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IR-4 Ornamental Horticulture Program Acibenzolar Crop Safety

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Date: May 14, 2015**

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Abstract

Acibenzolar is an active ingredient that stimulates plant defense systems. In 2002, IR-4 started testing Insimmo (acibenzolar) for safety on several ornamental horticulture crops. In 2008, IR-4 continued crop safety screening after a renewed interest in bringing this active ingredient to ornamental horticulture growers. From 2002 through 2014, the IR-4 Project completed 249 trials on 67 ornamental plant genera or species examining phytotoxicity related to foliar and/or drench applications of Insimmo. In these trials, 36 species or genera exhibited minimal or no injury after foliar applications. Based on this information, it is recommended that all but 2 of these crops be added to a list of tolerant plants when this active ingredient gains registration. While there was sufficient evidence of minimal or no injury for *Dianthus sp.* and *Pelargonium x hortorum*, a single trial for each crop did elicit moderate to severe injury. Further investigation on cultivar or species differences may be warranted.

Introduction

Acibenzolar is an active ingredient that stimulates plant defense systems. In 2002, IR-4 started testing Insimmo (acibenzolar) for safety on several ornamental horticulture crops. In 2008, IR-4 continued crop safety screening after a renewed interest in bringing this active ingredient to ornamental horticulture growers. From 2002 through 2014, the IR-4 Project completed 249 trials on 67 ornamental plant genera or species examining phytotoxicity related to foliar and/or drench applications of Insimmo.

Materials and Methods

Insimmo was tested as foliar and drench applications. Foliar applications were applied five times at 7 day intervals. The drench applications were applied once. For foliar applications, the application rates were 0.25, 0.5, 1.0 and 2.0 oz per 100 gal; for drench applications, the rates were 0.125 and 0.25 oz per 100 gal. All experiments had an untreated control. A minimum of six plants (replicate treatments) were required. Phytotoxicity was planned to be recorded on a scale of 0 to 10 (0 = No phytotoxicity; 10 = Complete kill), although one research used a 1 to 10 scale instead. Phytotoxicity was rate 7 days after each application. For testing, the following protocols were used: 08-012, 09-014, 10-009, 11-007, 12-010, 13-010, and 14-003. Please visit <http://ir4.rutgers.edu/ornamental/OrnamentalDrafts.cfm> to view and download these protocols.

Insimmo was supplied to 12 researchers (See list of researchers in Appendix 1) 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 acibenzolar.

Phytotoxicity

Across all plant species tested, acibenzolar exhibited no or minimal negative impact (Table 1) on 36 plant genera or species fell into this category. No crops exhibited significant injury (Table 3). There are 28 species or genera where less than 3 trials were conducted for either foliar or drench applications so there is not enough information available at this time (Table 4).

Please see Table 5 for a summary of the individual trial results.

Table 1. List of acibenzolar treated crops with no or minimal transitory injury.

<i>Acer sp.</i>	<i>Juniperus sp.</i>
<i>Antirrhinum majus</i>	<i>Osteospermum sp.</i>
<i>Aster sp.</i>	<i>Pelargonium x hortorum (see Freiburger)</i>
<i>Begonia sp.</i>	<i>Petunia sp.</i>
<i>Buddleia davidii</i>	<i>Phlox sp.</i>
<i>Calibrachoa sp.</i>	<i>Pinus sp.</i>
<i>Camellia sp.</i>	<i>Pseudotsuga menziesii</i>
<i>Chrysanthemum sp.</i>	<i>Pyracantha sp.</i>
<i>Coleus sp.</i>	<i>Quercus sp.</i>
<i>Cotoneaster sp.</i>	<i>Rhododendron sp. (azalea)</i>
<i>Dianthus sp (see Reding 2008)</i>	<i>Rosa sp.</i>
<i>Echinacea sp.</i>	<i>Scindapsus aureaus</i>
<i>Euonymus sp.</i>	<i>Thuja sp.</i>
<i>Helianthus sp.</i>	<i>Verbena sp.</i>
<i>Hemerocallis sp.</i>	<i>Viburnum sp.</i>
<i>Hibiscus sp.</i>	<i>Vinca sp.</i>
<i>Hosta sp.</i>	<i>Viola sp.</i>
<i>Hydrangea sp.</i>	<i>Zinnia sp.</i>

Table 2. List of acibenzolar treated crops with no injury at 1X but significant injury at 2X or 4X.

None

Table 3. List of acibenzolar treated crops with significant injury at 1X.

None

Table 4. List of acibenzolar treated crops where more information is needed.

<i>Abies sp.</i>	<i>Impatiens sp.</i>
<i>Aglaonema sp.</i>	<i>Lantana camara</i>
<i>Berberis sp.</i>	<i>Liriope muscari</i>
<i>Bougainvillea sp.</i>	<i>Lavandula angustifolia</i>
<i>Buxus sp.</i>	<i>Malus sp.</i>
<i>Coreopsis sp.</i>	<i>Picea sp.</i>
<i>Cornus florida</i>	<i>Potentilla sp.</i>
<i>Dahlia sp.</i>	<i>Raphiolepis indica</i>
<i>Euphorbia pulcherrima</i>	<i>Rudbeckia fulgida</i>
<i>Geranium magniflorum</i>	<i>Salvia officinalis</i>
<i>Gerbera sp.</i>	<i>Spiraea japonica</i>
<i>Gladiolus sp.</i>	<i>Syngonium podophyllum</i>
<i>Heuchera sp.</i>	<i>Syringa sp.</i>
<i>Ilex crenata</i>	<i>Taxus sp.</i>

