Medium Temperature Influences the Rooting Response of *Hibiscus rosa-sinensis* L.[1]

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Abstract

Adventitious rooting of stem cuttings of *Hibiscus rosa-sinensis* L. 'Pink Versicolor', 'Brilliant Red', 'Jim Hendry' and 'Silver Anniversary' was evaluated after propagation at medium temperatures of 18°, 22°, 26°, 30° and 34°C (65°, 72°, 79°, 86° and 93°F). Cuttings of all cultivars propagated at medium temperatures of 26° and 30°C rooted faster and developed more roots with larger fresh and dry weights. Rooting percentages for each cultivar was similar among all propagation medium temperatures, but 26° and 30°C (79° and 86°F) reduced the weeks required for rooting 50% of the cuttings and periods in weeks between 10% and 90% rooting. The most vigorous rooting 'Pink Versicolor' had more uniform root emergence and the best response at unfavorable medium temperatures, while the poorest 'Silver Anniversary' had inconsistent root formation at all temperatures.

Index words: hibiscus propagation, rooting temperature, asexual propagation

Introduction

Cuttings of certain clones of *Hibiscus rosa'sinensis* L. develop roots rapidly during propagation, while others take considerable time to root. Van Overbeek (12) propagated the difficult-to-root 'Purity' by grafting onto stem cuttings of the easily rooted 'Brilliant', which responded to auxin application. Later, Ryan (9) found cutting leaf retention was essential for rooting of 'Purity', and necessary when evaluating the rooting capacities of various cultivars. No propagation medium temperature recommendations have been reported for *H. rosa'sinensis*, although 20°C was reported best for *H. syriacus* (13). Based on experience of members (3), the American Hibiscus Society recommends propagation medium temperatures of 20° to 25°C (68° to 77°F). Halma (4) and Stoutmeyer (11) reported warm medium temperatures during propagation hasten root initial formation of most plant species. Hartmann and Kester (5) report that propagation medium temperatures of 21° to 27°C (70° to 80°F) are optimum for most plants, with temperatures below 21°C delaying rooting and above 27°C inhibiting rooting. Therefore, the purpose of this investigation was to compare rooting of several cultivars of hibiscus having varying rooting capacities over a range of propagation medium temperatures.

Materials and Methods

Vegetative stem cuttings of 'Brilliant Red', 'Pink Versicolor', 'Jim Hendry' and 'Silver Anniversary' were provided by commercial propagators. 'Pink Versicolor' initiates roots rapidly and in large numbers, while rooting of 'Brilliant Red' is slower and more typical of commercially produced hibiscus. 'Jim Hendry' and 'Silver Anniversary', large flowered exotic types of hibiscus, are commercially propagated by grafting, since cuttings reportedly fail to develop roots (7). Cuttings received from propagators were turgid, of uniform stem diameter, and 9 to 12 cm (3.5 to 5 in) in length.

The study was conducted in three 4 × 1.7 × 2.5 m (13 × 5.5 × 8 ft) plant growth chambers, each containing one 180 × 30 × 6.3 cm (72 × 12 × 2.5 in) flat aluminum temperature bar and refrigerated and hot water baths (Fig. 1). Hot or cold water were circulated through channels in the opposite ends of each aluminum bar to establish and maintain desired medium temperatures. Each bar had 192 holes of 3.75 cm (1.5 in) diameter and depth to hold the Metromix 500 (Vergro Co., Box 11385, Tampa, FL 33610) propagation medium, with 3 mm (1/8 in) drainage holes. Propagation medium temperature treatment means were 18°, 22°, 26°, 30°, and 34°C (65°, 72°, 79°, 86° and 93°F). Temperatures varied within ± 2°C (± 3.6°F) of the set points. Cuttings were syringed daily and covered by a tightly fitting polyethylene plastic film to maintain 100% RH. Growth chamber temperatures of the air above and beneath plastic canopies enclosing the cuttings and of the propagation medium treatments in each temperature bar were measured by thermocouples at 6 hr intervals and recorded by an Esterline Angus Recording Potentimeter, (Esterline Angus Intr. Co., Box 24000, Indianapolis, IN 46224). Chamber air temperatures were 20°C (68°F), which maintained air temperatures at 22°C (72°F) beneath plastic canopies during lighting periods. Chambers had alternating 12-hr lighting and dark periods with fluorescent and incandescent irradiation totaling 375$_{\mu}$ mol s^{-1} M^{-2} (2500 fc) at cutting height as measured by a LI-COR 185A quantum/radiometer photometer, (LiCor Co., 4421 Superior, Lincoln, NE 68504). Treatments consisted of 27 cuttings, nine in each of three replicated bars.

