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IR-4 Ornamental Horticulture Program Orkestra (Fluxapyroxad + Pyraclostrobin) Crop Safety

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Acknowledgements

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Abstract

The IR-4 Project screens new active ingredients for potential deleterious impacts to aid growers in selection of appropriate disease management tools for their crops. From 2014 to 2017, IR-4 completed 68 trials on 29 ornamental plant species examining phytotoxicity related to foliar applications of Orkestra (fluxapyroxad + pyraclostrobin). During 2016 and 2017, an additional 8 trials were conducted using drench application on 7 crops. In these trials, 13 species or genera exhibited minimal or no injury after foliar applications in a minimum of 3 trials for each crop. Nine of these are already on the current label for this active ingredient; the other four (*Aquilegia* sp, *Hemerocallis* sp., *Picea* sp. and *Pinus* sp.) can be added to a list of tolerant plants in the current label. Only two plant species (*Cornus florida* and *Impatiens hawkeri*) exhibited significant injury in one study. All trials for fifteen other species or genera exhibited no or minimal injury in the limited number of trials (one or two) for each crop. Six of these are already in the current label; BASF can consider adding the other nine to the label. Drench application caused no phytotoxicity on all crops tested.

Introduction

The IR-4 Project screens new active ingredients for potential deleterious impacts to aid growers in selection of appropriate disease management tools for their crops. During 2014 to 2017, IR-4 completed 68 trials on 29 ornamental plant species examining phytotoxicity related to foliar applications of Orkestra (fluxapyroxad + pyraclostrobin). During 2016 and 2017, additional 8 trials were conducted using drench application on 7 crops.

Materials and Methods

Orkestra was tested applied as foliar treatment typically 3 times at approximately 14 days intervals. The application rates were 8, 16 and 32 fl oz per 100 gal, plus a water treated control. Drench treatment was applied once at rates of 10, 20 and 40 fl oz per 100 gal. A minimum of six plants (replicate treatments) were required. Phytotoxicity was rated 7 days after each application using a scale of 0 to 10 (0 = no phytotoxicity; 10 = complete kill). The following protocols were used: 14-003, 15-003, 16-004, 16-005, 17-004, and 17-005. For more detailed materials and methods, including application rates for various products, please visit <http://ir4.rutgers.edu/ornamental/OrnamentalDrafts.cfm> to view and download these protocols.

Orkestra was supplied to researchers (See list of researchers in Appendix 1) by BASF.

Results and Summary

Based on the type and nature of injury seen with pesticide applications, tested plant species were placed into four 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 fluxapyroxad + pyraclostrobin, and 4) more data are needed to make informed recommendations.

Phytotoxicity

Across all plant species tested, Orkestra caused no or minimal negative impact on 13 plant species or genera (Table 1). Only one plant species (*Cornus florida*) exhibited significant injury in one study (Table 2). No crops exhibited significant injury at 1x (Table 3). There are 15 species or genera where less than 3 trials were conducted so there is not enough information available at this time (Table 4). All trials for these crops showed no or minimal, transitory phytotoxicity.

Please see **Error! Reference source not found.** for a list of research and a summary of the individual trial results with Orkestra.

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

<i>Aquilegia</i> sp.	<i>Pinus</i> sp.
<i>Dianthus</i> sp. ¹	<i>Pseudotsuga menziesii</i> ¹
<i>Hemerocallis</i> sp.	<i>Rosa</i> sp. ¹
<i>Hydrangea</i> spp. ¹	<i>Verbena</i> sp. ¹
<i>Lantana</i> sp. ¹	<i>Vinca</i> sp. ¹
<i>Leucanthemum</i> sp. ¹	<i>Zinnia</i> sp. ¹
<i>Picea</i> sp.	

¹ Already registered

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

*Cornus florida*¹
Impatiens hawkeri

¹ Injury observed was in the form of discolored and distorted leaves.

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

None

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

<i>Catharanthus roseus</i> ^{1,2}	<i>Magnolia virginiana</i> ²
<i>Chamaerops humilis</i> ²	<i>Osteospermum</i> sp. ²
<i>Coreopsis</i> sp. ^{1,2}	<i>Pelargonium x hortorum</i> ²
<i>Cornus amomum</i> ²	<i>Quercus</i> sp. ^{1,2}
<i>Cornus sericea</i> ²	<i>Salvia</i> sp. ^{1,2}
<i>Gerbera</i> sp. ²	<i>Ulmus</i> sp.
<i>Impatiens hawkeri</i> ^{1,2}	<i>Viola x wittrockiana</i> ^{1,2}
<i>Lupinus</i> sp. ²	

¹ Already registered.