Table 5 Detailed Summary of Crop Safety Testing with Acibenzolar

Notes: Table entries are sorted by crop Latin name. Only those trials with research reports received by 5/8/2015 are listed below.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
27314	Fir (Abies sp.) A. balsamea	Field Container	Freiberger	NJ	2008	Foliar	No injury at 0.5, 1.0 and 2.0 oz per 100 gal.
27314	Fir (Abies sp.) A. grandis and A concolor	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27315	Maple (Acer sp.) A. circinatum	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
27315	Maple (Acer sp.) A. circinatum and A macrophyllum	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27315	Maple (Acer sp.) A. rubrum	Field Container	Reding	OH	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal; slight growth difference at 2X and 4X; all plants marketable
27317	Aglaonema (Aglaonema sp.) 'Silver Queen'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27317	Aglaonema (Aglaonema sp.) 'Silver Queen'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
20284	Snapdragon (Antirrhinum majus)	Greenhouse	Hausbeck	MI	2002	Foliar	No injury at 1, 2, and 4 oz per 100 gal.
20284	Snapdragon (Antirrhinum majus)	Greenhouse	Krause	OH	2002	Foliar	No injury at 1, 2, and 4 oz per acre.
20284	Snapdragon (Antirrhinum majus) 'Bells Purple'	Greenhouse	Freiberger	NJ	2010	Drench	No injury at 0.125 and 0.25 oz per 100 gal.
20284	Snapdragon (Antirrhinum majus) 'Bells Purple'	Greenhouse	Freiberger	NJ	2010	Foliar	No injury at 0.25, 0.5, 1 and 2 oz per 100 gal.
20284	Snapdragon (Antirrhinum majus) 'Classic Lavender'	Greenhouse	Linderman	OR	2002	Foliar	No injury at 1, 2, and 4 oz per acre.
20284	Snapdragon (Antirrhinum majus) 'Montego'	Greenhouse	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
20284	Snapdragon (Antirrhinum majus) 'Montego'	Greenhouse	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
20284	Snapdragon (Antirrhinum majus) 'Montego Red'	Greenhouse	Freiberger	NJ	2010	Drench	No injury at 0.125 and 0.25 oz per 100 gal.
20284	Snapdragon (Antirrhinum majus) 'Montego Red'	Greenhouse	Freiberger	NJ	2010	Foliar	No injury at 0.25, 0.5, 1 and 2 oz per 100 gal.
20284	Snapdragon (Antirrhinum majus) 'Pink Rocket'	Greenhouse	Locke	MD	2002	Foliar	No injury at 1 oz per 100 gal, but moderate injury with 2 and 4 oz per 100 gal.
20284	Snapdragon (Antirrhinum majus) 'Sonnet Mix'	Greenhouse	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
20284	Snapdragon (Antirrhinum majus) 'Sonnet Mix'	Greenhouse	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
29490	Aster (Aster sp.)	Field Container	Wade	SC	2011	Drench	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
29490	Aster (Aster sp.)	Field Container	Wade	SC	2011	Foliar	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
29490	Aster (Aster sp.) 'Believe Purple'	Field Container	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 0.25, 0.5 and 1.0 oz per 100 gal applied 3 times.
27319	Begonia (Begonia sp.)	Field Container	Harvey	WA	2009	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal.
27319	Begonia (Begonia sp.) B. x tuberhybrida 'Illumination Trailing'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27319	Begonia (Begonia sp.) B. x tuberhybrida 'Illumination Trailing'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27319	Begonia (Begonia sp.) B. x tuberhybrida 'Nonstop'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27319	Begonia (Begonia sp.) B. x tuberhybrida 'Nonstop'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27319	Begonia (Begonia sp.) 'Olympia Red'	Field Container	Freiberger	NJ	2008	Foliar	No injury at 0.5, 1.0 and 2.0 oz per 100 gal.
27319	Begonia (Begonia sp.) 'Vodka Bright Red'	Field Container	Freiberger	NJ	2008	Foliar	No injury at 0.5, 1.0 and 2.0 oz per 100 gal.
27320	Barberry (Berberis sp.)	Field Container	Harvey	WA	2014	Foliar	No injury with 0.25, 0.5 and 1.0 oz per 100 gal applied 5 times.
27320	Barberry (Berberis sp.) B. thunbergii 'Rose Glow & 'Pow Wow'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
29996	Bougainvillea (Bougainvillea sp.)	Field Container	Wade	SC	2011	Drench	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
29996	Bougainvillea (Bougainvillea sp.)	Field Container	Wade	SC	2011	Foliar	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
29997	Butterfly Bush (Buddleia davidii)	Field Container	Harvey	WA	2011	Drench	No injury with 0.125 and 0.25 oz per 100 gal applied once.
29997	Butterfly Bush (Buddleia davidii)	Field Container	Harvey	WA	2011	Foliar	No injury with 0.25, 0.5, 1 and 2 oz per 100 gal applied 5 times.
29997	Butterfly Bush (Buddleia davidii)	Field Container	Wade	SC	2011	Drench	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
29997	Butterfly Bush (Buddleia davidii)	Field Container	Wade	SC	2011	Foliar	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
29997	Butterfly Bush (Buddleia davidii) 'Monum'	Field Container	Fraelich	GA	2012	Foliar	No injury or significant difference in plant growth or marketability with 0.25, 0.5 and 1 oz per 100 gal applied 5 times.
27321	Boxwood (Buxus sp.) B. microphylla 'Faulkner'	Field Container	Fraelich	GA	2012	Foliar	No injury or significant difference in plant growth or marketability with 0.25, 0.5 and 1 oz per 100 gal applied 5 times.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
27321	Boxwood (Buxus sp.) B. sempervirens 'Green Mountain'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27322	Calibrachoa (Calibrachoa sp.)	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal.
27322	Calibrachoa (Calibrachoa sp.)	Field Container	Reding	OH	2008	Foliar	No injury and no significant difference in growth or marketability at 0.5, 1 and 2 oz per 100 gal
27322	Calibrachoa (Calibrachoa sp.)	Field Container	Williams	IL	2013	Drench	No injury or growth reduction with 0.125, 0.25 and 0.5 oz per 100 gal applied 3 times at monthly intervals.
27322	Calibrachoa (Calibrachoa sp.)	Field Container	Williams	IL	2013	Foliar	No injury or growth reduction with 0.125, 0.25 and 0.5 oz per 100 gal applied 3 times at monthly intervals.
27322	Calibrachoa (Calibrachoa sp.) C. x hybrida 'Yellow'	Field Container	Hausbeck	MI	2011	Foliar or Drench	No injury with 0.25, 0.50, 0.75 and 2 oz per 100 gal applied foliar 5 times or with 0.125 and 0.25 oz per 100 gal applied drench once; slight delay in flowering with higher rates.
27322	Calibrachoa (Calibrachoa sp.) 'Callie Light Pink'	Field Container	Catlin	NY	2011	Drench	No injury or growth reduction with 0.125 and 0.25 oz per 100 gal.
27322	Calibrachoa (Calibrachoa sp.) 'Callie Light Pink'	Field Container	Catlin	NY	2011	Foliar	No injury or growth reduction with 1 and 2 oz per 100 gal applied 5 times.