Cuttings were trimmed to three leaves and the stems cut to a 8 cm (3 in) length. This was followed by a 1 sec. treatment of the basal portions with a 2500 ppm (0.25%) aqueous solution of the potassium salt (K-salt) formulation of indole-3-butyric acid (IBA) and insertion to 2 cm (3/4 in) in the moist medium. Syringing of the cuttings once daily in each bar resulted in infrequent irrigation of the propagation medium. All cuttings were removed and bases examined weekly between weeks 3 and 12. Root counts and measurements were made from those cuttings having root lengths exceeding 1 cm (3/8 in) while the others were replanted. Cutting root counts, total length of roots, and fresh and dry weights were measured. Dry root weights for cut-

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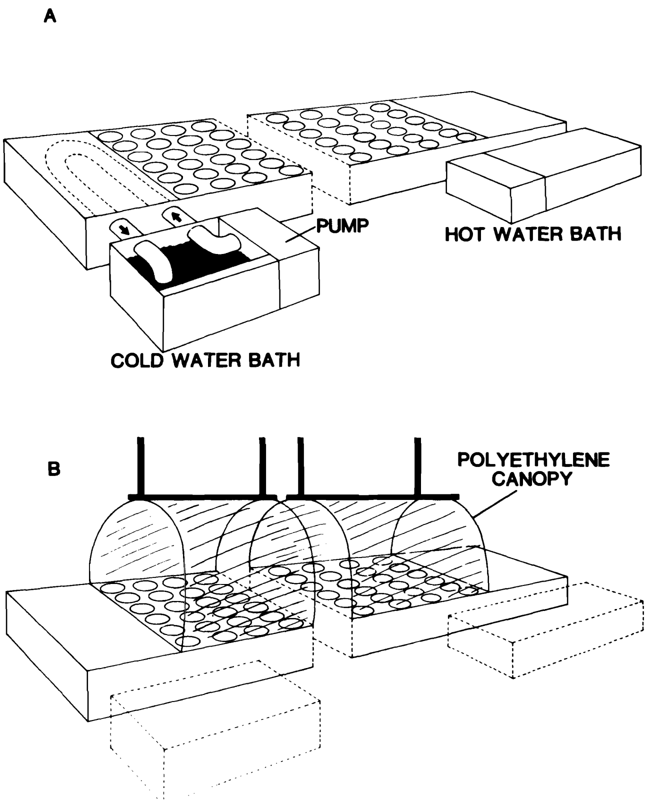

Fig. 1. Schematic of the propagation facility: (A) the aluminum bar with hot and cold water baths maintained the propagation medium within a temperature range of 18° to 34°C (65°F to 93°F); (B) syringing cuttings once daily, and a tight fitting polyethylene canopy provided 100% RH and maintained turgidity.

tings were determined after 48 hours at 40°C (104°F) in a forced-draft oven. The experimental design was a randomized complete block arranged as a 5 × 4 factorial, with data analyzed by an analysis of variance and multiple regression analysis.

Results and Discussion

Medium temperature influenced the time required for root initiation and root growth and development to 1 cm (3/8 inch). 'Pink Versicolor' achieved 100% rooting of cuttings at all medium temperatures, but root initiation and growth to 1 cm required fewer weeks and was most uniform among cuttings at 26° and 30°C (79° and 86°F), (Table 1). All cuttings of 'Pink Versicolor' rooted within 4 weeks at 26° and 30°C, but cuttings at 34°, 22°, and 18°C (93°, 72°, and 65°F) required 6, 7 and 10 weeks, respectively (Fig. 2). 'Brilliant Red' and 'Jim Hendry' had similar rooting percentages, weeks to 50% rooting and weeks between 10% and 90% rooting at each medium temperature (Table 1). All cuttings of 'Jim Hendry' had roots exceeding 1 cm by weeks 9 and 10 at 26° and 30°C (79° and 86°F) medium temperatures (Fig. 2). More variability in root initiation and growth occurred at 34°, 22° and 18°C (93°, 72° and 65°F), which significantly increased the weeks to 50% rooting and weeks between 10% and 90% rooting (Table 1). Cuttings of 'Silver Anniversary' failed to achieve 100% rooting at all medium temperatures during 12 weeks, although 22° and 26°C (72° and 79°F had significantly larger percentages (Table 1). The greater variation in root initiation and root growth of this cultivar were shown by the larger number of weeks to 50% rooting and between 10% and 90% rooting (Table 1).

Table 1. Effect of propagation medium temperature on rooting of hibiscus cultivars. Data are the means of 27 cuttings.

