Vegetative Propagation of Two Florida Native Wildflower Species: *Polygonella polygama* and *Polygonella robusta*©

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October flower (*Polygonella polygama*) and Sandhill wireweed (*P. robusta*) are native wildflowers with significant ornamental and landscape potential. Propagation by seed is limited by several factors including narrow collection times, seed source, storage conditions, and physiological seed dormancy. Propagation by stem cuttings may decrease production time, improve uniformity, and widen collection times. Experiments were conducted to determine the effects of α-naphthalene acetic acid (NAA) and indole-3-butyric acid (IBA) on rooting softwood cuttings of October flower and Sandhill wireweed collected from natural populations in central and south Florida. Softwood cuttings of each species were collected in the summer and quick dipped with nine different concentrations of K-NAA : K-IBA (0 : 0, 0 : 500, 0 : 1000, 250 : 0, 250 : 500, 250 : 1000, 500 : 0, 500 : 500, 1000 : 1000 ppm). Root initiation and quality were assessed after 6 weeks (Sandhill wireweed) or 8 weeks (October flower) under intermittent mist. Rooting of both species varied widely among auxin treatments and collection sites. Significant site × NAA × IBA interactions occurred for root index and percent rooting of Sandhill wireweed but not for October flower. Up to 63% and 80% rooting was achieved for October flower and Sandhill wireweed, respectively. However, most measured responses were not significantly different among auxin treatments. Root index and number of October flower were significantly affected by site, with greater rooting from the southern population. Root percent and number of Sandhill wireweed were significantly affected by site, with greater rooting from the central population.

INTRODUCTION

Native plants are widely recognized for their natural ability to adapt to tough conditions without substantial care once established. Native wildflowers, in particular, have an increasing role in ecological restoration, roadside beautification projects, and ornamental landscape use. The prolific white to pink flower spikes, perennial nature, and attractive foliage and form of *Polygonella polygama* (October flower) and *P. robusta* (Sandhill wireweed), both members of Polygonaceae, suggest that these wildflowers could have significant ornamental and landscape potential if an effective propagation method can be developed. October flower is typically found in sandhill and scrub habitats in the southeastern United States west to Texas. Its cream-colored flower spikes usually appear in late fall, thus earning its common name October flower. Sandhill wireweed is endemic to sandhill and scrub habitats of Florida. This mounding perennial is shorter with denser foliage and pink to cream flowers spikes that appear sporadically throughout the year. Both wildflowers typically grow in full sun and well-drained, nutrient-poor, sandy soils. They are tolerant of heat and drought, making them useful additions to natural landscapes, habitat restorations, and wildflower gardens (Gann et al., 2008; United States Department of Agriculture, National Resources Conservation, 2009; Wunderlin and Hansen, 2009).

October flower and Sandhill wireweed are both prolific bloomers with seed that is relatively easy to collect and clean. It has been determined that seed germination is inhibited by a physiological dormancy, rather than a physical or morphological dormancy (Heather et al., 2009). Although studies have been conducted to overcome this dormancy and improve germination (Heather et al., 2009), seed collection from natural populations is often restricted by varying seasonal conditions, management practices, or narrow collection windows. Vegetative propagation has served as a reliable alternative for several other coastal or scrub native species including Florida rosemary (*Ceratiola ericoides*) (Thetford et al., 2001), sea oats (*Uniola paniculata*) (Valero-Aracama et al., 2007), and dune sunflower (*Helianthus debilis*) (Norcini and Aldrich, 2000). Methods of auxin application to initiate and improve adventitious rooting have been well reviewed (Blyth et al., 2007). The objective of this study was to determine the effects of NAA and IBA on rooting October flower and Sandhill wireweed cuttings collected from natural populations in central and south Florida.

MATERIALS AND METHODS

Collection of Cuttings. Natural populations of October flower and Sandhill wireweed were identified in central and southern Florida and characterized by assessing neighboring species, burn history, population number, population health, disturbance affinity, and distribution (Table 1). From each site, terminal softwood stem cuttings approximately 10 cm (3.9 in.) in length were collected in the morning and kept moist

Table 1. Collection dates, site location, and site characteristics of October flower (*Polygonella polygama*) and Sandhill wireweed (*Polygonella robusta*).

Name	Collection date	Site	Florida location	Ecosystem	Neighboring species
October flower	8/28/2008	Haney Creek Preserve	South	oak scrub	*Pinus clausa*, *Quercus geminata*, *Q. myrtifolia*, *Q. chapmanii*, *Aristida* spp.
October flower	6/9/2009	Withlacoochee State Forest	Central	scrub	*Andropogon* spp., *Quercus geminata*, *Pinus clausa*, *Pityopsis*, *Aristida* spp.
Sandhill wireweed	7/21/2009	Jonathan Dickinson State Park	South	scrub	*Serenoa repens*, *Balduina* spp., *Licania michauxii*
Sandhill wireweed	6/9/2009	Pine Ridge proposed landfill	Central	sandhill	*Pinus palustris*, *Serenoa repens*, *Quercus geminata*, *Selaginella* spp., *Liatris tenuifolia*