27322	Calibrachoa (Calibrachoa sp.) 'Minifamous'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27322	Calibrachoa (Calibrachoa sp.) 'Minifamous'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27323	Camellia (Camellia sp.) C. japonica 'Eg Waterhouse' and 'Magnoliaeflora'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27323	Camellia (Camellia sp.) C. japonica 'Elena'	Field Container	Henn	MS	2014	Foliar	No injury or growth reduction with 0.25, 0.5 and 1.0 oz per 100 gal applied 5 times.
27323	Camellia (Camellia sp.) 'Magnoliaeflora'	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
20895	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) C. carinatum	Field Container	Hitcher	NJ	2002	Foliar	No injury at 1, 2, and 4 oz per 100 gal.
20895	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) C. carinatum	Field Container	Krause	OH	2002	Foliar	No injury at 1, 2, and 4 oz per 100 gal.
20895	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Hillside Sheffield Pink', 'Clara Curtis'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
20895	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Hillside Sheffield Pink', 'Clara Curtis'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27325	Coleus, Flamenettle (Coleus sp.)	Field Container	Harvey	WA	2009	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
27325	Coleus, Flamenettle (Coleus sp.)	Field Container	Reding	OH	2008	Foliar	No injury and no significant difference in growth or marketability at 0.5, 1 and 2 oz per 100 gal
27325	Coleus, Flamenettle (Coleus sp.) 'Black Dragon'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27325	Coleus, Flamenettle (Coleus sp.) 'Black Dragon'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27325	Coleus, Flamenettle (Coleus sp.) 'Defiance'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27325	Coleus, Flamenettle (Coleus sp.) 'Defiance'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27325	Coleus, Flamenettle (Coleus sp.) 'Solar Sunrise'	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal.
29990	Tickseed (Coreopsis sp.)	Field Container	Harvey	WA	2011	Drench	No injury with 0.125 and 0.25 oz per 100 gal applied once.
29990	Tickseed (Coreopsis sp.)	Field Container	Harvey	WA	2011	Foliar	No injury with 0.25, 0.5, 1 and 2 oz per 100 gal applied 5 times.
29990	Tickseed (Coreopsis sp.)	Field Container	Wade	SC	2011	Drench	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
29990	Tickseed (Coreopsis sp.)	Field Container	Wade	SC	2011	Foliar	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
29990	Tickseed (Coreopsis sp.) C. grandiflora 'Sunray'	Field Container	Grunwald	OR	2011	Drench	No injury with 0.125 and 0.25 oz per 100 gal.
29990	Tickseed (Coreopsis sp.) 'Early Sunrise'	Field Container	Kirk	MI	2011	Drench	No injury, leaf abscission or stunting with 0.25 and 0.5 oz per 100 gal.
29990	Tickseed (Coreopsis sp.) 'Early Sunrise'	Field Container	Kirk	MI	2011	Foliar	No injury or stunting with 0.25, 0.5, 1 and 2 oz per 100 gal applied 5 times.
27326	Dogwood, Flowering (Cornus florida)	Field Container	Reding	OH	2008	Foliar	No injury and no significant difference in growth or marketability at 0.5, 1 and 2 oz per 100 gal
27327	Cotoneaster (Cotoneaster sp.)	Field Container	Harvey	WA	2011	Drench	No injury with 0.125 and 0.25 oz per 100 gal applied once.
27327	Cotoneaster (Cotoneaster sp.)	Field Container	Harvey	WA	2011	Foliar	No injury with 0.25, 0.5, 1 and 2 oz per 100 gal applied 5 times.
27327	Cotoneaster (Cotoneaster sp.) C. dammeri 'Coral Beauty'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27327	Cotoneaster (Cotoneaster sp.) C. dammeri 'Coral Beauty'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27327	Cotoneaster (Cotoneaster sp.) C. dammeri 'Coral Beauty'	Field Container	Grunwald	OR	2011	Drench	No injury with 0.125 and 0.25 oz per 100 gal.
27327	Cotoneaster (Cotoneaster sp.) C. microphyllus 'Coral Blue'	Field Container	Harvey	WA	2010	Drench	No injury at 0.125 and 0.25 oz per 100 gal.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
27327	Cotoneaster (Cotoneaster sp.) C. microphyllus 'Coral Blue'	Field Container	Harvey	WA	2010	Foliar	No injury at 0.25, 0.5, 1.0 and 2.0 oz per 100 gal.
27327	Cotoneaster (Cotoneaster sp.) C. microphyllus 'Rock Spray'	Field Container	Harvey	WA	2010	Drench	No injury at 0.125 and 0.25 oz per 100 gal.
27327	Cotoneaster (Cotoneaster sp.) C. microphyllus 'Rock Spray'	Field Container	Harvey	WA	2010	Foliar	No injury at 0.25, 0.5, 1.0 and 2.0 oz per 100 gal.
27330	Dahlia (Dahlia sp.) 'Black Beauty'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27330	Dahlia (Dahlia sp.) 'Black Beauty'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27330	Dahlia (Dahlia sp.) D. dahlietta 'Betty'	Field Container	Grunwald	OR	2011	Drench	No injury with 0.125 and 0.25 oz per 100 gal.
27330	Dahlia (Dahlia sp.) 'Figaro Mix'	Field Container	Kirk	MI	2011	Drench	No injury, leaf abscission or stunting with 0.25 and 0.5 oz per 100 gal.
27330	Dahlia (Dahlia sp.) 'Figaro Mix'	Field Container	Kirk	MI	2011	Foliar	No injury or stunting with 0.25, 0.5, 1 and 2 oz per 100 gal applied 5 times; increased leaf abscission with highest rate.
27331	Pinks (Dianthus sp.) 'Cardinal Red'	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
27331	Pinks (Dianthus sp.) D. gratianopolitanus 'Firewitch'	Field Container	Fraelich	GA	2008	Over the top	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants marketable
27331	Pinks (Dianthus sp.) D. gratianopolitanus 'Zing Rose'	Field Container	Reding	OH	2008	Foliar	Severe injury at 0.5, 1 and 2 oz per 100 gal
27331	Pinks (Dianthus sp.) 'Fire Star'	Field Container	Boydston	WA	2008	Over the top	No injury or growth reduction at 0.5, 1 and 2 oz ai per 100 gal
27331	Pinks (Dianthus sp.) 'Spotti'	Field Container	Boydston	WA	2008	Over the top	No injury or growth reduction at 0.5, 1 and 2 oz ai per 100 gal
27332	Purple Coneflower (Echinacea sp.) E. purpurea 'Magnus and 'Twilight'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27332	Purple Coneflower (Echinacea sp.) E. purpurea 'Magnus'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27332	Purple Coneflower (Echinacea sp.) E. purpurea 'Magnus'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27332	Purple Coneflower (Echinacea sp.) E. purpurea 'Sunrise'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27332	Purple Coneflower (Echinacea sp.) E. purpurea 'Sunrise'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27334	Euonymus (Euonymus sp.)	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
27334	Euonymus (Euonymus sp.) E. fortunei 'Coloratus'	Field Container	Reding	OH	2008	Foliar	No injury and no significant difference in growth or marketability at 0.5, 1 and 2 oz per 100 gal