	Medium temp.		Rooting		
Cultivar	°C	°F	percent	Mean[z] weeks	Span[y] weeks
Pink Versicolor	18	65	100	4.9	5.5
	22	72	100	3.5	4.3
	26	79	100	3.2	2.6
	30	86	100	2.9	1.8
	34	93	100	4.8	3.7
Brilliant Red	18	65	89	6.2	6.4
	22	72	100	4.5	6.8
	26	79	100	3.9	4.5
	30	86	100	4.1	4.2
	34	93	100	5.8	7.0
Jim Hendry	18	65	93	5.8	6.2
	22	72	96	4.3	6.0
	26	79	100	3.0	4.7
	30	86	100	3.2	4.5
	34	93	93	5.1	7.4
Silver Anniversary	18	65	56	6.4	8.2
	22	72	70	5.1	7.5
	26	79	85	5.3	6.7
	30	86	59	5.9	6.4
	34	93	44	6.7	8.9
	HSD 5%		11	1.3	0.9

[z]Means to 50% rooting

[y]Weeks from 10% to 90° rooting

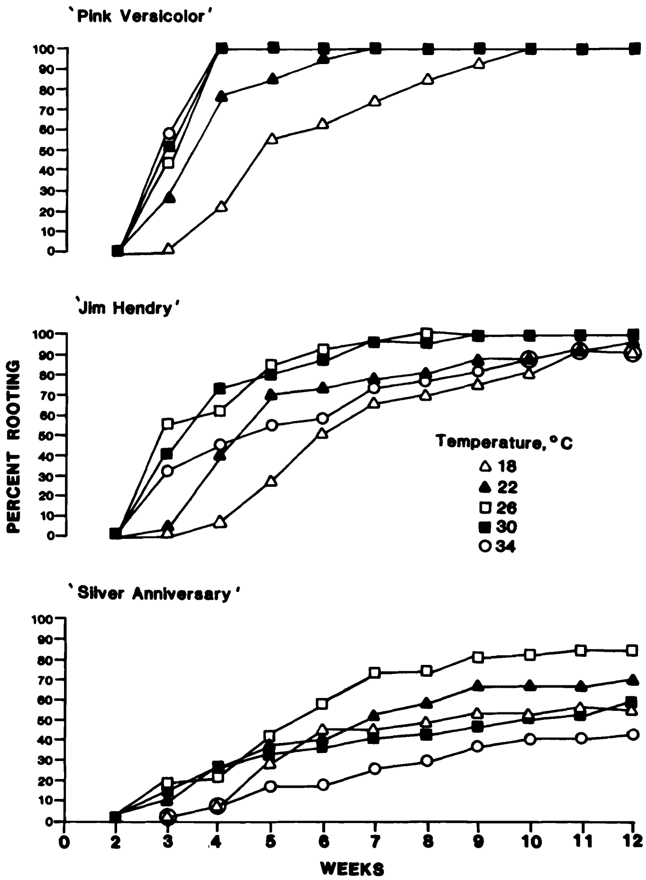

Fig. 2. Influence of medium temperatures on rooting of 'Pink Versicolor', 'Jim Hendry' and 'Silver Anniversary' hibiscus.

Mean numbers of roots formed per cutting varied among medium temperatures. Temperatures of 26° and 30°C (79° and 86°F) generally were most favorable for root initiation and growth (Table 2). Cuttings of 'Pink Versicolor' at 30°C had 2 and 5 times the numbers of roots as at 22°C (72°F) and 18°C (65°F), respectively. Similar trends were found for 'Brilliant Red', 'Jim Hendry' and 'Silver Anniversary'. Cuttings of 'Silver Anniversary' at 26°C and 30°C generally developed 2 or 3 roots and those at other temperatures 1 or 2 roots. For all cultivars, root numbers per cutting decreased above medium temperatures of 30°C (86°F), but more roots developed per cutting at 34° (93°F) than 18°C (65°F). The cultivar root number trend lines for medium temperature were similar to linear and quadratic (Table 2).

Although cuttings of large flowered cultivars 'Jim Hendry' and 'Silver Anniversary' had fewer roots with smaller fresh and dry weights after propagation, plants were vigorous after transplanting. Rooted cuttings of the four cultivars were grown in 3.8 l (1 gal) containers in the greenhouse and later transplanted to the landscape. Plants of all cultivars were of comparable size six months after transplanting, indicating adequate own-root vigor for large flowered types. These results indicate the current practice of grafting for propagating large flowered cultivars may be unnecessary.

