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Plant Propagation via Leaf Cuttings in Four Aquatic Species: Bur-Marigold, Sky Flower, East Indian Hygrophila and Water Primrose

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ABSTRACT

Economical methods for propagation of aquatic plants would help nursery growers in Florida effectively meet the need for ornamental landscaping and wetland restoration. Propagation of aquatic plants by leaf cuttings, as is commonly done with begonia (Begonia spp.) and African violet (Saintpaulia spp.) plants, would provide growers with a simple, inexpensive means of producing and promoting new species for the aquatic plant industry. To provide information on propagation by leaf cuttings, root and shoot initiation in four uniquely different aquatic species was evaluated under greenhouse conditions at the University of Florida Research and Education Center in Fort Lauderdale, Florida, from 15 May 2000 through 28 September 2000. Bur-marigold (Bidens laevis (L.) BSP), a perennial wetland native of Florida, was selected for the study due to its potential use in mass plantings and erosion control. Sky flower (Hydrolea corymbosa Macbr. ex Ell.), an aquatic perennial, produces a multitude of cornflower-blue blossoms throughout the summer months and shows promise in aquatic landscape settings. The third plant evaluated, East Indian Hygrophila (Hygrophila polysperma (Roxb.) T. Anderson), is listed as a weedy, invasive species by the USDA and was included due to its phenomenal capacity to produce abundant new plants from leaf cuttings. Lastly, water primrose (Ludwigia peruviana (L.) Hara), a common native plant with attractive yellow flowers, was studied since it is profuse and well adapted to this area.

INTRODUCTION

As the Florida population continues to grow, more and more wetland areas are lost to expansion and urbanization. Fortunately, public awareness has increased in the past few years and this has created the need for aquatic plant nurseries in Florida, which play a vital role in supplying ornamental aquatic plants for homeowners and native plants for use in wetland restoration projects. Development of efficient methods for propagation of aquatic plants will be of great benefit to the nursery industry by helping lower their production costs. Only a limited number of plant species can be produced via leaf cuttings (Hartman et al., 1997) and only a few aquatic plants produce new plants (i.e., adventitious roots and shoots) from their leaves. Little is known of the factors that cause plants to reproduce in this manner. If high numbers of plants could be produced from leaf tissue, this would eliminate the need to use costly tissue culture methods now employed for some aquatic species. Our study utilized whole leaves and top and bottom halves of leaves to evaluate adventitious root and shoot formation in four uniquely different species of aquatic plants: Bur-marigold (Bidens laevis (L.) BSP); sky flower (Hydrolea corymbosa Macbr. ex Ell.); East Indian Hygrophila (Hygrophila polysperma (Roxb.) T. Anderson); and water primrose (Ludwigia peruviana (L.) Hara).

Bur-marigold, a member of the Asteraceae family, occurs throughout Florida in wetland habitats such as meadows, marshes, ditches, slow-moving streams, and banks. Bur-marigold is an annual but functions as a short-lived perennial in our area of south Florida. Generally no more than 1.0 m in height, bur-marigold assumes a decumbent growth habit; the species reclines on the ground and roots at the nodes, often forming mats up to 2.0 m across. Leaves are opposite, lanceolate to elliptical in shape, unlobed, and sessile. Flowers which occur in late summer to early fall, are typical of the aster family and are large with bright yellow ray and disk flowers **(Figure 1)**. Resulting achenes (seeds) are numerous, strongly flattened and bear the classic two awns (narrow bristle-like appendages on each side) which aid in seed dispersal and give rise to the common names used to describe this species, including beggar-ticks, stick tights and bur-marigolds. Bur-marigold spreads readily by seed and is potentially useful in mass plantings and for erosion control. This species has been recommended for use in wetland restoration projects as a shallow water plant in areas with water levels to 30 cm in depth (Godfrey

and Wooten, 1981; Loftin, 1994; Tobe et al., 1998).