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
27334	Euonymus (Euonymus sp.) E. fotunei 'Colorata'	Field Container	Fraelich	GA	2008	Over the top	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants marketable
23112	Poinsettia (Euphorbia pulcherrima)	Greenhouse	Hausbeck	MI	2002	Foliar	Moderate injury with 0.5, 1.0 and 2.0 oz per 100 gal.
20281	Geranium (Geranium magniflorum) 'Johnson's Blue'	Greenhouse	Krause	OH	2002	Foliar	No injury at 1, 2, and 4 oz per acre.
20281	Geranium (Geranium magniflorum) 'Ringo'	Greenhouse	Locke	MD	2002	Foliar	No injury at 1, 2, and 4 oz per 100 gal.
27459	Transvaal Daisy (Gerbera sp.) 'Callie Light Pink'	Greenhouse	Catlin	NY	2011	Drench	Some injury (chlorosis, delayed bloom), though not significant, with 0.125 and 0.25 oz per 100 gal.
27459	Transvaal Daisy (Gerbera sp.) 'Callie Light Pink'	Greenhouse	Catlin	NY	2011	Foliar	Significant injury (chlorosis, delayed bloom) and growth reduction with 1 and 2 oz per 100 gal applied 5 times.
27459	Transvaal Daisy (Gerbera sp.) G. jamesonii	Greenhouse	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27459	Transvaal Daisy (Gerbera sp.) G. jamesonii	Greenhouse	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27459	Transvaal Daisy (Gerbera sp.) G. jamesonii 'White Majestic'	Greenhouse	Uber	CA	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal drench applied once.
27459	Transvaal Daisy (Gerbera sp.) G. jamesonii 'White Majestic'	Greenhouse	Uber	CA	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal foliar applied 5 times.
28140	Corn Flag, Sword Lily (Gladiolus sp.) 'Alaska'	Field Container	Kirk	MI	2011	Drench	No injury or stunting with 0.25 and 0.5 oz per 100 gal.
28140	Corn Flag, Sword Lily (Gladiolus sp.) 'Alaska'	Field Container	Kirk	MI	2011	Foliar	No injury with 0.25, 0.5, 1 and 2 oz per 100 gal applied 5 times; lowest rate increased plant height.
28140	Corn Flag, Sword Lily (Gladiolus sp.) G. grandiflora	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
28140	Corn Flag, Sword Lily (Gladiolus sp.) G. grandiflora	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
29991	Sunflower (Helianthus sp.)	Field Container	Harvey	WA	2011	Drench	No injury with 0.125 and 0.25 oz per 100 gal applied once.
29991	Sunflower (Helianthus sp.)	Field Container	Harvey	WA	2011	Foliar	No injury with 0.25, 0.5, 1 and 2 oz per 100 gal applied 5 times.
29991	Sunflower (Helianthus sp.) 'Table Mountain'	Field Container	Gu (TX A&M)	TX	2014	Foliar	No injury or growth reduction with 0.25, 0.5 and 1 oz per 100 gal applied 3 times.
27338	Daylily (Hemerocallis sp.) 'Grape Velvet'	Field Container	Reding	OH	2008	Foliar	No injury and no significant difference in growth or marketability at 0.5, 1 and 2 oz per 100 gal
27338	Daylily (Hemerocallis sp.) H. hybrida 'Aquarius'	Field Container	Fraelich	GA	2008	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants marketable.
27338	Daylily (Hemerocallis sp.) H. hybrida 'Hyperion'	Field Container	Boydston	WA	2008	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz ai per 100 gal.
27338	Daylily (Hemerocallis sp.) H. hybrida 'Stella de Oro'	Field Container	Boydston	WA	2008	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz ai per 100 gal.

