



[Environment Horticulture Program Research Summaries](#)

IR-4 Environmental Horticulture Program Azoxystrobin Crop Safety

**Authors: Ely Vea and Cristi L. Palmer
Date: 5/20/2019**

Acknowledgements

Susan Bierbrunner

Lori Harrison

J. Ray Frank

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2015-34383-23710 and 2017-34383-27100 with substantial cooperation and support from the State Agricultural Experiment Stations and USDA-ARS.

Table of Contents

Table of Contents	2
Table of Tables	3
Abstract	4
Introduction.....	5
Materials and Methods.....	5
Results and Summary	5
Phytotoxicity of Heritage	5
Label Suggestions	13
Appendix 1: Contributing Researchers	14

Table of Tables

Table 1.	List of Heritage 50WG treated crops with no or minimal transitory injury.	6
Table 2.	Detailed Summary of Crop Safety Testing with Heritage 50WG	7

Abstract

Azoxystrobin was registered as Heritage in the United States in 1997 as a turf fungicide. In April 2003, this label was updated to include applications for certain diseases on ornamental crops. The label contains an extensive list of environmental horticulture plants where Heritage can be used without causing phytotoxicity. From 1999 to 2014, the IR-4 Project conducted 107 trials on 77 ornamental plant species examining phytotoxicity related to Heritage applications. In these trials, only 2 crops (*Pseudotsuga menziesii* and *Tsuga heterophylla*) exhibited noticeable, significant injury and that was a slight height reduction and stem swelling at the 2X and 4X rates applied as drench to emerged seedlings. Based on this information, it is recommended that 54 plants in the IR-4 trials be added to the list of tolerant plants with the precautionary statements in the Plant Safety and Tolerant Ornamentals Plant sections of the current Heritage 50WG label.

Introduction

Azoxystrobin was registered as Heritage in the United States in 1997 as a turf fungicide. In April 2003, this label was updated to include applications for certain diseases on ornamental crops. From 1999 to 2014, the IR-4 Project conducted 107 trials primarily examining phytotoxicity related to Heritage applications.

Materials and Methods

Heritage was tested applied as foliar treatment typically twice at approximately 14 days interval. The application rates were typically 1, 2 and 4 oz of 50WG per acre or per 100 gal, plus a water treated control, although one researcher used 8, 16 and 32 oz per acre in 36 1999-2000 trials. In 2 trials, Heritage was applied as drench to emerged seedlings. A minimum of three plants (replicate treatments) were required with most researchers exceeding this minimum. Phytotoxicity was recorded on a scale of 0 to 10 (0 = no phytotoxicity; 10 = complete kill) one to four times from 1 to 8 weeks after initial application. For more detailed materials and methods, please see Appendix 1: Protocols, and visit <https://www.ir4project.org/ehc/ehc-registration-support-research/env-hort-researcher-resources/#Protocols> to view and download protocols 13-018 and 14-013.

Heritage was supplied to researchers (See list of researchers in Appendix 2) by Syngenta.

Results and Summary

Based on the type and nature of injury seen with pesticide applications, tested plant species were placed into three categories: 1) no significant phytotoxicity or growth differences from the untreated check or any injury was transitory, 2) no or minimal transitory injury seen at the 1X rate, but the 2X and/or 4X rates did cause significant phytotoxicity, 3) Significant injury sufficient to recommend growers not utilize azoxystrobin.

Phytotoxicity of Heritage

Across all plant species tested, Heritage exhibited no or minimal negative impact (Table 1). Seventy seven plant genera or species fell into this category.

Please see Table 2 for a summary of the individual trial results.

Table 1. List of Heritage 50WG treated crops with no or minimal transitory injury.

