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## **IR-4 Ornamental Horticulture Program Pyrifluquinazon Crop Safety**

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### **Acknowledgements**

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## **Abstract**

Pyriproxyfen was registered for use on greenhouse ornamental horticulture crops as foliar sprays in the United States in 2013 to manage whiteflies, aphids, leafhoppers, chilli thrips, and mealybugs. The label contains a list of crops tested for tolerance. From 2010 to 2015, the IR-4 Project conducted 127 trials on 29 ornamental plant species / genera examining phytotoxicity related to pyriproxyfen applications. In these trials, 23 species or genera exhibited minimal or no injury after foliar applications in a minimum of 3 trials for each crop. Nineteen of these are already in the current Rycar label; the other four can be added to the label. All trials for six other species or genera exhibited minimal or no injury in the limited number of trials (one or two) for each crop, and two of these are already registered.

## **Introduction**

Pyriproxyfen was registered for use on greenhouse ornamental horticulture crops as foliar sprays in the United States in 2013 to manage whiteflies, aphids, leafhoppers, chilli thrips, and mealybugs. The label contains a list of crops tested for tolerance. From 2010 to 2015, the IR-4 Project conducted 127 trials on 29 ornamental plant species / genera examining phytotoxicity related to pyriproxyfen applications.

## **Materials and Methods**

Pyriproxyfen was tested as foliar treatment typically three times at approximately 14 days interval or as a single drench application. The foliar application rates were typically 6.38, 12.76 and 25.52 fl oz per 100 gal, plus a water treated control. 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 IR-4 testing, the following protocols were used: 10-004, 11-016, 12-002, 13-002, 14-008 and 15-008. 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.

Pyriproxyfen was supplied to researchers (See list of researchers in Appendix 1) by Nichino and SePro.

## **Results and Summary**

### ***Phytotoxicity***

Based on the type and nature of injury seen with pesticide applications, tested plant species /genera 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 pyriproxyfen, and 4) more data is needed to make informed recommendations.

No significant injury was observed.

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

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

|  |   |
|--|---|
| <i>Alyssum sp.</i> <sup>1</sup>            | <i>Impatiens sp.</i> <sup>1</sup>           |
| <i>Angelonia angustifolia</i> <sup>1</sup> | <i>Impatiens hawkeri</i> <sup>1</sup>       |
| <i>Antirrhinum majus</i> <sup>1</sup>      | <i>Lobularia maritima</i> <sup>1</sup>      |
| <i>Bacopa sp.</i>                          | <i>Pelargonium x hortorum.</i> <sup>1</sup> |
| <i>Begonia sp.</i> <sup>1</sup>            | <i>Petunia sp.</i> <sup>1</sup>             |
| <i>Calibrachoa sp.</i>                     | <i>Rosa sp.</i> <sup>1</sup>                |
| <i>Chrysanthemum sp.</i> <sup>1</sup>      | <i>Salvia splendens</i> <sup>1</sup>        |
| <i>Dahlia sp.</i> <sup>1</sup>             | <i>Tagetes sp.</i> <sup>1</sup>             |
| <i>Dracaena sp.</i>                        | <i>Verbena sp.</i> <sup>1</sup>             |
| <i>Fuschia sp.</i>                         | <i>Viola sp.</i> <sup>1</sup>               |
| <i>Gerbera sp.</i> <sup>1</sup>            | <i>Zinnia sp.</i> <sup>1</sup>              |
| <i>Hedera sp.</i>                          |   |

<sup>1</sup> Already registered

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

None

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

None

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

|                                   |                                   |
|-----------------------------------|-----------------------------------|
| <i>Coreopsis sp.</i> <sup>1</sup> | <i>Hydrangea sp.</i> <sup>3</sup> |
| <i>Dianthus sp.</i> <sup>2</sup>  | <i>Rosa sp.</i> <sup>1,2</sup>    |
| <i>Gardenia sp.</i> <sup>1</sup>  |                                   |
| <i>Hibiscus sp.</i> <sup>1</sup>  |                                   |

