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Potential of 57 Species of Tropical Ornamental Plants for Cut Foliage Use

T.K. Broschat and H. Donselman

Fort Lauderdale Research and Education Center, University of Florida, 3205 College Avenue, Fort Lauderdale, FL 33314

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Abstract. **Foliage of 57 species of tropical ornamental plants was harvested and placed under a controlled indoor environment to determine its postharvest life. Foliage was placed in deionized water, pulsed for 4 hr with 2 mM silver thiosulfate, and then transferred to deionized water, pulsed for 4 hr with 800 mg·liter^{-1} 8-hydroxyquinoline citrate (8-HQC) and 20 g·liter^{-1} sucrose and then transferred to deionized water, or held in 200 mg·liter^{-1}, 8-HQC and 20 g·liter^{-1} sucrose for the duration of the experiment. Foliage of 40 species lasted longer than 20 days and 28 species lasted 30 days or more in deionized water alone. Pulsing or holding foliage in preservative solutions lengthened postharvest life over that in deionized water for 12 species, but deionized water alone was as good as or better than other solutions for 46 species.**

Tropical cut foliage is an important part of the florist industry. Although leatherleaf fern [*Rumohra adiantiformis* (G. Forst.) Ching] accounted for about 42% of the cut foliage marketed in this country in 1983, lesser quantities of other tropical and subtropical species, such as *Chamaedorea* sp., *Asparagus* spp., *Podocarpus macrophyllus* (Thunb.) D. Don, *Pittopsorum tobira* (Thunb.) Ait., *Cordyline terminalis* (L.) Kunth., *Eucalyptus cinerea* F.J. Muell. ex Benth., and others are also used (6, 10, 11). A large number of tropical plants potentially could be used as cut foliage, provided they could be produced and handled economically, and the foliage had suitable postharvest characteristics.

Pulsing foliage of *R. adiantiformis* with 8-HQC solutions has extended vase life in this species (7) and perhaps could be used to extend vase life of other potentially useful cut foliage species. The purpose of this experiment was to determine the postharvest lives of cut foliage from 57 species of tropical ornamental plants in several types of floral preservatives.

Undamaged mature leaflets (*Cocos nucifera, Brassaia actinophylla*, and *Schefflera octaphylla*), shoots (*Alpinia* spp., *Asparagus* spp., *Araucaria heterophylla, Eucalyptus shirleyi, Ficus retusa* 'Variegata', and *Podocarpus macrophyllus*), or leaves (all remaining species) were cut before 10:00 AM and immediately placed in deionized water. Environmental conditions under which plants were grown varied among species, but not within a species, and all foliage was harvested from a single plant or clone within a species. Foliage bases were recut with clippers within 1 hr of harvest and five replicates of each species were placed in each of the following solutions: a) deionized water, b) a 4-hr pulse in 2 mM silver thiosulfate (STS) and transfer to deionized water, c) a 4-hr pulse in 800 mg·liter^{-1} 8-HQC plus 20 g·liter^{-1} sucrose and transfer to deionized water, and (4) 200 mg·liter^{-1} 8-HQC plus 20 g·liter^{-1} sucrose for the duration of the experiment.

Leaves or shoots were placed five per 2.5-liter polyethylene container with no more than one leaf of each species per container. Containers were arranged in a completely randomized pattern. About 1 liter of solution was maintained in the containers throughout the experiment. Containers were placed on a bench with PPF at container level of 6 mol·s^{-1}·m^{-2} from cool-white fluorescent lamps. Photo-period was 24 hr, temperature was maintained at 23° ± 1°C, and relative humidity averaged 80% ± 10%. Leaves were

Table 1. Postharvest life (in days) of cut foliage from 57 species of tropical ornamental plants in several pulsing and holding solutions.