Figure 1. Flower and leaf cutting of bur-marigold

Sky flower is a member of the Hydrophyllaceae or Waterleaf family. Hydrolea corymbosa (the particular species used in this experiment) is the most common of the sky flowers seen in Florida and ranges from Leon County east and all the way south to Monroe County. It is a perennial herb, growing in and around shallow water in swampy woodlands, marshes, and ditches. The plant is 0.60 to 0.80 m in height with smooth or pubescent stems, and alternate, elliptic to lanceolate shaped leaves. Every summer, and extending into the early fall months, sky flower offers a profusion of flat or round-topped inflorescences called cymes with an intense shade of cornflower blue, although the blossoms may be purple or even white **(Figure 2)**. Individual flowers are bisexual with five petals each. Seed pods contain numerous, extremely small, oval-shaped seeds that germinate readily, although new plants are produced from rhizomes as well. Sky flower has been successfully grown in standard 2-gallon containers for several years at the Fort Lauderdale Research and Education Center. Sky flower has not yet been used as an aquatic landscape ornamental; however, its beauty and growth habit suggest significant potential (Gettys and Sutton, 1999; Godfrey and Wooten, 1981; Sutton and Robinette, 1996).

Figure 2a. Flower and growth habit of sky flower

Figure 2b. Close-up of sky flower

East Indian Hygrophila, first introduced into Florida in the 1950s for use in the aquatic ornamental industry, is native to the East Indies and a member of the Acanthaceae family. East Indian Hygrophila, also known as "Miramar Weed" (Vandiver, 1980) began creating serious weed problems in South Florida waterways in 1980, invading many of the habitats formerly populated by Hydrilla verticillata (L. f.) (Sutton, 1995). It is now naturalized in many rivers, canals, and static bodies of water in numerous Florida counties and is considered a noxious, weedy species by the United States Department of Agriculture (USDA, 2000). Weed problems currently occur primarily in warm areas of the state; however, the plants may withstand cold water temperatures as well (Schmitz and Nall, l984). Generally, East Indian Hygrophila prefers riverine habitats, growing profusely as a rooted, submersed, herbaceous perennial with square, decumbent stems and short stalks. Leaves are lanceolate or lance-elliptic, opposite and 2.0 to 7.0 cm in length. East Indian Hygrophila produces small, bisexual flowers (bluish-white in color) in apical leaf axils in the winter months **(Figure 3)**. The resultant seeds dehisce from capsules and may, or may not, play a major role in reproduction, as asexual reproduction readily occurs from portions of the brittle stems that break away from the parent plants. Large floating mats of vegetation clog Florida waterways, effectively disseminating East Indian Hygrophila to new habitats where stems easily create new plants by forming adventitious roots at the nodes.

Figure 3. Flower and growth habit of hygrophila

Water primrose, also known as seed box, is a wetland member of the Onagraceae or Evening Primrose Family. Water primrose is considered a native species and is found abundantly in Central Pensacola and South Florida in shallow water habitats such as ditches, marshes, swamps, and the like. It grows to a height of approximately 1.8 m as an annual or, more often, as a well-branched perennial herb or subshrub (due to the woodiness that develops at the base). Leaves, especially when young, are pubescent, alternate, and lanceolate in shape with tiny glandular stipules. Large, showy yellow flowers with 4 or 5 petals each are produced in the

summer and fall months in the upper leaf axils **(Figure 4)**. The resulting seed capsules are approximately 2.5 cm in length, broadly obconic and quadrangular at the apex. Water primrose seeds are eaten by ducks and other waterfowl which, no doubt, explains the number of "volunteers" occurring profusely in the South Florida landscape. Many Ludwigias are so abundant they are considered a "nuisance native" (Burks, personal communication), although others appreciate its decorative flowers and potential use in "emerse cultivation" (Muhlberg, 1980).

Figure 4a. Flower of water primrose

Figure 4b. Growth habit of water primrose

MATERIALS AND METHODS

Commercially available materials that are commonly used by the nursery industry were used in this study. Propagation trays with drainage (52.0 x 26.0 x 6.0 cm) were lined with paper toweling and filled to a level of approximately 1.0 cm with Scotts Metro-Mix 500© potting medium. Filled trays were sprayed with water to fully hydrate the potting medium and then allowed to drain. The plant material, consisting of fresh leaves from the four above-described species, was harvested from well-nourished stock plants and immersed in fresh water pending placement on the propagation trays. Each tray consisted of 12 leaves of one species placed flat on the surface of the moistened medium &endash; apex pointed to the top of the tray and base (petiole) pointed to the bottom of the tray (Figure 1). Each propagation tray held 12 leaves as follows: six whole leaves (WL), six leaves horizontally cut in half resulting in six sections designated as the "top of leaf" (TOL) and six sections designated as the "bottom of leaf" (BOL). Once prepared, all trays were placed under mist (10 second duration at 15 minute intervals, 24 hours per day, 7 days per week) in a teaching greenhouse. Four independent replicates of this experiment were conducted between 15 May and 28 September