<sup>1</sup> No injury in 1 trial

<sup>2</sup> Already registered

<sup>3</sup> No injury in 2 trials

**Table 5 Detailed Summary of Crop Safety Testing with Rycar (Pyrifluquinazon)**

Notes: Table entries are sorted by crop Latin name. Only those trials with research reports received by 8/10/2016 are listed below.

| PR#   | Crop   | Production Site | Researcher  | State | Year | Application Type | Results   |
|-------|--|-----------------|-------------|-------|------|------------------|---|
| 31133 | Madwort (Alyssum sp.) 'Clear Crystal Purple'                     | Field Container | Freiberger  | NJ    | 2013 | Foliar           | No phytotoxicity with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.  |
| 31133 | Madwort (Alyssum sp.) 'Wonderland DP Purple' & 'Wonderland Pink' | Field Container | Wade        | SC    | 2013 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times; all plants marketable.          |
| 31133 | Madwort (Alyssum sp.) 'Wonderland Rose'                          | Field Container | Davis       | MI    | 2011 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied three times.                             |
| 30183 | Angelonia (Angelonia angustifolia) 'Angel Mist Pink'             | Greenhouse      | Chen        | LA    | 2011 | Foliar           | No injury or significant difference in plant growth and quality with 6.38, 12.76 and 25.52 fl oz per 100 gal applied twice. |
| 30183 | Angelonia (Angelonia angustifolia) 'Serena Purple'               | Greenhouse      | Chen        | LA    | 2011 | Foliar           | No injury or significant difference in plant growth and quality with 6.38, 12.76 and 25.52 fl oz per 100 gal applied twice. |
| 30183 | Angelonia (Angelonia angustifolia) 'Sundancer Pink'              | Greenhouse      | Freiberger  | NJ    | 2013 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal mixed with surfactant applied 3 times.           |
| 30351 | Snapdragon (Antirrhinum majus)                                   | Field Container | Reding      | OH    | 2013 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times with NIS; all plants marketable. |
| 30351 | Snapdragon (Antirrhinum majus) 'Chimes Rose'                     | Field Container | Davis       | MI    | 2011 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied three times.                             |
| 30351 | Snapdragon (Antirrhinum majus) 'Peachy Dragon'                   | Field Container | Freiberger  | NJ    | 2012 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.                                 |
| 30351 | Snapdragon (Antirrhinum majus) 'Speedy Sonnet White'             | Field Container | DeFrancesco | OR    | 2013 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.                                 |
| 30665 | Water Hyssop (Bacopa sp.) 'Abunda Colossal Blue'                 | Greenhouse      | Chen        | LA    | 2013 | Foliar           | No significant injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied twice.                       |
| 30665 | Water Hyssop (Bacopa sp.) 'Abunda Colossal White'                | Greenhouse      | Chen        | LA    | 2013 | Foliar           | No significant injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied twice.                       |
| 30665 | Water Hyssop (Bacopa sp.) 'Blutopia Blue'                        | Greenhouse      | Freiberger  | NJ    | 2014 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal + NIS applied 3 times.                           |
| 30665 | Water Hyssop (Bacopa sp.) Suteracordata 'Snowstorm Pink'         | Greenhouse      | Gilrein     | NY    | 2013 | Foliar           | No injury on foliage or flowers with 6.38, 12.76, and 25.52 fl oz per 100 gal applied biweekly three times.                 |
| 30665 | Water Hyssop (Bacopa sp.) Suteracordata 'Snowstorm White'        | Greenhouse      | Gilrein     | NY    | 2013 | Foliar           | No injury on foliage or flowers with 6.38, 12.76, and 25.52 fl oz per 100 gal applied biweekly three times.                 |
| 30362 | Begonia (Begonia sp.) B. semperflorans 'Bada Boom'               | Field Container | Davis       | MI    | 2014 | Foliar           | No injury with 6.38, 12.76 and 25.52 fl oz per 100 gal + Capsil applied 3 times.  |

