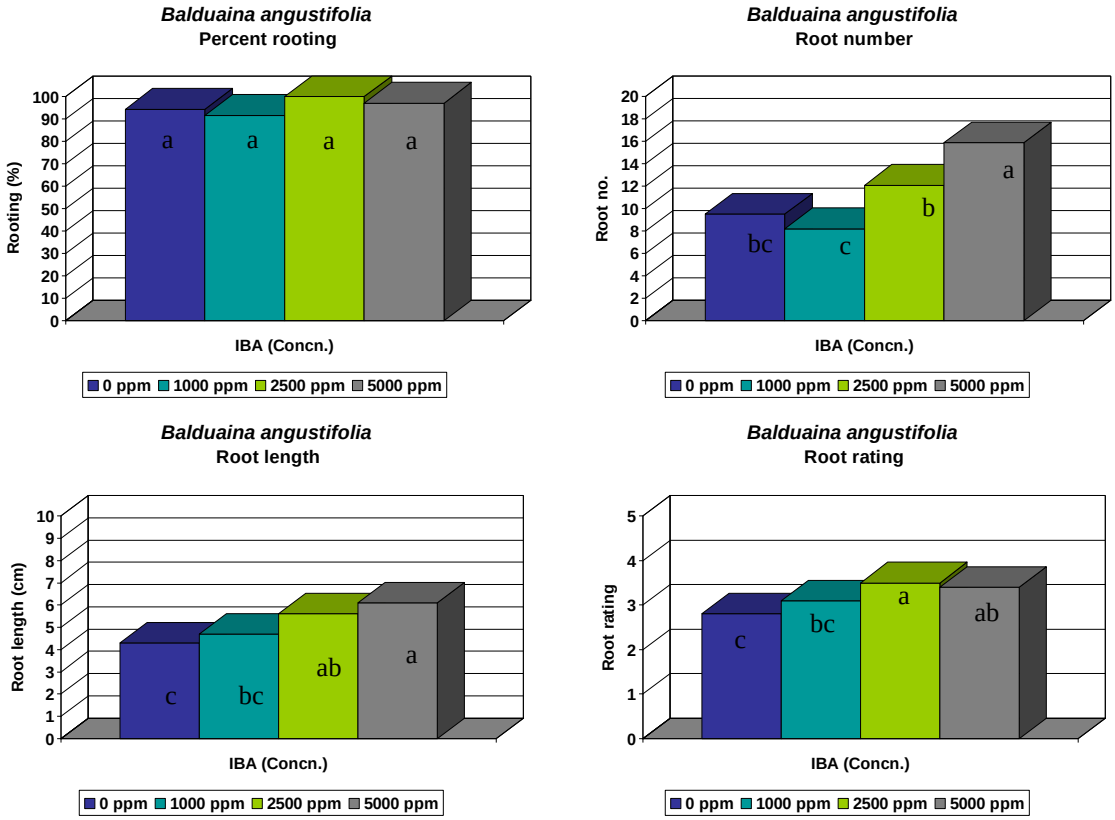
A second experiment with *Balduina* was initiated on July 31, 2008 with cuttings taken at two locations including: Fort Cooper State Park in Inverness, FL and San Felasco Hammock State Park in Gainesville, FL. Treatments evaluated included 4 concentrations of IBA(0, 1000, 2500, or 5000 ppm) and cuttings were rooted in Fafard 3B. Cuttings were evaluated for rooting on September 5, 2008 (approx. 5 weeks after sticking). There were no differences in rooting percentage (77 %), visual rating (2.8), root length (3.7 cm) or root number 9.26). Three liners were potted in gallon containers with Fafard 3B but they all began to form inflorescences and did not survive past bud initiation. This species may require propagation earlier in the year (Jan or Feb) but stock plants may need to be managed under a specific day length treatment to prevent floral bud initiation and produce viable vegetative cuttings. An initial investigation to determine if the species will respond to day length will be initiated after evaluation of rooting for cuttings stuck 19 May 2009.



Issues with cutting quality and inconsistent rooting in 2008 warranted subsequent rooting experiments with *Balduina angustifolia* in 2009. Softwood cuttings were collected in Poinciana Ridge (Florida) on May 19, 2009 and the basal portions (1 cm) treated with IBA (0, 1000, 2500, or 5000 ppm) prior to sticking in Fafard 3B. A total of 144 cuttings were stuck (6 replications each with 6 cuttings per IBA treatment). On June 25, 2009 (approx. 5 weeks after sticking) cuttings were evaluated for rooting.

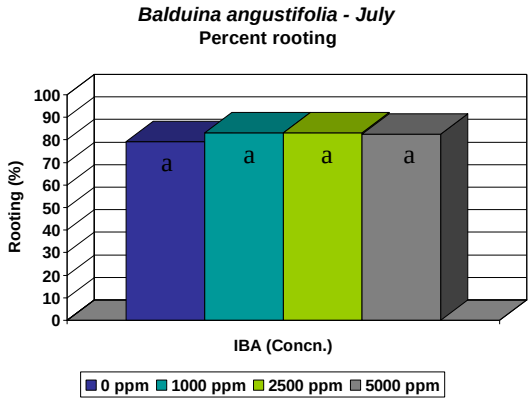
No differences in rooting percentages were evident and rooting for all IBA treatments exceeded 90%. Regression analysis indicated a significant increase in root number, root length, and visual rating with an

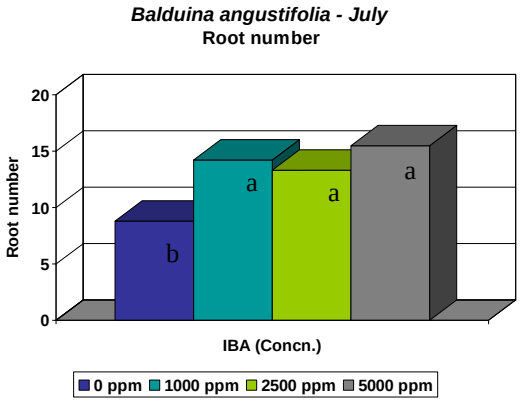
increase in IBA concentration. With IBA at 2500 or 5000 ppm, root number, root length and visual ratings were significantly greater than the nontreated control. With the application of IBA, visual ratings were 3 or greater. These results differ considerably from those obtained previously suggesting the shipping issues were a major factor in the poor rooting success noted in early 2008.

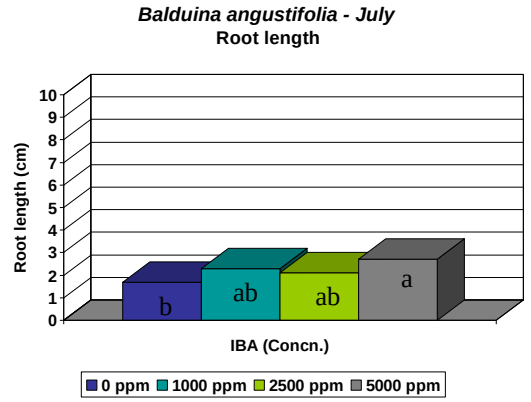


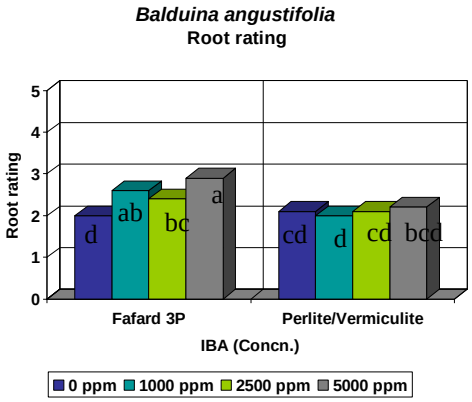
A second experiment was initiated in 2009 with softwood cuttings collected in Green Swamp West, Sumter County, Florida to determine effects of rooting substrates on propagation results. Cuttings arrived May 19, 2009 and the basal portions (1 cm) were treated with IBA (0, 1000, 2500, or 5000 ppm) prior to sticking in Fafard 3B or Perlite/Vermiculite (50:50 by volume). A total of 288 cuttings were stuck (a total of 144 cuttings per propagation substrate representing 6 replications each with 6 cuttings per IBA treatment). On July 28-29, 2009 (approx. 5 weeks after sticking) cuttings were evaluated for rooting.

No differences in rooting percentages were evident and the mean rooting percentage was 82% indicating neither propagation substrate nor IBA influenced the number of cuttings producing roots. Both propagation substrate and IBA affected root number and root length but there was no interaction of these main effects. Regardless of IBA application root number and root length were greater with cuttings rooted in Fafard 3B. Root number and root length increased as the rate of IBA increased regardless of the propagation substrate used. Application of IBA increased the number of roots per cutting compared to the nontreated control regardless of the application rate. Root length was greater than the nontreated control when IBA was applied at 5000 ppm but root length did not differ among cuttings rooted with IBA at 1000, 2500, and 5000 ppm. An interaction of the main effects of propagation substrate and IBA concentration was evident with visual ratings. While all visual ratings were between 2 and 2.9 there was no difference noted among cuttings rooted in Perlite/Vermiculite (2.12) while visual ratings increased as the rate of IBA increased when cuttings were propagated in Fafard3B.









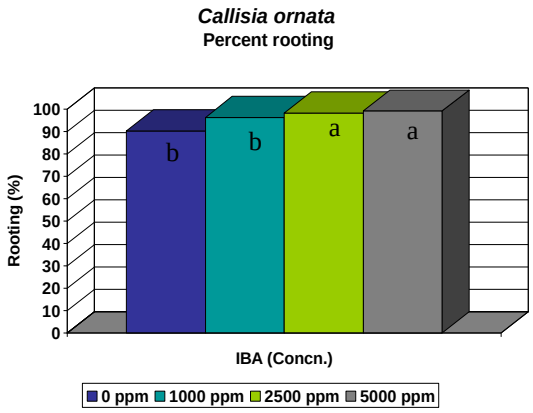
An observational study was initiated August 15, 2009 with rooted cuttings from the July Balduina experiment to determine if Balduina would be responsive to photoperiod (light treatments) as a method of reducing or eliminating floral development for stock plant management. Cuttings were subjected to one of three photoperiod treatments consisting of Short Day (9 hr. photoperiod), Night Interruption Photoperiod (9 hrs. + 10:00 p.m. - 2:00 a.m.), or Long Day (16 hr. photoperiod). Several plants had already shown signs of floral bud initiation at the time of potting so all plants were pruned to a consistent height thereby removing all existing flower buds and encouraging increased branching. Plants remained under the photoperiod treatments for 5 weeks and were evaluated for height, and two perpendicular widths and rated for flowers using the following scale: 1 = no flowers or flower buds; 2 = flower buds visible, no poen flowers; 3 = one to several open flowers; 4 = many open flowers, average to good flowering; 5 = abundant flowering, possible peak bloom.

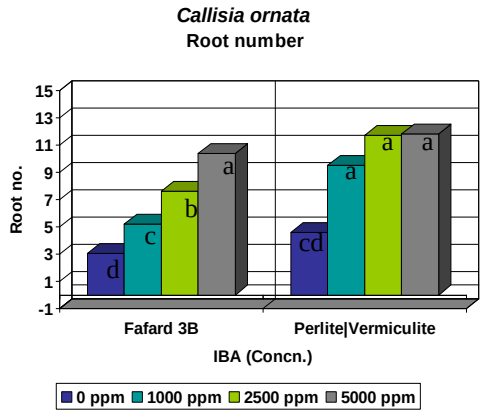
Unfortunately, the experiment had to be terminated on October 17, 2009 prior to full floral development but the potential to manage stock plants under lights was evident. After two months under the photoperiod treatments it appears that Balduina under Short Day photoperiod (9hr) flowered the most (left), the Night Interruption photoperiod (10-2) (middle) had fewer open flowers and were taller than the short day plants while those under Long Day photoperiod (16hr) (right) had fewer flowers than the Short Day plants and were the tallest among the photoperiod treatments. Two important findings were evident: 1 –floral initiation processes were already initiated by the liners prior to potting the plants and the plants continued to produce floral buds in spite of the

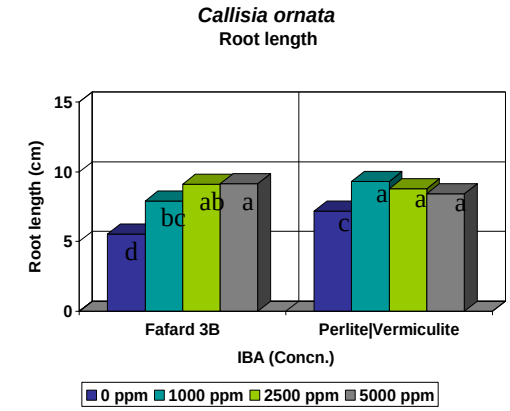
pruning or photoperiod treatment, and 2 – maintaining the plants under Long Day or Night Interruption photoperiods has the potential to minimize floral bud development and increase vegetative growth by producing taller stock plants from which to collect cuttings. This may warrant additional work to develop stock plant and cutting production protocols resulting in early season production of transplants. The application of the light treatments should begin prior to August since the transplants had already begun floral initiation.

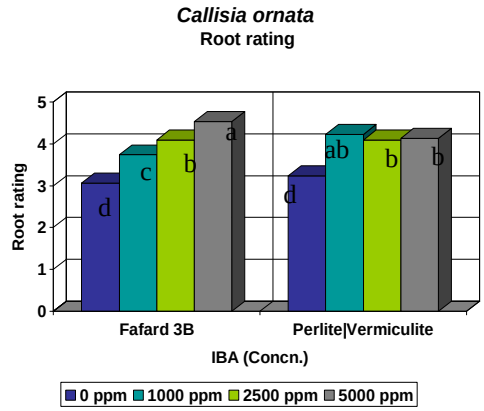
Callisia ornata. Softwood cuttings of *Callisia ornata* were collected on 10 June 2009 from 8 stock plants provided from Ft. Pierce. Softwood cuttings were prepared from leafy stems of current season growth. Entire stems were removed at the base and cut into 2 node cuttings (See photos). Prepared cuttings were visually graded on the basis of size (stem diameter) into three categories: 1. Light (Cuttings with slender stems and nodes – generally prepared from the apical portions of the stem); 2. Normal (Cuttings with medium size stems – generally prepared from the middle nodes of the stem); and 3. Heavy (Cuttings with thicker stems and heavier nodes at the base – generally prepared from the basal portions of the stems). There were not sufficient cuttings of all types to use this as a treatment. However, all cuttings within each block were of the same grade class. The basal portion (1 cm) of each cutting was treated with IBA (0, 1000, 2500, or 5000 ppm) prior to sticking in Fafard 3B. A total of 432 cuttings were stuck (9 replications with 6 cuttings per IBA treatment). On June 25, 2009 (approx. 3 weeks after sticking) cuttings were evaluated for rooting.