Total root length and fresh and dry root weights per cutting exhibited medium temperature response trends similar to those for root number. Root lengths and fresh and dry root weights per cutting generally were larger at 26° and 30°C (79° and 86°F) than at other temperatures (Table 2). Combining data for the four cultivars showed root numbers were 330%, root lengths 400%, fresh root weights 210% and dry root weights 250% larger at 26° (79°F) than 18°C (65°F) propagation medium temperatures. Comparisons of cuttings with similar root lengths showed unfavorable propagation medium temperatures reduced root numbers per cutting and total fresh and dry weights (Table 2).

Cultivar differences in root numbers and root fresh and dry weights generally were smaller at unfavorable medium temperatures than at 26° and 30°C (Table 2). 'Silver Anniversary' exhibited no consistent response pattern to different medium temperatures, with root numbers increasing only at 30° (86°F), root lengths and fresh weights at 26° and 30°C (79° and 86°F), and no differences were determined for dry weights. 'Pink Versicolor' had larger root numbers at 26° and 30°C than 'Brilliant Red' or 'Jim Hendry'.

Visual observations were made to compare morphological differences in root development resulting from various medium temperatures. Roots of all cultivars at 18° (65°F) and 22°C (72°F) were whiter, thicker in diameter and less branched than at warmer temperatures. At 34°C (93°F) roots appeared filamentous and "weak" in contrast to the "robust" appearance at lower temperatures. These results are in agreement with Nielson (9).

All cultivars exhibited best rooting at 26° and 30°C (79° and 86°F), but the natural differences in rooting response among the cultivars persisted. Howard (6) reported difficult-to-root species of plum (*Prunus domestica*) benefitted more from higher medium temperatures than easily rooted species. The most difficult-to-root cultivar in our study had the smallest benefit from 26° and 30°C (79° and 86°F). Burholt (1) suggested faster root formation at warm medium temperatures was associated with maximum cell division between 30° (86°F) and 35°C (95°F). Dykeman (2) compared root development of cuttings of *Chrysanthemum morifolium* 'Bright Golden Anne' with and without auxin treatment at various propagation medium temperatures and found far greater auxin benefit at 30° (86°F) than 25°C (77°F). Scott (10) reported that auxin activity in roots is much greater at higher temperatures. Our results indicate that at similar root lengths, cuttings propagated at medium temperatures of 26° and 30°C (79° and 86°F) produce more roots and the roots generally have larger fresh and dry weights per cutting.

Significance to the Nursery Industry

Large differences in root formation among cultivars of hibiscus encourages southern nurseries to produce easily propagated small flowered types, and avoid those with large exotic flowers that require grafting. Our results show that cultivars which root rapidly receive maximum benefit from propagation medium temperatures of 26° to 30°C (79° to 86°F). Enhanced rooting from warm medium temperatures declines with increased difficulty of rooting. Vigorous rooting 'Pink Versicolor', average rooting 'Brilliant Red' and 'Jim Hendry', and weak rooting 'Silver Anniversary' had 521%, 400%, 305% and 160% more roots per cutting, respectively, at 30°C (86°F) than 18°C (65°F) medium temperatures, with 26°C (79°F) and 22°C (72°F) intermediate. Cultivar differences of similar magnitude were found for fresh and dry weights at medium temperatures of 30°C and 18°C (86° and 65°F).

Table 2. **Effect of propagation medium temperature root numbers, total lengths, fresh and dry weights of hibiscus cultivars. Data are the means of 27 cuttings.**

Cultivar	Medium temp. °C	Medium temp. °F	Rooting parameters (means/cutting): root number	total length (mm)	fresh wt (mg)	dry wt (mg)
Pink Versicolor	18	65	1.4	15	139	19
	22	72	3.7	43	215	38
	26	79	6.4	95	288	49
	30	86	7.3	88	281	46
	34	93	7.0	76	269	42
	Significance:		L*	L**	L**	L**
			Q**	Q**	Q**	Q**
Brilliant Red	18	65	1.1	18	56	4
	22	72	2.4	31	84	7
	26	79	3.9	94	122	16
	30	86	4.4	98	106	12
	34	93	3.0	69	90	10
	Significance:		L*	L*	L**	L**
			Q**	Q**	Q**	Q**
Jim Hendry	18	65	1.7	19	42	5
	22	72	2.9	24	73	7
	26	79	4.2	50	110	14
	30	86	5.2	57	114	15
	34	93	3.8	30	91	9
	Significance:		L**	L**	L**	L**
			Q**	Q**	Q**	Q**
Silver Anniversary	18	65	1.5	17	41	5
	22	72	1.8	29	49	8
	26	79	2.2	46	60	9
	30	86	2.4	46	68	10
	34	93	2.0	28	44	7
	Significance:		L**	L**	L^{NS}	L*
			Q**	Q**	Q**	Q**
	HSD 5%		0.8	10	18	6

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