Growth and Shelf Life of *Impatiens* in Media Amended with Hydrophilic Polymer and Wetting Agent

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Summary. *Impatiens wallerana* **'Accent Red' were grown in a peat : perlite : vermiculite (PPV) or bark : peat : perlite (BPP) medium amended with SuperSorb-C (SS) or Soil Moist (SM) hydrophilic polymer and/or AquaGro-G (AG) wetting agent. In PPV or BPP, neither SS nor SM significantly increased shoot dry weight. In PPV, quality ratings were higher for plants grown in nonamended or SS- or SM- amended medium than for plants in AG-amended medium. In BPP, quality ratings were highest for plants grown in nonamended, AG-, or SM + AG-treated medium. Number of days from final irrigation to permanent wilting point (PWP) was greater in AG, SS + AG, or SM + AG treatments in PPV than in control, SS, or SM treatments, due to smaller plants in AG-amended media. In both media, root dry weight was not significantly greater with the use of either hydrophilic polymer or wetting agent. However, in PPV, AG suppressed root growth compared to the control.**

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Dry peat and bark, particularly pine bark, are difficult to wet; iron humates and a strongly adsorbed film of air on the surface of peat particles inhibit peat wetting (Bunt, 1988; Langerud and Sandvik, 1988), while surface waxes or resins may inhibit bark wetting (Bunt, 1988). When peat or bark is used in potting mixes, wetting agents are commonly added to decrease surface tension of water and promote wetting.

Hydrophilic polymers have been used in many areas of horticulture: bedding plants (Gehring and Lewis, 1980; Lamont and O'Connell,1987), potted flowering crops (Still, 1976), vegetable crops (Grossman et al., 1989), foliage plants (Wang, 1989), nursery stock and Christmas tree transplants (Carroll and Templeton, 1990; Hensley and Fackler, 1984), landscaping (Henderson et al., 1991), and hydroseeding (Perkins-Veazie et al., 199 1). Hydrophilic polymers are typically either starch-based or synthetically produced polyacrylics or polyacrylamides that absorb 20 to 500 times their weight in water, depending on product formulation and water quality. Tap water and fertilizer salts have been shown to reduce the absorption capacity of hydrophilic polymers (Foster and Keever, 1989; Wang and Gregg, 1990).

Although some manufacturers claim that 95% of the water retained by hydrophilic polymers is available to the plant, the concept of water availability, with regard to polymers, has been under debate. Container capacity of a soilless mix is increased by the addition of a hydrophilic polymer (Blodgett et al., 1993; Fonteno and Bilderback, 1993). However, the actual availability of this water to plant roots remains under question (Fonteno and Bilderback, 1993).

Hydrophilic polymers increase the number of hours to wilt (Gehring and Lewis, 1980), reduce irrigation frequency, and increase shelf life (Still, 1976). However, high rates of polymer result in less plant dry weight (Still, 1976). Dry weight reductions may be attributed to polymer phytotoxicity (Furuta and Autio, 1988).

Although wetting agents are commonly used in bedding plant media, study of the effect of polymers on plant growth in combination with a wetting agent has been limited. Absorption studies in which polymers were used in conjunction with a wetting agent indicate that more deionized water is absorbed into soilless mixes and is available to a plant when both are present compared to the hydrophilic polymer alone (Blodgett et al., 1993).

The objective of this study was to determine if the addition of hydrophilic polymer and wetting agent to soilless media affects growth, quality, and days to wilting of *Impatiens wallerana* 'Accent Red'.

Materials and methods

Plants were grown in a subirrigation system similar to that described by Elliott (1992). Irrigation time was set manually and tap water (pH 7.1) was used for all irrigations. The two potting mixes consisted of 2 peat :1 perlite :1 vermiculite (PPV), by volume, and 1 bark : 1 peat : 1 perlite (BPP), by volume. The materials used for the base mixes were sphagnum peat (Fafard Peat Moss Co., Ltd., Shippegan, N. B., Canada), composted pine bark (W.R. Grace & Co. Horticultural Products, Cambridge, Mass.), and horticultural-grade perlite and vermiculite (Terra-lite, W.R. Grace & Co). Mixes were amended with the hydrophilic polymer SuperSorb-C (Aquatrols Corp. of America, Cherry Hill, N. J.) at 1.5lb/yard^3 (890g·m^{-3}) or Soil Moist (JRM Chemical Division, Hudson, Ohio) at 1.2 lb/yard^3 (710 g·m^{-3}), or remained nonamended. Supersorb-C (SS) is a copolymer acrylamide acrylate while Soil Moist (SM) is a crosslinked modified acrylic polymer. Each of the mixes, including polymer treatments and nonamended mix, was then amended with the wetting agent AquaGro-G (a blended ester and ether-alcohol non-ionic surfactant on vermiculite, Aquatrols Corp.) at 1.5lb/yard^3 (890g·m^{-3}), or remained nonamended. All amendment materials, AG, SS, and SM, were added at manufacturers' specified rates for soilless mixes.