A total of 447 cuttings were prepared from the eight stock plants with 63 heavy cuttings, 315 normal cuttings, and 69 light cuttings. Both Auxin treatment and propagation substrate influenced rooting percentages but there was no interaction of these two main effects. Rooting exceeded 90% for all treatments and rooting percentage was greater with IBA at 2500 or 5000 compared to the nontreated control and IBA at 1000 ppm. Rooting percentages were greater with the use of perlite|vermiculite. Both propagation substrate and IBA had an impact on root number, root length and visual ratings. Generally, for cuttings rooted in Fafard 3B root number, length and visual ratings increased as IBA concentration increased. For cuttings rooted in perlite|vermiculite application of IBA increased root number, root length and visual ratings but the cuttings rooted in perlite|vermiculite did not respond to the increasing rates of IBA.

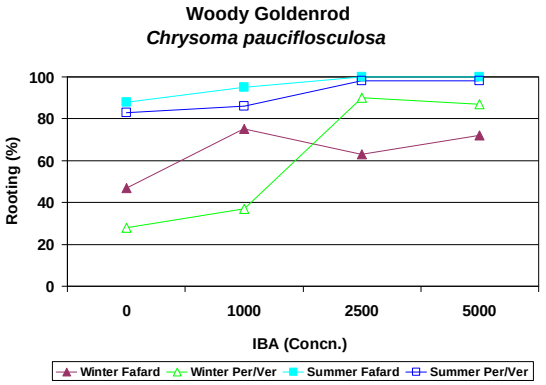


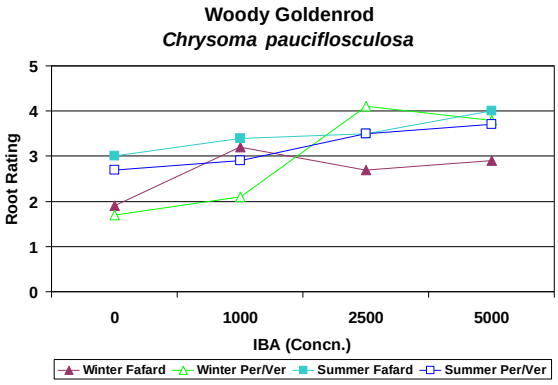


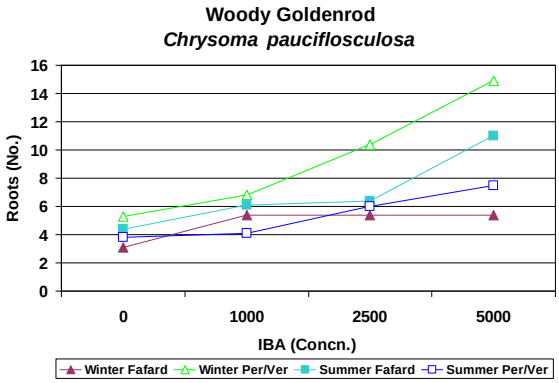


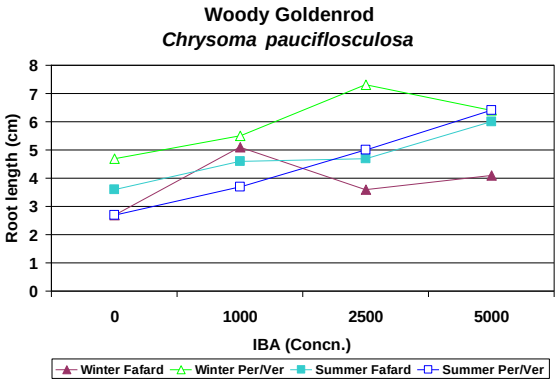


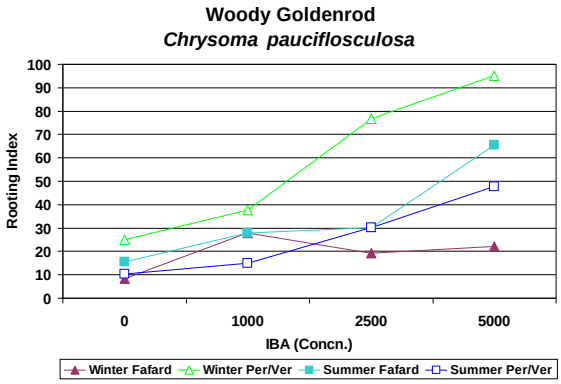
Chyrsoma pauciflosculosa. There have been 2 vegetative propagation experiments initiated with woody goldenrod. For both experiments the cuttings were collected from private property located 1 mile from the Milton Campus and treated with 0, 1250, 2500 or 5000 ppm IBA. The hardwood (dormant) cutting experiment was initiated 2/27/08 and the cuttings evaluated 4/17/2008. The visual rating scale was:1 = no roots, 2 = short roots visible, 3 = few long roots, 4 = many long roots; 5 = many long and branched roots. Rooting percentage of dormant cuttings appears to increase with the use of IBA and rooting percentage root number and root length of cuttings rooted in perlite/vermiculite were the greatest at the higher auxin concentrations. A spring softwood (greenwood) cutting experiment was initiated on ay 8, 2008. Results showed that dormant cuttings (Winter hardwood) rooted at lower percentages than cuttings from current season's growth (summer softwood). Hardwood cuttings rooted at greater percentages in Perlite/Vermiculite while summer softwood cuttings rooted equally well in either substrate. Higher rates of KIBA increased the number of roots per cutting and the length of roots when perlite/vermiculite was the propagation substrate. Rates of KIBA greater than 1000 ppm were necessary to achieve a visual rating of three or greater for both substrates. The interaction of substrate and cutting type for visual ratings suggests greater substrate drainage is necessary to maximize rooting and root quality for dormant winter cuttings while either substrate will be adequate to maximize these factors for summer softwood cuttings. Visual ratings also suggest application of KIBA is necessary to produce cuttings of the minimal quality characteristics (ie. a rating equal to or greater than 3).









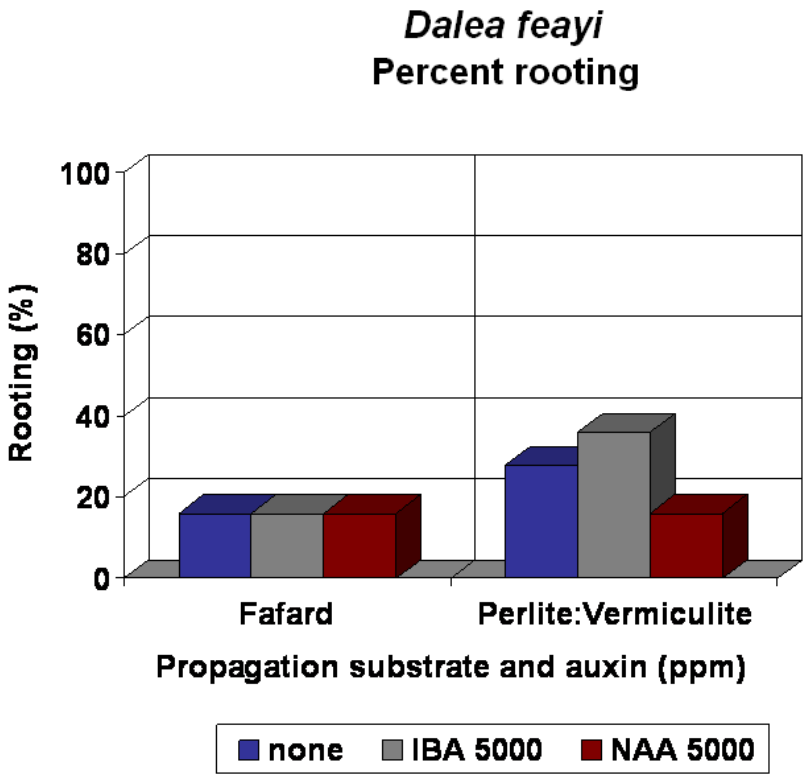


Dalea feayi. Cuttings were collected on July 22, 2008 from Jonathan Dickinson State Park (Martin County, FL) and an experiment initiated to test rooting with IBA, NAA and DipNGrow. Cuttings suffered 100 % mortality and were thought to be sensitive to the wet conditions of the propagation system.

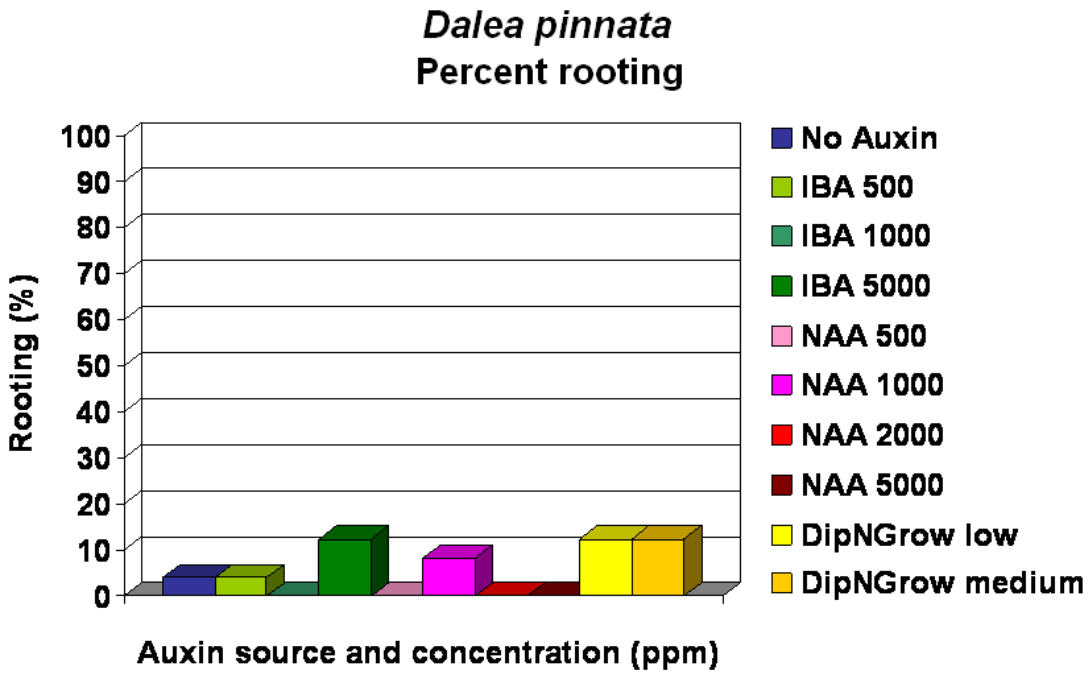
Cuttings were received from Hobe Sound, FL and stuck on 8/15/08. The base of the 3" cuttings were dipped 1 cm into 5000 ppm IBA or 5000 ppm NAA prior to sticking in Fafard 3B (45% sphagnum peat, processed pine bark, perlite, vermiculite mixture) and in 1:1 vermiculite/perlite. This experiment was designed with the intent to utilize a humidity chamber to reduce foliar applications of water. After an initial misting to water in cuttings no additional mist was planned unless symptoms of water deficit were evident. Humidity chambers were applied by placing clear plastic dome covers on each flat. On 8/26/08 domes were removed after evidence of a foliar fungus was discovered. A decreased mist application was initiated at 6 seconds every 20 minutes. On 8/27/08 cuttings were drenched with fungicide (Heritage) at ½ teaspoon per gallon. On 9/3/08 misting was further reduced to 2 seconds every 30 minutes. On 10/15/2008 cuttings were evaluated for rooting with only 28 cuttings rooted. There were a few more

cuttings rooted using the perlite:vermiculite substrate suggesting the rooting environment remains too wet.

Cuttings were also received from Withlacoochee State Forest (Citrus County, FL) on August 19, 2008. Cuttings suffered 100 % mortality within 2 weeks after sticking. Further experiments with cuttings will not be initiated until stock plants can be grown on site where the cuttings will be propagated to eliminate the need for shipping the cuttings and to ensure we begin with the highest quality cuttings.

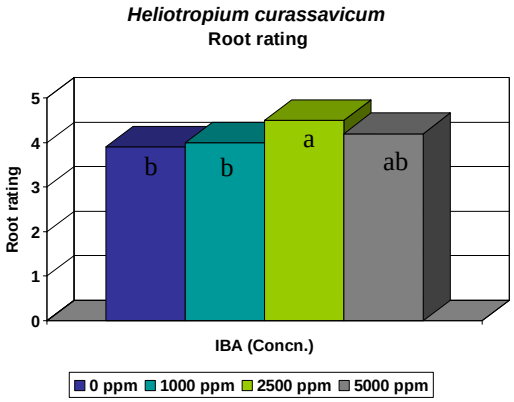


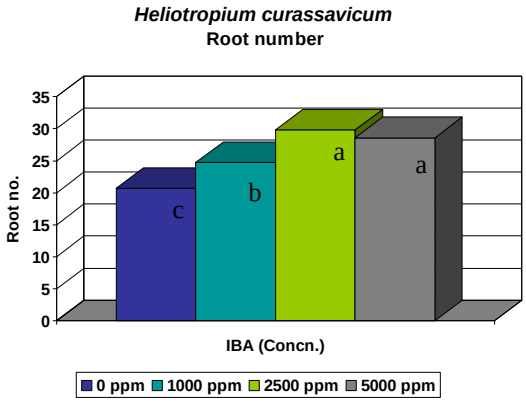
Dalea pinnata. Cuttings were collected from San Felasco Hammock Preserve State Park in Gainesville, FL on July 30, 2008 and shipped to Milton for sticking on July 31, 2008. The 3" cuttings were dipped 1 cm into one of 10 rooting treatments if IBA alone (0, 500, 1000, 5000 ppm), NAA alone (500, 1000, 2000, 5000 ppm), or one of two concentrations of *Dip 'N Grow* 1:19 (500 ppm IBA & 250 ppm NAA) or 1:9 (1000 ppm IBA & 500 ppm NAA). Cuttings were propagated in Fafard 3B with mist for 8 seconds every 10 minutes. The mist was reduced to 6 seconds every 20 minutes one week after sticking. Four (4) blocks of 6 cuttings for each treatment were taken. On 8/27/08 cuttings were drenched with fungicide (Heritage) at ½ teaspoon per gallon. On 9/3/08 misting was further reduced to 2 seconds every 30 minutes. On October 15, 2008 cuttings were evaluated for rooting with only 19 cuttings rooted. A second experiment was initiated on 14 August 2008 utilizing cuttings collected from Withlacoochee State Forest (Hernando County, FL) an application of Heritage fungicide and humidity chambers. Cutting mortality was 100% hence; further experiments with cuttings will not be initiated until stock plants can be grown on site where the cuttings will be propagated.

