Table 1. Influence of light and ancymidol levels on growth of *Peperomia obtusifolia* and *Ficus elastica* 'Decora' at the end of production (Phase I) and after postholding conditions (Phase II).

Species	Treatment	Phase I Internode length (cm)	Phase I Plant height (cm)	Phase II Internode length (cm)	Phase II Plant height (cm)	Phase II Fresh weight (g)	Grade[z]
Peperomia	Light (klx)						
	15	1.1a[y]	12.3a	0.9a[y]	14.1a	157a	3.0a
	30	1.1a	14.9b	0.9a	16.3b	200b	3.8b
	Ancymidol (mg/pot)						
	0	1.2a	15.9a	1.0a	17.6a	195a	3.4a
	0.25	1.1ab	13.8ab	0.9a	15.4b	162a	3.1a
	0.50	1.0b	12.9b	0.9ab	14.4bc	178a	3.4a
	1.00	0.8c	11.8b	0.8b	13.3c	179a	3.7a
Ficus	Light (klx)						
	15	2.9a	44.5a	3.0a	46.9a	212a	3.6a
	30	2.3b	37.7b	2.4b	39.9b	181b	3.8a
	Ancymidol (mg/pot)						
	0	2.4a	39.6a	2.6a	41.8a	197a	3.9a
	0.25	2.6a	41.1a	2.8a	43.8a	198a	3.6a
	0.50	2.6a	41.5a	2.8a	44.1a	196a	3.6a
	1.00	2.7a	42.0a	2.8a	43.9a	196a	3.7a

[z]Rated on a scale of 1 = poor, not salable; 3 = good, salable; and 5 = excellent quality.
[y]Mean separations within treatment groups in columns by Duncan's multiple range test, 5% level.

untreated plants. Fresh weight and plant grade were greater for plants produced under 30 klx light level (Table 1). Ancymidol showed no effect on fresh weight or plant grade at the termination of Phase II.

Internode length, plant height, and fresh weight of *Ficus* increased in plants produced at the lower light level of 15 klx in both Phase I and II (Table 1). Ancymidol treatments did no effect on internode length, plant height, or fresh weight for either Phase I or II (Table 1). At the termination of Phase II plant grade was unaffected by production light levels or ancymidol treatments; however, all plants were of good quality and no leaf drop occurred during 6 weeks indoors.

Hedera was not influenced by either production light levels or ancymidol treatments used in this experiment. The lack of response to ancymidol in *Hedera* was similar to findings by Criley (6). Cathey (2) reported growth retardation of *Hedera* by cutting the plants back at the time of application and measuring the softer new growth. Possibly, woody stem growth such as found in *Hedera* and *Ficus* is less responsive to the effects of ancymidol, as has been reported by others on woody species (1, 2). Growth of *Ficus* was greater under the lower production light level and was maintained during Phase II. However, this increased growth response may be commercially undesirable because the plants may be more difficult to handle in shipment due to elongated top growth. These results show that the growth and quality of *Peperomia* can be maintained under simulated interior conditions used in this study when using the higher production light level and the higer concentrations (0.5 and 1.0 mg/pot) of ancymidol.

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Development of Growth Media for Poinsettias[1]

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Abstract. **Rooted cuttings of 'Annette Hegg Lady' poinsettia (*Euphorbia pulcherrima* Willd.) were planted in growing media of equal volumes clay loam and sand or ash with 30 or 60% (by volume) pine bark, sphagnum moss peat, perlite, or rubber. Media physical measurements revealed better drainage with 60% perlite during maximum vegetative growth resulted in plants of highest quality: greater aerial fresh weight, increased height, greater inflorescence diameter, and higher grade.**

Highly porous growing mixtures yield best top growth and root development of poinsettia (1). Larson et al. (3) found soil a necessary mixture component for highest quality poinsettias on water mats; however, with hose or tube watering highest quality plants also were produced in mixtures containing 3 parts pine bark to 1 part sand. Tayama (7, 8) reported best plants in half hardwood bark (by volume) and observed no phytotoxicity. Poole and Fretz (5) recommend 25-30% aggregated fly ash as a substitute for sand and/or perlite in soilless mixtures for poinsettias and some other pot plants. None of these plant responses was related to physical growing media characteristics.

