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Plant Growth in Greenhouse Media Containing Colorado Peat

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Abstract

Plant growth of pothos, ***Epipremnun aureum,*** *geranium,* ***Pelargonium hortorum,*** *and petunia,* ***Petunia hybrida,*** *was evaluated in ten greenhouse-container media. Materials commonly used to formulate these media by Colorado greenhouse growers were also evaluated for their nutrient, pH, soluble salt, cation exchange capacity and organic matter contents.*

Native Colorado peats, although acidic, had relatively higher levels of nitrates, calcium, pH and soluble salts, and lower cation exchange capacity and organic matter content than Canadian peat.

Plant growth was measured by four parameters: plant height or stem length, number of leaves, fresh weight and dry weight. Plant growth was greater in media containing Canadian peat than media containing native Colorado peat. Soilless media produced more plant growth than media containing native Colorado soils. Plant growth in media prepared by commercial greenhouse growers was comparable to media formulated with Canadian peat.

Media containing native Colorado peats were not as conducive to the growth of greenhouse plants as media containing Canadian peat.

Experiments were designed to evaluate the chemical properties of ten greenhouse media containing peat and to evaluate the .growth of greenhouse plants in these media.

Media

Ten media, four collected from commercial greenhouse ranges in the Denver, Colorado area and six prepared at Colorado State University were used for this experiment.

The composition by volume of the four growers' media was as follows:

soil mix A
2 parts soil, texture unknown
1 part native Jefferson County peat, 58.8% organic matter
1 part cow manure, dehydrated, pulverized
1 part sand, particle size unknown
1 part sawdust, composted pine

soil mix B
5 parts soil mix A
1 part sand, particle size unknown
2 parts Canadian peat moss, shredded
5 lb. superphosphate/yd^3, 20% P_2O_5

soil mix C
30% soil, texture unknown
25% scoria, particle size ¼ inch or less
25% Canadian peat moss, shredded
20% redwood bark, composted, milled

soil mix D
6 parts soil (sandy clay)
3 parts Canadian peat moss, shredded
6 parts pine wood shavings
6 parts perlite, #8, between 6 and 8 mesh
2 parts bark, milled fir bark
2 lb. superphosphate/yd^3, 20% P_2O_5
3 lb. dolomitic limestome/yd^3, finely ground

The composition by volume of the six media prepared at Colorado State University was:

soil mix E
1 part soil, clay loam
1 part native Jefferson County peat, 58.8% organic matter
1 part perlite, #8, between 6 and 8 mesh

soil mix E2
1 part soil, clay loam
1 part native Estes Park peat, 47.8% organic matter
1 part perlite, #8, between 6 and 8 mesh

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soil mix F
1 part soil, clay loam
1 part Canadian peat moss, 94.6% organic matter
1 part perlite, #8, between 6 and 8 mesh

soilless mix G
1 part Canadian peat moss, 94.6% organic matter
1 part vermiculite, horticultural grade

soilless mix H
1 part native Jefferson County peat, 58.8% organic matter
1 part vermiculite, horticultural grade

soilless mix H2
1 part native Estes Park peat, 47.8% organic matter
1 part vermiculite, horticultural grade

All components of the media E, E2, F, G, H and H2 were mixed at their packaged moisture content. An electric concrete mixer was rotated for 6 minutes to thoroughly mix the components. Media A, B, C and D came from the greenhouse growers already mixed.

Media were poured into 4 inch standard plastic pots for growing geraniums and pothos and into cell packs for petunias. Enough of each medium was prepared to fill ten containers for each treatment for each of two different potting times.

Cultural Procedures

Two cultivars of *Petunia hybrida* ('Don Juan' and 'Glacier'), two cultivars of geranium, *Pelargonium hortorum* ('Snowmass' and 'Quest') and pothos *Scindapsis aureus* were grown in an FRP covered greenhouse at Colorado State University.

Terminal stem cuttings of geranium and pothos were taken on February 19 and March 5, and rooted in a perlite media under intermittent mist. Petunia seeds were sown on a peat-vermiculite media in shallow flats and placed under intermittent mist on February 19.

The petunia seedlings were removed from the mist propagation on March 1 and transplanted into six-cell plastic containers on March 22.

Geranium and pothos rooted cuttings from the first and second propagation dates were planted into 4 inch plastic pots on March 12 and April 2, respectively.

All plants, after planting, were placed in a greenhouse maintained at 60°F night temperature. Light intensity was reduced approximately 30% over the pothos with saran cloth. Plants were "hand-watered" with a nutrient solution when the surface of the media had dried. Those plants in a media of predominantly peat needed to be watered less frequently.