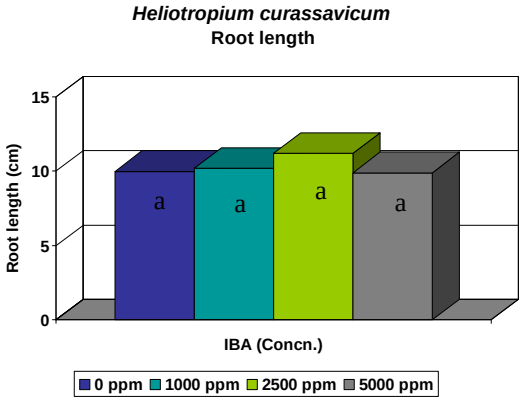


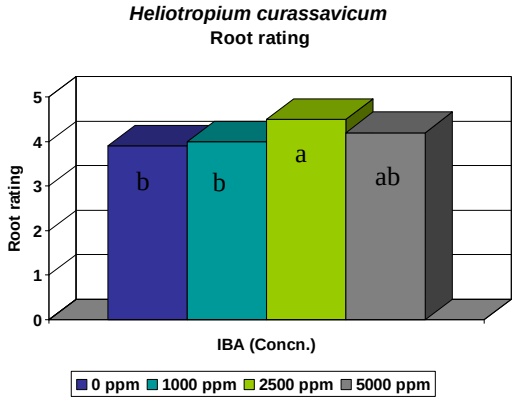
Heliotropium curassavicum. Softwood cuttings of *Heliotropium curassavicum* were collected on 10 June 2009 from 6 stock plants provided from Ft. Pierce. Softwood cuttings were prepared from leafy stems of current season growth. The basal portion (1 cm) of each cutting was treated with IBA (0, 1000, 2500, or 5000 ppm) prior to sticking in Fafard 3B. A total of 432 cuttings were stuck (9 replications with 6 cuttings per IBA treatment). On June 25, 2009 (approx. 3 weeks after sticking) cuttings were evaluated for rooting.

Auxin treatment did not influence the number of cuttings producing roots and rooting exceeded 95% for all treatments with an experiment-wise mean of 99%. Root number increased with IBA at 1000, 2500 or 5000 ppm and root number increased with an increase in IBA concentration. Root length did not differ with IBA application with an experiment-wise mean of 10.3 cm. Visual ratings were greater than 3 for all treatments and cuttings rooted with 2500 ppm IBA had the greatest rating (4.5).









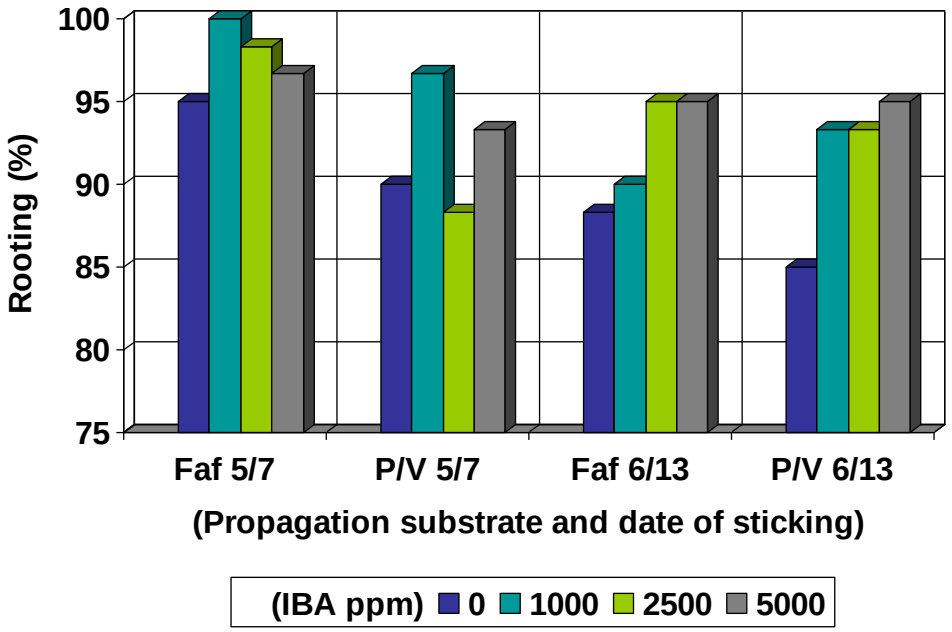
Licania michauxii. There were 2 vegetative propagation experiments completed with gopher apple. Two additional experiments suffered from leaf spot diseases present on the cuttings at the time of collection. Applications of fungicide were not successful in preventing the further spread of these leaf spot and total defoliation and cutting death occurred within two weeks under the high moisture environment of the propagation bench. For both completed experiments the cuttings were collected from the roadside 1 mile from the Milton Campus. Softwood (greenwood) cutting experiments were initiated 7 May 2008 and 13 June, 2008. Both Fafard 3B and perlite/vermiculite substrates were included in both experiments.

Rooting success was surprisingly high with most auxin treatments resulting in rooting percentages above 90%. Rooting percentages were lower with the use of perlite/vermiculite. In general, cuttings produced 2 to 3 roots although fewer roots were produced by cuttings prepared in May and rooted in perlite/vermiculite. Similarly, root length was from 3 to 4 cm for most cuttings with the exception of early cuttings rooted with perlite/vermiculite which had shorter roots of 2 cm. Visual ratings were at 3 or above for most cuttings with the exception of early cuttings rooted with perlite/vermiculite.

All rooted cuttings were transferred to 3 inch liner pots after evaluation. Within weeks of repotting the rooted cuttings defoliated and died. Several types of propagation containers will be utilized in Spring 2009 to propagate *Licania* but the rooted cuttings will not be disturbed to evaluate root quality. These rooted cuttings will be manipulated with treatments such as fertility or light exposure to initiate a flush of growth prior to initiation of leaf drop in the fall. (This 2009 experiment was terminated following failure of the mist system, cuttings remained on the propagation bench and many rooted but the high stress from a period without mist precluded collection of rooting data.)

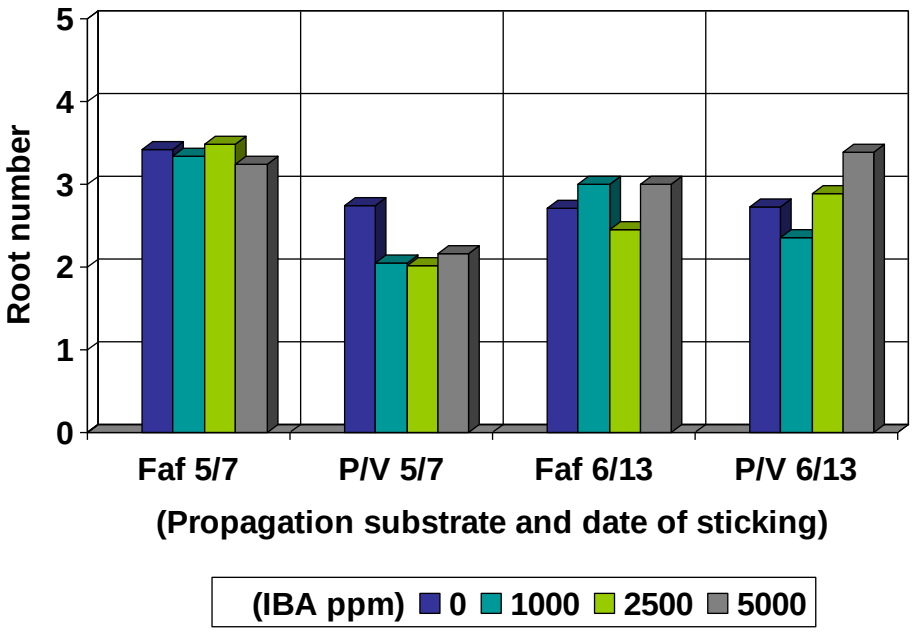
Licania michauxii

Percent rooting

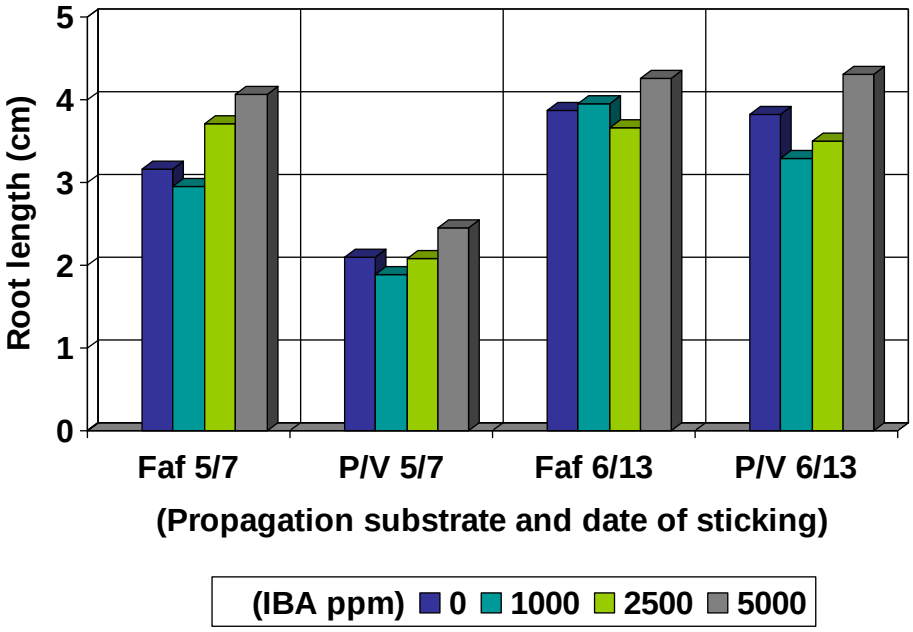


Licania michauxii

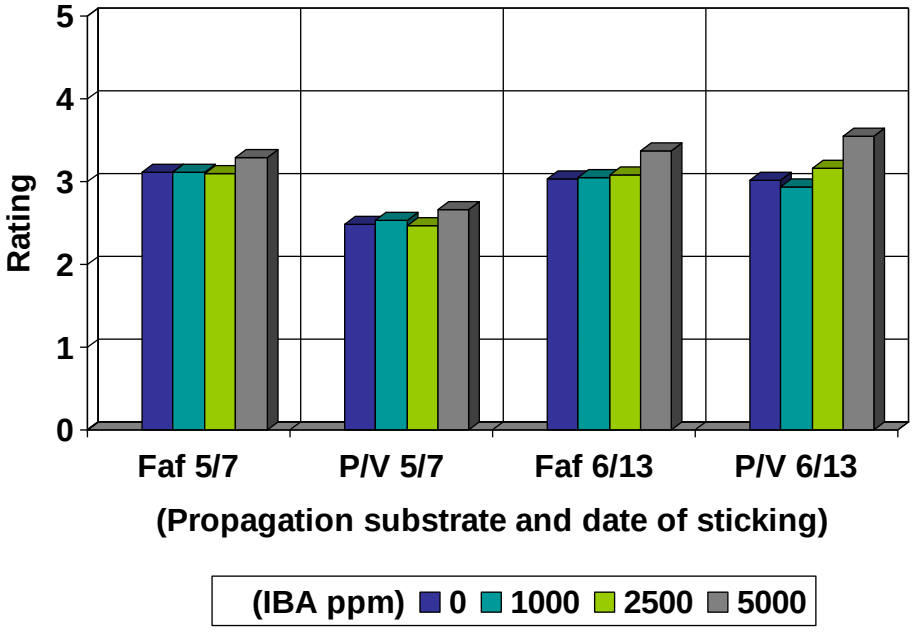
Root number



Licania michauxii
Root length



Licania michauxii
Visual Rating



Prior cutting experiments (2009) for this species resulted in rooted cuttings, however, few cuttings produced new growth prior to dormancy and died. Field investigations of this species revealed that it appears to have an extensive below-ground shrub or tree-like stem structure from which very few adventitious roots form. The leafy above-ground stems appear to be comprised mostly of ephemeral stems that do not contribute to the below-ground structure. Based on these observations, three types of cuttings were collected July 22, 2010 representing the traditional cutting type used in the prior experiments (leafy stem tips), a secondary stem tip representing the portion of stem just below the leafy stem tip (Secondary stem) and the tertiary stem tip representing the below ground portion of stem just below the secondary stem tip. July cutting collection also represented a later collection date than with previous experiments to avoid the flowering period and collect cuttings after additional carbohydrates had collected in the stems. Cuttings were treated with the same KIBA treatments as in prior experiments remained under intermittent mist until November 18, 2010 when they were evaluated for rooting. Many cuttings expressed callus development hence the percentage of cuttings with callus present was also evaluated.

July did not prove to be a good month for cutting collection as evidenced by the variable but lower rooting percentage for the traditional primary cutting type. Although sufficient rooting was not achieved to develop a propagation protocol we did learn a great deal about the response of these cutting types to auxin application. The higher concentration of auxin resulted in a greater percentage of rooted cuttings and an increase in the number of roots per cutting. Two interesting responses were the high rooting percentage of secondary cuttings in the absence of KIBA and the higher rooting percentage of tertiary cuttings treated with 5000 ppm KIBA. All tertiary cutting produced new shoots with 1 to 3 leaves during the propagation period. The development of new shoots on rooted primary cuttings has been an issue in cutting survival in previous studies and the development of adventitious bud on the older wood of the tertiary cuttings suggests larger cuttings with older wood may be necessary to successfully propagate and produce these plants. Further experiments are warranted to further investigate the current findings.

Rooting response (percent rooting, visual rating, and root number) of three types of Gopher apple stem cuttings to four concentrations of K-IBA.

	KIBA		Rooting (%)		Visual Rating		Root number	
Cutting type	conc.	n	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Leafy stem tip	0	30	10	31	2	2	0.9	3.9
	1000	30	7	25	1	1	0.2	0.7
	2500	30	10	31	1	1	1.1	4.3
	5000	30	27	45	2	1	1.3	2.5

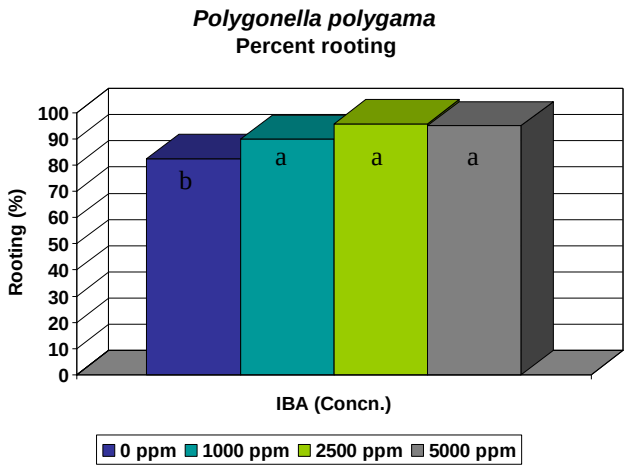
Secondary stem	0	30	30	47	1	0	0.3	0.5
	1000	25	0	0	1	0	0.0	0.0
	2500	29	3	19	1	0	0.2	0.9
	5000	30	7	25	1	0	0.1	0.6
Tertiary stem	0	30	3	18	1	0	0.0	0.2
	1000	30	3	18	1	0	0.0	0.2
	2500	30	7	25	1	0	0.1	0.3
	5000	30	10	31	1	0	0.1	0.3
	IBA conc.		0.0213		0.2073		0.4234	
	Cutting type		0.1348		0.0069		0.0019	
	conc*type		0.0043		0.7401		0.7467	

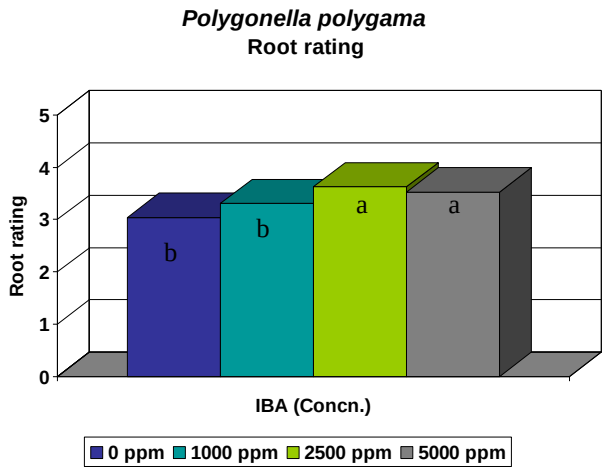
Rooting response(root length and callus production) of three types of Gopher apple stem cuttings to four concentrations of K-IBA.

