IR-4 Ornamental Horticulture Program
Pydiflumetofen + Fludioxonil Crop Safety

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Date: June 14, 2018

Acknowledgements
Susan Bierbrunner

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Abstract

Pydiflumetofen + Fludioxonil is a new fungicide being developed by Syngenta for the control of foliar and soil-borne diseases of ornamental horticulture crops. The IR-4 Project completed 37 crop safety trials on 24 ornamental horticulture plant species or genera during 2015 to 2017. In these trials, all 24 species or genera exhibited minimal or no injury. Two species or genera (Lupinus sp. and Petunia x hybrida) exhibited minimal or no injury in 3 trials and 22 species or genera exhibited minimal or no injury in the limited number of trials (one or two) for each crop. Syngenta may consider adding these to the label.
Introduction
Pydiflumetofen + Fludioxonil is a new fungicide being developed by Syngenta for the control of foliar and soil-borne diseases of ornamental horticulture crops. The IR-4 Project completed 37 crop safety trials on 24 ornamental horticulture plant species or genera during 2015 to 2017.

Materials and Methods
Pydiflumetofen + Fludioxonil was applied as foliar treatment typically 3 times at approximately 14 days intervals; in a few trials, it was applied as a single drench treatment. The application rates were 27.8, 54.6 and 109.2 fl oz per 100 gal, plus a water treated control. A minimum of ten plants (replicate treatments) were required. Phytotoxicity was planned to be recorded on a scale of 0 to 10 (0 = No phytotoxicity; 10 = Complete kill). Phytotoxicity was rated weekly up to 6 weeks after initial application. For IR-4 testing, the following protocols were used: 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.

Pydiflumetofen + Fludioxonil was supplied to 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 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 at the 1X rate sufficient to recommend growers not utilize Pydiflumetofen + Fludioxonil, and 4) more data is needed to make informed recommendations.

Phytotoxicity
Across all crops tested, Pydiflumetofen + Fludioxonil exhibited no or minimal negative impact on all plant species or genera. Two species or genera (Lupinus sp. and Petunia x hybrida) exhibited minimal or no injury in 3 trials (Table 1) and 22 species or genera exhibited minimal or no injury in the limited number of trials (one or two) for each crop (Table 4).

Please see Table 5 for a summary of the individual trial results.
Table 1.  List of Pydiflumetofen + Fludioxonil treated crops with no or minimal transitory injury.

*Lupinus* sp.
*Petunia x hybrida*

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

None

Table 3.  List of Pydiflumetofen + Fludioxonil treated crops with significant injury at 1X.

None

Table 4.  List of Pydiflumetofen + Fludioxonil treated crops where more information is needed.

*Alyssum* sp.\(^1\)
*Antirrhinum majus*\(^2\)
*Begonia* sp.\(^2\)
*Calibrachoa* sp.\(^2\)
*Chamaerops humilis*\(^1\)
*Chrysanthemum/Dendranthema x morifolium*\(^1\)
*Coreopsis* sp.\(^1\)
*Dianthus* sp.\(^2\)
*Dianthus carpophyllus*\(^1\)
*Euphorbia pulcherrima*\(^2\)
*Gerbera* sp.\(^1\)
*Impatiens hawkeri*\(^1\)

*Impatiens walleriana*\(^1\)
*Osteospermum ecklonis*\(^2\)
*Osteospermum* sp.\(^1\)
*Pelargonium x hortorum*\(^1\)
*Salvia greggi*\(^1\)
*Salvia* sp.\(^1\)
*Verbena x hybrida*\(^1\)
*Verbena* sp.\(^2\)
*Viola* sp.\(^1\)
*Viola x wittrockiana*\(^1\)

\(^1\) No injury in 1 trial
\(^2\) No injury in 2 trials
Table 5  Detailed Summary of Crop Safety Testing with Pydiflumetofen + Fludioxonil.

Notes: Table entries are sorted by crop Latin name. Only those trials with research reports received by 5/31/2018 are listed below.