Species	DI water	STS/DI water	8-HQC + sucrose/ DI water	8-HQC + sucrose
Acoelorrhaphe wrightii (Grisch & Wendl.) H. Wendl. ex Becc.	18.0 a[y]	15.8 ab	12.7 b	16.2 ab
Alocasia x amazonica André.	11.2 a	10.2 a	9.4 a	11.4 a
A. cucullata (Lour.) G. Don.	11.0 a	6.4 b	6.5 b	8.2 ab
Alpinia purpurata (Vieill.) K. Schum.	17.8 a	17.0 a	9.2 a	14.7 a
Alpinia sp.	15.6 a	12.8 a	11.6 a	12.0 a
A. zerumbet (Pers.) B. L. Burtt & R. M. Sm. 'Variegata'	51.2 ab	59.6 a	32.5 b	63.8 a
Araucaria heterophylla (Salisb.) Franco	143.2 a	136.7 a	67.0 b	126.5 a
Asparagus densiflorus (Kunth.) Jessop 'Sprengeri'	6.6 b	9.8 a	12.2 a	6.6 b
A. retrofractus L.	13.4 ab	12.5 b	15.6 a	15.6 a
Aspidistra elatior Blume	36.4 a	40.2 a	26.2 a	34.8 a
Brassaia actinophylla Endl.	23.0 ab	26.4 a	23.0 ab	16.7 b
Calathea lancifolia Boom	57.6 ab	83.7 a	29.0 c	34.9 bc
C. louisae Gagnep.	14.5 a	15.2 a	11.3 a	10.3 a
C. picturata (Linden) C. Koch & Linden	33.3 a	23.0 b	14.0 c	19.8 bc
C. rufibarba Fenzl.	26.0 b	46.5 a	18.0 b	21.4 b
C. zebrina (Sims) Lindl.	17.0 a	17.2 a	5.2 a	11.2 a
Chamaedorea cataractarum Mart.	58.2 a	40.0 a	17.8 b	35.6 ab
C. elegans Mart.	30.4 b	92.0 a	26.4 b	32.8 b
C. seifrizii Burret	25.3 a	23.7 a	18.8 a	25.2 a
Chrysalidocarpus lutescens H. Wendl	31.2 a	21.0 ab	26.0 ab	19.2 b
Cocos nucifera L. 'Malayan Dwarf'	51.0 ab	52.7 ab	44.2 b	60.6 a
Codiaeum variegatum pictum (Lodd.) Mull. Arg.[x]	124.0 a	129.4 a	115.6 a	127.4 a
Cordyline terminalis (L.) Kunth cv 1	26.8 b	67.7 a	11.7 b	84.0 a
C. terminalis cv 2	47.2 a	29.7 a	19.0 a	35.4 a

continued

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Table 1 continued.

Species	DI water	STS/DI water	8-HQC + sucrose/ DI water	8-HQC + sucrose
Cycas revoluta Thunb.	57.8 a	56.2 a	44.8 a	41.7 a
Cyperus alternifolius L.	12.4 a	8.7 a	9.5 a	17.5 a
Dasylirion longissimum Lem.	61.4 a	76.7 ab	69.5 ab	83.6 a
Dizygotheca elegantissima (Hort. Veitch) R. vig. & Guillaum	80.3 a	66.6 a	24.2 b	61.0 a
Dracaena angustifolia (Medic.) Roxb. 'Honoriae'	54.2 ab	32.8 b	61.5 a	51.2 ab
D. deremensis Engl. 'Janet Craig'	127.0 a	150.0 a	138.8 a	150.0 a
D. fragrans (L.) Ker-Gawl. 'Massangeana'	120.2 b	5.8 d	47.2 c	136.7 a
D. marginata Lam.	33.0 a	29.7 a	22.0 a	47.2 a
Eucalyptus shirleyi Maid.	18.0 b	19.7 b	30.4 a	22.0 b
Ficus lyrata Warb.	86.7 a	56.2 ab	24.4 b	57.8 ab
F. retusa L. 'Variegata'	9.4 a	8.0 a	9.2 a	9.0 a
Heliconia x *nickeriensis* Maas & deRooij	26.6 a	20.3 ab	10.8 c	18.5 b
H. psittacorum L. 'Andromeda'	27.0 a	6.7 b	9.6 b	25.2 a
H. stricta Huber 'Dwarf Jamaican'	8.4 b	12.2 a	7.2 b	6.6 b
Pandanus veitchii Hort. Veitch ex. M. T. Mast. & T. Moore 'Compacta'	137.5 a	121.1 a	148.0 a	150.0 a
Philodendron Schott. 'Red Emerald'	46.4 b	93.8 a	21.6 c	40.2 bc
Phoenix roebelenii O'Brien[z]	33.7 a	22.0 b	17.0 b	23.7 b
Platycerium bifurcatum (Cav.) C. Chr.	23.0 a	19.4 a	20.4 a	38.4 a
Podocarpus macrophyllus (Thunb.) D. Don[x]	147.8 a	136.2 a	53.2 b	150.0 a
Polypodium punctatum (L.) Swartz 'Grandiceps'	93.0 a	93.6 a	25.2 b	114.0 a
Polyscias filicifolia (C. Moore) L. H. Bailey	55.2 b	89.4 a	17.8 c	24.6 c
P. fruticosa (L.) Harms	11.2 ab	7.8 b	14.5 a	10.6 ab
P. guilfoylei (Bull.) L. H. Bailey 'Variegata'[x]	57.0 a	32.8 ab	23.0 ab	22.6 b
P. pinnata J. R. & G. Forst. 'Pennockii'[x]	65.8 a	47.7 a	26.7 a	60.0 a
Rhapis excelsa (Thunb.) A. Henry	19.0 a	24.4 a	28.0 a	27.0 a
Rumohra adiantiformis (G. Forst.) Ching	18.7 a	20.0 a	20.4 a	17.6 a
Schefflera arboricola Hayata ex Kanehira	21.4 b	26.2 ab	29.8 a	22.4 b
S. octaphylla (Lour.) Harms.	34.6 a	30.5 a	32.8 a	26.5 a
Schefflera sp.	29.0 b	42.6 a	24.0 b	22.6 b
Schismatoglottis picta Schott.	8.8 ab	4.2 b	6.8 b	16.7 a
Spathiphyllum Schott. 'Londonii'	27.8 a	23.0 ab	17.8 b	23.7 ab
Stenocarpus sinuatus (A. cunn.) Endl.	28.2 a	28.2 a	27.2 a	57.2 a
Syngonium podophyllum Schott.	11.4 a	7.0 a	11.2 a	9.0 a
Yucca elephantipes Regel	115.7 a	62.8 ab	47.4 b	95.3 ab