| PR#   | Crop   | Production Site | Researcher  | State | Year | Application Type | Results  |
|-------|--|-----------------|-------------|-------|------|------------------|--|
| 30362 | Begonia (Begonia sp.) B. semperflorens 'Green Leaf'                        | Field Container | Davis       | MI    | 2010 | Foliar           | No significant injury at 6.38, 12.76, and 25.52 fl oz per 100 gal.   |
| 29317 | Begonia (Begonia sp.) B. x semperflorens-cultorum 'Cocktail Rum'           | Greenhouse      | Gilrein     | NY    | 2011 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal.  |
| 29317 | Begonia (Begonia sp.) B. x semperflorens-cultorum 'Eureka GL White'        | Greenhouse      | Gilrein     | NY    | 2011 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal.  |
| 30362 | Begonia (Begonia sp.) 'Big Rose'   | Field Container | Uber        | CA    | 2013 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal + Capsil applied 3 times.                   |
| 29317 | Begonia (Begonia sp.) 'Cocktail Pink'                                      | Greenhouse      | Chen        | LA    | 2012 | Foliar           | No injury with 6.38, 12.76 and 25.52 fl oz per 100 gal applied twice; virtually no growth reduction.                   |
| 29317 | Begonia (Begonia sp.) 'Cocktail White'                                     | Greenhouse      | Chen        | LA    | 2012 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied twice.                              |
| 29317 | Begonia (Begonia sp.) 'Dragon Wing Red'                                    | Greenhouse      | Freiberger  | NJ    | 2011 | Foliar           | No and very minor injury (at 4X) with 6.4, 12.8 and 25.5 fl oz per 100 gal + surfactant applied 3 times.               |
| 29317 | Begonia (Begonia sp.) 'Non-stop Orange'                                    | Greenhouse      | Freiberger  | NJ    | 2011 | Foliar           | No and very minor injury (at 4X) with 6.4, 12.8 and 25.5 fl oz per 100 gal + surfactant applied 3 times.               |
| 30362 | Begonia (Begonia sp.) 'Red'  | Field Container | Davis       | MI    | 2011 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied three times.                        |
| 31689 | Calibrachoa (Calibrachoa sp.) 'Banana Chocolate'                           | Greenhouse      | Gilrein     | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times. |
| 31689 | Calibrachoa (Calibrachoa sp.) 'Kabloom White'                              | Greenhouse      | Freiberger  | NJ    | 2014 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.                            |
| 31689 | Calibrachoa (Calibrachoa sp.) 'Lemon Slice'                                | Greenhouse      | Gilrein     | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times. |
| 31689 | Calibrachoa (Calibrachoa sp.) 'MiniFamous TM Compact Blue'                 | Greenhouse      | DeFrancesco | OR    | 2015 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.6 fl oz per 100 gal applied biweekly.                              |
| 31689 | Calibrachoa (Calibrachoa sp.) 'Superbells Lemon Slice'                     | Greenhouse      | Vafaie      | TX    | 2015 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.6 fl oz per 100 gal + Preference applied 3 times biweekly.         |
| 30536 | Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Jamestown'         | Greenhouse      | Uber        | CA    | 2015 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.7 fl oz per 100 gal + Capsil applied 3 times.                      |
| 30536 | Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Outrageous Orange' | Greenhouse      | Gilrein     | NY    | 2012 | Foliar           | No injury on foliage or flowers at 6.38, 12.76, and 25.52 fl oz per 100 gal applied biweekly 3 times.                  |
| 30536 | Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sly Jenna'         | Greenhouse      | Chen        | LA    | 2010 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.5 fl oz per 100 gal applied twice.                                 |