We initiated this experiment with 'Annette Hegg Lady' poinsettia to determine the influence of pine bark, peat, perlite, and rubber (from ground automobile tires) on poinsettia growth and quality. Rooted cuttings about 7 cm in length were planted 1 per 15 cm standard pot on September 1, 1977, in each of 20 growing media of largely readily-available constituents (e.g. pine bark, sphagnum moss peat, perlite). There were 6 plants per treatment randomly arranged. Plants were not pinched and were grown under natural photoperiods at 16.7°C (60°F) minimum nights until November 1 when 15.6°C (60°F) minimum nights were imposed until January 4, 1978. Media pH were adjusted initially using dolomitic limestone 14 kg m^{-3}. Fertilization followed Shanks' recommendations: soluble 25N-4.4P-8.3K (600 ppm N) applied weekly (6) until November 25. The growing media treatments consisted of 30 or 60% (by volume) non-composted pine bark (*Pinus taeda* L.), sphagnum moss peat, perlite (horticultural grade), or rubber, the remaining either equal volume Cecil clay loam soil (clayey kaolenitic

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thermic typic Hapludults) and inert components sand or ash. The particle size distributions of the bark, rubber, ash, and sand are listed in Table 1. Air and water content at 40 cm tension and saturated hydraulic conductivity of the soil mixtures were determined initially and at test termination.

Measurements of saturated flow were made under saturated conditions using a 8.89 cm hydraulic head. Capillary and non-capilliary porosities were calculated using weight at saturation, 40 cm moisture tension, and oven dried (2).

The analysis of variance revealed no differences for recorded plant measurements (aerial fresh weight, height, grade, inflorescence diameter, and root fresh weight) at either material rate (5% level) between soil:material:ash or soil:material:sand. Except for a larger inflorescence diameter in perlite than in peat, plants grown at the lower level of bark, peat, or perlite did not differ from one another, and all were larger than plants in rubber (Table 2).

At the high material level, plants in perlite were superior to those in bark for aerial measurements. Also, those in perlite were taller than those in peat; thus, perlite was the best material at the high level (Table 2). At both levels, plants grown in rubber were inferior in grade to those in other materials.

Only 3 differences were found comparing material levels (i.e., low vs. high). Plants were taller and graded higher at the low bark level, and root fresh weight in peat was greater at the high level (Table 2).

Initially, a greater air content (40 cm tension) was found for mixtures at the high rate of materials with ash but not at either material rate with sand. At termination, greater aeration was found at the high rate of materials for both sand and ash mixtures (Table 3). Faster saturated flow rates resulted from the greater percent of larger pores (drained at 40 cm tension) at the material high rate. The saturated flow rates were 2.5 times faster in mixtures at the high material rate than at the low material rate (Table 3).

Although differences were small, peat and rubber initially had the greatest air content (percent air filled pores at 40 cm tension, Table 4). The air content decreased in mixtures during the study except for the high level of bark with sand and the low level of rubber with ash (Table 4). Although the rubber media had more air filled pores than peat or perlite at termination, this is not of practical significance because plants grew poorly in rubber. A bioassay was run with tomato (*Lycopersicon esculentum* Mill. 'Walter') which revealed the inclusion of rubber in the medium inhibited growth: after 5 weeks, the fresh weight of plants from seed germinated in equal volumes soil:sand was 5 times that of those in 60% rubber (by volume), 3 times that of those in 30% rubber.

A first order interaction (material x rate) was found initially but not terminally for water content. Initially, at the high rate, bark and peat media had a greater water content (40 cm tension) than perlite, which was greater than rubber (Table 4). Initially, at the low rate, mixtures with peat and perlite had more water filled pores than rubber, bark media not differing from others. The percentage of water filled pores (40 cm tension) in mixtures increased during the study, in peat mixtures the most (Table 4). At termination, peat mixtures had more water filled pores than other mixtures.