² For these plants, the one or two trials presented here indicate no phytotoxicity or slight, transient injury, but these findings need to be confirmed.

Table 5 Detailed Summary of Crop Safety Testing with Orkestra (fluxapyroxad + pyraclostrobin)

Notes: Table entries are sorted by crop Latin name. Only those trials with research reports received by 12/11/2017 are listed below.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
31765	Columbine (<i>Aquilegia</i> sp.)	Field Container	Grunwald	OR	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal; all plants saleable.
31765	Columbine (<i>Aquilegia</i> sp.) <i>A. canadensis</i> 'Little Lanterns'	Field Container	Catlin	NY	2014	Foliar	No injury or significant growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times; unacceptable spray residue at 2X and 4X after 3rd application.
31765	Columbine (<i>Aquilegia</i> sp.) <i>A. chrysantha</i> 'Yellow Queen'	Field Container	DeFrancesco	OR	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times biweekly.
31765	Columbine (<i>Aquilegia</i> sp.) 'Texas Gold'	Field Container	Gu	TX	2015	Foliar	No injury with 8 and 16, moderate with 32 fl oz per 100 gal applied 3 times; no growth reduction.
32214	Madagascar Periwinkle (<i>Catharanthus roseus</i>) 'Cora Burgundy'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times; no delay in blooming.
32214	Madagascar Periwinkle (<i>Catharanthus roseus</i>) 'Pacifica XP Burgundy Halo'	Greenhouse	Hand	OH	2016	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
33070	Palm, Mediterranean Fan (<i>Chamaerops humilis</i>)	Field Container	Palmateer	FL	2016	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
32416	Tickseed (<i>Coreopsis</i> sp.) 'Early Sunrise Yellow'	Greenhouse	Bodine	NJ	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31772	Dogwood (<i>Cornus</i> sp.)	Field Container	Grunwald	OR	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31772	Dogwood (<i>Cornus</i> sp.) <i>C. amomum</i>	Field Container	Braze	MA	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31772	Dogwood (<i>Cornus</i> sp.) <i>C. florida</i>	Field Container	Reding	OH	2015	Foliar	Moderate to high injury increasing with rates (8, 16 and 32 fl oz per 100 gal) applied 3 times; no growth reduction but 4X treated plants not marketable.
31772	Dogwood (<i>Cornus</i> sp.) <i>C. sericea</i>	Field Container	DeFrancesco	OR	2016	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times biweekly.
31772	Dogwood (<i>Cornus</i> sp.) <i>C. sericea</i>	Field Container	DeFrancesco	OR	2016	Drench	No injury or growth reduction with 10, 20 and 40 fl oz per 100 gal.
31761	Pink (<i>Dianthus</i> sp.)	Field Container	Grunwald	OR	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal; all plants saleable.
31761	Pink (<i>Dianthus</i> sp.) <i>D. chinensis</i> 'First Love'	Field Container	DeFrancesco	OR	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31761	Pink (<i>Dianthus</i> sp.) <i>D. gratianopolitanus</i> 'Firewitch'	Field Container	Hausbeck	MI	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times; visible spray residue on treated plants.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
31761	Pink (Dianthus sp.) 'Neon Star'	Field Container	Hand	OH	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
32368	Transvaal Daisy (Gerbera sp.) 'Jaguar Deep Orange'	Greenhouse	Freiberger	NJ	2016	Drench	No injury or growth reduction with 10, 20 and 40 fl oz per 100 gal.
31766	Daylily (Hemerocallis sp.)	Field Container	Grunwald	OR	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal; all plants saleable.
31766	Daylily (Hemerocallis sp.)	Field Container	Reding	OH	2015	Foliar	No injury with 8, slight and moderate with 16 and 32, fl oz per 100 gal applied 3 times; good recovery, with all plants marketable at end of trial.
31766	Daylily (Hemerocallis sp.) Hemerocallis x 'Stella De Oro'	Field Container	Fraelich	GA	2015	Foliar	No injury or difference in plant growth and marketability with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31767	Hydrangea (Hydrangea sp.) H. macrophylla 'Nikko Blue'	Field Container	Fraelich	GA	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31767	Hydrangea (Hydrangea sp.) H. macrophylla 'PIIHM-II'	Field Container	DeFrancisco	OR	2015	Foliar	No injury, but moderate growth reduction, with 8, 16 and 32 fl oz per 100 gal applied 3 times biweekly.
31767	Hydrangea (Hydrangea sp.) H. macrophylla 'Robert'	Field Container	DeFrancisco	OR	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31767	Hydrangea (Hydrangea sp.) H. quercifolia	Field Container	Gu	TX	2015	Foliar	No injury with 8 and 16, slight with 32 fl oz per 100 gal applied 3 times; no growth reduction. Researcher recommends repeating trial.