The nutrient solution contained ammonium nitrate, potassium nitrate, calcium nitrate, phosphoric acid, magnesium sulfate, Borax and zinc sulfate, and supplied the following concentrations of nutrients in solution:

nitrogen - NH_4	20.0	ppm N
nitrogen - NO_3	190.0	ppm N
phosphorus	25.6	ppm P
potassium	255.0	ppm K
calcium	158.0	ppm Ca
magnesium	53.3	ppm Mg
boron	.8	ppm B
zinc	.3	ppm Zn
sulfur	71.0	ppm S

The electrical conductivity of this fertilizer solution was 150×10^{-5} mhos.

Results and Discussion

Chemical Properties of the Media

The nutrient levels, pH and soluble salt levels of the different peats, vermiculite, perlite and soil used to formulate the media prepared at Colorado State University are given in Table 1.

Using Spurway tests, recommended nutrient levels for most bedding and pot plants given by one source are listed as follows (2):

Nitrate-N	30-50 ppm
Phosphorus	5 ppm
Potassium	20-40 ppm
Calcium	150 ppm
Soluble Salts	200×10^{-5} mhos or less

As seen in Table 1, few components will provide these recommended nutrient levels alone.

Canadian peat, vermiculite and perlite are generally low in nutrients and soluble salts; however, native peats and soil have higher levels, especially calcium.

The cation exchange capacity of the various media components and the organic matter content of the peats used in preparing the Colorado State University media are given in Table 2.

Table 1. Nutrient levels in Spurway extracts, pH and soluble salt levels of the various media components prepared at Colorado State University.

Substrate	NO_3-N (ppm)	P (ppm)	K (ppm)	Ca (ppm)	pH	SS (10^{-5} mhos)
Canadian Peat	0	.6	14	55	4.4	13
Jefferson Co., Peat	39	.2	21	>400	5.9	120
Estes Park Peat	50	0	12	>200	4.9	80
Vermiculite	0	.3	10	5	7.4	1
Perlite	0	.1	1	18	7.9	0
Soil (Clay Loam)	12	.9	35	>400	7.7	46

Table 2. Cation exchange capacity (CEC) of the media components and the organic matter content (OM) of the peats used in preparing the Colorado State University media.

Component	CEC (meq/100 g dry weight)	OM (% by dry weight)
Canadian Peat	139.0	94.6
Jefferson Co. Peat	75.0	58.8
Estes Park Peat	69.0	47.8
Vermiculite	27.5	
Perlite	3.0	
Soil (Clay Loam)	15.3	

The cation exchange capacity of the vermiculite and soil fell within the satisfactory range for containerized media (10-30 meq/100 g dry wt.) (4); however, the perlite was much lower.

The organic matter content of the native Colorado peats was only a little more than one-half that of the Canadian peat moss. These low organic matter peats generally gave less than optimum growth of plants compared to Canadian peat as an amendment.

Initial chemical properties of the various media used in the experiments are shown in Table 3.

The total soluble salts ranged from 27 × 10^{-5} mhos to 300 × 10^{-5} mhos, one of the media having a larger value than the recommended 200 × 10^{-5} mhos or less. If this recommended value is correct, the high soluble salt content should be a significant problem with one medium, (A).

Plant Growth in Various Media

The effects of the ten different media on stem length, plant height, number of leaves, fresh and dry weight per plant are presented in Table 4.

Canadian peat mixed with vermiculite at a 1:1 proportion (G) always gave as good as or better growth than either of the native peats with vermiculite. There was no significant difference in the measurements of growth between the native peats.

Canadian peat mixed with soil and perlite at a 1:1:1 proportion (F) always gave as good as or better results than either one of the two native peats mixed with soil and perlite. Again, there was no significant difference in growth between plants growing in the two native peat media.

Media D, G, B and C, all containing Canadian peat, gave the best overall growth. Medium A with Jefferson County peat gave inferior results. Media D and G had relatively lower pH values than were recommended by some researchers (1, 2). And, although these two media proved to be the best for plant growth, the probable cause was the high proportion of Canadian peat. Medium A had high soluble salts.

In general, all the other media did not give very successful results, particularly media H, E2, H2 and E that contained native Colorado peat.

Nelson (3) reported that media with a high percentage of Canadian peat, Colorado peat or vermiculite held the greatest amounts of available water and those high in soil or sand held the least. He stated that, in general, soilless media possessed the most desirable physical properties and media containing only soil and/or sand consistently had the least desirable properties. Physical properties of Colorado peat were more desirable when mixed with perlite or vermiculite, rather than soil or sand.

He found that media containing 40% Canadian peat or above resulted in aeration porosities of at least 30%, except when soil was the other component. Media high in Colorado peat generally ranged between 20-30%. The fresh and dry weight of *Chrysanthemum morifolium* Ram. 'Paragon' grown in six-inch standard plastic pots were positively correlated with percent aeration porosity.

In our research, greater variability in plant growth could be attributed to the source of peat (native Colorado vs. Canadian) than to the differences in chemical properties of the media. Perhaps the physical properties of peat have a greater influence on plant growth than the chemical properties.