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27338	Daylily (Hemerocallis sp.) H. hybrida 'Stella De Oro'	Field Container	Fraelich	GA	2008	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; very slight stunting at 2X and 4X; all plants marketable
27338	Daylily (Hemerocallis sp.) 'Happy Returns'	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal.
27339	Alumroot (Heuchera sp.)	Field Container	Harvey	WA	2009	Foliar	No injury at 0.5,1 and 2 oz per 100 gal.
27339	Alumroot (Heuchera sp.) H. micrantha 'Palace Purple'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
29998	Mallow, Rose Mallow (Hibiscus sp.)	Field Container	Wade	SC	2011	Drench	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
29998	Mallow, Rose Mallow (Hibiscus sp.)	Field Container	Wade	SC	2011	Foliar	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
29998	Mallow, Rose Mallow (Hibiscus sp.) H. trionum 'Simply Love'	Field Container	DeFrancesco	OR	2014	Foliar	No injury or growth reduction with 0.25, 0.5 and 1 oz per 100 gal applied 5 times.
19124	Lily, Plantain (Hosta fortunei)	Field Container	Fraelich	GA	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants marketable.
19124	Lily, Plantain (Hosta fortunei)	Field Container	Harvey	WA	2009	Foliar	No injury at 0.5,1 and 2 oz per 100 gal.
19124	Lily, Plantain (Hosta fortunei)	Field Container	Krause	OH	2000	Drench	No injury with 0.05, 0.1, and 0.2 g per liter.
19124	Lily, Plantain (Hosta fortunei) 'Aoki' and 'Francee'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27460	Hydrangea (Hydrangea sp.)	Field Container	Harvey	WA	2011	Drench	No injury with 0.125 and 0.25 oz per 100 gal applied once.
27460	Hydrangea (Hydrangea sp.)	Field Container	Harvey	WA	2011	Foliar	No injury with 0.25, 0.5, 1 and 2 oz per 100 gal applied 5 times.
27460	Hydrangea (Hydrangea sp.)	Field Container	Wade	SC	2011	Drench	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
27460	Hydrangea (Hydrangea sp.)	Field Container	Wade	SC	2011	Foliar	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
27460	Hydrangea (Hydrangea sp.) 'Angel Blush'	Field Container	Harvey	WA	2010	Drench	No injury at 0.125 and 0.25, 1.0 per 100 gal.
27460	Hydrangea (Hydrangea sp.) 'Angel Blush'	Field Container	Harvey	WA	2010	Foliar	No injury at 0.25, 0.5, 1.0 and 2.0 oz per 100 gal.
27460	Hydrangea (Hydrangea sp.) H. macrophylla 'Taube'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
27460	Hydrangea (Hydrangea sp.) H. macrophylla 'Taube'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27460	Hydrangea (Hydrangea sp.) H. macrophylla 'Taube'	Field Container	Grunwald	OR	2011	Drench	No injury with 0.125 and 0.25 oz per 100 gal.
27460	Hydrangea (Hydrangea sp.) 'Pink Delight'	Field Container	Harvey	WA	2010	Drench	No injury at 0.125 and 0.25, 1.0 per 100 gal.
27460	Hydrangea (Hydrangea sp.) 'Pink Delight'	Field Container	Harvey	WA	2010	Foliar	No injury at 0.25, 0.5, 1.0 and 2.0 oz per 100 gal.
27340	Holly, Japanese (Ilex crenata)	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
27340	Holly, Japanese (Ilex crenata) 'Beehive'	Field Container	Reding	OH	2008	Foliar	No injury and no significant difference in growth or marketability at 0.5, 1 and 2 oz per 100 gal
20282	Balsam (Impatiens sp.)	Greenhouse	Krause	OH	2002	Foliar	Moderate reduction in flowering at 1, 2, and 4 oz per acre with 3 biweekly applications, but no difference was observed at the end of the experiment.
20282	Balsam (Impatiens sp.) 'Camellia flowers Mixed Colors'	Greenhouse	Locke	MD	2002	Foliar	Moderate to severe injury increasing with rate (1, 2, 4 oz per 100 gal).
23111	Garden Impatiens (Impatiens walleriana)	Greenhouse	Hausbeck	MI	2002	Foliar	No injury at 0.5, 1, and 2 oz per 100 gal with 3 biweekly applications.
27461	Juniper (Juniperus sp.)	Field Container	Harvey	WA	2014	Foliar	No injury with 0.25, 0.5 and 1.0 oz per 100 gal applied 5 times.
27461	Juniper (Juniperus sp.) J. conferta 'Blue Pacific'	Field Container	Fraelich	GA	2012	Foliar	No injury or significant difference in plant growth or marketability with 0.25, 0.5 and 1 oz per 100 gal applied 5 times.
27461	Juniper (Juniperus sp.) J. procumbens 'Nana'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
30831	Shrub Verbena (Lantana sp.) L. camara 'Confetti'	Greenhouse	Grunwald	OR	2012	Drench	No injury or growth reduction with 0.125, 0.25 and 0.5 oz per 100 gal; all plants saleable.
30831	Shrub Verbena (Lantana sp.) L. camara 'Confetti'	Greenhouse	Grunwald	OR	2012	Foliar	No injury or growth reduction with 0.25, 0.5 and 1 oz per 100 gal applied 3 times; all plants saleable.
27341	Lavender (Lavandula sp.) L. angustifolia 'Purple Bouquet' and 'Buena Vista'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27342	Lilyturf, Creeping (Liriope sp.) L. muscari 'Aztec Grass'	Field Container	Fraelich	GA	2012	Over the top	No injury or significant difference in plant growth or marketability with 0.25, 0.5 and 1 oz per 100 gal applied 5 times.
21394	Apple & Crabapple (Non-Bearing) (Malus sp.) 'Spring Snow'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
30841	Daffodil (Narcissus sp.) 'Tete-a-Tete'	Greenhouse	Freiberger	NJ	2013	Foliar	Severe injury after the final application with 0.25, 0.5 and 1 oz per 100 gal applied 5 times.
30844	African Daisy (Osteospermum sp.)	Greenhouse	Williams	IL	2013	Foliar	No injury or growth reduction with 0.125, 0.25 and 0.5 oz per 100 gal applied 3 times at monthly intervals.