<table>
<thead>
<tr>
<th>PR#</th>
<th>Crop</th>
<th>Production Site</th>
<th>Researcher</th>
<th>State</th>
<th>Year</th>
<th>Application Type</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>32447</td>
<td>Madwort (Alyssum sp.) 'Snow Crystals'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6 and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>32456</td>
<td>Garden Snapdragon (Antirrhinum majus) 'Orange'</td>
<td>Greenhouse</td>
<td>Hausbeck</td>
<td>MI</td>
<td>2017</td>
<td>Foliar</td>
<td>No injury with 27.8, 55.6 and 111.2 fl oz per 100 gal applied 3 times biweekly; slight stunting with 4X.</td>
</tr>
<tr>
<td>32456</td>
<td>Garden Snapdragon (Antirrhinum majus) 'Sonnet Mix'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6 and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>32459</td>
<td>Begonia (Begonia sp.) B. semperflorens 'Bada Bing'</td>
<td>Greenhouse</td>
<td>Hausbeck</td>
<td>MI</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 55.6 and 111.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>32459</td>
<td>Begonia (Begonia sp.) 'Dragon Wing Red'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6 and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>33056</td>
<td>Begonia (Begonia sp.) 'Summerwings Rose'</td>
<td>Shadehouse/Lathehouse</td>
<td>Klett</td>
<td>CO</td>
<td>2017</td>
<td>Drench</td>
<td>No injury with 27.8, 55.6 and 111.2 fl oz per 100 gal; moderate growth reduction at 4X.</td>
</tr>
<tr>
<td>32455</td>
<td>Calibrachoa (Calibrachoa sp.) 'Kabloom Deep Blue'</td>
<td>Greenhouse</td>
<td>Bodine</td>
<td>NJ</td>
<td>2015</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6, and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>33054</td>
<td>Calibrachoa (Calibrachoa sp.) MiniFamous Double Amethyst</td>
<td>Shadehouse/Lathehouse</td>
<td>Klett</td>
<td>CO</td>
<td>2017</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 55.6 and 111.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>33065</td>
<td>Palm, Mediterranean Fan (Chamaerops humilis)</td>
<td>Field Container</td>
<td>Palmateer</td>
<td>FL</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>32453</td>
<td>Hardy Mum (Chrysanthemum/Dendranthema x morifolium) 'Orange Blush'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6 and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>32450</td>
<td>Tickseed (Coreopsis sp.) 'Nana'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6 and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>32446</td>
<td>Pink (Dianthus sp.) D. caryophyllus 'Crimson Red'</td>
<td>Greenhouse</td>
<td>Uber</td>
<td>CA</td>
<td>2017</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 55.6 and 111.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>32446</td>
<td>Pink (Dianthus sp.) 'Diabunda Purple Picot'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6 and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>33055</td>
<td>Pink (Dianthus sp.) Dianthus SCENT FIRST POT Coral Reef</td>
<td>Shadehouse/Lathehouse</td>
<td>Klett</td>
<td>CO</td>
<td>2017</td>
<td>Foliar</td>
<td>No injury with 27.8, 55.6 and 111.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>32463</td>
<td>Poinsettia (Euphorbia pulcherrima) 'Whitestar'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Drench</td>
<td>No injury, growth reduction or delayed blooming with 27.8, 54.6 and 109.2 fl oz per 100 gal.</td>
</tr>
<tr>
<td>32463</td>
<td>Poinsettia (Euphorbia pulcherrima) 'Whitestar'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury, growth reduction or delayed blooming with 27.8, 55.6 and 111.2 fl oz per 100 gal.</td>
</tr>
<tr>
<td>32451</td>
<td>Transvaal Daisy (Gerbera sp.) 'Garvenia Sweet Honey'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury with 27.8 and 54.6, some leaf necrosis with 109.2 fl oz per 100 gal applied 3 times; decreased flowering and smaller leaf size at all rates.</td>
</tr>
<tr>
<td>PR#</td>
<td>Crop</td>
<td>Production Site</td>
<td>Researcher</td>
<td>State</td>
<td>Year</td>
<td>Application Type</td>
<td>Results</td>
</tr>
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<td>------</td>
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</tr>
<tr>
<td>32462</td>
<td>Impatiens, New Guinea (Impatiens hawkeri) 'Super Sonic Purple'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury with 27.8, 54.6 and 109.2 fl oz per 100 gal for first 2 applications, some leaf yellowing after third application increasing with each rate.</td>
</tr>
<tr>
<td>32461</td>
<td>Impatiens, Common Garden/Buzzy Lizzy (Impatiens walleriana) 'Super XP Pink'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6 and 109.2 fl oz per 100 gal applied 3 times; slight decrease in flowering.</td>
</tr>
<tr>
<td>32445</td>