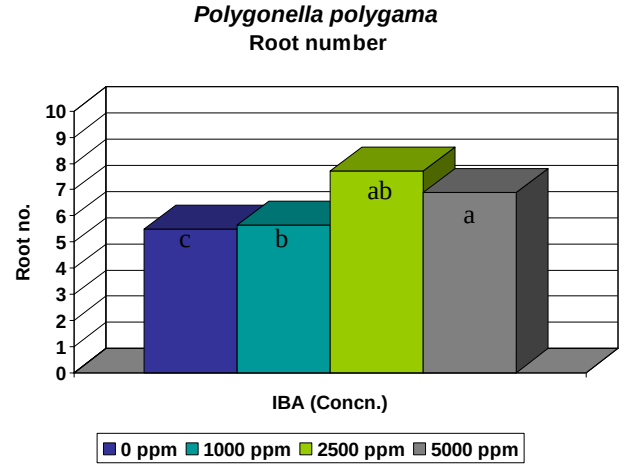
	KIBA		Root length (cm)		callus (%)	
Cutting type	conc.	n	Mean	Std Dev	Mean	Std Dev
Leafy stem tip	0	30	8	26	10	31
	1000	30	3	15	20	41
	2500	30	4	19	23	43
	5000	30	18	36	20	41
Secondary stem	0	30	3	8	33	48
	1000	25	0	0	20	41
	2500	29	1	7	7	26
	5000	30	2	11	27	45
Tertiary stem	0	30	0	1	3	18
	1000	30	0	1	0	0
	2500	30	0	1	10	31
	5000	30	1	2	3	18
	IBA conc.		0.0615		0.8956	
	Cutting type		0.0001		0.0002	
	Conc.*type		0.1053		0.0507	

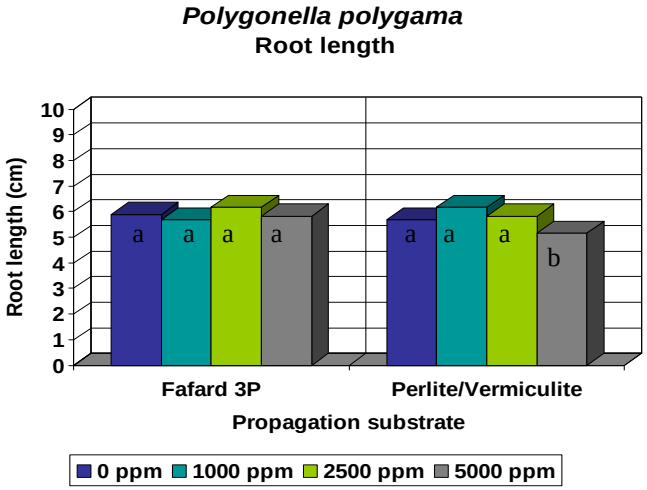
Polygonella polygama. A spring softwood (greenwood) cutting experiment was initiated with October flower on 21 May 2008. Cuttings were collected from Henderson Beach State Park.

Rooting percentage, root rating and root number did not differ with Fafard and Perlite/ Vermiculite. Cuttings root @ 83% without IBA and from 86 to 98% with 1000 to 5000 ppm IBA. There was an interaction between propagation substrate and root length. Root length did not differ among cuttings propagated in Fafard 3P but length of cuttings rooted in Perlite/Vermiculite at 5000 ppm KIBA were from 1.0 to 2 cm longer than root length of all cuttings rooted in Fafard 3P and all other Perlite/Vermiculite/KIBA combinations.









Softwood cuttings of ***Polygonella polygama*** were collected on 13 May 2009 from Big Lagoon State Park. Approximately 3 inch spring softwood cuttings were prepared from leafy stems of current season growth. The basal portion (1 cm) of each cutting was treated with IBA (0, 1000, 2500, or 5000 ppm) prior to sticking in Fafard 3B. A total of 144 cuttings were stuck (6 replications with 6 cuttings per IBA treatment). On June 30, 2009 (approx. 7 weeks after sticking) cuttings were evaluated for rooting.

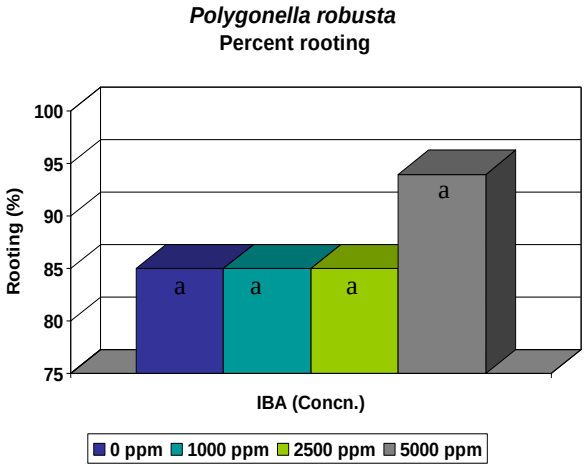
The softwood cuttings did not show a significant increase in rooting percentage, root number, root length or visual rating in response to auxin treatment. In general, cuttings rooted with KIBA did show numerical increases in these variables compared to the nontreated control but the increases were not significantly different. The experiment-wise means were: percent rooting 88.9%, Root number 6.4, Root length 7.3 cm and Visual rating 4.3. These cuttings rooted at acceptable numbers and received visual ratings exceeding 3 regardless of Auxin application rate.

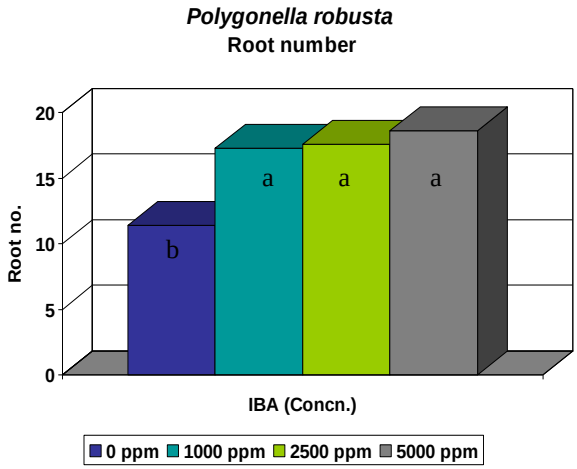
Polygonella robusta. A spring softwood (greenwood) cutting experiment was initiated with Sandhill wireweed on 21 May 2008. Cuttings were collected from Henderson Beach State Park and the experiment included only the Fafard 3B substrate.

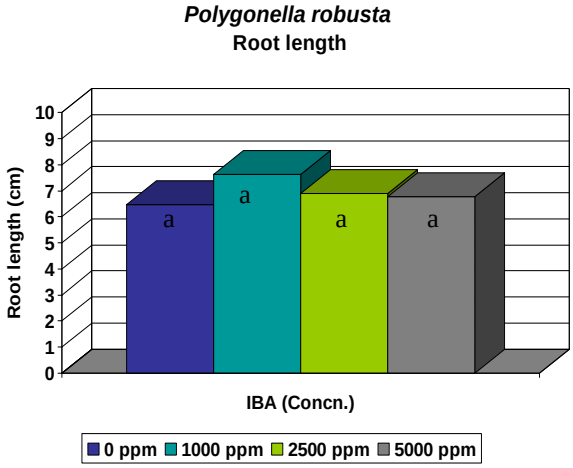
Rooting percentages did not differ among the auxin concentrations. Cuttings rooted with KIBA produced more roots than cuttings rooted without KIBA. Root length did not differ. The mean visual ratings indicate the minimum rating of 3 and would be considered a high quality rooted cutting. Rooted cuttings were potted in 3 inch liner pots and later transplanted to gallon containers using Fafard 3B.

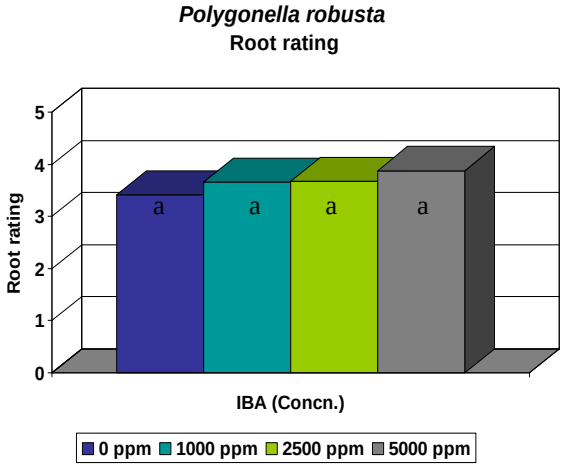
Many of these rooted liners died over a 2 month period in container production and it is suspected the production substrate remained too wet between waterings.

An additional experiment was initiated 20 May 2009 with both Fafard 3B and Perlite/Vermiculite substrates. Rooted cuttings will be potted in a pinebark based substrate after initial rooting evaluation to determine if a courser production substrate will be suitable for container production of this species.









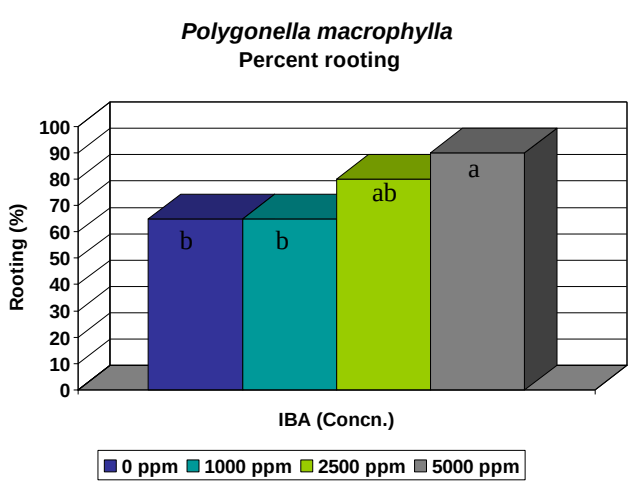
Softwood cuttings of *Polygonella robusta* were received on 20 May 2009 from Hawks Bluff. Approximately 3 inch spring softwood cuttings were prepared from leafy stems of current season growth. The basal portion (1 cm) of each cutting was treated with IBA (0, 1000, 2500, or 5000 ppm) prior to sticking in Fafard 3B. A total of 288 cuttings were stuck (6 replications with 6 cuttings per IBA treatment). On June 30, 2009 (approx. 7 weeks after sticking) cuttings were evaluated for rooting.

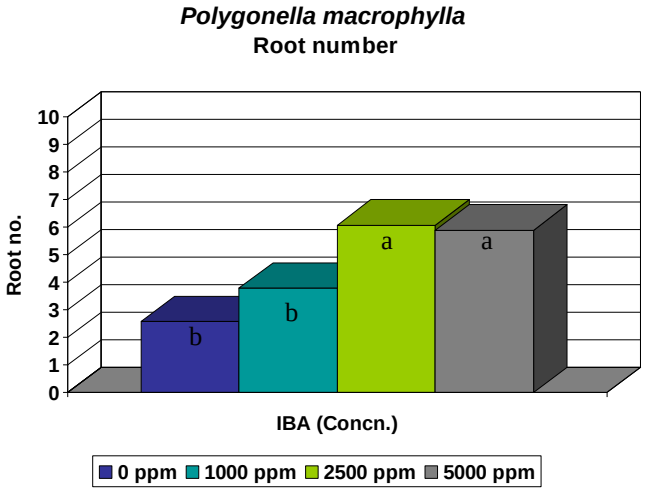
The softwood cuttings did not show a significant increase in rooting percentage in response to auxin treatment or propagation substrate. The experiment-wise mean Rooting percentage was 92%. There was no difference in root numbers among cuttings rooted in Fafard 3B and Perlite|vermiculite. However, regression analysis indicated root number increased as the rate of KIBA increased but there were no significant differences in root number within the KIBA rates tested. Root length did not differ among KIBA and nontreated cuttings but cuttings rooted in Fafard 3B had significantly longer roots than cuttings rooted in perlite|vermiculite. Overall, visual ratings for P. robusta cuttings were similar among all rates of KIBA. However, visual ratings of cuttings rooted in Fafard 3B were significantly higher than visual ratings of cuttings rooted in perlite|vermiculite. Visual ratings did not exceed 3 regardless of Auxin or propagation substrate treatments.

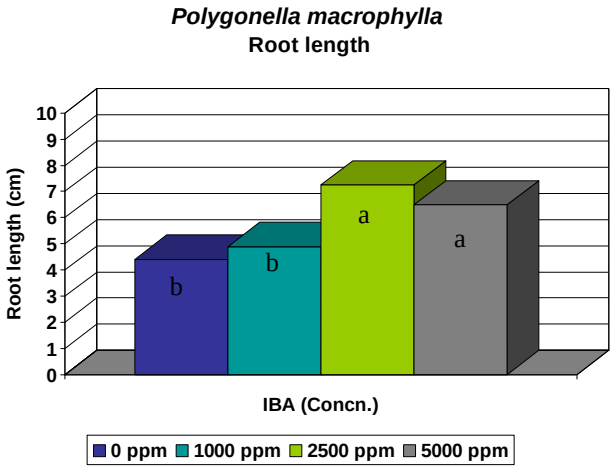
Polygonella macrophylla. A spring softwood cutting experiment was initiated with Large-leaved jointweed on 21 May 2008. Cuttings were collected from Henderson Beach State Park, Fort Walton, FL. 5000 ppm KIBA increased rooting percentages to 90% compared to 65% for cuttings rooted without KIBA.

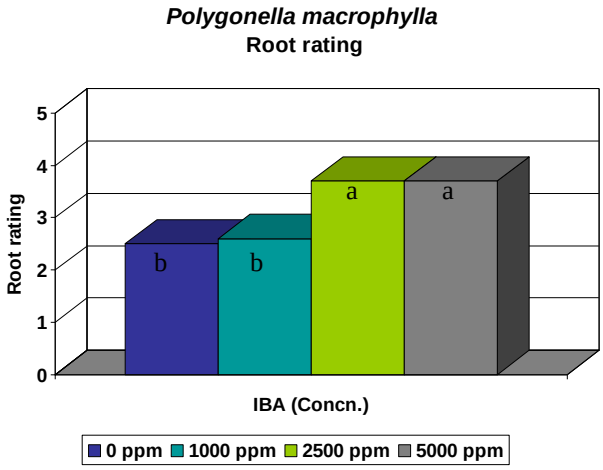
Cuttings rooted with 2500 or 5000 ppm KIBA produced twice the number of roots and had longer roots than cuttings rooted without KIBA. The mean visual ratings indicate cuttings rooted with KIBA at 2500 and 5000 ppm met the minimum rating of 3 and would be considered a high quality rooted cutting.