| PR#   | Crop   | Production Site | Researcher  | State | Year | Application Type | Results  |
|-------|--|-----------------|-------------|-------|------|------------------|--|
| 30536 | Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sparkle White' | Greenhouse      | Gilrein     | NY    | 2012 | Foliar           | No injury on foliage or flowers at 6.38, 12.76, and 25.52 fl oz per 100 gal applied biweekly 3 times.                  |
| 31691 | Tickseed (Coreopsis sp.) 'Early Sunrise Yellow'                        | Greenhouse      | Freiberger  | NJ    | 2014 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.                            |
| 30374 | Dahlia (Dahlia sp.) 'Dahlietta Leanne'                                 | Field Container | Chen        | LA    | 2013 | Foliar           | No significant injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied twice.                  |
| 30374 | Dahlia (Dahlia sp.) 'Dahlietta Marissa'                                | Field Container | Chen        | LA    | 2013 | Foliar           | No significant injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied twice.                  |
| 30374 | Dahlia (Dahlia sp.) 'Figaro Mix'                                       | Field Container | Davis       | MI    | 2011 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied three times.                        |
| 30374 | Dahlia (Dahlia sp.) 'Figaro Mix'                                       | Field Container | Freiberger  | NJ    | 2013 | Foliar           | No phytotoxicity with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.   |
| 30595 | Pinks (Dianthus sp.) D. barbatus                                       | Greenhouse      | DeFrancesco | OR    | 2015 | Foliar           | No injury, but moderate growth reduction, with 6.4, 12.8 and 25.6 fl oz per 100 gal applied biweekly.                  |
| 30595 | Pinks (Dianthus sp.) 'Floral Lace Crimson'                             | Greenhouse      | Freiberger  | NJ    | 2013 | Foliar           | No injury or growth reduction with 6.38, 12.72 and 25.58 fl oz per 100 gal mixed with surfactant applied 3 times.      |
| 31696 | Dracaena (Dracaena sp.) D. indivisa                                    | Greenhouse      | Gilrein     | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times. |
| 31696 | Dracaena (Dracaena sp.) D. marginata                                   | Greenhouse      | Uber        | CA    | 2014 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.5 fl oz per 100 gal + Capsil applied 3 times.                      |
| 31696 | Dracaena (Dracaena sp.) D. marginata                                   | Greenhouse      | Uber        | CA    | 2015 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.6 fl oz per 100 gal + Capsil applied 3 times.                      |
| 31696 | Dracaena (Dracaena sp.) 'Spikes'                                       | Greenhouse      | Freiberger  | NJ    | 2014 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.                            |
| 29318 | Fuschia, Ladies-Eardrops (Fuschia sp.) 'Dollar Princess'               | Greenhouse      | Freiberger  | NJ    | 2015 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.                            |
| 29318 | Fuschia, Ladies-Eardrops (Fuschia sp.) F. magellanica 'Lena'           | Greenhouse      | Gilrein     | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times. |
| 29318 | Fuschia, Ladies-Eardrops (Fuschia sp.) F. magellanica 'Swingtime'      | Greenhouse      | Gilrein     | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times. |
| 30596 | Jasmine, Cape, Common Gardenia (Gardenia sp.) G. augusta               | Greenhouse      | Uber        | CA    | 2013 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal + Capsil applied 3 times.                   |
| 29319 | Transvaal Daisy (Gerbera sp.) 'Festival Lt. Eye Orange'                | Greenhouse      | Edmunds     | CO    | 2010 | Spray-to-wet     | No injury at 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.  |
| 29319 | Transvaal Daisy (Gerbera sp.) 'Jaguar Pink'                            | Greenhouse      | Gilrein     | NY    | 2012 | Foliar           | No injury on foliage or flowers with 6.38, 12.76, and 25.52 fl oz per 100 gal applied biweekly three times.            |