Initially, the saturated flow rates were the same for all materials except perlite which was one-half the rate of the others (Table 4). There were large changes in flow rates with time, with 60 and 43% reductions in rubber and peat media, respectively, which at termination were lower than that of bark media. Saturated flow rates remained stable in the perlite and bark media and at termination there were no differences in flow rates between these media.

Maximum material effect on plant growth might be expected at the high material rate. Initially, the bark mixture retained more water than the perlite mixture. Because the percent water filled pores of perlite and bark mixtures terminally were not different, yet initially different at the high material rate, we believe plants grew less in the bark mixture because this mixture retained more water than optimum during the time of maximum plant growth. Erratic plant growth resonses were found at the high peat level. Peat is extremely difficult to distribute uniformly within a mixture. Mazur et al. (4) found inharmonious relationships for physical measurements of peat mixtures

Table 1. Particle size distribution of pine bark, rubber, ash, and sand.[Z]

Media component	Distribution <0.05 mm	0.5–0.1 mm	0.1–0.25 mm	0.25–0.5 mm	0.5–1.0 mm	1.0–2.0 mm	2.0–6.3 mm	6.3–12.5 mm	>23.5 mm
Bark		3	7	14	21	24	31		
Rubber			2	12	29	38	19		
Ash	1	5	17	17	18	13	21	7	1
Sand			4	17	49	26	4		

[Z]Non-composted, milled pine bark; rubber from ground automobile tires; ash from coal; and naturally-washed sand.

Table 2. The effects of low (30% volume) and high (60% volume) levels of pine bark, peat, perlite, or rubber combined with equal volume soil and ash or sand on growth and flowering of 'Annette Hegg Lady' poinsettia.

Media component	Shoot fresh wt (g)	Plant ht (cm)[Z]	Plant grade[Y]	Inflorescence diam (cm)[X]	Root fresh wt (g)
		Low level			
Bark	62.5a[W]	*31.3a	*3.2a	27.9ab	42.6a
Peat	63.5a	28.4a	3.3a	25.2b	38.6a
Perlite	72.5a	32.4a	3.8a	29.6a	54.8a
Rubber	0.3b	5.2b	0.6b	0.0c	2.7b
		High level			
Bark	49.7b	24.4b	2.4b	23.8b	57.7a
Peat	55.4ab	29.1b	3.6a	26.8ab	*59.2a
Perlite	71.5a	34.5a	3.7a	30.3a	43.3a
Rubber	0.6c	5.2c	0.5c	1.5c	2.8b

[Z]Measured from growing media top surface to top of inflorescence.
[Y]Visual rating: 4 highest grade based on uniformity in appearance, scale of plant with pot, and attractiveness of foliage and inflorescences.
[X]Measured across bract top surface at widest distance.
[W]Mean separation within columns by Duncan's multiple range test (5% level). Companion means (i.e., same material, different level) are different for rate if the higher value is preceded by an asterisk.

Table 3 Saturated flow, air content, and water content in mixtures with low and high rates of bark, peat, perlite, or rubber (initially and terminally).

Material rate[z]	Initial		Terminal
	Saturated hydraulic conductivity (cm/min)[y]		
Low (30%)	0.7 b[x]		0.5 b
High (60%)	1.9 a		1.5 a
	Air content at 40 cm tension (%)[w]		
	Rate x inert component		
	Ash	Sand	
Low (30%)	27.4 b	32.6 a	24.4 b
High (60%)	35.2 a	35.1 a	28.6 a
	Water content at 40 cm tension (%)[y]		
Low (30%)	21.3 a		27.4a
High (60%)	21.7 a		30.8a

[z]Low rate bark, peat, perlite, or rubber: 30% vol; high: 60% vol.
[y]No significant interactions.
[x]Mean separation by Duncan's multiple rante test (5% level)
[w]Only significant interaction (5% level): initially for material rate x inert component.

Table 4. Saturated flow, air content, and water content of mixtures, as influenced by four materials. (initially, terminally, and with time).