<td>Lupine (Lupinus sp.) 'Gallery Blue'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Drench</td>
<td>No injury with 27.8, 54.6 and 109.2 fl oz per 100 gal at first 2 evaluations, last evaluation not done; no growth reduction.</td>
</tr>
<tr>
<td>32445</td>
<td>Lupine (Lupinus sp.) 'Russell Mix'</td>
<td>Greenhouse</td>
<td>Baysal-Gurel</td>
<td>TN</td>
<td>2017</td>
<td>Drench</td>
<td>No injury or growth reduction with 27.8, 55.6 and 111.2 fl oz per 100 gal.</td>
</tr>
<tr>
<td>32445</td>
<td>Lupine (Lupinus sp.) 'Russell Mix'</td>
<td>Greenhouse</td>
<td>Baysal-Gurel</td>
<td>TN</td>
<td>2017</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 55.6 and 111.2 fl oz per 100 gal applied 3 times biweekly.</td>
</tr>
<tr>
<td>32454</td>
<td>Daisybush (Osteospermum sp.) 'Asti Purple'</td>
<td>Greenhouse</td>
<td>Bodine</td>
<td>MI</td>
<td>2015</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6, and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>32454</td>
<td>Daisybush (Osteospermum sp.) O. ecklonis 'Rose Magic'</td>
<td>Greenhouse</td>
<td>Hausbeck</td>
<td>MI</td>
<td>2017</td>
<td>Drench</td>
<td>No injury or growth reduction with 27.8, 54.6 and 109.2 fl oz per 100 gal.</td>
</tr>
<tr>
<td>32454</td>
<td>Daisybush (Osteospermum sp.) O. ecklonis 'Rose Magic'</td>
<td>Greenhouse</td>
<td>Hausbeck</td>
<td>MI</td>
<td>2017</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6 and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>32448</td>
<td>Geranium, Zonal (Pelargonium x hortorum) 'Zonal Tango Orange'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury with 27.8 and 54.6, some leaf necrosis with 109.2 fl oz per 100 gal applied 3 times; slight to moderate reduction of leaf size and flowering increasing with rates.</td>
</tr>
<tr>
<td>32457</td>
<td>Petunia (Petunia sp.) Petunia x hybrida 'Carpet velvet'</td>
<td>Greenhouse</td>
<td>Hand</td>
<td>OH</td>
<td>2017</td>
<td>Drench</td>
<td>Minor injury (chlorosis) with 27.8, 54.6 and 109.2 fl oz per 100 gal; no growth reduction.</td>
</tr>
<tr>
<td>32457</td>
<td>Petunia (Petunia sp.) Petunia x hybrida 'Carpet velvet'</td>
<td>Greenhouse</td>
<td>Hand</td>
<td>OH</td>
<td>2017</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 55.6 and 111.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>32457</td>
<td>Petunia (Petunia sp.) Petunia x hybrida 'Dreams Midnight'</td>
<td>Greenhouse</td>
<td>Uber</td>
<td>CA</td>
<td>2017</td>
<td>Drench</td>
<td>No injury or growth reduction with 27.8, 54.6 and 109.2 fl oz per 100 gal.</td>
</tr>
<tr>
<td>32457</td>
<td>Petunia (Petunia sp.) 'Tritunia Blue'</td>
<td>Greenhouse</td>
<td>Bodine</td>
<td>NJ</td>
<td>2015</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6, and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>32448</td>
<td>Sage (Salvia sp.) 'Evolution White'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6 and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>33057</td>
<td>Sage (Salvia sp.) S. greggi 'Raspberry'</td>
<td>Shadehouse/Lathehouse</td>
<td>Klett</td>
<td>CO</td>
<td>2017</td>
<td>Drench</td>
<td>No injury or growth reduction with 27.8, 55.6 and 111.2 fl oz per 100 gal.</td>
</tr>
<tr>
<td>32452</td>
<td>Vervain (Verbena sp.) 'Burgundy Wink'</td>
<td>Greenhouse</td>
<td>Hausbeck</td>
<td>MI</td>
<td>2017</td>
<td>Drench</td>
<td>No injury or growth reduction with 27.8, 55.6 and 111.2 fl oz per 100 gal.</td>
</tr>
<tr>
<td>32452</td>
<td>Vervain (Verbena sp.) 'Lanai Vintage Vodka'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6 and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
<tr>
<td>33058</td>
<td>Vervain (Verbena sp.) V. x hybrida 'Lanai Magenta'</td>
<td>Shadehouse/Lathehouse</td>
<td>Klett</td>
<td>CO</td>
<td>2017</td>
<td>Drench</td>
<td>No injury or growth reduction with 27.8, 55.6 and 111.2 fl oz per 100 gal.</td>
</tr>
<tr>
<td>PR#</td>
<td>Crop</td>
<td>Production Site</td>
<td>Researcher</td>
<td>State</td>
<td>Year</td>
<td>Application Type</td>
<td>Results</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------------------------</td>
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</tr>
<tr>
<td>32460</td>
<td>Pansy (Viola sp.) 'Colossus Yellow'</td>
<td>Greenhouse</td>
<td>Freiberger</td>
<td>NJ</td>
<td>2016</td>
<td>Drench</td>
<td>No injury with 27.8, 54.6 and 109.2 fl oz per 100 gal at first 2 evaluations, last evaluation not done; no growth reduction.</td>
</tr>
<tr>
<td>32449</td>
<td>Wittrock's Violet; Pansy (Viola x wittrockiana) 'Delta Orange Blotch'</td>
<td>Greenhouse</td>
<td>Bodine</td>
<td>NJ</td>
<td>2015</td>
<td>Foliar</td>
<td>No injury or growth reduction with 27.8, 54.6, and 109.2 fl oz per 100 gal applied 3 times.</td>
</tr>
</tbody>
</table>
Label Suggestions