| PR#   | Crop  | Production Site | Researcher | State | Year | Application Type | Results  |
|-------|---|-----------------|------------|-------|------|------------------|--|
| 29319 | Transvaal Daisy (Gerbera sp.) 'Royal Red'                             | Greenhouse      | Gilrein    | NY    | 2012 | Foliar           | No injury on foliage or flowers with 6.38, 12.76, and 25.52 fl oz per 100 gal applied biweekly three times.            |
| 31695 | Ivy (Hedera sp.) 'Baltica'  | Greenhouse      | Gilrein    | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times. |
| 31695 | Ivy (Hedera sp.) 'Gold Child'   | Greenhouse      | Gilrein    | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times. |
| 31695 | Ivy (Hedera sp.) H. Algeriensis 'Gloire de Marengo'                   | Greenhouse      | Gilrein    | NY    | 2015 | Foliar           | No injury or reduction of plant growth and quality with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.       |
| 31695 | Ivy (Hedera sp.) H. helix   | Greenhouse      | Uber       | CA    | 2015 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.6 fl oz per 100 gal + Capsil applied 3 times.                      |
| 31695 | Ivy (Hedera sp.) H. helix 'Needlepoint'                               | Greenhouse      | Gilrein    | NY    | 2015 | Foliar           | No injury or reduction of plant growth and quality with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.       |
| 31692 | Rosemallow (Hibiscus sp.) 'Luna White'                                | Greenhouse      | Freiberger | NJ    | 2015 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.6 fl oz per 100 gal applied 3 times.                               |
| 31693 | Hydrangea (Hydrangea sp.) H. macrophylla 'Nikko Blue'                 | Field Container | Gilrein    | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times. |
| 31693 | Hydrangea (Hydrangea sp.) H. paniculata 'Grandiflora'                 | Field Container | Gilrein    | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times. |
| 30363 | New Guinea Impatiens (Impatiens hawkeri)                              | Field Container | Reding     | OH    | 2013 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times; all plants marketable.     |
| 30363 | New Guinea Impatiens (Impatiens hawkeri) 'Cherry Red'                 | Field Container | Freiberger | NJ    | 2013 | Foliar           | No phytotoxicity with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.   |
| 29321 | New Guinea Impatiens (Impatiens hawkeri) 'Dazzler Violet'             | Greenhouse      | Chen       | LA    | 2010 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.5 fl oz per 100 gal applied twice.                                 |
| 30363 | New Guinea Impatiens (Impatiens hawkeri) 'Divine Violet'              | Field Container | Freiberger | NJ    | 2013 | Foliar           | No phytotoxicity with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.   |
| 30363 | New Guinea Impatiens (Impatiens hawkeri) I. walleriana 'Stardust Red' | Field Container | Davis      | MI    | 2011 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied three times.                        |
| 29321 | New Guinea Impatiens (Impatiens hawkeri) 'Paradise Bright Red'        | Greenhouse      | Freiberger | NJ    | 2011 | Foliar           | No to very minor injury with 6.4, 12.8 and 25.5 fl oz per 100 gal + surfactant applied 3 times.                        |
| 29321 | New Guinea Impatiens (Impatiens hawkeri) 'Paradise Lavender Blue'     | Greenhouse      | Freiberger | NJ    | 2011 | Foliar           | No to very minor injury with 6.4, 12.8 and 25.5 fl oz per 100 gal + surfactant applied 3 times.                        |
| 29321 | New Guinea Impatiens (Impatiens hawkeri) 'Patchwork Salmon'           | Greenhouse      | Chen       | LA    | 2011 | Foliar           | No significant injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied twice.                  |
| 29321 | New Guinea Impatiens (Impatiens hawkeri) 'Sonic Lilac'                | Greenhouse      | Chen       | LA    | 2011 | Foliar           | No significant injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied twice.                  |