[z]Spines were cut off petioles prior to use.

[y]Mean separation within rows by Waller–Duncan k-ratio method, k-ratio = 100.

[x]Foliage often initiated roots after 60 days or more.

examined daily and those showing signs of wilting, yellowing, or other discoloration, or abscission or necrosis were removed and the number of days from harvest recorded. The experiment was terminated after 150 days, even though some leaves remained in excellent condition after that time. Data were analyzed within species by analysis of variance with mean separation by the Waller–Duncan k-ratio method.

Foliage postharvest life in deionized water exceeded 2 weeks for 47 of the 57 species tested, 20 days for 40 species, and 30 days for 28 species (Table 1). Deionized water alone was as good as or better than other treatments for 46 of the 57 species. Postharvest life of *Asparagus densiflorus* 'Sprengeri', *Calathea rufibarba, Chamaedorea elegans, Cordyline terminalis, Heliconia stricta* 'Dwarf Jamaican', *Philodendron* 'Red Emerald', *Polyscias filicifolia*, and *Schefflera* sp. was extended beyond that for deionized water when leaves were pulsed for 4 hr in STS and held in deionized water. Since STS is known to inhibit ethylene activity in plants (12), ethylene does not appear to be the primary cause of senescence in cut foliage for the majority of species tested. Leaves of *A. densiflours* 'Sprengeri', *Eucalyptus shirleyi*, and *Schefflera arboricola* pulsed for 4 hr in 800 mg·liter^{-1} 8-HQC plus 20 g·liter^{-1} sucrose lasted longer than those held in deionized water alone, whereas leaves of *Cordyline terminalis, Dasylirion longissimum*, and *Dracaena marginata* held continuously in 200 mg·liter^{-1} 8-HQC plus 20 g·liter^{-1} sucrose lasted longer than control leaves in deionized water.

This study shows that foliage of many attractive tropical ornamental plants potentially could be used in the cut foliage industry, although, within a species, many preharvest factors such as harvest time of day (8), irrigation level (4), fertility level (4), genetic differences (1, 2), production temperature (8), time of year (3, 5), leaf age (5), and production light intensity (9) can have significant effects on postharvest lives of cut foliage. Postharvest life in deionized water for about 70% of the species tested exceeded that of *R. adiantiformis* one of the most popular cut foliage crops in this country, and additional refinement of production and postharvest handling of these plants could result in even longer postharvest life.

Postharvest life was extended for some of these species by pulsing or holding the foliage in preservative solutions, but the reduced postharvest lives of other species in 8-HQC or STS may have been due to phytotoxicity of these materials at the applied concentrations, and further testing of individual species with these materials at varying concentrations or pulsing times is needed.

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Growth Responses of Seedlings to Varying Rates of Fresh and Aged Spent Mushroom Compost

Virginia I. Lohr
Department of Horticulture and Landscape Architecture, Washington State University, Pullman, WA 99164–6414

David L. Coffey
Department of Plant and Soil Science, University of Tennessee, Knoxville, TN 37901–1071

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Abstract. **Seedlings of broccoli (*Brassica oleracea* L. Group *italica*), lettuce (*Lactuca sativa* L.), marigold (*Tagetes patula* L.), and tomato (*Lycopersicon esculentum* Mill.) were grown in 50% (by volume) vermiculite and 0%, 12.5%, 25%, 37.5%, or 50% fresh or aged spent mushroom compost, with Canadian peat comprising the remaining portion. Percent dry weight of the plants decreased linearly, whereas dry weight, height, and quality ratings showed quadratic responses as the rate of compost in the growing mix increased. Plants were smaller in fresh than in aged spent mushroom compost. Lettuce, marigold, and tomato (moderately salt-sensitive crops) grew best with 25% aged spent mushroom compost, and broccoli (moderately salt-tolerant) grew best with 37.5% aged compost.**