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30844	African Daisy (<i>Osteospermum</i> sp.) 'Akila'	Greenhouse	Freiberger	NJ	2014	Drench	No injury or growth reduction with 0.125, 0.25 and 0.5 oz per 100 gal.
30844	African Daisy (<i>Osteospermum</i> sp.) 'Copper Purple'	Greenhouse	Grunwald	OR	2012	Drench	No injury or growth reduction with 0.125, 0.25 and 0.5 oz per 100 gal; all plants saleable.
30844	African Daisy (<i>Osteospermum</i> sp.) 'Copper Purple'	Greenhouse	Grunwald	OR	2012	Foliar	No injury or growth reduction with 0.25, 0.5 and 1 oz per 100 gal applied 3 times; all plants saleable.
30844	African Daisy (<i>Osteospermum</i> sp.) 'Margarita White'	Greenhouse	Freiberger	NJ	2013	Foliar	No injury or growth reduction with 0.25, 0.5 and 1 oz per 100 gal applied 5 times.
27344	Geranium (<i>Pelargonium</i> sp.)	Field Container	Harvey	WA	2009	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal.
27344	Geranium (<i>Pelargonium</i> sp.) P x hortorum	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27344	Geranium (<i>Pelargonium</i> sp.) P. hortorum	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
27344	Geranium (<i>Pelargonium</i> sp.) P. peltatum	Field Container	Reding	OH	2008	Foliar	No injury and no significant difference in growth or marketability at 0.5, 1 and 2 oz per 100 gal
27344	Geranium (<i>Pelargonium</i> sp.) P. x hortorum	Field Container	Fraelich	GA	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants marketable.
27336	Geranium, Zonal (<i>Pelargonium</i> x hortorum) 'Maverick Red'	Field Container	Freiberger	NJ	2008	Foliar	No to moderate injury increasing with rate (0.5, 1.0, 2.0 oz per 100 gal), exhibited more with later applications.
27336	Geranium, Zonal (<i>Pelargonium</i> x hortorum) 'Orbit Red'	Field Container	Freiberger	NJ	2008	Foliar	No to moderate injury increasing with rate (0.5, 1.0, 2.0 oz per 100 gal), exhibited more with later applications.
23110	Petunia (<i>Petunia</i> sp.)	Greenhouse	Hausbeck	MI	2002	Foliar	No injury at 0.5, 1.0, and 2.0 oz per 100 gal.
23110	Petunia (<i>Petunia</i> sp.) 'Celebrity Blue Ice'	Greenhouse	Freiberger	NJ	2010	Foliar	No injury applied foliar at 0.25, 0.5, 1 and 2 oz per 100 gal.
23110	Petunia (<i>Petunia</i> sp.) 'Dream Red'	Greenhouse	Freiberger	NJ	2008	Foliar	No injury at 0.5, 1.0 and 2.0 oz per 100 gal.
23110	Petunia (<i>Petunia</i> sp.) 'Dream White'	Greenhouse	Freiberger	NJ	2010	Drench	No injury applied drench at 0.125 and 0.25 oz per 100 gal.
30578	Petunia (<i>Petunia</i> sp.) 'Madness'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
30578	Petunia (<i>Petunia</i> sp.) 'Madness'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
23110	Petunia (<i>Petunia</i> sp.) 'Madness Red'	Greenhouse	Freiberger	NJ	2008	Foliar	No injury at 0.5, 1.0 and 2.0 oz per 100 gal.
30578	Petunia (<i>Petunia</i> sp.) 'Picobella Mix'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
30578	Petunia (<i>Petunia</i> sp.) 'Picobella Mix'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27347	Carolinia Phlox (<i>Phlox</i> sp.) 'Creeping Blue'	Field Container	Harvey	WA	2010	Foliar	No injury at 0.25, 0.5, 1.0 and 2.0 oz per 100 gal.

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27347	Carolinia Phlox (Phlox sp.) 'Creeper Blue'	Field Container	Harvey	WA	2010	Drench	No injury at 0.125 and 0.25.
27347	Carolinia Phlox (Phlox sp.) P. subulata 'Red Wings'	Field Container	Fraelich	GA	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants marketable.
27347	Carolinia Phlox (Phlox sp.) P. subulata 'Red Wings'	Field Container	Harvey	WA	2010	Drench	No injury at 0.125 and 0.25.
27347	Carolinia Phlox (Phlox sp.) P. subulata 'Red Wings'	Field Container	Harvey	WA	2010	Foliar	No injury at 0.25, 0.5, 1.0 and 2.0 oz per 100 gal.
27349	Spruce (Picea sp.) P. sitchensis and P. nidiformis	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27350	Pine (Pinus sp.) P. ponderosa	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
27350	Pine (Pinus sp.) P. ponderosa and P. contorta contorta	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27350	Pine (Pinus sp.) P. taeda	Field Container	Fraelich	GA	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants marketable.
27351	Cinquefoil (Potentilla sp.) P. fruticosa 'Mango Tango' and Goldfinger'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
30845	Fir, Douglas (Pseudotsuga menziesii)	Greenhouse	DeFrancesco	OR	2012	Drench	No injury or growth reduction with 0.125, 0.25 and 0.5 oz per 100 gal.
30845	Fir, Douglas (Pseudotsuga menziesii)	Greenhouse	DeFrancesco	OR	2012	Foliar	No injury or growth reduction with 0.25, 0.5 and 1 oz per 100 gal applied 5 times.
30845	Fir, Douglas (Pseudotsuga menziesii)	Greenhouse	Grunwald	OR	2012	Drench	No injury or growth reduction with 0.125, 0.25 and 0.5 oz per 100 gal; all plants saleable.
30845	Fir, Douglas (Pseudotsuga menziesii)	Greenhouse	Grunwald	OR	2012	Foliar	No injury or growth reduction with 0.25, 0.5 and 1 oz per 100 gal applied 3 times; all plants saleable.
27792	Firethorn (Pyracantha sp.) P. koidzumii 'Santa Cruz'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27792	Firethorn (Pyracantha sp.) P. koidzumii 'Santa Cruz'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27792	Firethorn (Pyracantha sp.) 'Santa Cruz'	Field Container	Uber	CA	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal drench applied once.
27792	Firethorn (Pyracantha sp.) 'Santa Cruz'	Field Container	Uber	CA	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal foliar applied 5 times.
27792	Firethorn (Pyracantha sp.) 'Yukon'	Field Container	Harvey	WA	2010	Drench	No injury at 0.125 and 0.25 oz per 100 gal.
27792	Firethorn (Pyracantha sp.) 'Yukon'	Field Container	Harvey	WA	2010	Foliar	No injury at 0.25, 0.5, 1.0 and 2.0 oz per 100 gal.
27352	Oak (Quercus sp.) Q. alba	Field Container	Freiberger	NJ	2008	Foliar	All plants were infected with powdery mildew which complicated assessments.
27352	Oak (Quercus sp.) Q. garryana and Q. kelloggii	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.