Table 2. 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 NAA, 0 IBA	2.0 ± 0.1	30.0 ± 6.2	3.3 ± 1.1	2.2 ± 0.3
	0 NAA, 500 IBA	2.6 ± 0.2	60.0 ± 11.3	3.6 ± 0.2	4.0 ± 1.0
	0 NAA, 1000 IBA	2.2 ± 0.1	43.3 ± 8.5	4.2 ± 0.3	5.2 ± 0.3
	250 NAA, 0 IBA	1.9 ± 0.2	36.7 ± 9.7	2.6 ± 0.5	4.6 ± 0.8
	250 NAA, 500 IBA	1.8 ± 0.2	26.7 ± 11.3	2.3 ± 0.1	4.2 ± 1.6
	250 NAA, 1000 IBA	2.4 ± 0.3	46.7 ± 16.2	3.6 ± 0.5	4.4 ± 0.3
	500 NAA, 0 IBA	2.5 ± 0.1	56.7 ± 4.1	3.2 ± 0.4	3.8 ± 0.6
	500 NAA, 500 IBA	2.3 ± 0.3	50.0 ± 15.8	3.3 ± 1.8	3.0 ± 0.5
	500 NAA, 1000 IBA	2.1 ± 0.4	43.3 ± 17.2	2.8 ± 0.4	4.9 ± 0.8
South	0 NAA, 0 IBA	2.7 ± 0.3	53.3 ± 9.7	3.8 ± 0.7	2.6 ± 0.6
	0 NAA, 500 IBA	2.8 ± 0.4	60.0 ± 13.5	4.0 ± 0.7	3.7 ± 0.5
	0 NAA, 1000 IBA	2.2 ± 0.1	40.0 ± 6.7	4.1 ± 1.0	2.7 ± 0.5
	250 NAA, 0 IBA	1.8 ± 0.2	26.7 ± 11.3	4.0 ± 0.8	4.8 ± 0.7
	250 NAA, 500 IBA	2.6 ± 0.3	50.0 ± 13.9	4.1 ± 0.8	2.7 ± 0.4
	250 NAA, 1000 IBA	2.5 ± 0.2	63.3 ± 9.7	4.2 ± 0.2	4.5 ± 0.5
	500 NAA, 0 IBA	2.6 ± 0.3	50.0 ± 9.1	4.1 ± 0.7	2.8 ± 0.6
	500 NAA, 500 IBA	2.4 ± 0.2	56.7 ± 8.5	4.6 ± 0.8	3.4 ± 0.7
	500 NAA, 1000 IBA	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
NAA × IBA	*	NS	NS	NS
Site × NAA × IBA NS	NS	NS	NS	

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

Table 3. 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 NAA, 0 IBA	3.0 ± 0.5	56.7 ± 19.4	8.9 ± 1.7	6.3 ± 1.7
	0 NAA, 500 IBA	3.0 ± 0.3	60.0 ± 12.5	7.7 ± 0.9	7.3 ± 1.7
	0 NAA, 1000 IBA	3.3 ± 0.3 NS	76.7 ± 11.3 NS	7.6 ± 1.0	7.9 ± 1.4
	250 NAA, 0 IBA	2.9 ± 0.2	66.7 ± 5.3	6.2 ± 0.7	6.1 ± 2.2
	250 NAA, 500 IBA	2.8 ± 0.4	60.0 ± 15.5	7.5 ± 1.6	8.2 ± 1.9
	250 NAA, 1000 IBA	2.8 ± 0.6 NS	53.3 ± 17.8 NS	9.6 ± 1.7	8.3 ± 1.0
	500 NAA, 0 IBA	1.6 ± 0.4	20.0 ± 12.3	5.8 ± 2.4	2.9 ± 0.7
	500 NAA, 500 IBA	2.7 ± 0.5	53.3 ± 13.3	7.7 ± 0.8	6.1 ± 0.8
	500 NAA, 1000 IBA	2.9 ± 0.2 L*	63.3 ± 9.7 L*	7.3 ± 0.4	8.1 ± 1.0
South	0 NAA, 0 IBA	2.8 ± 0.3	50.0 ± 11.8	7.4 ± 1.7	2.3 ±1.1
	0 NAA, 500 IBA	2.1 ± 0.2	13.3 ± 8.2	3.0 ± 0.0	1.7 ± 0.8
	0 NAA, 1000 IBA	2.1 ± 0.1 L*	16.7 ± 5.3 Q*	4.1 ± 0.5	4.4 ± 0.6
	250 NAA, 0 IBA	2.1 ± 0.1	10.0 ± 6.7	5.0 ± 0.0	10.1 ± 0.3
	250 NAA, 500 IBA	3.6 ± 0.3	80.0 ± 6.2	8.5 ± 1.4	6.9 ± 0.8
	250 NAA, 1000 IBA	2.9 ± 0.4 Q**	50.0 ± 14.9 Q***	10.9 ± 2.0	4.8 ± 0.5
	500 NAA, 0 IBA	2.9 ± 0.2	53.3 ± 6.2	6.4 ± 1.2	6.8 ± 1.9
	500 NAA, 500 IBA	2.4 ± 0.4	23.3 ± 16.3	9.4 ± 4.3	7.6 ± 0.2
	500 NAA, 1000 IBA	2.3 ± 0.2 NS	23.3 ± 11.3 NS	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	*
NAA × IBA	NS	*	*	NS
Site × NAA × IBA	**	***	NS	NS

