Survival and Growth of Transplanted Orchid Seedlings Enhanced by DCPTA

James H. Keithly, Daniel P. Jones, and Henry Yokoyama
U.S. Department of Agriculture, Agricultural Research Service, Fruit
and Vegetable Chemistry Laboratory, 263 South Chester Avenue,
Pasadena, CA 91106

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Abstract. The growth-enhancing property of DCPTA was tested on transplanted seedlings of *Brassolaeliocattleya* × Hort. (Blc. Bryce Canyon × Lc. Pirate King), *Dendrobium* × Blume. Hickham Deb, *Epidendrum radicans* Pav. ex Lindl., *Laeliocattleya* × Rolfe Prism Palette 'The Clown', and *Phalaenopsis* × Blume. [Pink Zebra × (Jutta Brungor × Music)]. After 3 to 6 months of greenhouse growth, plants treated with 30 μM DCPTA produced a 2- to 3-fold increase in root growth compared to the controls. Shoot growth, root : shoot ratio, and the survival of DCPTA-treated plants were increased significantly when compared with controls. Chemical name used: 2-(3,4-dichlorophenoxy)triethylamine (DCPTA).

Worldwide commercial orchid production has advanced rapidly due to improvements in clonal propagation methods (Churchill et al., 1973; Tanaka and Sakanishi, 1977), hybridization programs (Griesbach, 1985), and air-freight delivery systems. Orchid culture is very time-consuming in that 2 to 5 years are required to produce mature, flowering plants from seed or clonal propagations. Or-

chid culture requires the routine transfer of seedlings from an aseptic agar culture to greenhouse pot culture. Seedling losses after transplanting often reduce production efficiency and can delay the commercial development of new orchid hybrids. In this study, the effects of DCPTA were examined on the survival and growth of transplanted *Epidendrum*, *Dendrobium*, *Brassolaeliocattleya*, *Laeliocattleya*, and *Phalaenopsis* seedlings.

Seedlings of *Epidendrum radicans*, *Dendrobium* × Hickham Deb, and clonal propagules of *Laeliocattleya* × Prism Palette 'The Clown' were purchased as 14- to 18-month-old plants grown on aseptic agar media in sealed flasks. Plants of *Phalaenopsis* × [Pink Zebra × (Jutta Brungor × Music)] and *Brassolaeliocattleya* × (Blc. Bryce Canyon × Lc.

Pirate King) were obtained as 3-month-old seedlings grown in community pots (20 to 25 plants per pot). Plants were removed from the flasks or community pots. For each genus, seedlings of a uniform size were divided by random selection into 60 plants/DCPTA treatment. Orchid seedlings were totally immersed for 2 h in solutions of 3, 30, or 300 μM DCPTA (1, 10, and 100 ppm DCPTA, respectively) that contained 0.1% Tween 80 (v/v). DCPTA had been synthesized and purified according to Poling et al. (1977) and Echols et al. (1981), respectively. Control plants were soaked for 2 h in 0.1% Tween 80 (v/v). After treatment, seedlings were divided into three replicates of 20 plants each. Each group of 20 seedlings was planted in a 15 × 38-cm plastic tray filled with 2 seedling-grade fir bark : 1 coarse perlite : 1 New Zealand sphagnum moss (by volume). Trays were arranged as a randomized complete block. All genera were grown using the same environmental conditions (Gordon, 1988). Plants were grown in a greenhouse under 40% Saran shade cloth and received a photosynthetic photon flux (PPF) of 600 to 800 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ photosynthetically active radiation (PAR). Photoperiod was adjusted to 12 h using metal halide lamps (PPF at plant height, 150 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PAR). Greenhouse temperature control was maintained at a 28 ± 4C day/20 ± 2C night. Plants were fertilized every 10 days with 0.5 g 30N-4.5P-8.2K/liter that contained chelated Fe and micronutrients. For each genus, the percentage of seedling survival in each treatment was determined after 3 to 6 months of plant growth. At this time, 20 randomly selected plants from each treatment were divided into shoot and root samples. Leaf areas were determined using a Delta-T video leaf area meter (Decagon Devices, Pullman, Wash.). Dry weights of shoot and root samples were determined after they were dried to constant weight at 70C. All seedling sur-

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Table 1. Effect of DCPTA on the survival and growth of orchid seedlings.