| PR#   | Crop  | Production Site | Researcher  | State | Year | Application Type | Results  |
|-------|---|-----------------|-------------|-------|------|------------------|--|
| 29321 | New Guinea Impatiens (Impatiens hawkeri) 'Super Elfin Red'        | Greenhouse      | Chen        | LA    | 2010 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.5 fl oz per 100 gal applied twice.   |
| 30363 | New Guinea Impatiens (Impatiens hawkeri) 'Sweet Cherry'           | Field Container | Uber        | CA    | 2013 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal + Capsil applied 3 times.                               |
| 29320 | Balsam (Impatiens sp.) 'Cherry Splash'                            | Greenhouse      | Gilrein     | NY    | 2012 | Foliar           | No injury at 6.38, 12.76, and 25.52 fl oz per 100 gal applied biweekly three times.  |
| 29320 | Balsam (Impatiens sp.) 'Double Camellia Mix'                      | Greenhouse      | Freiberger  | NJ    | 2011 | Foliar           | Minor injury with 6.4, 12.8 and 25.5 fl oz per 100 gal + surfactant applied 3 times.   |
| 29320 | Balsam (Impatiens sp.) 'Extra Dwarf Tom Thumb'                    | Greenhouse      | Freiberger  | NJ    | 2011 | Foliar           | Minor injury with 6.4, 12.8 and 25.5 fl oz per 100 gal + surfactant applied 3 times.   |
| 30382 | Balsam (Impatiens sp.) I. walleriana 'Dazzler Pink'               | Field Container | Davis       | MI    | 2010 | Foliar           | No significant injury at 6.38, 12.76, and 25.52 fl oz per 100 gal.   |
| 30382 | Balsam (Impatiens sp.) 'Super Elfin Lavender'                     | Field Container | Wade        | SC    | 2012 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied with surfactant 3 times; all plants marketable. |
| 30382 | Balsam (Impatiens sp.) 'Super Elfin XP Pink'                      | Field Container | Wade        | SC    | 2012 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied with surfactant 3 times; all plants marketable. |
| 29320 | Balsam (Impatiens sp.) 'Super Elfin XP Red'                       | Greenhouse      | Gilrein     | NY    | 2012 | Foliar           | No injury at 6.38, 12.76, and 25.52 fl oz per 100 gal applied biweekly three times.  |
| 31599 | Sweet Alyssum (Lobulariamaritima) 'Clear Crystal Lavender Shades' | Field Container | Gilrein     | NY    | 2015 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times; improved plant quality.                |
| 31599 | Sweet Alyssum (Lobulariamaritima) 'Easter Bonnet Peach'           | Field Container | Gilrein     | NY    | 2015 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times; improved plant quality.                |
| 31599 | Sweet Alyssum (Lobulariamaritima) 'Clear Crystal White'           | Field Container | DeFrancesco | OR    | 2013 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.  |
| 30375 | Geranium, Zonal (Pelargonium x hortorum) 'Cranesbill'             | Field Container | Uber        | CA    | 2013 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal + Capsil applied 3 times.                               |
| 30375 | Geranium, Zonal (Pelargonium x hortorum) 'Orbit Pink Seed'        | Field Container | Davis       | MI    | 2011 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied three times.                                    |
| 30375 | Geranium, Zonal (Pelargonium x hortorum) 'Pinto Salmon'           | Field Container | Gilrein     | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.             |
| 30375 | Geranium, Zonal (Pelargonium x hortorum) 'Pinto White'            | Field Container | Gilrein     | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.             |
| 30364 | Petunia (Petunia sp.)   | Field Container | Reding      | OH    | 2013 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times with NIS; all plants marketable.        |

| PR#   | Crop  | Production Site | Researcher | State | Year | Application Type | Results  |
|-------|---|-----------------|------------|-------|------|------------------|--|
| 30364 | Petunia (Petunia sp.) 'Dreams White'                  | Field Container | Davis      | MI    | 2011 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied three times.  |
| 29322 | Petunia (Petunia sp.) 'Easy Wave Rose'                | Greenhouse      | Chen       | LA    | 2010 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.5 fl oz per 100 gal applied twice.   |
| 30364 | Petunia (Petunia sp.) P. x hybrida 'Prism Sunshine'   | Field Container | Davis      | MI    | 2010 | Foliar           | No significant injury at 6.38, 12.76, and 25.52 fl oz per 100 gal.   |
| 30364 | Petunia (Petunia sp.) 'SGL Dreams Red'                | Field Container | Wade       | SC    | 2012 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied with surfactant 3 times; all plants marketable.   |
| 30364 | Petunia (Petunia sp.) 'SGL Dreams White'              | Field Container | Wade       | SC    | 2012 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied with surfactant 3 times; all plants marketable.   |
| 29322 | Petunia (Petunia sp.) 'Shockwave Coconut'             | Greenhouse      | Freiberger | NJ    | 2011 | Foliar           | Virtually no injury with 6.4, 12.8 and 25.5 fl oz per 100 gal + surfactant applied 3 times.  |
| 29322 | Petunia (Petunia sp.) 'Wave Purple'                   | Greenhouse      | Freiberger | NJ    | 2011 | Foliar           | Virtually no injury with 6.4, 12.8 and 25.5 fl oz per 100 gal + surfactant applied 3 times.  |
| 30597 | Rose (Rosa sp.) 'First Impression'                    | Greenhouse      | Gilrein    | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.   |
| 30597 | Rose (Rosa sp.) 'Powerhouse'                          | Greenhouse      | Gilrein    | NY    | 2014 | Foliar           | No injury on leaves and flowers, and no growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.   |
| 30597 | Rose (Rosa sp.) 'Radrazz'                             | Greenhouse      | Freiberger | NJ    | 2013 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.5 fl oz per 100 gal applied 3 times.   |
| 31690 | Sage, Scarlet (Salvia splendens)                      | Greenhouse      | Freiberger | NJ    | 2014 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.  |
| 31690 | Sage, Scarlet (Salvia splendens)                      | Greenhouse      | Uber       | CA    | 2015 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.6 fl oz per 100 gal + Capsil applied 3 times.  |
| 31690 | Sage, Scarlet (Salvia splendens) 'Lighthouse Red'     | Greenhouse      | Gilrein    | NY    | 2014 | Foliar           | No injury on leaves and flowers with 6.38 and 12.76, moderate with 25.52 fl oz per 100 gal applied 3 times; no significant growth reduction; unacceptable plant quality at 4X. |
| 31690 | Sage, Scarlet (Salvia splendens) S. splendens 'Sally' | Greenhouse      | Davis      | MI    | 2014 | Foliar           | No injury with 6.38, 12.76 and 25.52 fl oz per 100 gal + Capsil applied 3 times.   |
| 31690 | Sage, Scarlet (Salvia splendens) 'Vista Purple'       | Greenhouse      | Gilrein    | NY    | 2014 | Foliar           | No injury on leaves and flowers with 6.38 and 12.76, moderate with 25.52 fl oz per 100 gal applied 3 times; no significant growth reduction; unacceptable plant quality at 4X. |
| 30383 | Marigold (Tagetes sp.) 'Antigua Orange'               | Field Container | Wade       | SC    | 2012 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied with surfactant 3 times; all plants marketable.   |

