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

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**Acknowledgements  
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## Abstract

Sultan (cyflumetofen) was registered for use on greenhouse ornamental horticulture crops as foliar sprays in the United States on May 9, 2014 to manage mites. The label does not contain a list of crops tested for tolerance. During 2014 and 2015, the IR-4 Project conducted 69 trials on 21 ornamental plant species examining phytotoxicity related to cyflumetofen applications. Only one crop (*Impatiens walleriana*) exhibited significant injury or growth reduction during these experiments.

## Introduction

Sultan (cyflumetofen) was registered for use on greenhouse ornamental horticulture crops as foliar sprays in the United States on May 9, 2014 to manage mites. The label does not contain a list of crops tested for tolerance. During 2014 and 2015, the IR-4 Project conducted 29 trials on 21 ornamental plant species examining phytotoxicity related to cyflumetofen applications.

## Materials and Methods

Cyflumetofen 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 13.7, 27.4, and 54.8 fl oz per 100 gal, plus a water treated control; a non ionic surfactant was co-applied by most researchers. 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 6 weeks after initial application. For IR-4 testing, the following protocols were used: 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.

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

## Results and Summary

### ***Phytotoxicity***

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 cyflumetofen, and 4) more data are needed to make informed recommendations.

Only one crop (*Impatiens walleriana*) exhibited significant injury or growth reduction during these experiments.

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

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

*Alyssum sp.*  
*Angelonia angustifolia*  
*Antirrhinum majus*  
*Chrysanthemum/Dendranthema sp.*  
*Dahlia sp.*  
*Draceana sp.*  
*Fuschia sp.*  
*Hedera sp.*  
*Hibiscus sp.*  
*Hydrangea sp.*  
*Impatiens hawkeri*  
*Salvia splendens*  
*Viola sp.*

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

*Impatiens walleriana*

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

*None*

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

<i>Calibrachoa sp.</i> <sup>1</sup>	<i>Heucherella sp.</i> <sup>1</sup>
<i>Coreopsis sp.</i> <sup>1</sup>	<i>Pelargonium sp.</i> <sup>1</sup>
<i>Geranium sp.</i> <sup>1</sup>	<i>Rosa sp.</i> <sup>1</sup>
<i>Gerbera sp.</i> <sup>1</sup>	

<sup>1</sup> 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 Cyflumetofen**