DCPTA (μ M)	DAT ^z	Shoot dry wt (mg)	Root dry wt (mg)	Leaf area (cm ²)	Survival (%)	Root : shoot ratio ^y
Epidendrum radicans						
0	97	73	23	12.7	65.0	0.31
3		113	42	21.0	90.0	0.37
30		166	59	27.2	95.0	0.35
300		119	50	21.9	65.0	0.42
Significance ^x		Q**	Q**	Q**	Q**	L*
Dendrobium X Hickham Deb						
0	126	152	32	20.6	78.5	0.21
3		168	34	20.9	80.0	0.20
30		213	89	24.7	85.5	0.42
300		144	20	20.1	75.5	0.14
Significance		Q*	Q*	Q*	Q*	Q*
Laeliocattleya X Prism Palette 'The Clown'						
0	93	15	16	4.6	80.0	1.07
3		25	29	7.7	88.5	1.13
30		41	53	12.4	91.5	1.27
300		34	40	9.9	72.8	1.18
Significance		Q**	Q**	Q**	Q*	L*Q*
Brassolaeliocattleya X (Blc. Bryce Canyon x Lc. Pirate King)						
0	172	325	217	24.7	60.0	0.67
3		413	265	37.9	67.3	0.64
30		525	485	42.3	80.0	0.92
300		366	224	25.3	61.3	0.61
Significance		Q*	Q*	Q*	Q**	Q*
Phalaenopsis X [Pink Zebra x (Jutta Brungor x Music)]						
0	128	163	169	14.1	72.3	1.04
3		201	222	20.0	70.0	1.10
30		426	483	35.7	83.5	1.13
300		172	162	13.7	68.7	0.94
Significance		Q**	Q**	Q**	Q*	Q*

^zDays after DCPTA treatment.^yCalculated from dry weight values.^xSignificance: linear (L) and quadratic (Q), $P = 0.05$ (*) or 0.01 (**). Fig. 1. Typical effect of DCPTA on the seedling growth of *Epidendrum radicans*. Plants were photographed 97 days after DCPTA treatment.

vival and growth data were subjected to analysis of variance (ANOVA) with linear and quadratic regression analyses. Percentile means were transformed to arcsin values before ANOVA (Zar, 1974). For each genus, DCPTA tests were performed twice. Over time, three independent plant growth experiments were conducted.

Application of DCPTA as a soak treat-

ment to transplanted orchid seedlings significantly improved seedling survival and plant growth when compared with controls (Table 1). The dose response characteristics of DCPTA treatment showed significant quadratic responses in the five orchid genera tested. Promotive effects of DCPTA on shoot and root growth were observed at 3 and 30 μ M, and growth inhibition was observed with

300 μ M. Typical promotive effects of 30 μ M DCPTA on seedling growth are shown in Fig. 1. Leaf area development of all plants paralleled shoot development. Linear correlation coefficients of shoot dry weight and leaf area ranged from $r = 0.82$ for *Dendrobium* seedlings to $r = 0.91$ for *Laeliocattleya* seedlings. Root development of plants treated with 30 μ M DCPTA showed a 2- to 3-fold increase over the root growth of controls in the five test genera. The acceleration of root growth by DCPTA significantly increased the root: shoot ratio of plants treated with 30 μ M DCPTA compared with controls. Seedling survival after DCPTA treatment was increased significantly in all genera (Table 1). Significant quadratic responses indicated promotive and inhibitory effects in the 30- and 300- μ M DCPTA treatments, respectively.

Primary root elongation and the rate of seedling root development are often used as measures of seedling vigor (Steiner et al., 1989). In this study, DCPTA treatment significantly increased seedling vigor in all genera. These results are consistent with previous studies that showed DCPTA significantly increased the root: shoot ratio of cotton (*Gossypium hirsutum* L.) (Gausman et al., 1988) and primary root development (Keithly et al., 1991) of seedling plants.

Orchid seedling losses following the transfer of plants from aseptic growth media to pot culture are common, and seedling mortality may exceed 50% during the first 6 months of greenhouse growth (D. P. J., unpublished results). Our study showed that DCPTA enhanced seedling survival after the transplanting of five commercially important orchid genera. It is important to note that DCPTA enhanced the survival of plants that were transferred from agar cultures to greenhouse pot culture (*Epidendrum*, *Dendrobium*, and *Laeliocattleya*) and of seedlings that were preconditioned to greenhouse pot culture (*Brassolaeliocattleya* and *Phalaenopsis*). In a previous study (Keithly and Yokoyama, 1990), DCPTA application to *Phalaenopsis* seedlings significantly increased the vegetative growth rate and reduced the time to flowering. In this study, 30 μ M DCPTA significantly enhanced seedling vigor and seedling survival after transplanting. These results suggest that DCPTA may be used to improve seedling productivity and increase the efficiency of orchid production.

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