Paclobutrazol Drench Activity in Peat-based Substrates Containing Woodchip Aggregates

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ABSTRACT

Increased grower and substrate manufacturer interest in utilizing fresh wood components in greenhouse mixes as an alternative/supplement to peat or perlite have generated many questions and possibilities for the horticulture industry. Wood components are desirable due to their abundance; locality and renewability compared to some other substrate components. This interest, and the many unanswered questions surrounding their use, justifies further evaluation of these materials in greenhouse mixes. Paclobutrazol drench applications of 0, 1, 2, and 4 mg a.i./pot were applied to ‘Pacino Gold’ potted sunflowers (Helianthus annuus L.) grown in peat-based substrates amended with perlite or woodchip aggregates at 30% (by volume), to study the efficacy of paclobutrazol (Piccolo). Growth indices and plant dry weights decreased as paclobutrazol rate increased for plants in both substrates. Growth indices of potted sunflower grown in both substrates were not significantly different at each paclobutrazol application rate; however the dry weights of plants grown in pine wood chips were significantly less at the 2 and 4 mg application rates compared to plants grown in the perlite substrate. These dry weight differences at the higher paclobutrazol rates had no visual effect on plant size, shape and overall appearance which means plants grown in both substrates were equally saleable.

INTRODUCTION

Soilless growing media became popular in the 1960’s when Cornell University introduced their new peat-lite mixes as an alternative to topsoil for growing plants in containers. Since the transition to soilless growing media (substrate), the basic components have been peat, coir, vermiculite, and perlite. Perlite is a lightweight, non-renewable, inorganic, silicaceous aggregate that allows aeration and gas exchange in substrates. The cost of perlite has increased significantly in recent years due to increased transportation costs, especially since the majority of perlite has to be shipped from overseas. In recent years, alternative substrate components have been investigated to decrease costs and utilize more renewable and local/regional products. Specific alternatives to perlite that have been investigated include parboiled rice hulls, growstones and processed corn cobs (Evans and Gachukia, 2004; Evans, 2011; Weldon et al., 2011). In addition to these alternative aggregates, many researchers have reported the effectiveness of using fresh pine wood in greenhouse substrates (Fain et al., 2008; Wright and Browder, 2005). While it has been hypothesized that perlite is not needed in greenhouse substrates that contain fresh pine wood as a component, little work has actually been conducted to support this claim.

A common cultural practice of controlling growth of greenhouse crops is the application of plant growth retardants (PGRs). Applying PGRs to crops allows growers to
decrease the rate of growth or flowering, hold plants longer in production and to produce uniform, compact, and marketable plants. One common method of PGR application is through drenches, which provide more uniform results and increase the duration of effectiveness compared with foliar sprays (Boldt, 2008). Paclobutrazol provides size control on many floricultural crops (Barrett and Nell, 1989) and is active when applied to the growing media and taken up through the roots (Barrett and Bartuska, 1982). However, the efficacy of PGR drenches can be affected by the amount of active ingredient (a.i.), solution volume applied, and substrate components (Barrett, et al., 2009).

Numerous studies have reported that PGR drench efficacy is reduced when organic components are included in substrates including pine bark (Barrett, 1982; Million et al., 1998). In a study by Evans et al. (1998) found the activity of paclobutrazol drench of potted sunflowers in coir and peat-based substrates to be similar at 2 mg compared to a reduction in plant height at 4 mg in coir-based substrates. This reduction suggests an increase in PGR activity at higher concentration in coir-based substrates and the higher water holding capacity of the substrate. Similar drench concentrations of paclobutrazol as recommended for peat-based substrates could be used for coir-based substrates to control plant size of potted floricultural crops, although, to compensate for the greater amount of plant growth in coir-based substrates, PGR concentrations may need to be increased slightly to achieve similar plant heights as with peat-based substrates (Evans et al., 1998).

MATERIAL AND METHODS

On 19 Dec. 2011, eight-year-old loblolly pine trees (Pinus taeda L.) were harvested at ground level and de-limbed in Chatham county, NC and subsequently stored under a shelter for protection from the weather. On 3 Jan. 2012 pine logs were chipped in a DR Chipper (18 HP DR Power Equipment, model 356447; Vergennes, VT) resulting in smaller wood chips. Wood chips were then hammer-milled through a 6.35 mm screen [(¼ L x ¼ W x 3/16 H –inch); Meadows Mills, North Wilkesboro, NC]. On 11 Jan. substrates were blended to contain 30% (by vol.) perlite or woodchips with the remainder being sphagnum peat (peat) to produce a total of two substrate treatments. After formulation of the substrates, dolomitic limestone was incorporated at 9 lb/yd³ (5.3 kg•m⁻³) and Aquatrols 2000G wetting agent at 202.8g/yd³ [(0.26 kg•m⁻³); Aquatrols, Paulsboro, NJ]. Substrates were allowed to incubate for 4 d in closed bags to allow lime (pH) equilibration before potting. Substrates did not contain a pre-plant starter-charge fertilizer.