32413	New Guinea Impatiens (Impatiens hawkeri) 'Harmony Deep Red'	Greenhouse	Bodine	NJ	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
32413	New Guinea Impatiens (Impatiens hawkeri) 'Orchid Star'	Greenhouse	Hausbeck	MI	2017	Foliar	No injury with 8, minor with 16 and severe with 32 fl oz per 100 gal applied 3 times; moderate stunting with 4X. 1X and 2X treated plants marketable.
31769	Lantana (Lantana sp.)	Field Container	Grunwald	OR	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31769	Lantana (Lantana sp.) 'Chapel Hill Yellow'	Field Container	Fraelich	GA	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31769	Lantana (Lantana sp.) Lantana x 'Moni' 'Confetti Spreading'	Field Container	Fraelich	GA	2015	Foliar	No injury or difference in plant growth and marketability with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31762	Max Chrysanthemum (Leucanthemum maximum)	Field Container	Grunwald	OR	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31762	Max Chrysanthemum (Leucanthemum maximum) 'Shasta Daisy'	Field Container	Catlin	NY	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times biweekly.
32712	Daisy (Leucanthemum x superbum) 'Snowcap'	Field Container	Klett	CO	2016	Drench	No injury or growth reduction with 10, 20 and 40 fl oz per 100 gal.
32712	Daisy (Leucanthemum x superbum) 'Snowcap'	Field Container	Klett	CO	2016	Foliar	No injury with 8, 16 and 32 fl oz per 100 gal applied 3 times (7/13, 8/9, 8/23); moderate growth reduction.
32418	Lupine (Lupinus sp.) 'Gallery Mix'	Greenhouse	Bodine	NJ	2015	Foliar	No significant injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
31775	Magnolia (Magnolia sp.) M. virginiana 'Sweet Bay'	Field Container	Wade	SC	2017	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times biweekly. all plants marketable.
32215	Daisybush (Osteospermum sp.) 'Summertime Blueberry'	Greenhouse	Freiberger	NJ	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
32417	Geranium, Zonal (Pelargonium x hortorum) 'Maverick Violet'	Greenhouse	Bodine	NJ	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31778	Spruce (Picea sp.)	Field Container	Grunwald	OR	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal; all plants saleable.
31778	Spruce (Picea sp.) P. glauca	Field Container	Brazee	MA	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31778	Spruce (Picea sp.) P. sitchensis	Field Container	DeFrancisco	CA	2016	Drench	No injury or growth reduction with 10, 20 and 40 fl oz per 100 gal.
31778	Spruce (Picea sp.) P. sitchensis	Field Container	DeFrancisco	OR	2016	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times biweekly.
31777	Pine (Pinus sp.)	Field Container	Grunwald	OR	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal; all plants saleable.
31777	Pine (Pinus sp.) P. taeda	Field Container	Fraelich	GA	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31777	Pine (Pinus sp.) P. taeda	Field Container	Henn	MS	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31774	Fir, Douglas (Pseudotsuga menziesii)	Field Container	Brazee	MA	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31774	Fir, Douglas (Pseudotsuga menziesii)	Field Container	DeFrancisco	OR	2016	Drench	No injury or growth reduction with 10, 20 and 40 fl oz per 100 gal.
31774	Fir, Douglas (Pseudotsuga menziesii)	Field Container	DeFrancisco	OR	2016	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times biweekly.
31774	Fir, Douglas (Pseudotsuga menziesii)	Field Container	Grunwald	OR	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal; all plants saleable.
31776	Oak (Quercus sp.)	Field Container	Grunwald	OR	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31768	Rose (Rosa sp.)	Field Container	Grunwald	OR	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal; all plants saleable.
31768	Rose (Rosa sp.)	Field Container	Baysal-Gurel	TN	2016	Drench	No injury or growth reduction with 10, 20 and 40 fl oz per 100 gal applied 3 times.
31768	Rose (Rosa sp.) 'Old Blush'	Field Container	Wade	SC	2017	Drench	No injury or growth reduction with 10, 20 and 40 fl oz per 100 gal applied 3 times; all plants marketable.
31768	Rose (Rosa sp.) 'Old Blush'	Field Container	Wade	SC	2017	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times; all plants marketable.
32415	Sage (Salvia sp.) 'New Dimension Blue'	Greenhouse	Bodine	NJ	2015	Foliar	No significant injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31773	Elm (Ulmus sp.)	Field Container	Grunwald	OR	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal; all plants saleable.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