<i>Abies fraseri</i> ¹	<i>Lavandula angustifolia</i>
<i>Abies procera</i>	<i>Ligustrum</i> sp.
<i>Acer saccharum</i> ¹	<i>Lilium</i> sp.
<i>Anemone pulsatilla</i>	<i>Lobelia cardinalis</i>
<i>Aurinia saxatilis</i>	<i>Lonicera xylosteum</i>
<i>Betula nigra</i> ¹	<i>Monarda x hybrida</i>
<i>Buxus microphylla</i>	<i>Nepeta cataria</i>
<i>Buxus sempervirens</i> ¹	<i>Penstemon barbatus</i>
<i>Centaurea dealbata</i>	<i>Perovskia atriplicifolia</i>
<i>Chrysanthemum x hybrida</i>	<i>Phlox</i> sp. ¹
<i>Chrysanthemum</i> sp. ¹	<i>Pieris japonica</i> ¹
<i>Chrysanthemum x superbum</i>	<i>Populus deltoids</i>
<i>Clematis</i> sp.	<i>Populus nigra</i>
<i>Coreopsis</i> sp.	<i>Potentilla</i> sp. ¹
<i>Cornus florida</i> ¹	<i>Primula</i> sp. ¹
<i>Crocsmia x crocosmiflora</i>	<i>Pseudotsuga menziesii</i>
<i>Cotoneaster</i> sp.	<i>Quercus palustris</i> ¹
<i>Dahlia</i> sp.	<i>Rhododendron</i> sp. ¹
<i>Delphinium</i> sp. ¹	<i>Rosa</i> sp. ¹
<i>Dianthus chinensis</i>	<i>Rudbeckia hirta</i> ¹
<i>Digitalis mertonensis</i>	<i>Salvia splendens</i>
<i>Euonymus alatus</i> ¹	<i>Schizachyrium scopalarium</i>
<i>Forsythia</i> sp.	<i>Solidago canadensis</i>
<i>Gaillardia grandiflora</i>	<i>Syringa reflexa</i>
<i>Galium odoratum</i>	<i>Syringa</i> sp.
<i>Geranium magniflorum</i>	<i>Taxus x media</i>
<i>Gladiolus</i> sp.	<i>Teucrium chamaedris</i>
<i>Gleditsia tricanthos</i>	<i>Thuja plicata</i>
<i>Hedera helix</i> ¹	<i>Thuja</i> sp.
<i>Heliopsis helianthoides</i>	<i>Thymus vulgaris</i>
<i>Hibiscus althea</i>	<i>Tsuga canadensis</i>
<i>Hosta fortunei</i>	<i>Tsuga heterophylla</i>
<i>Ilex cornuta</i>	<i>Verbena</i> sp. ¹
<i>Iris xiphium</i>	<i>Verbena x hybrida</i>
<i>Juniperus</i> sp. ¹	<i>Veronica</i> sp.
<i>Lagerstroemia indica</i> ¹	<i>Viola cornuta</i>
<i>Lathyrus odoratus</i>	<i>Weigela</i> sp.

¹ Already registered

Table 2. Detailed Summary of Crop Safety Testing with Heritage 50WG

Notes: Table entries are sorted by crop Latin name. Only those trials with research reports received by 4/1/2015 are listed below.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
13778	Fir (<i>Abies</i> sp.) <i>A. fraseri</i>	Field Container	Benson	NC	2002	Drench	No injury at 1, 2 and 4 oz product per 100 gal
13778	Fir (<i>Abies</i> sp.) <i>A. procera</i>	Field Container	Linderman	OR	2001	Foliar	No injury at 4, 8 and 16 oz product per acre
13781	Maple (<i>Acer</i> sp.) <i>A. saccharum</i>	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13883	Anemone (<i>Anemone</i> sp.) <i>A. pulsatilla</i>	Field Container	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
13892	Basket-Of-Gold (<i>Aurinia saxatilis</i>)	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
14165	Basket-Of-Gold (<i>Aurinia saxatilis</i>)	Field In-Ground	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13787	Birch (<i>Betula</i> sp.) <i>B. nigra</i>	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13745	Boxwood (<i>Buxus</i> sp.) <i>B. microphylla</i> 'Winter Gem'	Field Container	Pscheidt	OR	2013	Foliar	No injury or growth reduction with 4 and 8 oz per 100 gal applied 3 times.
13745	Boxwood (<i>Buxus</i> sp.) <i>B. microphylla</i> 'Winter Gem'	Field Container	Pscheidt	OR	2014	Foliar	No injury or height reduction with 8 oz per 100 gal, with or without Silwet L-77, applied 3 times.
13745	Boxwood (<i>Buxus</i> sp.) <i>B. sempervirens</i> 'Suffruticosa'	Field Container	Pscheidt	OR	2013	Foliar	No injury or growth reduction with 4 and 8 oz per 100 gal applied 3 times.
13745	Boxwood (<i>Buxus</i> sp.) <i>B. sempervirens</i> 'Suffruticosa'	Field Container	Pscheidt	OR	2014	Foliar	No injury or height reduction with 8 oz per 100 gal, with or without Silwet L-77, applied 3 times.
13745	Boxwood (<i>Buxus</i> sp.) 'Green Velvet'	Field Container	Pscheidt	OR	2013	Foliar	No injury or growth reduction with 4 and 8 oz per 100 gal applied 3 times.
13745	Boxwood (<i>Buxus</i> sp.) 'Green Velvet'	Field Container	Pscheidt	OR	2014	Foliar	No injury or height reduction with 8 oz per 100 gal, with or without Silwet L-77, applied 3 times.
13899	Knapweed (<i>Centaurea</i> sp.) <i>C. dealbata</i>	Field Container	Linderman	OR	2000	Foliar	No injury at 8, 16 and 32 oz product per acre
13903	Chrysanthemum, Garden (<i>Chrysanthemum/Dendranthema</i> sp.) <i>Chrysanthemum</i> cv 'Raquel'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13903	Chrysanthemum, Garden (<i>Chrysanthemum/Dendranthema</i> sp.) <i>Chrysanthemum</i> x <i>hybrida</i> 'Snowland'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13903	Chrysanthemum, Garden (<i>Chrysanthemum/Dendranthema</i> sp.) <i>Chrysanthemum</i> x <i>superbum</i> 'Snowland'	Field Container	Linderman	OR	2001	Foliar	No trial report posted