A spring softwood cutting experiment was repeated with Large-leaved jointweed on 13 May, 2009.



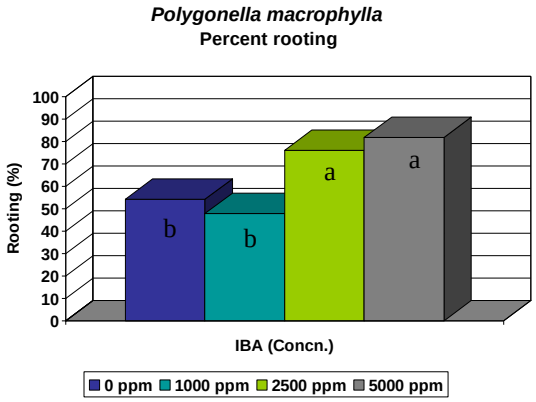


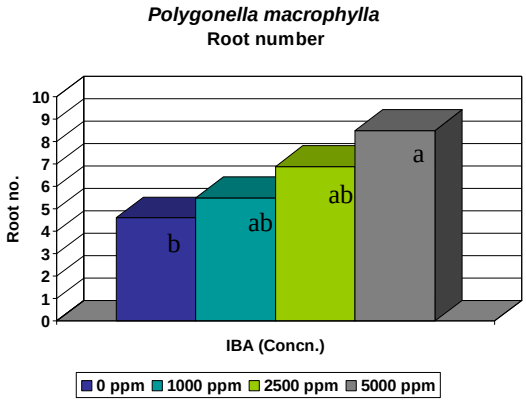


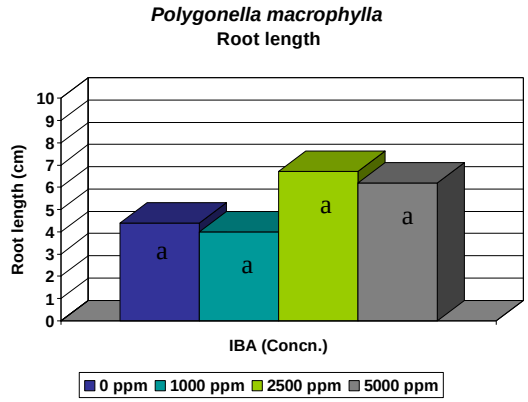


Softwood cuttings of *Polygonella macrophylla* were collected on 13 May 2009 from Big Lagoon State Park. Approximately 3 inch spring softwood cuttings were prepared from leafy stems of current season growth and no more than 2/3 of branch terminals were removed from a single plant. The basal portion (1 cm) of each cutting was treated with IBA (0, 1000, 2500, or 5000 ppm) prior to sticking in Fafard 3B. A total of 96 cuttings were stuck (4 replications with 6 cuttings per IBA treatment). On June 30, 2009 (approx. 7 weeks after sticking) cuttings were evaluated for rooting.

Auxin treatment increased the number of cuttings producing roots and IBA applied at 2500 or 5000 ppm increase rooting compared to IBA at 1000 pmm or the nontreated control. Rooting percentage increased as the rate of IBA increased with maximum rooting of 82% for cuttings treated with IBA at 5000 ppm. Root number increased with an increase in IBA concentration but only cuttings treated with IBA at 5000 ppm differed from the nontreated control. Root length did not differ with IBA application with an experiment-wise mean of 5.3 cm. Visual ratings increased as the rate of IBA increase but only cuttings treated with IBA at 2500 or 5000 ppm were greater than 3 and both differed from cuttings treated with IBA at 1000 ppm and the nontreated control. Rooted cuttings were potted into 1 gallon containers and will be returned to Big Lagoon State Park winter 2009.


Polygonella macrophylla
Percent rooting
Rooting (%)
100
90
80
70
60
50
40
30
20
10
0
b
b
a
a
IBA (Concn.)
0 ppm
1000 ppm
2500 ppm
5000 ppm


Polygonella macrophylla
Root number
Root no.
10
9
8
7
6
5
4
3
2
1
0
b
ab
ab
a
IBA (Concn.)
0 ppm
1000 ppm
2500 ppm
5000 ppm


Polygonella macrophylla
Root length
Root length (cm)
10
9
8
7
6
5
4
3
2
1
0
a
a
a
a
IBA (Concn.)
0 ppm
1000 ppm
2500 ppm
5000 ppm

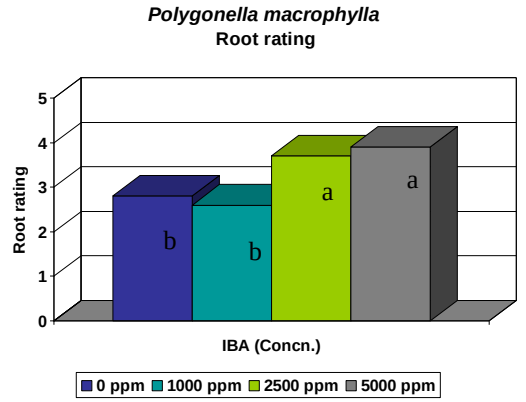

Polygonella macrophylla
Root rating
Root rating
5
4
3
2
1
0
b
b
a
a
IBA (Concn.)
0 ppm
1000 ppm
2500 ppm
5000 ppm

Table 1. Ten native wildflower species evaluated for the study.

Botanical Name	Common Name	Family	Habitat	Comments
Balduina angustifolia	Coastalplain honeycomb-head; Yellow buttons	Asteraceae	Sandhills, scrub, dunes	Annual with yellow disk and ray florets. Perez (2006) has identified that seeds are dormant at shedding (*i.e.* physiological dormancy) and require a period of cold stratification for dormancy alleviation.
Callisia ornata	Florida scrub roseling	Commelinaceae	Scrub and sandhills	Perennial with 3-petaled pink flowers. Seed production is limited..better candidate for asexual propagation.
Chrysoma pauciflosculosa	Woody goldenrod	Asteraceae	Coastal dunes, scrub and sandhills	Tough shrubby herbaceous perennial. Scrub, dunes, sandhills. Showy flowers.
Dalea feayi	Feay's prairieclover	Fabaceae	Scrub and sandhills	Perennial herb with profuse pink-purple multi-staminate, globular flowers. Ruder and Wilson (2006) obtained highest germination (49%) with scarified seeds, but additional research is needed to address production and landscape establishment.
Dalea pinnata var. *pinnata*	Summer farewell	Fabaceae	Sandhills and scrub	Perennial herb with white, terminal, multi-staminate flowers. Perez (2006) has determined that seeds do not imbibe water at shedding (*i.e.* physically dormant). Mechanical and acid scarifications for 10 min alleviate dormancy and promote germination. Germination was improved after scarification for seeds incubated at 15 or 25°C. Germination in scarified seed was reduced when seeds were incubated at 35°C.
Heliotropium curassavicum	Seaside heliotrope	Boraginaceae	Dunes	Sprawling succulent perennial, blue-green foliage and white flowers.
Licania michauxii	Gopher-Apple	Chrysobalan-aceae	Sandhills	Dwarf, woody groundcover having white flowers followed by one-seeded fruit. "A valuable wildlife and landscape plant that is very difficult to transplant" (Mesozoic Landscapes, Lake Worth).
Polygonella	Large-leaved	Polygonaceae	Coastal	Tough herbaceous perennial, High

macrophylla	Jointweed		dunes and scrub	restoration potential; showy inflorescence. Propagation has seasonal and cutting-type requirements for success (Thetford, 2006). http://www.centerforplantconservation.org/ASP/CPC_ViewProfile.asp?CPCNum=3576.
Polygonella polygama	Jointweed; October flower	Polygonaceae	Coastal dunes and scrub	Tough herbaceous perennial, High restoration potential; showy inflorescence.
Polygonella robusta	Largeflower jointweed; Sandhill wireweed	Polygonaceae	Sandhills and scrub	Woody perennial with white-pink fringed flower spikes. Perez (2006) found that imbibition in this species occurs slowly; therefore, it is not considered physically dormant. Seeds require 4-6 weeks of winter temperatures to initiate dormancy alleviation. However, summer temperatures completely inhibit germination.

Table 2: Date, location, coordinates, and quantity of seed collected from natural wildflower populations.

Species	Collection Date	Collection Site	GPS Coordinates[y]
Balduina angustifolia	12/15/07	Green Swamp West – Sumter County	---[z]
	2/9/08	Scrub Oak Preserve – Martin County	N2998629 E582506
	2/15/08	Withlacoochee State Forest – Citrus County	N3192862 E361123
	3/6/08	Haney Creek Preserve –Martin County	N3011545 E573911
	11/26/08	Withlacoochee State Forest – Citrus County	N3192989 E360484
	5/17/09	Haney Creek Preserve –Martin County	N3011545 E573911
	5/18/09	Poinciana Ridge – Martin County	N2998629 E582506
	6/9/09	Pine Ridge - Orange County	N3151606 E435659
Callisia ornata	7/6/10	Indian River Research and Ed. Center	N3033783 E558401
	8/1/10	Indian River Research and Ed. Center	N3033783 E558401
Chrysoma pauciflosculosa	1/2/08	Pensacola Beach – Escambia Cty	Zone 16 N3353590 E459476
	10/29/09	Milton – Collected by Mack	Zone 16 N3386836 E492025
	11/6/09	Milton – Collected by Mack	Zone 16 N3386836 E492025
	11/9/09	Milton – Collected by Mack	Zone 16 N3386836 E492025
	11/16/09	Milton – Collected by Mack	Zone 16 N3386836 E492025
Chrysoma pauciflosculosa	11/19/09	Milton – Collected by Mack	Zone 16 N3386836 E492025
	11/30/09	Milton – Collected by Mack	Zone 16 N3386836 E492025
	11/30/09	Bagdad Highway – Mack	Zone 16 N3385234 E504606

	12/4/09	Perdido Key - Collected by Mack	Zone 16 N3352120 E455126
	12/7/09	Milton – Collected by Mack	Zone 16 N3386836 E492025
Dalea feayi	> 1 year	Cruickshank Trail – Brevard County	---[z]
	6/6/07	Cruickshank Trail – Brevard County	---[z]
	7/21/08	Jonathan Dickinson SP – Martin County	N2988855 E588216
	11/26/08	Withlacoochee State Forest – Citrus County	N3192989 E360484
Dalea pinnata var. pinnata	12/15/07	Green Swamp West – Sumter County	---[z]
	11/26/08	Withlacoochee State Forest – Hernando Cty	N3164502 E374371
	1/7/10	Withlacoochee State Forest – Hernando Cty	N3164546 E374377
Heliotropium curassavicum	3/20/08	Matheson Hammock Park – Miami Dade	N2840452 E574610
	4/15/08	Homestead Bayfront Park – Miami Dade	N2816256 E566880
Licania michauxii	7/24/08	Savannas Preserve SP – Martin County	N3015459 E575188
	8/16/08	Withlacoochee State Forest – Hernando Cty	N3164502 E374371
Licania michauxii	8/21/08	Jonathan Dickinson SP – Martin County	N2986065 E584952
	8/21/08	Savannas Preserve SP – Martin County	N3015459 E575188
	9/21/08	Withlacoochee State Forest – Hernando Cty	N3164502 E374371
	9/4/09	Sugar Hill – Martin County	N3014541 E575270
	10/5/09	Sugar Hill – Martin County	N3014541 E575270
Polygonella macrophylla	11/12/08	Big Lagoon State Park – Escambia Cty	Zone 16 N3353650 E459481
Polygonella polygama	11/19/07	The Natives – Polk County	---[z]
	2/9/08	Scrub Oak Preserve –	N2998629

		Martin County	E582506
	2/15/08	Withlacoochee State Forest – Citrus County	N3192989 E360484
	3/7/08	Haney Creek Preserve –Martin County	N3011739 E573801
	11/12/08	Big Lagoon State Park – Escambia Cty	Zone 16 N3353540 E459509
	11/24/08	Jonathan Dickinson SP – Martin County	N2985831 E584374
	11/25/08	Haney Creek Preserve –Martin County	N3011739 E573801
	11/26/08	Withlacoochee State Forest – Citrus County	N3192989 E360484
Polygonella robusta	11/19/07	The Natives – Polk County	---[z]
	12/12/07	The Natives – Polk County	---[z]
	11/24/08	Jonathan Dickinson SP – Martin County	N2988855 E588216
Polygonella robusta	11/25/08	Savannas Preserve SP – Martin County	N3015459 E575188

[y]UTM UPS coordinate system; WGS 84, zone 17N or 16N where noted
[z]GPS Coordinates not available

Table 3: Viability and germination methods used to evaluate 10 wildflower species. ** Indicates seeds were not found on species.

Botanical Name	**Viablilty** – 2 reps of 100						**Germination** – 4 reps of 100			
	Pre-conditioning	Seed bisection	TZ (%)	Time (H)	Temp (C)	Positive viability	Temp (C)	1st Count (days)	Final Count (days)	Substrate
Balduina angustifolia	Imbibe between moist blotter paper for 18 hours at 20 C.	Laterally; remove distal end of cotyledons	1.0	6	35	Entire embryo evenly stained; slight damage to root tip acceptable; slight damage to cotyledons acceptable	20	7	14	Blue blotter paper
Callisia ornata	Imbibe between moist blotter paper overnight at 20-25 C.	Laterally	1.0	Over-night	30-35	Entire embryo must stain evenly. Off-color endosperm may be indicative of presence of internal disease.	20	7	14	Blue blotter paper
Chrysoma pauciflosculosa	Imbibe on moist blotter paper for 18 hours at 20 C.	Laterally; remove distal end of cotyledons	1.0	6	35	Entire embryo evenly stained; slight damage to root tip acceptable; slight damage to cotyledons acceptable	20	7	14	Blue blotter paper
Dalea feayi	Imbibe between moist blotter paper for 18 hours at 20 C.	Slice end of cotyledons	1.0	5-6	35	Entire embryo evenly stained, turgid, and unfractured; slight damage to radicle acceptable; half or more of cotyledons attached to embryo axis and evenly stained.	20	7	14	Blue blotter paper
Dalea pinnata var. *pinnata*	Imbibe between moist blotter paper for 18 hours at 20 C.	Slice end of cotyledons	1.0	5-6	35	Entire embryo evenly stained, turgid, and unfractured; slight damage to radicle acceptable; half or more of cotyledons attached to embryo axis and evenly stained.	20	7	14	Blue blotter paper

Heliotropium curassavicum	Imbibe between moist blotter paper for 18 hours at 20 C.	Longitudinally through embryo; seed kept intact at distal end	0.1	5-6	35	Entire embryo evenly stained; endosperm will not stain; unstained outside edge of scutellar region acceptable; greenish colored pericarp acceptable if embryo stained normal	20-30	7	21	Blue blotter paper
Licania michauxii	Remove testa, overnight water soak at room temp.	Longitudinally; place both halves cut side down on blotter paper	1.0	24	35	Entire embryo must stain	20-30	14	28	Sand
Polygonella macrophylla	Imbibe between moist blotter paper for 18 hours at 20 C.	Longitudinally; leaving seed intact at top of cotyledons	1.0	Over-night	30-35	Entire embryo evenly stained; endosperm is not living and will not stain	20	7	14	Blue blotter paper
Polygonella polygama	Imbibe between moist blotter paper for 18 hours at 20 C.	Longitudinally; leaving seed intact at top of cotyledons	1.0	Over-night	30-35	Entire embryo evenly stained; endosperm is not living and will not stain	20	7	14	Blue blotter paper
Polygonella robusta	Imbibe between moist blotter paper for overnight at 20-25 C.	Longitudinally; leaving seed intact at top of cotyledons	1.0	Over-night	30-35	Entire embryo evenly stained; endosperm is not living and will not stain	20	7	14	Blue blotter paper

Table 4: Viability and germination of seed collected from natural populations of ten native wildflowers.