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27352	Oak (<i>Quercus</i> sp.) <i>Q. rubra</i>	Field Container	DeFrancesco	OR	2012	Drench	No injury but slight growth reduction with 0.125, 0.25 and 0.5 oz per 100 gal.
27352	Oak (<i>Quercus</i> sp.) <i>Q. rubra</i>	Field Container	DeFrancesco	OR	2012	Foliar	No injury or growth reduction with 0.25, 0.5 and 1 oz per 100 gal applied 5 times.
27353	Indian Hawthorn (<i>Raphiolepis indica</i>) 'Minor'	Field Container	Fraelich	GA	2012	Over the top	No injury or significant difference in plant growth or marketability with 0.25, 0.5 and 1 oz per 100 gal applied 5 times.
27353	Indian Hawthorn (<i>Raphiolepis indica</i>) 'Snow Caps'	Field Container	Fraelich	GA	2008	Over the top	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants marketable
27354	Azalea (<i>Rhododendron</i> sp.) 'Lee's Dark Purple'	Field Container	Reding	OH	2008	Foliar	No injury and no significant difference in growth or marketability at 0.5, 1 and 2 oz per 100 gal
27354	Azalea (<i>Rhododendron</i> sp.) 'Lees Dark Purple and 'Catawbiense Boursault'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27354	Azalea (<i>Rhododendron</i> sp.) 'Nova Zembla'	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
27354	Azalea (<i>Rhododendron</i> sp.) 'White'	Field Container	Freiberger	NJ	2008	Foliar	No injury at 0.5, 1.0 and 2.0 oz per 100 gal.
20286	Rose (<i>Rosa</i> sp.) 'Crimson Meidiland'	Field Container	Boydston	WA	2008	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz ai per 100 gal
20286	Rose (<i>Rosa</i> sp.) 'Joyful Jubilee'	Field Container	Boydston	WA	2008	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz ai per 100 gal
20286	Rose (<i>Rosa</i> sp.) 'Nutmaka'	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
27355	Coneflower (<i>Rudbeckia</i> sp.) <i>R. fulgida</i> 'Earlybird'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27355	Coneflower (<i>Rudbeckia</i> sp.) <i>R. fulgida</i> 'Earlybird'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27355	Coneflower (<i>Rudbeckia</i> sp.) <i>R. fulgida</i> 'Goldstrum'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27355	Coneflower (<i>Rudbeckia</i> sp.) <i>R. fulgida</i> 'Goldstrum'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27355	Coneflower (<i>Rudbeckia</i> sp.) <i>R. fulgida</i> 'Goldstrum', 'Earlybird'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
28141	Sage, common (<i>Salvia officinalis</i>)	Field Container	Fraelich	GA	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants marketable.
28141	Sage, common (<i>Salvia officinalis</i>) 'Berggarten'	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27333	Pothos, <i>Epipremnum</i> (<i>Scindapsus aureus</i>)	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27333	Pothos, <i>Epipremnum</i> (<i>Scindapsus aureus</i>)	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.

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27333	Pothos, Epipremnum (Scindapsus aureus)	Field Container	Gu (TX A&M)	TX	2014	Foliar	No injury or growth reduction with 0.25, 0.5 and 1 oz per 100 gal applied 3 times.
27357	Bridal-Wreath (Spiraea sp.) S. japonica 'Little Princess'	Field Container	Fraelich	GA	2008	Over the top	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants marketable
20283	Nephthytis, African Evergreen (Syngonium podophyllum)	Greenhouse	Locke	MD	2002	Foliar	No injury at 1, 2, and 4 oz per 100 gal.
21398	Lilac (Syringa sp.) 'President Grevy'	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
21398	Lilac (Syringa sp.) S. reticulata	Field Container	Freiberger	NJ	2008	Foliar	All plants were infected with powdery mildew which complicated assessments.
21398	Lilac (Syringa sp.) S. vulgaris 'President Greevy'	Field Container	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
21398	Lilac (Syringa sp.) S. vulgaris 'President Greevy'	Field Container	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27359	Yew (Taxus sp.) T. baccata and T. brevifolia	Field Container	Grunwald	OR	2009	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants saleable.
27360	Arborvitae (Thuja sp.)	Field Container	Grunwald	OR	2009	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal.
27360	Arborvitae (Thuja sp.) T. occidentalis	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
27360	Arborvitae (Thuja sp.) T. occidentalis	Field Container	Reding	OH	2008	Foliar	No injury and no significant difference in growth or marketability at 0.5, 1 and 2 oz per 100 gal
27463	Vervain (Verbena sp.) 'Obsession Blue Eye'	Greenhouse	Freiberger	NJ	2010	Drench	No injury applied drench at 0.125 and 0.25 oz per 100 gal.
27463	Vervain (Verbena sp.) 'Obsession Blue Eye'	Greenhouse	Freiberger	NJ	2010	Foliar	No injury applied foliar at 0.25, 0.5, 1 and 2 oz per 100 gal.
27463	Vervain (Verbena sp.) V. x hybrida 'Obsession'	Greenhouse	Grunwald	OR	2010	Drench	No injury or growth reduction at 0.125 and 0.25 oz per 100 gal applied drench; all treated plants saleable.
27463	Vervain (Verbena sp.) V. x hybrida 'Obsession'	Greenhouse	Grunwald	OR	2010	Foliar	No injury or growth reduction at 0.25, 0.5, 1 and 2 oz per 100 gal applied foliar; all treated plants saleable.
27463	Vervain (Verbena sp.) V. x hybrida 'Obsession Red'	Greenhouse	Grunwald	OR	2011	Drench	No injury with 0.125 and 0.25 oz per 100 gal.
27363	Arrowwood (Viburnum sp.) V. dentatum	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
27363	Arrowwood (Viburnum sp.) V. dentatum 'Blue Muffin'	Field Container	Reding	OH	2008	Foliar	No injury and no significant difference in growth or marketability at 0.5, 1 and 2 oz per 100 gal
27363	Arrowwood (Viburnum sp.) V. tinus 'compatum'	Field Container	Fraelich	GA	2008	Over the top	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants marketable
27364	Periwinkle (Vinca sp.) 'Bowles'	Field Container	Grunwald	OR	2008	Foliar	No injury at 0.5, 1 and 2 oz per 100 gal
27364	Periwinkle (Vinca sp.) V. minor 'Atropurpurea' and 'Bowles'	Field Container	Boydston	WA	2008	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz ai per 100 gal

