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Evaluation of Container Ornamental Species Tolerance to Three *p*-hydroxyphenylpyruvate Dioxygenase-inhibiting Herbicides

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Summary. **Selective weed control in ornamental plant production can be difficult as many herbicides can cause unacceptable injury. Research was conducted to evaluate the tolerance of several ornamental species to applications of *p*-hydroxyphenylpyruvate dioxygenase (HPPD)-inhibiting herbicides for the control of problematic weeds in ornamental production. Mestotrione (0.09, 0.18, and 0.36 lb/acre), tembotrione (0.08, 0.16, and 0.32 lb/acre), and topramezone (0.016, 0.032, and 0.064 lb/acre) were applied alone postemergence (POST) in comparison with the photosystem II-inhibiting herbicide, bentazon (0.5 lb/acre). All herbicide treatments, with the exception of the two highest rates of tembotrione, caused less than 8% injury to 'Noble Upright' japanese holly (*Ilex crenata*) and 'Compactus' burning bush (*Euonymus alatus*). Similarly, no herbicide treatment caused greater than 12% injury to 'Girard's Rose' azalea (*Azalea*). Conversely, all herbicides injured flowering dogwood (*Cornus florida*) 10% to 23%. Mesotrione- and tembotrione-injured 'Radrazz' rose (*Rosa*) 18% to 55%, compared with only 5% to 18% with topramezone. 'Siloam June Bug' daylily (*Hemerocallis*) injury with topramezone and tembotrione was less than 10%. Topramezone was the only herbicide evaluated that provided at least 93% control of redroot pigweed (*Amaranthus retroflexus*) with all application rates by 4 weeks after treatment (WAT). Redroot pigweed was controlled 67% to 100% with mesotrione and tembotrione by 4 WAT, but this activity was variable among application rates. Spotted spurge (*Chamaesyce maculata*) was only adequately controlled by mesotrione applications at 0.18 and 0.36 lb/acre, whereas chamberbitter (*Phyllanthus urinaria*) was not controlled sufficiently with any herbicide evaluated in these studies. Yellow nutsedge (*Cyperus esculentus*) was suppressed 72% to 87% with mesotrione applications at 0.18 lb/acre or higher and with bentazon at 0.5 lb/acre by 4 WAT. All other herbicide treatments provided less than 58% control of yellow nutsedge. In the second study, 'Patriot' hosta (*Hosta*), 'Green Sheen' pachysandra (*Pachysandra terminalis*), autumn fern (*Dryopteris erythrosora*), 'Little Princess' spirea (*Spiraea japonica*), 'Green Giant' arborvitae (*Thuja plicata*), and 'Rosea' weigela (*Weigela florida*) displayed no response to topramezone when applied at 0.024 and 0.095 lb/acre. Since 10 ornamental species in our studies exhibited less than 10% herbicidal response with all rates of at least one HPPD-inhibiting herbicide then it is possible that these herbicides may provide selective POST weed control in ornamental production systems.**

Controlling weed contamination in nursery stock is difficult in ornamental production. Although cultural practices for weed control in nurseries include mulching and the use of fabrics to impede the development of emerging weeds, these techniques are not completely effective in the absence of a chemical control (Case et al., 2005; Mathers and Ozkan, 2001). Acetyl-CoA carboxylase inhibitors are effective at remedially managing grasses in dicotyledonous nursery stock (Senesac, 2002); however, selective control of broadleaf weeds in ornamental systems is more difficult. In part, challenges derive in that both broadleaf weeds and many desirable ornamentals are both dicotyledonous species with variable sensitivity to postemergence herbicides (Case et al., 2005; Derr, 1994).

To date, there are few POST herbicides registered for selective broadleaf control in ornamental plants. These herbicides do not provide broad-spectrum broadleaf weed control in ornamental production and/or are not registered for use over the top of many ornamental species.

Mesotrione, topramezone, and tembotrione are herbicides that inhibit the HPPD enzyme. These herbicides impede the production of plastoquinone in susceptible species, ultimately preventing the production of photoprotective carotenoid compounds. As a result, the plant's ability to sequester singlet- and triplet-state oxygen and dissipate excess photosynthetic active radiation is compromised (Niyogi, 1999). Eventually foliar plant tissue becomes bleached, necrotic, and photosynthetically inactive resulting in plant death. Mesotrione, topramezone, and tembotrione are labeled for weed control in corn (*Zea mays*) and multiple turfgrass species (Elmore et al., 2011; Gettys and Haller, 2009). Weeds controlled by these herbicides include (but are not limited to) common cocklebur (*Xanthium strumarium*), common lambsquarters (*Chenopodium album*), smartweed species (*Polygonum* sp.), common ragweed (*Ambrosia artemisiifolia*), yellow nutsedge, nimblewill (*Muhlenbergia schreberi*), and crabgrass (*Digitaria* sp.) (Beam et al., 2006; Giese et al., 2005; Jones and Christians, 2007; Senseman, 2007; Willis et al., 2006).

Several researchers have reported moderate injury (<45%) to burning bush, vinca (*Vinca* sp.), and loblolly pine (*Pinus taeda*) with mesotrione applications (Jackson et al., 2009; Little et al., 2004; Senesac and Tsontakis-Bradley, 2007). Other researchers (Vea and Palmer, 2010) showed that mesotrione applications caused unacceptable phytotoxicity to over 20 ornamental plant species. However, data describing ornamental tolerance to topramezone and tembotrione are minimal. Thus, our objective was to determine ornamental tolerance and weed control efficacy with applications of the HPPD-inhibiting herbicides mesotrione, tembotrione, and topramezone compared with bentazon, an important ornamental herbicide on common ornamental plant and weed species in Tennessee.

Materials and methods

Site description. Two studies were conducted in a shadehouse structure at the University of Tennessee (Knoxville, lat. 35.9465°N, long. 83.9386°W) evaluating ornamental tolerance and weed control efficacy with mesotrione, tembotrione, and