| PR#   | Crop   | Production Site | Researcher | State | Year | Application Type | Results  |
|-------|--|-----------------|------------|-------|------|------------------|--|
| 30383 | Marigold (Tagetes sp.) 'Antigua Yellow'                    | Field Container | Wade       | SC    | 2012 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied with surfactant 3 times; all plants marketable. |
| 29323 | Marigold (Tagetes sp.) 'Marvel Orange'                     | Greenhouse      | Freiberger | NJ    | 2011 | Foliar           | No to very minor injury (at 4X) with 6.4, 12.8 and 25.5 fl oz per 100 gal + surfactant applied 3 times.                            |
| 30383 | Marigold (Tagetes sp.) T. erecta 'Inca Orange'             | Field Container | Davis      | MI    | 2010 | Foliar           | No significant injury at 6.38, 12.76, and 25.52 fl oz per 100 gal.   |
| 30383 | Marigold (Tagetes sp.) T. patula 'Bonanza Yellow'          | Field Container | Davis      | MI    | 2011 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied three times.                                    |
| 29323 | Marigold (Tagetes sp.) 'Taishan Orange'                    | Greenhouse      | Chen       | LA    | 2010 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.5 fl oz per 100 gal applied twice.   |
| 29323 | Marigold (Tagetes sp.) 'Taishan Yellow'                    | Greenhouse      | Chen       | LA    | 2010 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.5 fl oz per 100 gal applied twice.   |
| 29323 | Marigold (Tagetes sp.) 'Tiger Eyes'                        | Greenhouse      | Freiberger | NJ    | 2011 | Foliar           | No to very minor injury (at 4X) with 6.4, 12.8 and 25.5 fl oz per 100 gal + surfactant applied 3 times.                            |
| 29324 | Vervain (Verbena sp.)                                      | Greenhouse      | Davis      | MI    | 2013 | Foliar           | No injury with 6.38, 12.76 and 25.52 fl oz per 100 gal + Capsil applied 3 times.   |
| 29324 | Vervain (Verbena sp.) 'Homestead Purple'                   | Greenhouse      | Chen       | LA    | 2010 | Foliar           | No injury with 6.4, 12.8 and 25.5 fl oz per 100 gal applied twice.   |
| 30365 | Vervain (Verbena sp.) 'Obsession Pink'                     | Field Container | Wade       | SC    | 2012 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied with surfactant 3 times; all plants marketable. |
| 30365 | Vervain (Verbena sp.) 'Obsession Scarlet'                  | Field Container | Davis      | MI    | 2014 |                  | Moderate injury after the 3rd application with 6.38, 12.76 and 25.52 fl oz per 100 gal + Capsil.                                   |
| 29324 | Vervain (Verbena sp.) 'Quartz x P Scarlet'                 | Greenhouse      | Edmunds    | CO    | 2010 | Spray-to-wet     | No injury at 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.  |
| 30365 | Vervain (Verbena sp.) 'Quartz XP Purple'                   | Field Container | Wade       | SC    | 2012 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied with surfactant 3 times; all plants marketable. |
| 29324 | Vervain (Verbena sp.) 'Serenity Pink'                      | Greenhouse      | Chen       | LA    | 2010 | Foliar           | No injury with 6.4, 12.8 and 25.5 fl oz per 100 gal applied twice; height reduction at 4X.   |
| 29324 | Vervain (Verbena sp.) V. hybrida 'Obsession Blue with Eye' | Greenhouse      | Gilrein    | NY    | 2011 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal.  |
| 29324 | Vervain (Verbena sp.) V. hybrida 'Quartz White'            | Greenhouse      | Gilrein    | NY    | 2011 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal.  |
| 29325 | Pansy (Viola sp.)  | Greenhouse      | Uber       | CA    | 2015 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.6 fl oz per 100 gal + Capsil applied 3 times.                                  |
| 29325 | Pansy (Viola sp.) 'Dynamite Scarlet'                       | Greenhouse      | Chen       | LA    | 2010 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.5 fl oz per 100 gal applied twice.   |
| 29325 | Pansy (Viola sp.) 'Matrix Blue Cross'                      | Greenhouse      | Freiberger | NJ    | 2014 | Foliar           | No injury or growth reduction with 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.  |