In this report, all plants exhibited no or minimal injury after foliar treatments of Pydiflumetofen + Fludioxonil at 27.8, 54.6 and 109.2 fl oz per 100 gal, suggesting that this active ingredient is safe to ornamental horticulture crops. Given the lack of phytotoxicity across so many different plant species and genera, it is suggested that all the 24 plants in Table 1 and Table 4 (listed below) that showed no injury be placed on the Pydiflumetofen + Fludioxonil label if Syngenta has similar results on these crops. Or a general statement can be placed on the label such as ‘has not been demonstrated to cause damage on various ornamental plant species according to labeled use instructions. Pydiflumetofen + Fludioxonil 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 Pydiflumetofen + Fludioxonil to that crop’.

Alyssum sp.
Antirrhinum majus
Begonia sp.
Calibrachoa sp.
Chamaerops humilis
Chrysanthemum/Dendranthema x morifolium
Coreopsis sp.
Dianthus sp.
Dianthus carpophyllus
Euphorbia pulcherrima
Gerbera sp.
Impatiens hawkeri
Impatiens walleriana
Lupinus sp.
Osteospermum ecklonis
Osteospermum sp.
Pelargonium x hortorum
Petunia x hybrida
Salvia greggi
Salvia sp.
Verbena x hybrida
Verbena sp.
Viola sp.
Viola x wittrockiana
Appendix 1: Contributing Researchers

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