Impatiens wallerana 'Accent Red' (Spark Plugs, Ball Seed, Co., West Chicago, Ill.) were transplanted into 11-cm square pots. Osmocote 14N–6.2 P–7.7K(Sierra Chemical Co., Newark, Calif.) at 11.8 lb/yard^3 (7 kg·m^{-3}), dolomitic limestone (J.E. Baker Co., York, Pa.) at 3.4 lb/yard^3 (2 kg·m^{-3}), and fritted trace elements 555 (Robert B. Peters Co., Allentown, Pa.) at 0.0012 lb/yard^3 (0.7 g·m^{-3}) were added to each medium.

After transplanting, all pots were thoroughly irrigated overhead to establish capillarity and then placed on a subirrigation system housed in a greenhouse with average air temperatures of 26 ± 2C (day) and 21 ± 2C (night).

Two blocks of each treatment containing four repetitions each resulted in a total of 96 plants. A randomized complete-block design was used with a split-plot arrangement of treatments. Wetting agent was the main plot, while hydrophilic polymer and medium treatments were subplots.

All plants within a treatment were irrigated if at least one plant within that treatment required irrigation. Irrigation need was determined subjectively by pot weight, medium color and moistness, and visually observed turgor condition of the plant.

Nine weeks after potting, plants were rated visually immediately before determining the permanent wilting point (PWP). Plants were rated individually on a scale from 1 (lowest quality) to 4 (highest quality). At evaluation, four plants were chosen from the entire crop as standards to represent ratings from 1 to 4. All other plants were compared visually to these four standards to-determine each plant's individual rating. Evaluations were based on visual observations of plant size, leaf color, flower color, flower and bud number. and overall appearance.

Immediately after visual rating, all plantswereirrigated and moved to a controlled atmosphere growth room. Plants wererandomly placed on a bench lighted with cool-white fluorescent lamps averaging 140 $\mu mol m^{-2} \cdot s^{-1}$ at plant height and a 12-h photoperiod. Temperature of the growth room was 21 ± 2C.

To determine if a plant had reached its PWP. each plant was allowed to wilt until all leaves were flaccid. The plant was then moved to a 25 × 25 × 13-inch (63.5 × 63.5 × 33.0-cm) ultrasonic fog chamber (Shira Aeroponics, Bethesda, Md.). A plant was considered to beat PWP if it failed to recover after 3 h in the fog chamber. At PWP. shoot and roots were harvested and their dry weights recorded. If the plant recovered, it was returned to the lighted bench, allowed to rewilt, and then returned to the fog chamber.

Results and discussion

In PPV amended with hydrophilic polymer alone, growth, as measured by shoot and root dry weight, was not significantly different than controls (Table 1). However, in treatments with AG added, shoot and root dry weight were, at best, 52% and 55%, respectively, of control plants. The deleterious effect of AG on shoot dry weight and quality rating was significantly lessened when AG was combined with SM. A similar effect was observed for SS + AG, but only for quality rating.

In BPP (Table 1), only plants grown in SM- or SM + AG amended media had dry weights comparable to control plants. AG alone resulted in lower root dry weight, but the decrease in shoot dry weight and quality rating was not significant. SS resulted in lower shoot and root dry weight and quality rating, but no significant decrease was recorded for SM. In the SS + AG treatment, shoot and root dry weights were not different from AG alone; only the quality rating was lower. In the SM + AG medium, no decrease was noted for shoot dry weight and quality rating, and root dry weight was comparable to control plants.

Days from final irrigation to PWP in PPV was greater for AG, SS + AG, or SM + AG than for control, SS, or SM treatments (Table 1) and was similar to results for days to wilt per gram of shoot dry weight. The effects of medium amendments on days to wilt may be compared best on a shoot dry weight basis, as there were great differences in plant size at the beginning of the wilting phase of the experiment.