| PR#   | Crop   | Production Site | Researcher | State | Year | Application Type | Results   |
|-------|--|-----------------|------------|-------|------|------------------|---|
| 29325 | Pansy (Viola sp.) V. wittrockiana                | Greenhouse      | Davis      | MI    | 2014 | Foliar           | Slight injury after the 1st application with complete recovery at 6.38, 12.76 and 25.52 fl oz per 100 gal + Capsil applied 3 times. |
| 29326 | Zinnia (Zinnia sp.) 'Elegans Envy'               | Greenhouse      | Freiberger | NJ    | 2011 | Foliar           | No to minor injury with 6.4, 12.8 and 25.5 fl oz per 100 gal + surfactant applied 3 times.  |
| 29326 | Zinnia (Zinnia sp.) 'Magellan Coral'             | Greenhouse      | Edmunds    | CO    | 2010 | Spray-to-wet     | No injury at 6.38, 12.76 and 25.52 fl oz per 100 gal applied 3 times.   |
| 29326 | Zinnia (Zinnia sp.) 'Profusion Knee-high Yellow' | Greenhouse      | Chen       | LA    | 2011 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.5 fl oz per 100 gal applied twice.  |
| 29326 | Zinnia (Zinnia sp.) 'Red Spider'                 | Greenhouse      | Freiberger | NJ    | 2011 | Foliar           | No to minor injury with 6.4, 12.8 and 25.5 fl oz per 100 gal + surfactant applied 3 times.  |
| 29326 | Zinnia (Zinnia sp.) 'Zahra White'                | Greenhouse      | Chen       | LA    | 2011 | Foliar           | No injury or growth reduction with 6.4, 12.8 and 25.5 fl oz per 100 gal applied twice.  |

## Label Suggestions

We recommend that these four crops listed below be added to the current label:

*Calibrachoa sp.*

*Dracaena sp.*

*Fuschia sp.*

*Hedera sp.*

Given the lack of phytotoxicity across so many different plant species and genera, it is suggested that all the 4 plants in Table 4 (listed below) that showed no injury be added to the Rycar label if SePro have similar results on these crops:

*Coreopsis sp.*

*Gardenia sp.*

*Hibiscus sp.*

*Hydrangea sp.*

## Appendix 1: Contributing Researchers

|                     |   |
|---------------------|---|
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