Material	Initial		Terminal	Change			
			Saturated hydraulic conductivity (cm/min)[z]				
Bark	1.4 a[y]		1.5 a	0.1 a			
Peat	1.4 a		0.8 b	-0.6 ab			
Perlite	0.7 b		1.0 ab	0.3 a			
Rubber	1.5 a		0.6 b	-0.9 b			
			Air content at 40 cm tension (%)[x]				
				Material x Rate x Inert Component			
				Ash		Sand	
				High[w] (60%)	Low (30%)	High (60%)	Low (30%)
Bark	31.3 b		27.6 ab	- 7.5 a	-0.6 ab	2.2 a	- 8.2 ab
Peat	36.2 a		25.2 b	-12.9 a	-3.0 ab	-9.9 b	-18.1 b
Perlite	27.7 b		23.8 b	- 2.4 a	-9.9 b	-3.0 ab	- 0.2 a
Rubber	35.3 a		29.4 a	-10.1 a	2.2 a	-8.4 ab	-7.5 ab
			Water content at 40 cm tension (%)[v]				
	Material x Rate						
	High[w] (60%)	Low (30%)					
Bark	26.1 a	20.4 ab	28.6 b	5.4 b			
Peat	28.0 a	24.7 a	38.3 a	12.0 a			
Perlite	20.6 b	22.5 a	28.4 b	6.8 b			
Rubber	12.3 c	11.7 b	21.0 c	6.0 b			

[z]No significant interaction (5% level).
[y]Mean separation by Duncan's multiple range test (5% level).
[x]Significant second order interaction (5% level) for change (i.e., material x rate x inert component).
[w]Low material rate: 30% vol; high; 60/ vol.
[v]Significant first order interaction (5% level) only initially for material x rate.

and postulated that peat clumps within mixtures disrupt uniform pore distribution. If so, this condition may influence plant growth, resulting in uncorrelated plant growth measurements.

This research revealed the quality of 'Annette Hegg Lady' was influenced most by the water-air content of the mixtures, and the air content was more influential than saturated hydraulic conductivity. We therefore conclude that in these artificial mixtures, drainage (percent water filled pores at 40 cm) was the main factor influencing plant growth and quality.

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Control of Plant Height and Flowering of Zinnia by Photoperiod and Growth Retardants[1]

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***Abstract.* Flowering time, plant height and weight of *Zinnia elegans* Jacq were reduced by 4 weeks of 9 hour photoperiods. Multiple application of butanedioic acid mono-2, 2 dimethylhydrazide (daminozide) reduced plant height and flower diameter but increased time to flower without affecting fresh weight while ancymidol restricted height and fresh weight but not time to flower.**

Although zinnias currently rank among the top 5 garden annuals grown in the United States and Canada, they account for only about 1% of the total plants in a typical bedding plant operation (5). About 85% of zinnias grown by consumers are pruchased as packet seeds. Poor sales of zinnias as bedding may have been caused by sowing too early, nonuniformity of bloom at sales time, and excessive etiolation of the plants (2). Applications of daminozide restricted zinnia plant height without affecting time to flower (1, 3, 4), and one cultivar responded to foliar applications of both ancymidol and daminozide (4).

The objectives of these studies were to examine flowering and growth responses of zinnias to variable lengths of short day treatments and to multiple applications of daminozide or ancymidol.

Effect of Photoperiod. Seeds of *Zinnia elegans* were sown under must either July 20, 1979, ('Gold Sun,' Fruit Bowl 'Tangerine') or July 27 ('Peter Pan Red Flame,' Exp 79-22[6], Exp 27-29[6]). Seedlings were transplanted on August 6 to VSP soilless media (Michigan Peat Company, Houston, Texas) with 32 plants (4 x 8 cells) arranged in a standard bedding flat (26.5 x 52 cm). Plants were exposed to 9 hr days by drawing black cloth over the plants at 5 PM and remov-

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[5]Appreciation to Goldsmith Seed Co., Bodger Seed Co. and Taki Seed for seed furnished for this study.
[6]Selection of Goldsmith Seed Co., Gilroy, California.