In BPP, control, SM, SS + AG, and SM + AG, plants reached PWP in the fewest days compared to other BPP treatments. In contrast, days to PWP for AG and SS was greater than for other treatments. On a gram dry weight basis, control, SM, and SM + AG plants reached PWP in the fewest days and SS plants required the greatest number of days. AG and SS + AG were intermediate. In this experiment, while polymers did not enhance or decrease the growth of *Impatiens* 'Accent Red' in the PPV medium, the addition of SS resulted in lower shoot dry weight and quality in the BPP medium than control. Furuta and Autio (1988) reported reduced growth of *Zinnia elegans* with the addition of a hydrophilic polymer to the growing medium. Similarly, Lament and O'Connell (1987) found that media amended with polymers did not increase the shoot dry weight of mari-

Table 1. *Shoot dry weights, root dry weights, quality rating, and number of days to wilt for* Impatiens wallerana *'Accent Red' grown in PPV and BPP media.*

Treatment	Shoot dry wt	Root dry wt	Quality rating	Days to wilt	Days to wilt/g shoot dry wt
PPV[z] medium					
C[y]	3.8 a[x]	1.8 a	3.6 ab	7.1 c	1.9 c
AG	1.1 c	0.3 c	1.4 d	27.0 a	32.8 a
SS	3.7 a	1.4 ab	3.1 b	9.6 c	3.4 c
SS + AG	1.4 bc	0.7 bc	2.0 c	24.1 a	26.8 ab
SM	4.1a	1.5 ab	3.7 a	8.1 c	2.1 c
SM + AG	2.0 b	1.0 a–c	2.1 c	16.7 b	14.6 bc
			Pr > F		
WA	0.0001	0.0004	0.0001	0.0001	0.0001
HP	0.1674	0.7181	0.1219	0.1123	0.1711
WA × HP	0.5785	0.2155	0.0536	0.0816	0.1839
BPP[x] medium					
C	4.2 ab	3.1 a	3.6 ab	5.3 b	1.3 b
AG	3.5 bc	2.1 bc	3.5 ab	10.4 a	3.3 ab
SS	3.3 c	1.7 c	3.0 cd	10.9 a	3.6 a
SS + AG	3.2 c	2.2 bc	2.6 d	8.3 ab	2.6 ab
SM	4.3 ab	2.8 ab	3.2 bc	6.0 b	1.5 b
SM + AG	4.5 a	3.2 a	3.7 a	5.9 b	1.6 b
			Pr > F		
WA	0.4246	0.8113	0.9298	0.4538	0.4922
HP	0.0013	0.0016	0.0001	0.0252	0.0528
WA × HP	0.2241	0.0167	0.0444	0.0119	0.0501

[z]*PPV = 2 peat : 1 perlite:1 vermiculite, BPP = 1 bark : 1 peat : 1 perlite.*
[y]*C = Control, SS = SuperSorb-C, SM = Soil Moist, AG = AquaGro-G, WA = wetting agent, HP = hydrophilic polymer.*
[x]*Values under same column within the same medium followed by same letters are not significantly different at* P *= 0.05, Waller–Duncan K ratio* t *test. Each mean based on four plants.*

golds *(Tagetes patula).*

AG in the formulation used here (the manufacturer reports that the formulation has been changed) appears to be phytotoxic, but the effects are medium-dependent. Shoot and root dry weights and quality of *Impatiens* grown in AG-amended PPV medium were lower than in controls, but not in the BPP medium. Bhat et al. (1992) also reported that shoot and, more severely, root development of New Guinea impatiens was adversely affected by the use of AG. The same study shows that less-sensitive crops, such as chrysanthemums *(Dendranthema × grandiflora)* and geraniums (*Pelargonium × hortorum),* are unaffected by AG, even at high rates. In our experiment, the phytotoxicity of AG was reduced when combined with polymers in the PPV medium. In the BPP medium, there was less evidence of growth reduction when AG was applied alone or in combination with polymer.

Although there was a slight increase in average number of days to wilt with the use of hydrophilic polymers, their use with this crop and irrigation system cannot be recommended because there was no increase in shoot dry weight, root dry weight, or quality rating. In addition, the combination of this formulation of AG and a high peat-based medium was detrimental to the growth of impatiens. Caution is advised when using a wetting agent with particularly sensitive cropssuch as impatiens and, as always, testing of new products on a small sample of the crop is highly recommended.

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