The rising cost of peatmoss, a major ingredient in many soilless potting mixes, has led to a search for inexpensive and locally available alternative substrates for container-grown crops (4, 12). Spent mushroom compost (SMC), a by-product of the mushroom industry, has been considered as a peat substitute. The responses of plants to varying amounts of SMC have not been thoroughly studied. Rathier (9) used a fixed rate of 33% fresh or aged SMC by volume, in combinations with perlite and peatmoss or soil. Plants grown in SMC were superior to those grown in a low-fertility control mix composed of perlite, peat, and soil. Lohr et al. (6) grew transplants in mixtures of 0%, 25%, and 50% fresh or aged SMC with vermiculite and peat. Generally, transplants grown in 25% SMC were larger than those in 50% SMC. In the present study, seedling responses to 0%, 12.5%, 25%, 37.5%, and 50% (by volume) fresh SMC or SMC aged for 6 weeks were investigated.

Treatment growth media were prepared using fresh SMC and SMC that had aged aerobically for 6 weeks (7). SMC consisted of decomposed straw, horse manure, peat, limestone chips, gypsum, cottonseed meal, urea, and residual fungal mycelia (7). The electrical conductivities (EC) of saturated paste extracts of fresh and aged SMC were 24 and 30 $dS \cdot m^{-1}$, respectively. The pH values of saturated paste extracts of fresh and aged SMC were 6.9 and 7.3, respectively. All media contained 50% (by volume) horticultural grade vermiculite (pH 4.7) and 0%, 12.5%, 25%, 37.5%, or 50% SMC, with Canadian peat (pH 4.1) comprising any remaining portion. To control pH, $\approx 3\ kg \cdot m^{-3}$ of dolomitic limestone was added to mixes containing 0% SMC, while 3 and 4 $kg \cdot m^{-3}$ of $(NH_4)_2SO_4$ were added to mixes containing 37.5% and 50% SMC, respectively. There were no additions to the mixes containing 12.5% or 25% SMC.

Seeds of 'Premium Crop' broccoli, 'Black Seeded Simpson' lettuce, 'Orange Boy' marigold, and 'Walter' tomato were sown in treatment media in plastic cell packs, with six 4 × 6 × 6 cm cells per pack. These were thinned randomly to one seedling per cell. Plants were grown by standard production methods in a greenhouse at 16°C minimum and 35°C maximum air temperature. Each cell pack was fertilized weekly with ≈150 ml of 35N–15P–30K (mM). Standard Trace Element Mixture (W. R. Grace, Fogelsville, Pa.) was applied at a rate of 0.3 $mg \cdot liter^{-1}$ with early fertilizations.

Plants were harvested after 6 weeks. A quality rating for consumer acceptability, based on a scale from 1 to 5, was determined. Cell packs rated 1 were unsalable. Those rated 2 could be sold only at reduced prices. Average packs were rated 3. Cell packs rated 4 and 5 contained uniform plants of good and exceptional quality, respectively. Heights, dry weights, and percent dry weights were determined. EC and pH values of saturated paste extracts from the growth media, before and after growing plants, were measured. Experiments were conducted in the spring and were repeated in the summer of 1982.

The experimental design was a randomized complete block with five treatments (0%, 12.5%, 25%, 37.5%, and 50% SMC) and five blocks. The six plants in each cell pack represented one experimental unit. Separate experiments were conducted with fresh and with aged SMC. Multivariate analyses of variance (5) were conducted to partition the variation in dry weight, height, and percent dry weight simultaneously. Although there were some seasonal differences, the overall trends for the spring and summer runs were similar. Data from both runs were combined

Table 1. Electrical conductivity (EC) and pH of saturated paste extracts from soilless media containing varying rates of fresh or aged spent mushroom compost (SMC), before and after growing seedlings.

Percent of SMC	EC ($dS \cdot m^{-1}$) Initial	EC After 6 weeks	pH Initial	pH After 6 weeks
Fresh				
0.0	0.9	1.6	5.7	6.7
12.5	4.6	3.8	6.2	6.0
25.0	6.4	5.6	6.3	6.5
37.5	9.9	6.4	6.2	6.4
50.0	11.6	7.1	6.4	6.6
Aged				
0.0	0.9	1.6	5.7	6.7
12.5	4.4	4.7	6.2	6.0
25.0	6.7	6.0	6.1	6.3
37.5	11.0	7.2	6.2	6.5
50.0	13.6	7.7	6.3	6.4

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