Botanical name	Common name	Pre-germination viability[x] (%)	Germination[y] (n=400) (%)	Dormant (%)	Total viable (%)	Germination of viable seed (%)	Greenhouse germination[z] (n=100) (%)
Balduina angustifolia	Coastalplain honeycomb-head; Yellow buttons	80	19	45	64	30	15 (12/11/07) 0 (4/15/08) 0 (5/30/08)
Callisia ornata	Florida scrub roseling	20	0	18	18	0	29 (8/11/10)
Chrysoma pauciflosculosa	Woody goldenrod	51	13	19	32	40	3 (1/4/08) 6.5 (3/31/10)
Dalea feayi	Feay's prairieclover	80	4	68	72	5	1 (12/14/07) 3 (4/15/08) 5 (11/24/08)
Dalea pinnata var. *pinnata*	Summer farewell	93	3	82	85	3	13 (12/13/07) (n=90) 1 (2/27/09) (n=21)
Heliotropium curassavicum	Seaside heliotrope	45	47	0	47	100	54 (4/15/08)
Licania michauxii[w]	Gopher-Apple	84	82	0	82	100	28 (9/11/08)
Polygonella macrophylla	Large-leaved Jointweed	90	38	52	90	42	31 (11/24/08)
Polygonella polygama	Jointweed; October flower	93	63	25	88	72	0 (4/15/08) 4 (5/30/08) 67 (3/17/09) (n=84) 68 (3/17/09) (n=84)
Polygonella robusta	Largeflower jointweed	59	47	10	57	80	25 (12/10/07) 76 (2/27/09) 34 (3/17/09) (n=84)

[v] Seed source not located this season.

[w] MidWest Seed Services inc. TZ: Two replications of 100 seeds were soaked in water overnight. Seeds were cut longitudinally and both halves stained with 1.0% TZ for 24 hours at 35 C. Germination: Four replications of 100 seeds were germinated on sand in a 6"x 9" germination box at 20-30C. Germination counted at 14 and 28 days.
[x] MidWest Seed Services inc. Two replications of 100 seeds were pretreated by allowing them to imbide between moist blotter paper for 18 hours at 20 C. Seeds were then cut per the standards for each species and stained with 1% TZ at 30-35 C. Heliotropium seed received 0.1% TZ.
[y] MidWest Seed Services inc. Four replications of 100 seeds were germinated on two layers of blue blotter paper in a 6"x 9" germination box at 20C. Germination counted at 7 and 14 days for all species but Heliotropium which was counted at 7 and 21 days.
[z] Indian River Research and Education Center. 100 seeds were sown in propagation half flats (12 7/8" x 9 ½") (Dillen Products, Middlefield, OH) in Fafard Superfine Germinating Mix. Placed under mist at 12seconds/hour. 28 day germination period.

Table 5. Final germination percent (FGP) of non-scarified and scarified wildflower seed collected from natural populations in southern Florida. Seeds were germinated with light (12 hr photoperiod) in germination boxes placed in growth chambers set at 20/10, 25/15, 30/20 and 35/25 °C for 28 days. Four replications of 50 seeds (n=200) were subjected to each treatment.

	Control				Acid Scarified [z]			
Species	20/10	25/15	30/20	35/25	20/10	25/15	30/20	35/25
Callisia ornata	38.50	47.00	29.00	1.00	0.00	0.50	0.00	0.00
Chrysoma pauciflosculosa	37.50	23.50	10.50	1.50	---[x]	---[x]	---[x]	---[x]
Dalea feayi	0.50	3.00	2.50	3.50	66.00	71.00	44.00	50.00
Heliotropium curassavicum	54.50	56.50	42.50	36.50	8.50	7.00	10.50	7.50
Licania michauxii [y]	21.33	25.33	50.67	46.67	0.00	0.00	0.00	0.00
Polygonella macrophylla	42.50	5.00	0.50	1.00	48.00	35.00	40.00	32.00
Polygonella polygama	85.50	73.50	53.00	17.00	24.00	30.00	25.00	19.00
Polygonella robusta	67.50	45.00	38.50	15.50	10.00	1.00	3.00	3.00

[x] Due to the physiology of the seed, Chysoma seeds were not subjected to acid scarification.
[y] Licania was given 60 days germination time.
[z] 18M scarification for 5 min.

Table 6. Dates, sites, and locations of vegetative cuttings collected for rooting experiments.

Species	Collection Date	Collection Site	GPS Coordinates
Balduina angustifolia	June		Collected by Hector
	5/18/09	Poinciana Ridge – Martin County	Collected by Steve
Callisia ornata	7/20/08	Savannas Preserve SP – Martin County	N3019819 E572117
	7/21/08	Jonathan Dickinson SP – Martin County	N2986065 E584952
	7/21/08	Haney Creek Preserve –Martin County	N3011483 E573570
	8/21/08	Jonathan Dickinson SP – Martin County	N2986065 E584952
	6/9/09	Pine Ridge - Orange County	N3151606 E435659
Chrysoma pauciflosculosa	2/27/08	1 mile from Milton campus	Zone 16 N3386836 E492025
	5/8/08	1 mile from Milton campus	Zone 16 N3386836 E492025
Dalea feayi	7/21/08	Jonathan Dickinson SP – Martin County	N2988855 E588216
	8/15/08	Withlacoochee State Forest – Citrus County	N3192861 E361120
Dalea pinnata	8/15/08	Withlacoochee State Forest – Hernando Cty	N3164502 E374371
Licania michauxii	5/7/08	1 mile from Milton campus	Zone 16 N3385457 E505690
	5/22/08	1 mile from Milton campus	Zone 16 N3385457 E505690
Polygonella macrophylla	5/21/08	Henderson Beach State Park	Zone 45 N3361666 E447196
	5/13/09	Big Lagoon State Park	Zone 16 N3353650 E459481
Polygonella polygama	5/21/08	Henderson Beach State Park	Collected by Mack
	7/21/08	Haney Creek Preserve –Martin County	N3011483 E573570
	8/14/08	Haney Creek Preserve –Martin County	Collected by Alison
	5/17/09	Haney Creek Preserve –Martin County	Collected by Steve

	5/18/09	Poinciana Ridge – Martin County	Collected by Steve
	6/9/09	Withlacoochee State Forest – Citrus County	N3192989 E360484
	5/13/2009	Big Lagoon State Park	Zone 16 N3353650 E459481
Polygonella polygama var. bracteata	5/17/09	Haney Creek Preserve –Martin County	Collected by Steve
Polygonella robusta	7/22/08	Sugarhill Community–Martin County	N3014763 E575017
	8/14/08	Jonathan Dickinson SP – Martin County	Collected by Alison
		Central Florida	Collected by Alison
	5/17/09	Savannas Preserve SP – Martin County	Collected by Steve
	6/9/09	Pine Ridge - Orange County	N3151606 E435659

[y]UTM UPS coordinate system; WGS 84, zone 17N or 16N where noted
[z]GPS Coordinates not available

Table 7. Analysis of soil from the three sites in Florida used for native wildflower field evaluation.

Florida planting site	Organic matter (%)	Est. N release ($lbs \cdot A^{-1}$)	P (ppm)	K (ppm)	Mg (ppm)	Ca (ppm)	pH	EC (mmhos /cm)	CEC ($meq \cdot 100g^{-1}$)
Milton	1.3	70	20	17	7	110	5.3	0.01	1.1
Gainesville	2.9	102	133	71	49	499	6.4	0.11	3.4
Fort Pierce	2.8	100	56	79	102	1132	5.9	0.08	8.6

Table 8. Propagation and production summary of ten wildflower species.

Botanical Name	Seed propagation	Vegetative propagation	Landscape evaluation
Balduina angustifolia	No germination at high temperatures, very low (8%) at low temperatures for the new seed batch from Martin Co. Low seed viability (6% post TZ). GNV seed source will be re-visited in late December-early January.	Cuttings root readily with or without 1000 ppm IBA	In progress - Multi-site evaluation initiated July 17 2009. Earlier study still in ground (Ft. Pierce) 1 plant/gal
Callisia ornata	Stock plants produced limited seeds, difficult collection window for field collection	Cuttings root readily with 1000 ppm IBA:500 ppm NAA Rooting exceeded 90%, rooting percentage was greater with IBA at 2500 or 5000 compared to the nontreated control and IBA at 1000 ppm.	In progress - Multi-site evaluation initiated July 17 2009. Initial results suggest 1 plant per pot is optimal rather than 3 plants/pot. Plants exhibit stoloniferous behavior similar to spider plants in pots.
Chrysoma pauciflosculosa	Very low viability (15%) of initial seeds collected in Milton, no germination at any of the temperatures. Seeds were either harvested prematurely or desiccated from storage. Plants in Milton are presently in fruit from early season flowers but all seed appear to be empty at this time- we are monitoring plants for seed development.	Softwood (Summer) cuttings root @ 85% without IBA and from 93 to 100% with 1000 to 5000 ppm IBA. Rooting with Fafard3P is slightly greater than with Perlite/ Vermiculite. Dormant (Winter) cuttings root poorly without KIBA (28-40%). Rooting % did not exceed 75% in Fafard 3P with KIBA from 1000 to 5000 ppm. Rooting was from 87 to 90% in Perlite/Vermiculite with KIBA from 2500 to 5000 ppm.	In progress (Milton) evaluating trade gallon, treepot and quarts with and without irrigation. Additional cuttings and liners in production. Multi-site evaluation initiated April 20 from cuttings. Will produce plugs from seeds for statewide trial (seeds collected in Nov 2009 from Milton)
Dalea feayi	Seeds have been collected and will be subjected to temperature studies in fort pierce.	All cutting propagation experiments failed. The last two experiments employed an enclosed propagation system without mist but cuttings continued to rot and also had signs of foliar phytophthera. The propagation environment continues to be a challenge for this species.	In progress - Multi-site evaluation initiated July 17, 2009.

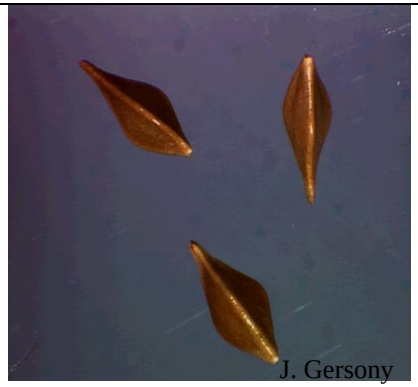
Dalea pinnata var. *pinnata*	Seed source will be visited in late December-early January when seeds are known to be at shedding stage. However, site has not received burn treatments in 2 years and plants may not be present.	All cutting propagation experiments failed. The last two experiments employed an enclosed propagation system without mist but cuttings continued to rot and also had signs of foliar phytophthera. The propagation environment continues to be a challenge for this species.	Seeds will be collected in Dec 2009.
Heliotropium curassavicum	Seeds germinate readily without pretreatment (47% viability). Collect when green and allow to dehisce.	Cuttings root readily with or without IBA talc KIBA does not influence the number of cuttings producing roots and rooting exceeded 95%. Root number increased with KIBA at 1000, 2500 or 5000 ppm.	In progress - Multi-site evaluation initiated July 17 2009. Plants perform optimal if 3 per pot and one hard pruning prior to transplanting.
Licania michauxii	Seeds were collected from multiple locations. Initial viability and germination was high (84%) indicating no endogenous dormancy (endocarp was removed). Viability appears to vary significantly among collection sites. Non-scarified seeds and fruits (seeds + endocarp) imbibe readily. Therefore, physical dormancy not present. All viable seeds completed germination by 10th day of imbibition experiment. Fresh seeds non-dormant at shedding. Warmer temperatures stimulate germination in the light. Germination high at all temperatures in the dark.	Successful rooting of cuttings in Milton (88 to 100% rooting) both with and without IBA from 1000 to 5000 ppm with both early spring and summer cuttings. Rooting with Fafard is slightly greater than with Perlite/ Vermiculite. Currently evaluating NAA.	In progress - Multi-site evaluation initiated July 17 2009. (Milton) Cuttings are sensitive to handling from evaluation procedures requiring production of additional cuttings for field evaluation. Cuttings stuck May 2009 in 4 different propagation containers using 5000ppm IBA in an attempt to produce plants for container and field evaluation.
Polygonella macrophylla	Best germination achieved at lowest temperature (20/10). GA nominally improved germination.	Cuttings root at 65% with and without 1000 ppm IBA. Rooting at 2500 ppm IBA was 80% and with 5000 ppm 90%. Root number increased as the rate of KIBA increased.	In progress-Multi-site evaluation initiation July 17, 2009 (seedlings) In progress - Multi-site evaluation initiated April 20 2009 (cuttings). Rooted cuttings showing signs

			of inflorescence development. Plants propagated in Milton to be planted in west, central and south FL 3-3" liners transplanted to gallon containers and the inflorescences removed 10 Nov. 2008.
Polygonella polygama	Generally low germination (15%) though viability is higher (65%), but greatest occurs at lower temperatures (22°C day/11°C night). Presoaking in GA_3 nominally increased germination percentage. Nicked and un-nicked seeds imbibed regularly, though nicked seeds imbibed at a faster rate. Seed collected in Milton from Big Lagoon State Park 12 Nov. 2008, shipped to Fort Pierce.	Rooting percentage, root rating and root number did not differ with Fafard and Perlite/ Vermiculite. Cuttings root @ 83% without IBA and from 86 to 98% with 1000 to 5000 ppm IBA. There was an interaction between propagation substrate and root length. Root length did not differ among cuttings propagated in Fafard 3P but length of cuttings rooted in Perlite/Vermiculite at 5000 ppm KIBA were from 1.0 to 2 cm longer than root length of all cuttings rooted in Fafard 3P and all other Perlite/Vermiculite/KIBA combinations.	In progress-Multi-site evaluation initiation July 14, 2009 (seedlings) In progress - Multi-site evaluation initiated April 20 2009 (cuttings). Rooted cuttings planted in Milton were sensitive to frequent rainfall. Returned to the greenhouse for better water management.
Polygonella robusta	Higher germination (58%) than *P. polygama*. Greatest germination occurs at lower temperatures (22°C day/11°C night). Presoaking in GA_3 did not improve germination. Seeds imbibed regularly, similar to *P. polygama.*	Cuttings root readily, but perform best with 2000ppm IBA: 1000ppm NAA. Milton - Softwood cuttings show no response to auxin treatment or propagation substrate. Cuttings rooted at 92% and there was no difference in root numbers among cuttings rooted in Fafard 3B and Perlite|vermiculite.	In progress-Multi-site evaluation initiation July 17, 2009 (seedlings) In progress - Multi-site evaluation initiated April 20 2009 (cuttings).