31773	Elm (<i>Ulmus</i> sp.) <i>U. parvifolia</i>	Field Container	Henn	MS	2014	Foliar	Slight injury (bleaching/interveinal chlorosis) with 8, 16 and 32 fl oz per 100 gal applied 3 times; no significant growth reduction.
31773	Elm (<i>Ulmus</i> sp.) <i>U. parvifolia</i>	Field Container	Uber	CA	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31763	Vervain (<i>Verbena</i> sp.)	Field Container	Harvey	WA	2015	Foliar	No injury or growth reduction with 8, moderate and severe with 16 and 32 fl oz per 100 gal, applied 3 times.
31763	Vervain (<i>Verbena</i> sp.) 'Lanai Premium Twister Amethyst'	Field Container	Reding	OH	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times; all plants marketable.
31763	Vervain (<i>Verbena</i> sp.) <i>V. hastata</i>	Field Container	Catlin	NY	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31763	Vervain (<i>Verbena</i> sp.) <i>Verbena canadensis</i> 'Homestead Purple'	Field Container	Fraelich	GA	2015	Foliar	No injury or difference in plant growth and marketability with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31770	Periwinkle (<i>Vinca</i> sp.)	Field Container	Harvey	WA	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31770	Periwinkle (<i>Vinca</i> sp.) <i>V. maculata</i>	Field Container	Reding	OH	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times; all plants marketable.
31770	Periwinkle (<i>Vinca</i> sp.) <i>V. pacifica</i> 'Dark Red'	Field Container	Wade	SC	2017	Drench	No injury or growth reduction with 10, 20 and 40 fl oz per 100 gal applied 3 times; all plants marketable.
31770	Periwinkle (<i>Vinca</i> sp.) <i>V. pacifica</i> 'Dark Red'	Field Container	Wade	SC	2017	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times; all plants marketable.
32411	Wittrock's Violet; Pansy (<i>Viola</i> X <i>wittrockiana</i>) 'Colossus Yellow'	Greenhouse	Freiberger	NJ	2016	Drench	No injury or growth reduction with 10, 20 and 40 fl oz per 100 gal.
32411	Wittrock's Violet; Pansy (<i>Viola</i> X <i>wittrockiana</i>) 'Delta Orange Blotch'	Greenhouse	Bodine	NJ	2015	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31764	Zinnia (<i>Zinnia</i> sp.)	Field Container	Grunwald	OR	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal; all plants saleable.
31764	Zinnia (<i>Zinnia</i> sp.) 'Dreamland Red'	Field Container	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times.
31764	Zinnia (<i>Zinnia</i> sp.) 'Envy'	Field Container	Catlin	NY	2014	Foliar	No injury or significant growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times; unacceptable spray residue at 4X after 3rd application.
32217	Zinnia (<i>Zinnia</i> sp.) 'Magellan Pink'	Greenhouse	Hand	OH	2016	Foliar	No injury with 8 and 16, very slight with 28 fl oz per 100 gal applied 3 times; increased plant width at 1X and 2X.
32217	Zinnia (<i>Zinnia</i> sp.) 'Profusion Cherry'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 8, 16 and 32 fl oz per 100 gal applied 3 times; no delay in blooming.
31764	Zinnia (<i>Zinnia</i> sp.) 'Profusion Cherry'	Field Container	Reding	OH	2015	Foliar	No injury or growth reduction with 8, 16 and 32 oz per 100 gal applied 3 times; all plants marketable.

Label Suggestions

In this report, 13 species or genera exhibited no or minimal injury after foliar treatments of Orkestra (fluxapyroxad + pyraclostrobin) at 8, 16 and 32 fl oz per 100 gal.; nine of these are already in the current label. These other four can be included in the label: *Aquilegia* sp., *Hemerocallis* sp., *Picea* sp., and *Pinus* sp.

Given the lack of phytotoxicity across so many different plant species and genera, it is suggested that all the nine plants in Table 4 (listed below) that showed no injury and are not yet included in the current label be placed on the label if BASF has similar results on these crops. Or a general statement can be placed on the label such as 'Orkestra has not been demonstrated to cause damage on various ornamental plant species according to labeled use instructions. Orkestra may be used on a wide number of crops, but must be tested on a limited portion of the crop prior to applying to the whole crop if the grower has no previous experience applying Orkestra to that crop'.

Chamaerops humilis

Cornus amomum

Cornus sericea

Gerbera sp.

Lupinus sp.

Magnolia virginiana

Osteospermum sp.

Pelargonium x hortorum

Ulmus sp.

Appendix 1: Contributing Researchers

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