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Table 3. Initial nutrient levels in Spurway extracts, pH and soluble salt levels of the media used for the growth of various bedding and pot plants.

Media	NO_3-N (ppm)	P (ppm)	K (ppm)	Ca (ppm)	pH	SS (x10^{-5} mhos)
A-Commercial Supplier A	39	>11	>80	>400	7.0	300
B-Commercial Grower B	17	>11	68	>400	6.8	170
C-Commercial Grower C	74	>11	18	390	7.3	27
D-Commercial Grower D	0	>11	27	120	6.0	50
E-Jeff. Co. Peat, Soil, Perlite	20	.5	19	>400	7.4	140
E2-Estes Park Peat, Soil, Perlite	8	.4	18	>400	7.5	55
F-Canadian Peat, Soil, Perlite	0	.8	20	>400	7.9	35
G-Canadian Peat, Vermiculite	5	.5	17	19	4.2	27
H-Jeff. Co. Peat, Vermiculite	3	.3	20	380	5.4	160
H2-Estes Park Peat, Vermiculite	2	.3	20	72	5.6	55

Table 4. Effect of the different media on the growth of pothos, geraniums and petunias. Treatments with same letter or set of letters do not differ significantly at 5% level.

Media	Stem Length (cm)	Number of Leaves	Adjusted Fresh Weight (g)	Adjusted Dry Weight (g)
	Pothos - 1st Potting			
A	61.1ab	12.1ab	35.3	4.2
B	62.7ab	12.6ab	34.0	3.9
C	63.8ab	12.0ab	37.8	4.5
D	66.2ab	13.5a	42.1	5.2
E	40.1c	10.0c	15.0	1.9
F	55.9abc	11.8abc	28.7	3.6
G	71.2a	12.6ab	44.0	5.5
H	53.8bc	11.2bc	22.6	2.9
	Pothos - 2nd Potting			
A	50.5a	10.8a	31.5	3.7
B	53.5a	11.0a	30.6	3.3
C	49.8a	10.6a	31.9	3.7
D	48.4ab	9.5a	31.0	3.5
E2	31.0c	8.7a	13.7	1.7
F	46.3abc	10.4a	17.6	2.2
G	46.7abc	10.1a	30.0	3.5
H2	32.1bc	8.4a	10.4	1.4

Media	Plant Height (cm)	Adjusted Fresh Weight (g)	Adjusted Dry Weight (g)
	Geranium 'Snowmass' - 1st Potting		
A	16.0bc	30.9	4.6
B	13.7c	40.2	5.7
C	17.2b	54.6	7.7
D	21.0a	83.0	10.6
E	10.2d	1.4	.2
F	14.9bc	27.2	4.4
G	20.9a	64.3	9.3
H	14.9bc	14.6	2.4
	Geranium 'Snowmass' - 2nd Potting		
A	11.9bc	23.2	3.8
B	13.2bc	41.0	6.4
C	14.0b	37.1	5.7
D	16.7a	53.2	7.5
E2	11.0c	12.2	1.9
F	11.7bc	19.4	3.2
G	17.0a	44.9	6.2
H2	11.1c	8.0	1.2
	Geranium 'Quest' - 1st Potting		
A	17.3c	45.0	6.6
B	23.9a	89.0	11.8
C	20.4b	71.5	9.6
D	24.2a	95.3	12.3
E	12.9d	8.4	1.5
F	13.8d	26.8	4.2
G	21.1b	71.9	10.2
H	14.0d	10.5	1.9
	Geranium 'Quest' - 2nd Potting		
A	14.9b	35.5	5.1
B	15.8b	47.7	6.5
C	14.5b	41.7	6.3
D	20.2a	76.4	10.9
E2	14.1B	7.5	1.4
F	14.4b	21.4	3.7
G	17.1abc	50.5	7.5
H2	11.3c	4.0	.7
	Petunia - 'Don Juan'		
A	19.7a	20.6bcd	1.7b
B	18.7ab	26.9ab	2.5a
C	18.5ab	24.0abc	2.0b
D	19.6a	25.5abc	2.4ab
E	5.9d	4.0e	.3d
E2	4.7d	4.4e	.4d
F	14.0c	16.7d	1.3c
G	18.0ab	28.0a	2.4ab
H	17.7abc	19.4cd	1.3c
H2	15.5bc	20.4bcd	1.3c
	Petunia - 'Glacier'		
A	19.7bcde	25.8bcd	2.3cd
B	24.2a	30.5ab	2.7abc
C	21.7abc	24.4cd	2.3bcd
D	21.5abcd	29.3abc	2.8ab
E	16.0ef	13.5e	1.0h
E2	12.5f	14.1e	1.3gh
F	19.0cde	25.1bcd	2.2de
G	23.7ab	34.4a	3.1a
H	19.0cde	22.4d	1.8ef
H2	17.2de	20.8d	1.6fg

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