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
13843	Leather Flower (Clematis sp.) 'Elsa Spaeth'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13906	Tickseed (Coreopsis sp.) 'Early Sunrise'	Field Container	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
14179	Tickseed (Coreopsis sp.) 'Early Sunrise'	Field In-Ground	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
13795	Dogwood, Flowering (Cornus florida)	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13746	Cotoneaster (Cotoneaster sp.) 'Variegated Rockspray'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13907	Montbretia (Crococsmia x crocosmiiflora) 'Lucifer'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13908	Dahlia (Dahlia sp.) 'Diana's Memory'	Field Container	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
14181	Dahlia (Dahlia sp.) 'Sunny Yellow'	Field In-Ground	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
13910	Larkspur (Delphinium sp.) 'Double Special Imperial Giant Mixture'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13912	Pink (Dianthus sp.) D. chinensis 'Carpet Crimson'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
14185	Pink (Dianthus sp.) D. chinensis 'Carpet Crimson'	Field In-Ground	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13914	Foxglove (Digitalis sp.) D. x mertonensis 'Strawberry'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13803	Burning Bush (Euonymus alatus) 'Compacta'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
14078	Forsythia (Forsythia sp.) 'Lynwood Gold'	Field In-Ground	Englander	RI	1999	Foliar	No injury at 1, 2 and 4 oz product per 100 gal
13805	Forsythia (Forsythia sp.) 'Lynwood Gold'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13927	Strawberry (Non-Bearing) (Fragaria sp.) Totem	Field Container	Linderman	OR	1999		Wrong PR # - Trial report is for PR # 13928 already summarized
13928	Blanket Flower (Gaillardia sp.) G. grandiflora 'Goblin'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
14201	Blanket Flower (Gaillardia sp.) G. grandiflora 'Goblin'	Field In-Ground	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13929	Sweetscented Bedstraw (Galium odoratum)	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
14202	Sweetscented Bedstraw (Galium odoratum)	Field In-Ground	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
14202	Sweetscented Bedstraw (Galium odoratum)	Field In-Ground	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
13931	Hardy Geranium (Geranium magniflorum) 'Dynamo Deep Scarlet'	Field Container	Locke	MD	1999	Foliar	No injury at 1, slight marginal floral necrosis at 2 and 4 oz product per acre
13931	Hardy Geranium (Geranium magniflorum) 'Maverick Red'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13933	Gladiolus (Gladiolus sp.) 'Nova Lux'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13857	Locust (Gleditsia sp.) G. tricanthos 'Inermis'	Field Container	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
13844	Ivy, English (Hedera helix)	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13937	Smooth Oxeye (Heliopsis helianthoides) 'Summer Sun'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
14055	Rose-Of-Sharon (Hibiscus syriacus) H. althea 'Arden's Blue'	Field In-Ground	Englander	RI	1999	Foliar	No injury at 1, 2 and 4 oz product per 100 gal
13942	Lily, Plantain (Hosta fortunei) 'Gold Standard'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13749	Holly (Ilex sp.) I. cornuta 'Dwarf Burfordi'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
14218	Iris, Spanish (Iris xiphium)	Field In-Ground	Chastagner	WA	2001	Foliar	No injury at 1, 2 and 4 oz product per acre
14218	Iris, Spanish (Iris xiphium) 'Blue Diamond'	Field In-Ground	Chastagner	WA	2002	Foliar	
13944	Iris, Spanish (Iris xiphium) I. sibirica 'Blue King'	Field Container	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
13766	Juniper (Juniperus sp.) J. chinensis 'Spartan'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
14039	Juniper (Juniperus sp.) 'Pfitzerana'	Field In-Ground	Englander	RI	1999	Foliar	No injury at 1, 2 and 4 oz product per 100 gal
13816	Crape Myrtle (Lagerstroemia indica)	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13949	Sweet Pea (Lathyrus odoratus) 'Explorer Mixed'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13950	Lavender (Lavandula sp.) L. angustifolia 'Munstead'	Field Container	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
13951	Max Chrysanthemum (Leucanthemum maximum) Chrysanthemum x superbum 'Little Miss Muffet'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
14225	Max Chrysanthemum (Leucanthemum maximum) Chrysanthemum x superbum 'Little Miss Muffet'	Field In-Ground	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
13951	Max Chrysanthemum (Leucanthemum maximum) Chrysanthemum x superbum 'Snowland'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13817	Privet (Ligustrum sp.)	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13954	Lily (Lilium sp.) 'Paramount'	Field Container	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
13954	Lily (Lilium sp.) 'Pixie Pink'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