Non-significant (NS) or significant at = 0.05 (*), 0.01 (**), or 0.001 (***). L or Q indicates a linear or quadratic IBA trend for rooting parameters having significant site × NAA × IBA interactions.

between paper towels in zip-top plastic bags. Cuttings were stored on newspapers between icepacks in a cooler for transportation to the processing site in Gainesville. Prior to treatment, cuttings were trimmed and the foliage removed from the basal 3 cm (1.2 in.) of each cutting. Nine auxin treatments of potassium indole-3-butyric acid (K-IBA) and potassium 1-naphthaleneacetic acid (K-NAA) were formulated from 10,000 ppm stock solutions that were diluted to appropriate concentrations with distilled water. The basal 1 cm (0.4 in.) of each cutting was quick dipped in one of nine IBA:NAA solutions (0:0, 0:500, 0:1000, 250:0, 250:500, 250:1000, 500:0, 500:500, 1000:1000 ppm) and allowed to air dry prior to sticking. Cuttings were inserted 2 cm (0.8 in.) deep into 72-plug cell trays filled with pre-moistened soilless Fafard 2P media (Fafard Inc., Apopka, Florida). The trays were placed in a mist house where intermittent mist operated 8 sec every 10 min during the daytime. After 2 weeks, mist was reduced to 5 sec every 20 min. Greenhouse temperature was set at 27 °C (80 °F) with a natural photoperiod of approximately 300 $\mu mol \cdot m^{-2} \cdot s^{-1}$ of light reaching the benches. For each species, a split plot experimental design was used with the collection site as the main plot and the randomized auxin treatments as the subplot, where six cuttings per treatment were replicated 5 times.

Data Collection. Cuttings were removed from mist after 6 weeks (Sandhill wireweed) or 8 weeks (October flower). Media was carefully removed from roots by rinsing with tap water. For each experiment, rooting was assessed using four parameters: a visual root quality rating (rooting index), rooting percentage, root length, and root number. A cutting was considered rooted if it had one adventitious root ≥ 1 mm in length. Rooting index was based on a scale from 1 to 5, where 1 = dead, 2 = alive without roots, 3 = light rooting that does not hold media, 4 = medium rooting that holds media that is mostly removed with a light shake, and 5 = heavy rooting that holds onto media that must be removed with washing. Rooting percentage was calculated using the number of cuttings that received a rating of 3, 4, or 5. Root length was recorded as the longest primary root from each cutting. Data were subjected to ANOVA and regression analysis using SAS v.9.1 (SAS Institute, Cary, NC). Rooting percentage data were arcsine square root transformed with untransformed means presented. Significance of main effects and interactions was determined using SAS PROC MIXED.

RESULTS AND DISCUSSION

October Flower. Site × NAA × IBA interactions were not significant for measured rooting parameters (Table 2). Root index and root number were significantly greater when cuttings were collected in south Florida compared to central Florida (Table 2). For central Florida cuttings, the 0 NAA : 1000 IBA and 500 NAA : 1000 IBA treatments produced roots that were 2.2 and 2.4 times longer (respectively) than control plants, but rooting percent and root number was not different among treatments. For south Florida cuttings, up to 63% rooting could be achieved with 250 NAA : 1000 IBA (Table 2), but rooting was highly variable and not significant from untreated controls.

Sandhill Wireweed. Significant Site × NAA × IBA interactions occurred for root index and root percentage (Table 3). The site from which cuttings were collected (central or south Florida) also affected rooting percent and root number (Table 3). For central Florida, at 500 ppm NAA, linear IBA responses were observed with root index and root percent. For south Florida, at 0 or 250 NAA, linear or quadratic IBA responses were observed. On average, 77% rooting was achieved from central Florida cuttings treated with 0 NAA : 1000 IBA and 80% rooting was achieved from south Florida cuttings treated with 250 NAA : 500 IBA (Table 3).

Regardless of species, no single auxin treatment proved to be most effective in promoting adventitious root formation. Sandhill wireweed cuttings appeared to have a greater response to auxin application, with greater root indices and rooting percentages than October flower. The plant population from which cuttings were collected also affected root initiation and quality. Cutting maturity, substrate, moisture, auxin concentration, year, and stock plant management can significantly affect root potential (Blythe et al., 2007; Thetford et al., 2001). Future studies will address these factors using higher auxin concentrations and various stock plant management regimes.

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