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
27364	Periwinkle (<i>Vinca</i> sp.) <i>V. minor</i> 'Bowles'	Field Container	Fraelich	GA	2008	Foliar	No injury or growth reduction at 0.5, 1 and 2 oz per 100 gal; all plants marketable
27364	Periwinkle (<i>Vinca</i> sp.) <i>V. minor</i> 'Ralph Shugert'	Field Container	Reding	OH	2008	Foliar	No injury and no significant difference in growth or marketability at 0.5, 1 and 2 oz per 100 gal
20285	Pansy (<i>Viola</i> sp.)	Greenhouse	Hausbeck	MI	2002	Foliar	No injury at 0.5, 1.0, and 2.0 oz per 100 gal.
20285	Pansy (<i>Viola</i> sp.) 'Clear Sky Blue'	Greenhouse	Locke	MD	2002	Foliar	No injury at 1, 2, and 4 oz per 100 gal, but flower colors were lighter on the two higher rates.
20285	Pansy (<i>Viola</i> sp.) <i>V. X wittrockiana</i> 'Accord Daffodil'	Greenhouse	Linderman	OR	2002	Foliar	No injury at 1, 2, and 4 oz per acre.
29491	Zinnia (<i>Zinnia</i> sp.)	Field Container	Wade	SC	2011	Drench	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
29491	Zinnia (<i>Zinnia</i> sp.)	Field Container	Wade	SC	2011	Foliar	No injury or growth reduction with 0.25, 0.50, 1.0 and 2.0 oz per 100 gal applied foliar 5 times or with 0.25 and 0.5 oz applied drench once; all plants marketable.
29491	Zinnia (<i>Zinnia</i> sp.) 'Uproar Rose'	Field Container	Kirk	MI	2011	Drench	No injury, leaf abscission or stunting with 0.25 and 0.5 oz per 100 gal.
29491	Zinnia (<i>Zinnia</i> sp.) 'Uproar Rose'	Field Container	Kirk	MI	2011	Foliar	No injury with 0.25, 0.5, 1 and 2 oz per 100 gal applied 5 times; increased leaf abscission w/ 1 and 2 oz, slight stunting w/ lowest rate..
29491	Zinnia (<i>Zinnia</i> sp.) <i>Z. elegans</i> 'Binary Mix'	Field Container	Grunwald	OR	2011	Drench	No injury with 0.125 and 0.25 oz per 100 gal.
29491	Zinnia (<i>Zinnia</i> sp.) <i>Z. marylandica</i> 'Sahara Fire'	Field Container	Hausbeck	MI	2011	Foliar or Drench	No injury or growth reduction with 0.25, 0.50, 0.75 and 2 oz per 100 gal applied foliar 5 times or with 0.125 and 0.25 oz per 100 gal applied drench once.

Label Suggestions

In this report, 36 species or genera exhibited minimal or no injury after foliar and/or drench treatments of acibenzolar. Of these, 34 can be added to the EPA label:

<i>Acer sp.</i>	<i>Juniperus sp.</i>
<i>Antirrhinum majus</i>	<i>Osteospermum sp.</i>
<i>Aster sp.</i>	<i>Petunia sp.</i>
<i>Begonia sp.</i>	<i>Phlox sp.</i>
<i>Buddleia davidii</i>	<i>Pinus sp.</i>
<i>Calibrachoa sp.</i>	<i>Pseudotsuga menziesii</i>
<i>Camellia sp.</i>	<i>Pyracantha sp.</i>
<i>Chrysanthemum sp.</i>	<i>Quercus sp.</i>
<i>Coleus sp.</i>	<i>Rhododendron sp. (azalea)</i>
<i>Cotoneaster sp.</i>	<i>Rosa sp.</i>
<i>Echinacea sp.</i>	<i>Scindapsus aureus</i>
<i>Euonymus sp.</i>	<i>Thuja sp.</i>
<i>Helianthus sp.</i>	<i>Verbena sp.</i>
<i>Hemerocallis sp.</i>	<i>Viburnum sp.</i>
<i>Hibiscus sp.</i>	<i>Vinca sp.</i>
<i>Hosta sp.</i>	<i>Viola sp.</i>
<i>Hydrangea sp.</i>	<i>Zinnia sp.</i>

While there was sufficient evidence of minimal or no injury for *Dianthus sp.* and *Pelargonium x hortorum*, a single trial for each crop did elicit moderate to severe injury. Further investigation on cultivar or species differences may be warranted.

Appendix 1: Contributing Researchers

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