14228	Lily (Lilium sp.) 'Pixie Pink'	Field In-Ground	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13956	Cardinal Flower (Lobelia cardinalis)	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13800	Honeysuckle (Lonicera sp.) L. xylosteum 'Emerald Mound'	Field Container	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
13961	Bee Balm, Scarlet (Monarda didyma) M. x hybrida 'Lambada'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
14235	Bee Balm, Scarlet (Monarda didyma) M. x hybrida 'Lambada'	Field In-Ground	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13962	Catnip (Nepeta cataria)	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
14241	Beard-Tongue (Penstemon sp.) P. barbatus 'Rondo'	Field In-Ground	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13968	Sage, Russian (Perovskia sp.) P. atriplicifolia	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13971	Phlox (Phlox sp.) 'Dolly'	Field Container	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
13754	Andromeda, Japanese; Japanese Pieris (Pieris japonica) 'Mountain Fire'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
17244	Cottonwood (Populus sp.) P. deltoides	Field In-Ground	Chastagner	WA	2002	Foliar	No significant injury at 2 oz product per 100 gal
17244	Cottonwood (Populus sp.) P. nigra 'Lombardy'	Field In-Ground	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13826	Cinquefoil (Potentilla sp.) 'Goldfinger'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
14250	Primrose (Primula sp.) 'Ducat Scarlet'	Field In-Ground	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
14316	Fir, Douglas (Pseudotsuga menziesii)	Field In-Ground	Lambe	WA	2002		No trial report posted
20252	Fir, Douglas (Pseudotsuga menziesii)	Greenhouse	Lambe	WA	2002	Drench	No injury at 1, slight at 2 and 4 oz product per 100 gal
13772	Fir, Douglas (Pseudotsuga menziesii)	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
13866	Oak (<i>Quercus</i> sp.) <i>Q. palustris</i>	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13758	Azalea & Rhododendron (<i>Rhododendron</i> sp.) 'Catawbiense'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
14030	Azalea & Rhododendron (<i>Rhododendron</i> sp.) 'Gibraltar'	Field In-Ground	Englander	RI	1999	Foliar	No injury at 1, 2 and 4 oz product per 100 gal
13757	Azalea & Rhododendron (<i>Rhododendron</i> sp.) Glacier	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13829	Rose (<i>Rosa</i> sp.) 'Queen Elizabeth'	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13916	Coneflower (<i>Rudbeckia</i> sp.) <i>R. hirta</i> 'Indian Summer'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13980	Woodland Sage (<i>Salvia x sylvestris</i>) <i>S. splendens</i> 'Scarlet Bicolor'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
14014	Blue Stem (<i>Schizachyrium</i> sp.) <i>S. scoparium</i>	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13984	Goldenrod (<i>Solidago</i> sp.) <i>S. canadensis</i> 'Crown of Rays'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13833	Lilac (<i>Syringa</i> sp.)	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13833	Lilac (<i>Syringa</i> sp.) <i>S. reflexa</i>	Field Container	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
14106	Lilac (<i>Syringa</i> sp.) <i>S. reflexa</i>	Field In-Ground	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
14047	Yew (<i>Taxus</i> sp.) <i>T. x media</i> 'Densiformis'	Field In-Ground	Englander	RI	1999	Foliar	No injury at 1, 2 and 4 oz product per 100 gal
13989	Germander (<i>Teucrium</i> sp.) <i>T. chamaedris</i>	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
20257	Red Cedar, Western (<i>Thuja plicata</i>)	Greenhouse	Linderman	OR	2001	Foliar	No injury at 4, 8 and 16 oz product per acre
14048	Red Cedar, Arborvitae (<i>Thuja</i> sp.) 'Techni'	Field In-Ground	Englander	RI	1999	Foliar	No significant injury at 1, 2 and 4 oz product per 100 gal
13991	Thyme (Non-Bearing) (<i>Thymus</i> sp.) <i>T. vulgaris</i>	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
18683	Hemlock, Western (<i>Tsuga heterophylla</i>)	Greenhouse	Benson	WA	2002		Very slight injury.
20253	Hemlock, Western (<i>Tsuga heterophylla</i>)	Greenhouse	Lambe	WA	2002	Drench	No injury at 1, slight injury and reduction in height and stem caliper at 2 and 4 oz product per 100 gal
13777	Hemlock (<i>Tsuga</i> sp.) <i>T. canadensis</i>	Field Container	Locke	MD	1999	Foliar	No injury at 1, 2 and 4 oz product per acre
13995	Vervain (<i>Verbena</i> sp.) 'Romance Scarlet'	Field Container	Locke	MD	1999	Foliar	No injury at 1, slight marginal floral necrosis at 2 and 4 ai per acre
13995	Vervain (<i>Verbena</i> sp.) <i>V. x hybrida</i> 'Pink Parfait'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
14269	Vervain (Verbena sp.) V. x hybrida 'Pink Parfait'	Field In-Ground	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13996	Speedwell (Veronica sp.) 'Pink Shades'	Field Container	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
14270	Speedwell (Veronica sp.) 'Pink Shades'	Field In-Ground	Linderman	OR	1999	Foliar	No injury at 8, 16 and 32 oz product per acre
13997	Violet (Viola sp.) V. cornuta 'Sorbet Blueberry Cream'	Field Container	Linderman	OR	2000	Foliar	No injury at 1, 2 and 4 oz product per acre
14112	Weigela (Weigela sp.) 'White Knight'	Field In-Ground	Englander	RI	1999	Foliar	No injury at 1, 2 and 4 oz product per 100 gal