2000. Temperatures were recorded on the mist bench of the greenhouse **(Table 1)**.

Table 1
Greenhouse Temperatures

Culture Period	Dates	Min. Temp. (OC)	Max. Temp. (OC)	Mean Temp. (OC)
1	15 May to 12 Jun 00	19.0	34.5	27.2
2	25 May to 22 Jun 00	20.5	37.0	28.4
3	15 Aug to 12 Sep 00	20.5	37.0	26.8
				27.0

RESULTS

Our results follow in **Table 2**, below. Values for root and shoot production are listed as percentages for whole leaves (WL), top of leaves (TOL), and bottom of leaves (BOL) placed under mist in a greenhouse for 4 weeks. Each value is based on a mean of 6 leaves or cuttings.

Table 2
Root and Shoot Production in Leaf Cuttings after 4 Weeks

	Production					
Plant / Culture	Roots			Shoots		
Period	WL	TOL	BOL	WL	TOL	BOL
Bur-marigold						
1	50	0	17	0	0	0
2	33	0	33	0	0	0
3	50	0	0	0	0	0
4	83	17	50	0	0	0
Sky Flower						
1	33	0	67	17	0	0
2	33	0	50	0	0	0
3	67	33	33	0	0	0
4	83	17	83	17	0	0
E. Indian Hygrophila						
1	100	100	100	100	100	100
2	100	100	100	100	100	100
3	100	100	100	100	100	100
4	100	100	100	100	100	100
Water Primrose						
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
						0

DISCUSSION

The lack of adventitious root and shoot production in bur-marigold and water primrose suggests that it is not possible to propagate these two species using leaf cuttings. East Indian Hygrophila was propagated efficiently and readily and produced adventitious roots and shoots in 100% of the leaf cuttings by week 4 **(Figures 5 and 6)**. Unfortunately, it remains listed by the U.S. Government as a noxious, weedy species and cannot be offered

for commercial use in the state of Florida. Interestingly enough, East Indian Hygrophila is commercially raised by Florida aquatic nurserymen and marketed out-of-state for the aquarium trade. Of all the locally marketable species evaluated, sky flower exhibited the most promise. Our findings suggest that, given time, sky flower will produce both adventitious roots and shoots from leaf cuttings. Additional studies should be undertaken to more fully evaluate its potential for propagation by leaf cuttings and use in aquascape and restoration projects.

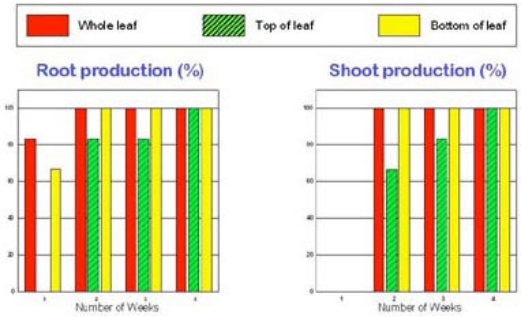

Figure 5. Production of roots and shoots by East Indian Hydrophila from 15 MAy to 12 June 2000 held under mist in a greenhouse. Each value is the mean of six leaf cuttings.

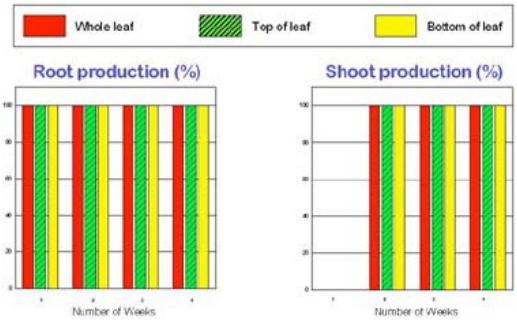

Figure 6. Production of roots and shoots by East Indian Hygrophila from 31 Aug to 28 Sept 2000 held under mist in a greenhouse. Each value is the mean of six leaf cuttings.

4	31 Aug to 28 Sep 00	22.0	36.0			
4		0	0	17	0	0

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