Figure 1: Plant images of form, flower and seed.

Botanical Name	Plant Form	Flower	Seed
Balduina angustifolia	 K. Ruder	 K. Muller	 J. Gersony
Callisia ornata	 A. Heather	 K. Muller	 J. Gersony
Chrysoma pauciflosculosa	 K. Muller	 K. Muller	 J. Gersony

Dalea feayi	 K. Ruder	 K. Ruder	 J. Gersony
Dalea pinnata var. *pinnata*	 A. Heather	 F. Almira	 J. Gersony
Heliotropium curassavicum	 S. Woodmansee	 K. Muller	 J. Gersony

Licania michauxii	 K. Muller	 K. Muller	 K. Muller
Polygonella macrophylla	 K. Muller	 M. Thetford	 J. Gersony
Polygonella polygama	 K. Ruder	 M. Thetford	 J. Gersony

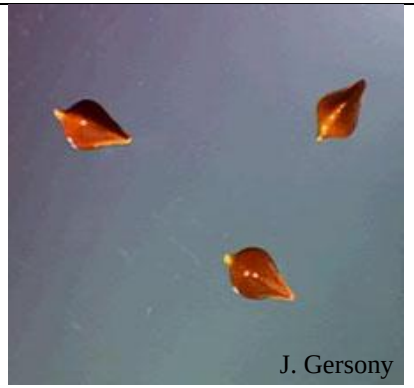
Polygonella robusta	 K. Muller	 S. Woodmansee	 J. Gersony

Figure 2: Map of 17 different seed collection sites across the state.

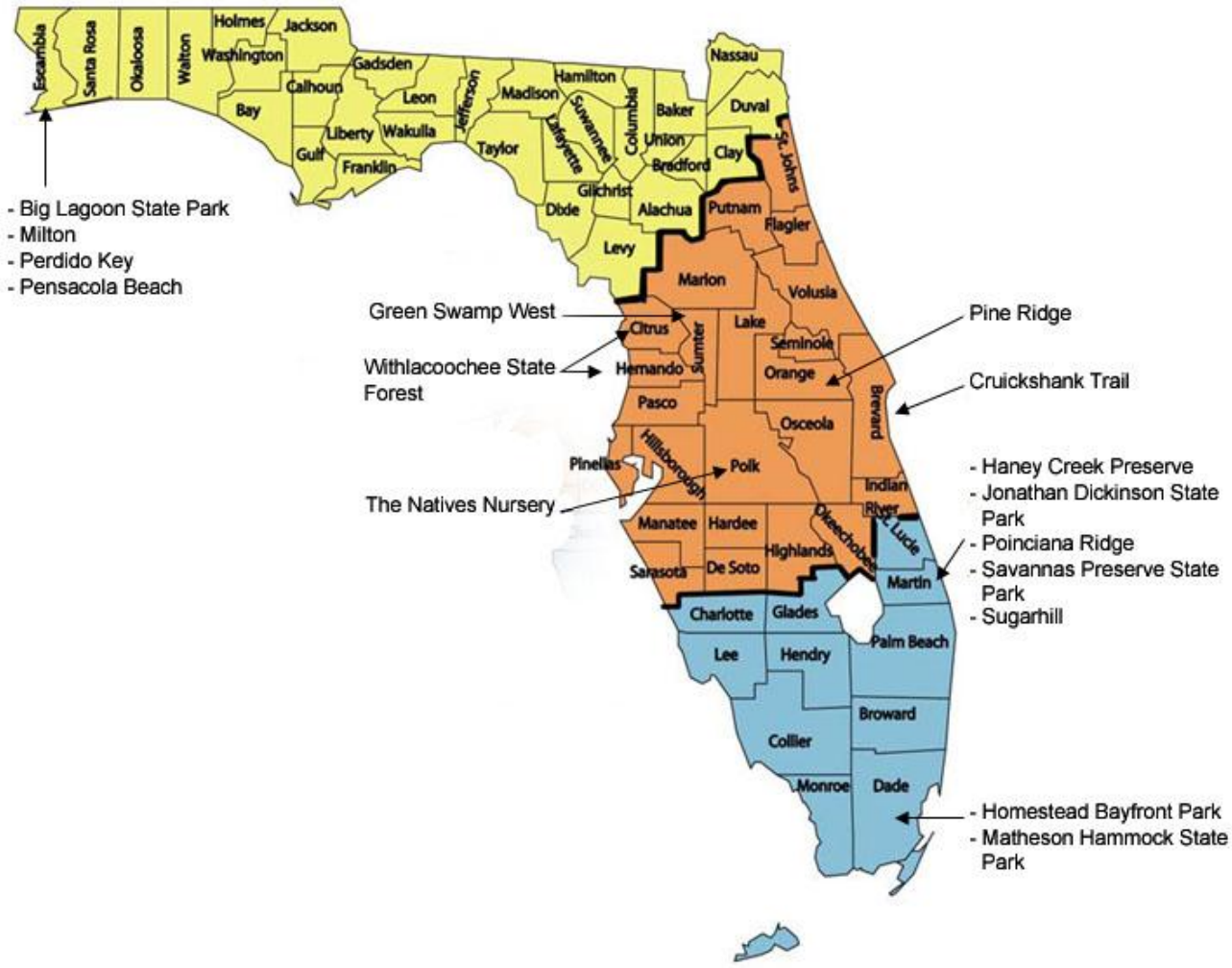


Figure 3: Map of 9 different cutting collection sites across the state.

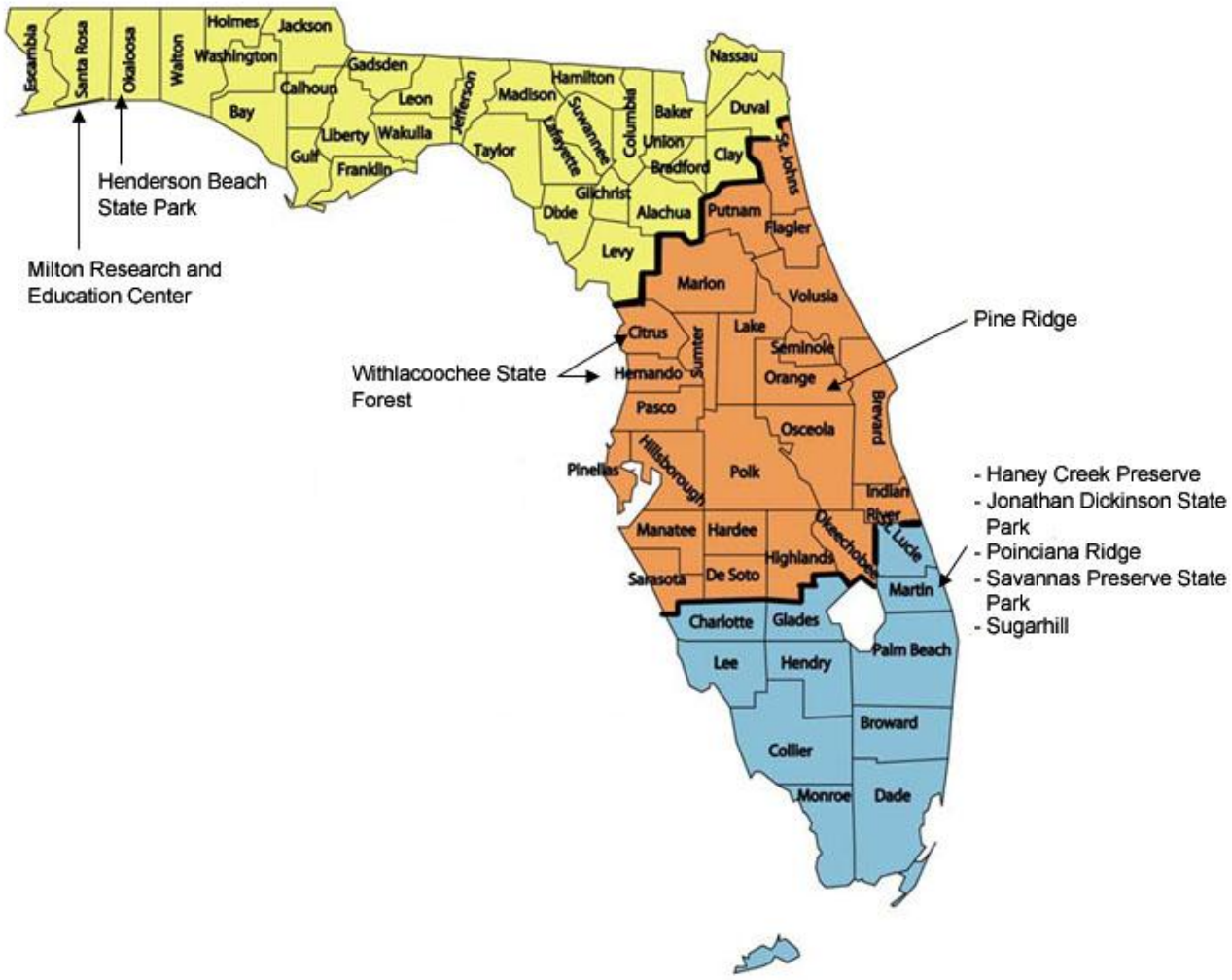


Figure 4. (Part 1 –vegetative propagation). Monthly flower and visual quality of wildflowers planted in northwest (Milton), central (Gainesville), and south (Fort Pierce) FL. Study was initiated April 20, 2009.