Label Suggestions

Typically, IR-4 bases label suggestions on a minimum of three trials on any given plant species. However, given the lack of phytotoxicity across so many different plant species and genera, it is suggested that the following 54 plants in the IR-4 trials be added to the list of tolerant plants with the current precautionary statements in the Plant Safety and Tolerant Ornamentals Plant sections of the Heritage 50WG label.

Abies procera

Anemone pulsatilla

Aurinia saxatilis

Buxus microphylla

Centaurea dealbata

Chrysanthemum x hybrida

Chrysanthemum x superbum

Clematis sp.

Coreopsis sp.

Cotoneaster sp.

Crocasmia x crocosmiflora

Dahlia sp.

Dianthus chinensis

Digitalis mertonensis

Forsythia sp.

Gaillardia grandiflora

Galium odoratum

Geranium magniflorum

Gladiolus sp.

Gleditsia tricanthos

Heliopsis helianthoides

Hibiscus althea

Hosta fortunei

Ilex cornuta

Iris xiphium

Lathyrus odoratus

Lavandula angustifolia

Ligustrum sp.

Lilium sp.

Lobelia cardinalis

Lonicera xylosteum

Monarda x hybrida

Nepeta cataria

Penstemon barbatus

Perovskia atriplicifolia

Populus deltoids

Populus nigra

Pseudotsuga menziesii

Salvia splendens

Schizachyrium scopalarium

Solidago canadensis

Syringa reflexa

Syringa sp.

Taxus x media

Teucrium chamaedris

Thuja plicata

Thuja sp.

Thymus vulgaris

Tsuga canadensis

Tsuga heterophylla

Verbena x hybrida

Veronica sp.

Viola cornuta

Weigela sp.

Appendix 1: Contributing Researchers

Dr. Mike Benson <i>(retired)</i>	North Carolina State University Department of Plant Pathology 840 Method Rd. – Unit 3 Raleigh, NC 27695
Dr. Gary Chastagner	Washington State University Research and Extension Center 7612 Pioneer Way East Puyallup, WA 98371
Dr. L. Englander <i>(retired)</i>	University of Rhode Island Department of Plant Sciences Kingston, RI 02881
Dr. Robert C. Lambe	Port Ludlow, WA 98365
Dr. Bob Linderman <i>(retired)</i>	USDA-ARS Horticultural Crops Research Lab 3420 NW Orchard Avenue Corvallis, OR 97330 541-738-4062
Dr. James Locke <i>(retired)</i>	USDA-ARS Greenhouse Production Research Group 2801 W. Bancroft Street Mail Stop 604 Toledo, OH 43606
Dr. Jay Pscheidt	Oregon State University Dept. of Botany and Plant Pathology Corvallis OR 97331-2903