On 27 Dec. 2011 ‘Pacino Gold’ potted sunflower seeds were double sown into 1203 cell packs [(8 L x 4 W x 5.5 H -cm); ITML Horticultural Products, Middlefield, Ohio] containing Fafard 1P mix (Fafard, Anderson, South Carolina) in a glasshouse in Raleigh, North Carolina. On 3 Jan. 2012, germinated seedlings were pinched at the substrate line to leave one seedling per cell. On 20 Jan. 2012, sunflowers were potted in 12.7-cm (6-in), diameter plastics containers (ITML Horticultural Products, Middlefield, OH) filled with each substrate. The seedlings were grown in a polyhouse in Raleigh, NC and grown at 23°C day/ 17°C night temperatures. Plants in each substrate were watered by emitters on a drip line at the same time, as needed depending upon weather conditions,
and were never allowed to show any symptoms of water stress. Plants were fertilized at each watering with 200 ppm nitrogen (N) injected by TrueAdvantage Dosmatic (Hydro Systems Co., Cincinnati, OH) with Ultrasol 13N-0.9P-10.8K Water Soluble Seedling Plus (SQM North America, Atlanta, GA) containing 0.3% ammonium (NH₄-N) and 12.7% nitrate (NO₃-N). Fifth-teen days after potting, 0.00, 1.25, 2.50, and 5.00 mL of solution containing 0, 1, 2, 4 mg (a.i) paclobutrazol [(Piccolo 10XC), Fines Americas, Walnut Creek, CA] was beaker applied to each container. The experimental design was completely randomized with eight single-plant replications of two substrates x four PGR treatment combinations. Between 8 – 23 Mar. a final growth index (GI) [(height + widest width + perpendicular width) ÷ 3] of each plant was recorded at the first sign of flower anthesis. Shoots were severed at the substrate surface, dried at 70°C for one week, and weighed. Data were subjected to analysis of variance by the general linear model procedures and regression analysis (version 9.2: SAS Institute, Cary, N.C.). Means were separated by least significant differences at $P \leq 0.005$.

RESULTS AND DISCUSSION

As paclobutrazol rate increased, GI decreased similarly in both substrates (Fig. 1). Even though GI of plants was similar between substrates at the 2 and 4 mg/a.i. drench application rates, there was a difference in dry weights at these same rates (Fig. 2). The absence of GI differences is likely a result of increased axillary branching that was observed and measured (as paclobutrazol rate increased) as part of the GI formula. It is unclear why the dry weight differences occurred at the higher rates, but it is clear that there is no “tie-up” of paclobutrazol in substrates containing woodchips as evident by similar or increased growth control compared to plants grown in perlite substrates. It’s worth noting that at the zero paclobutrazol rate, GI of plants were similar in both substrates indicating no growth differences that could have been caused by substrate physical or chemical properties, fertility or pH management in this experiment. The lack of growth differences means that pine wood chips can be utilized in place of perlite with no change to cultural practices for growing sunflower.

Despite differences in dry weight at higher rates of paclobutrazol drench, sunflower size and appearance were visually similar and produced marketable plants. Additional work with other species, PGR rates and wood chip percentages need to be conducted. Pine wood chips do not appear to negatively affect paclobutrazol drench activity on plant growth, which has been a concern of many growers who have considered using the less expensive pine chips in place of perlite in their peat mixes.

LITERATURE CITED


Boldt, J. L. 2008. Whole plant response of chrysanthemum to paclobutrazol, chlormequat chloride, and (s)-abscisic acid as a function of exposure time using a split root system. MS Thesis.


Figure 1. Paclobutrazol drench activity on growth index \([(\text{height} + \text{widest width} + \text{perpendicular width}) \div 3]\) of ‘Pacino Gold’ potted sunflowers in peat-based substrates containing either 30% perlite or fresh pine wood chip aggregates.

Figure 2. Paclobutrazol drench activity on ‘Pacino Gold’ potted sunflower dry weights grown in peat-based substrates containing either 30% perlite or fresh pine wood chip aggregates.