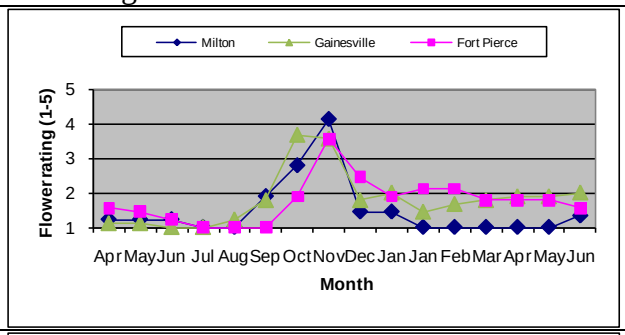
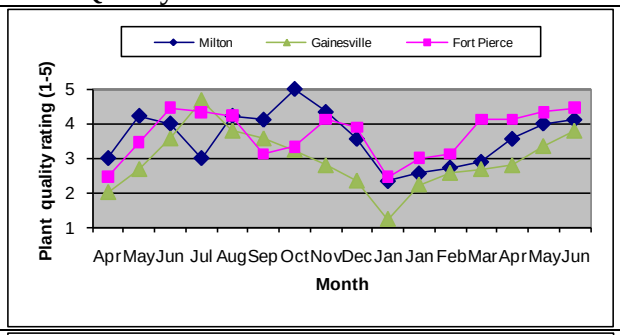
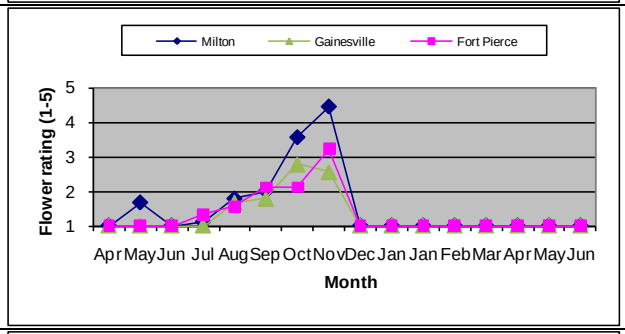
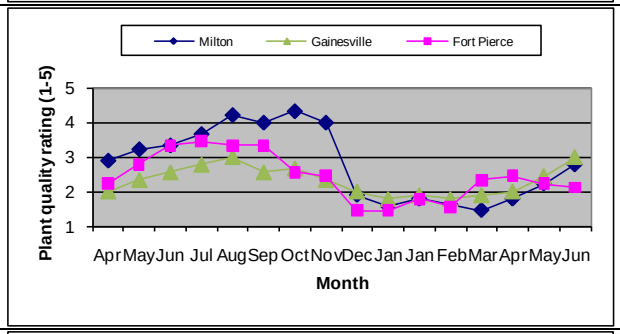
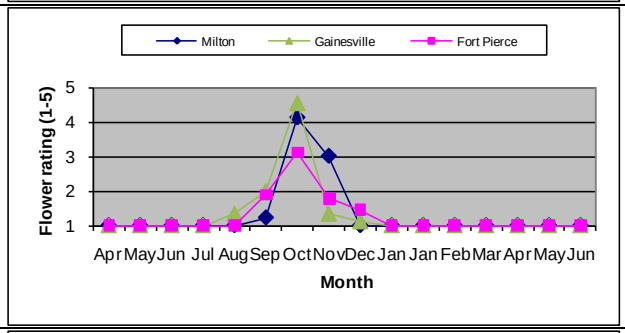
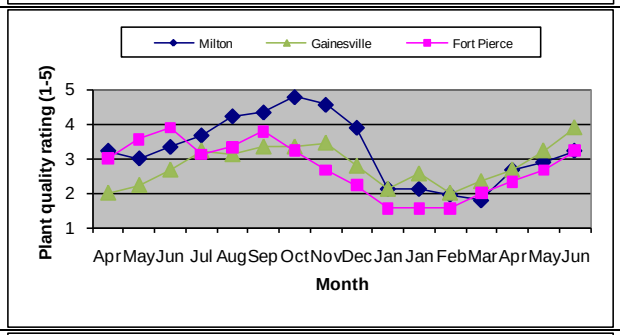
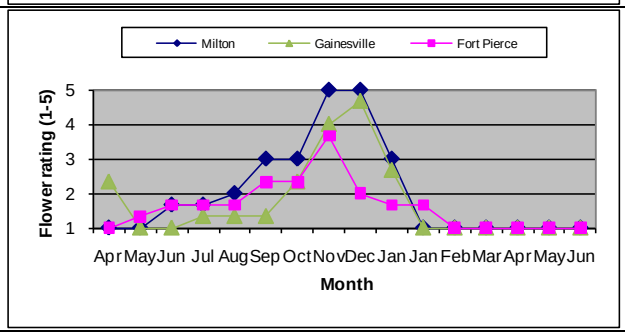
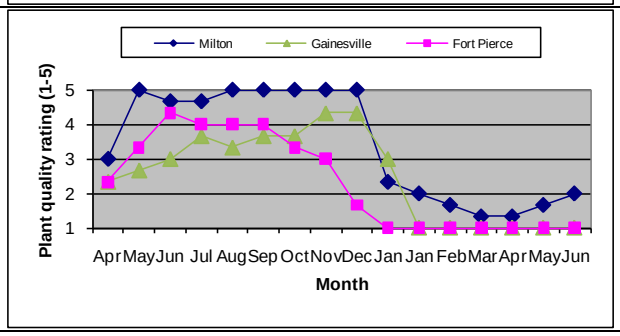
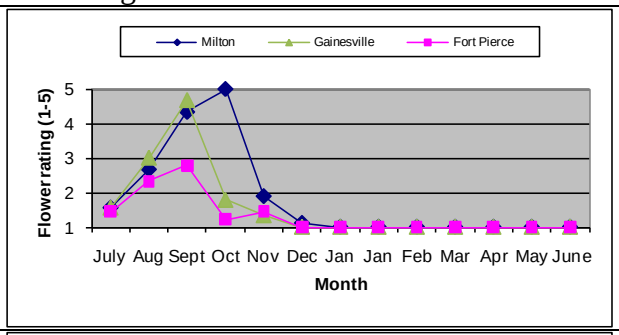
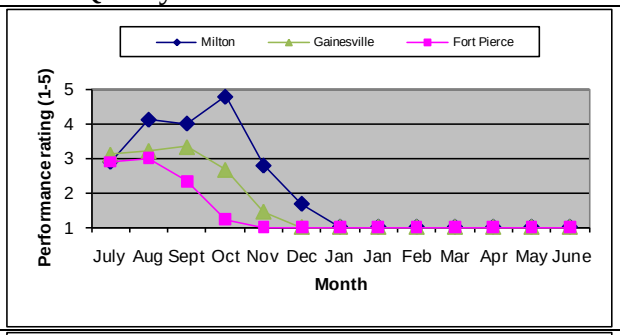
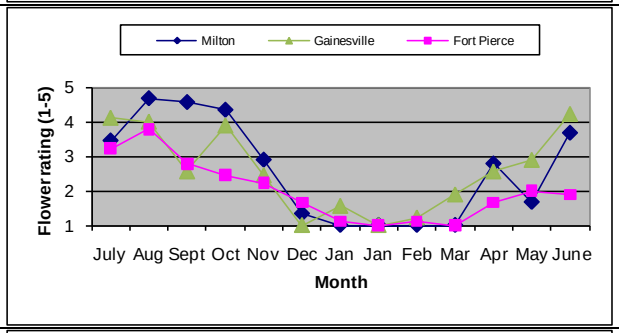
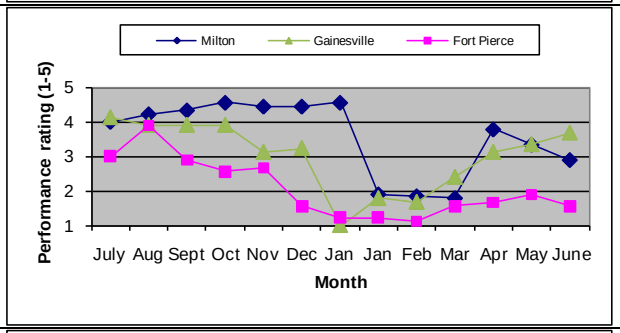
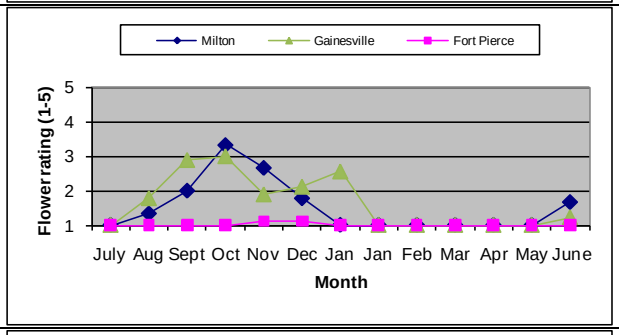
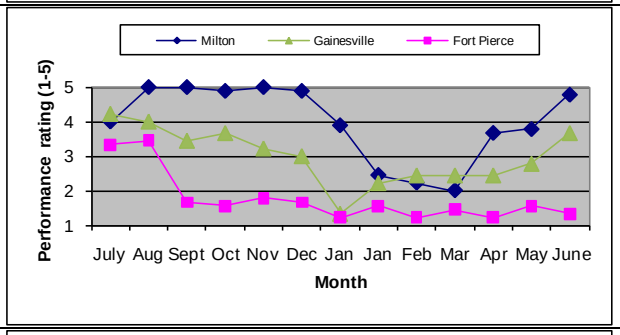
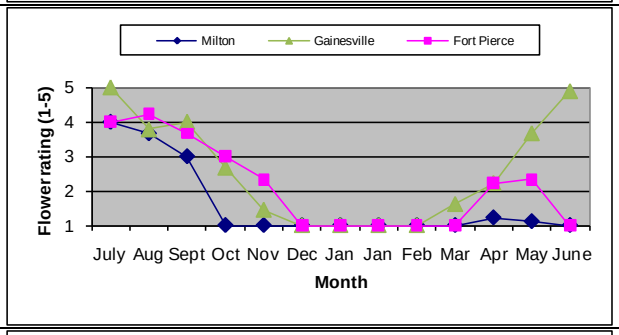
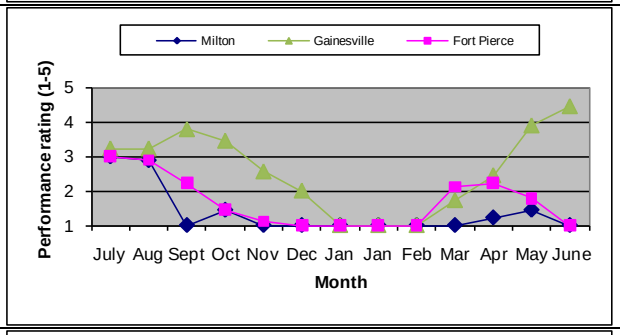
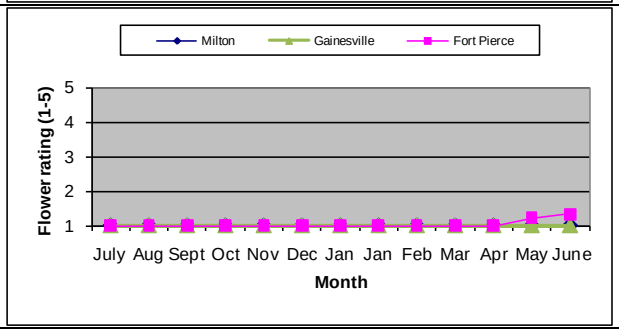
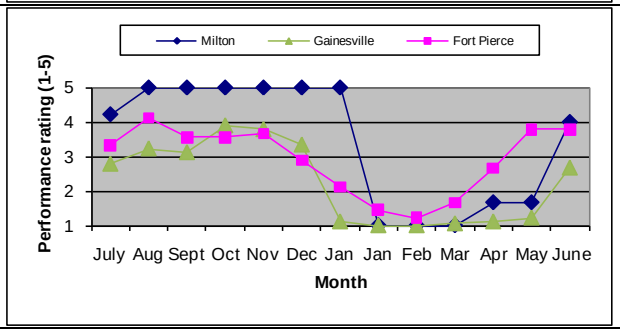
Cultivar	Flowering Chart	Plant Quality Chart
Chrysoma pauciflosculosa		
Polygonella macrophylla		
Polygonella polygama		
Polygonella robusta		

Figure 5. (Part 2 –seed propagation). Monthly flower and visual quality of wildflowers planted in northwest (Milton), central (Gainesville), and south (Fort Pierce) FL. Study was initiated July 17 2009.

Cultivar	Flowering Chart	Plant Quality Chart
Balduina angustifolia		
Callisia ornata		
Dalea feayi		
Heliotropium curassavicum		
Licania michauxii		

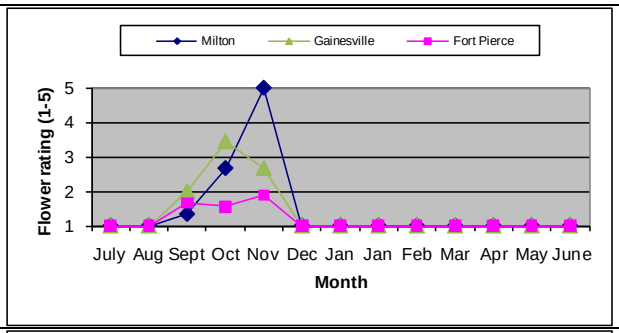
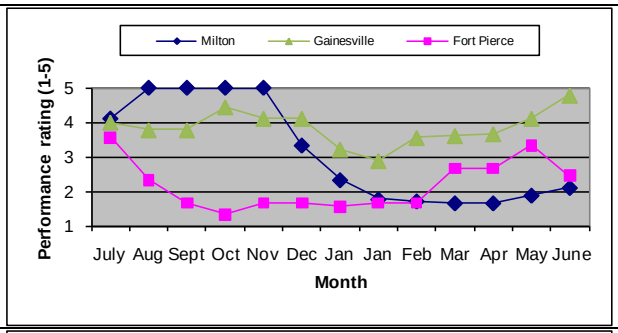
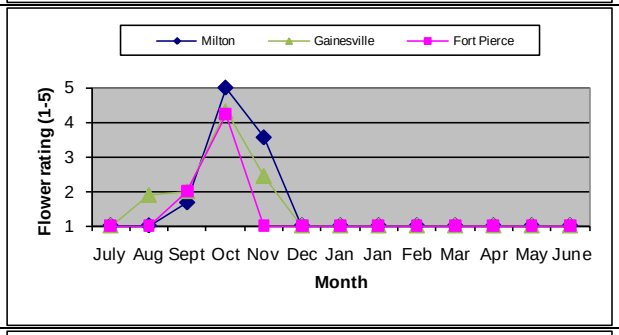
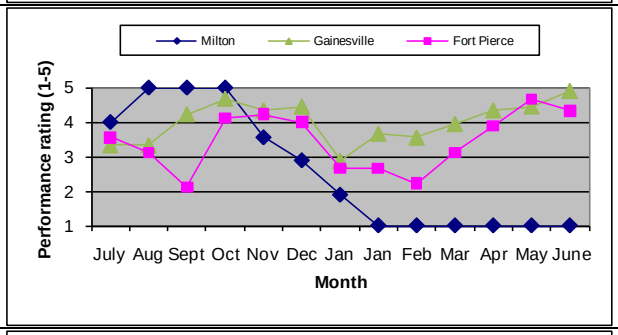
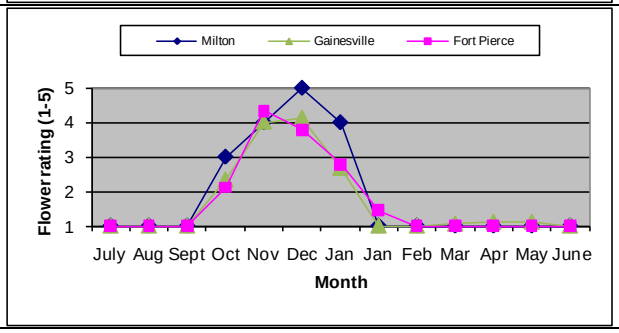
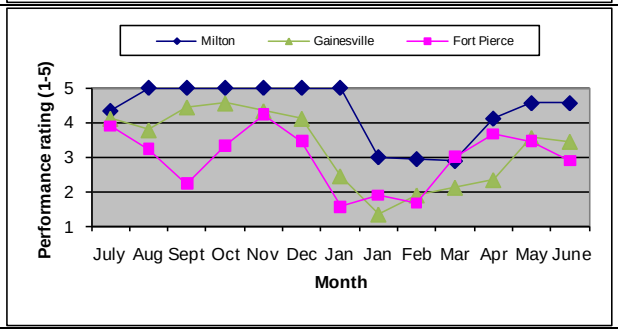
Polygonella macrophylla		
Polygonella polygama		
Polygonella robusta		

Figure 6. Landscape trial field design at Milton, Gainesville, and Fort Pierce respectively.

Table 9: Growth index of 4 Wildflower species propagated from cuttings grown for 28 weeks in Northern (Milton), Central (Gainesville) and Southern (Fort Pierce) Florida.

Name	Northern Florida	Central Florida	Southern Florida
Chrysoma pauciflosculosa	57.42	70.40	42.33
Polygonella macrophylla	50.06	52.44	44.24
Polygonella polygama	59.95	48.11	43.87
Polygonella robusta	78.84	55.56	67.33

Table 10: Growth index of 8 wildflower species grown for 16 weeks in Northern (Milton), Central (Gainesville) and Southern (Fort Pierce) Florida.

Name	Northern Florida	Central Florida	Southern Florida
Balduina angustifolia	49.02	43.39	27.00
Callisia ornata	37.30	29.41	14.56
Dalea feayi	50.19	66.67	21.67
Heliotropium curassavicum	22.69	54.93	29.19
Licania michauxii	17.16	20.26	14.41
Polygonella macrophylla	64.82	50.15	16.63
Polygonella polygama	54.10	49.15	27.11
Polygonella robusta	64.24	54.74	31.15

Table 11: Composition and cost analysis of 4 media selected for native wildflower container study.

Media	Peat	Pine Bark	Vermiculite	Perlite	Coarse Sand	Cypress Dust	Bark Ash	Price per Bag
Atlas 3000	40	50			10			$6.75
Atlas 7000	40			10	30	20		$5.15
Fafard 3B	45	25	10	20				$8.12
Metro Mix 300	15	35	35	10			5	$10.86

Table 12: Soil analysis of the 4 media selected for native wildflower container study.

Media	Organic matter (%)	Est. N release ($lbs \cdot A^{-1}$)	P (ppm)	K (ppm)	Mg (ppm)	Ca (ppm)
Atlas 3000	9.9	242	18	445	288	2010
Atlas 7000	9.9	242	7	22	152	429
Fafard 3B	9.9	242	29	118	233	1160
Metro Mix 300	9.9	242	86	98	246	791

Table 13. Physical and chemical properties of the media[z].

Media	pH	EC	CEC	Initial moisture	Air filled porosity	Total porosity	Container Capacity	Bulk density	Particle density
		(mmhos·cm)	(meg/100g)	----------(% by vol)----------				($g \cdot cm^3$)	($g \cdot cm^3$)
Atlas 3000	6.9	0.79	14.5	69.06	7.53	68.73	61.20	0.23	0.74
Atlas 7000	6.2	0.09	2.9	47.95	4.43	59.90	55.47	0.56	1.39
Fafard 3B	5.8	0.49	10.1	76.18	4.95	60.56	55.61	0.13	0.33
Metro Mix 300	6.2	0.52	7.3	72.26	3.31	63.58	60.27	0.19	0.52

[z]Data measured prior to transplanting.