Notes: Table entries are sorted by crop Latin name. Only those trials with research reports received by 7/15/2016 are listed below.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
31723	Madwort (Alyssum sp.)	Field Container	Reding	OH	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal + NIS applied 3 times; all plants marketable.
31723	Madwort (Alyssum sp.) '(Easter Bonnet', 'Deep Pink'	Field Container	Wade	SC	2014	Foliar	No injury with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times biweekly; all plants marketable.
31723	Madwort (Alyssum sp.) A. maritima 'Wonderlanf'	Field Container	Davis	MI	2014	Foliar	No injury with 13.76, 27.4 and 54.8 fl oz per 100 gal + Capsil applied 3 times.
31723	Madwort (Alyssum sp.) A. maritimum 'Wonderland'	Field Container	Davis	MI	2015	Foliar	No significant injury with 13.7, 27.4 and 54.8 fl oz per acre + Capsil applied 3 times.
31723	Madwort (Alyssum sp.) A. saxatilis 'Goldkugel'	Field Container	DeFrancesco	OR	2014	Foliar	No injury or significant growth reduction with 13.7, 27.4 and 54.8 fl oz per acre + NIS.
31723	Madwort (Alyssum sp.) Alyssum saxatile 'Summit'	Field Container	Freiberger	NJ	2014	Foliar	No injury or significant growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31731	Angelonia (Angelonia angustifolia) 'Serena Blue'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31731	Angelonia (Angelonia angustifolia) 'Serenita Purple'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31731	Angelonia (Angelonia angustifolia) 'Serenita Raspberry'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31722	Snapdragon (Antirrhinum majus) 'Mini Chimes'	Greenhouse	Davis	MI	2014	Foliar	No injury with 13.76, 27.4 and 54.8 fl oz per 100 gal + Capsil applied 3 times.
31722	Snapdragon (Antirrhinum majus) 'Orange Candy Show'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31722	Snapdragon (Antirrhinum majus) 'Red Rocket'	Greenhouse	DeFrancesco	OR	2014	Foliar	No injury or significant growth reduction with 13.7, 27.4 and 54.8 fl oz per acre + NIS.
31724	Calibrachoa (Calibrachoa sp.)	Greenhouse	Davis	MI	2015	Foliar	No significant injury with 13.7, 27.4 and 54.8 fl oz per acre + Capsil applied 3 times.
31724	Calibrachoa (Calibrachoa sp.) 'Kabloom White'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31728	Hardy Mum (Chrysanthemum/Dendranthema x morifolium)	Field Container	Reding	OH	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal + NIS applied 3 times; all plants marketable.
31728	Hardy Mum (Chrysanthemum/Dendranthema x morifolium) 'Outrageous Orange'	Field Container	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31728	Hardy Mum (Chrysanthemum/Dendranthema x morifolium) 'Sparkle White'	Field Container	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
31732	Tickseed ( <i>Coreopsis</i> sp.) C. auriculata	Field Container	Uber	CA	2015	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31732	Tickseed ( <i>Coreopsis</i> sp.) 'Early Sunrise'	Field Container	Wade	SC	2014	Foliar	No injury with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times biweekly; all plants marketable.
31718	Dahlia ( <i>Dahlia</i> sp.) D hybrida 'Grandahlia Deep Red'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31718	Dahlia ( <i>Dahlia</i> sp.) D hybrida 'Grandahlia Pink'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31718	Dahlia ( <i>Dahlia</i> sp.) D hybrida 'Grandahlia White'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31718	Dahlia ( <i>Dahlia</i> sp.) D hybrida 'Grandahlia White'Orange	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31718	Dahlia ( <i>Dahlia</i> sp.) D hybrida 'Grandahlia Yellow'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31718	Dahlia ( <i>Dahlia</i> sp.) D. hortensis 'Figaro'	Greenhouse	Davis	MI	2014	Foliar	No injury with 13.76, 27.4 and 54.8 fl oz per 100 gal + Capsil applied 3 times.
32264	Dahlia ( <i>Dahlia</i> sp.) D. hortensis 'Figaro'	Field Container	Davis	MI	2015	Foliar	No significant injury with 13.7, 27.4 and 54.8 fl oz per acre + Capsil applied 3 times.
31718	Dahlia ( <i>Dahlia</i> sp.) 'Fresco Mix'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31738	Dracaena ( <i>Dracaena</i> sp.) <i>Cordylene australis</i>	Greenhouse	Gilrein	NY	2015	Foliar	No injury or reduction in plant growth and quality with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31738	Dracaena ( <i>Dracaena</i> sp.) D. indivisa	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31738	Dracaena ( <i>Dracaena</i> sp.) D. marginata	Greenhouse	Uber	CA	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal + Capsil applied 3 times.
31738	Dracaena ( <i>Dracaena</i> sp.) 'Spikes'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31730	Fuschia, Ladies-Eardrops ( <i>Fuschia</i> sp.) F. magellanica 'Lena'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31730	Fuschia, Ladies-Eardrops ( <i>Fuschia</i> sp.) F. magellanica 'Swingtime'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31730	Fuschia, Ladies-Eardrops ( <i>Fuschia</i> sp.) F. x hybrida 'Neon White'	Greenhouse	Gilrein	NY	2015	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times; improved plant quality.
31730	Fuschia, Ladies-Eardrops ( <i>Fuschia</i> sp.) F. x hybrida 'Southgate'	Greenhouse	Gilrein	NY	2015	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times; improved plant quality.
31730	Fuschia, Ladies-Eardrops ( <i>Fuschia</i> sp.) 'Marinka'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury and more vigorous plants with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31721	Transvaal Daisy ( <i>Gerbera</i> sp.) 'Mega Rev Mix'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31736	Ivy ( <i>Hedera</i> sp.) 'English Ivy-Green'	Field Container	Wade	SC	2014	Foliar	No injury with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times biweekly; all plants marketable.



PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
31736	Ivy (Hedera sp.) H. canariensis	Field Container	Uber	CA	2015	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31736	Ivy (Hedera sp.) H. helix	Field Container	Davis	MI	2015	Foliar	No significant injury with 13.7, 27.4 and 54.8 fl oz per acre + Capsil applied 3 times.
31735	Foamy Bells (Heucherella sp.) Heucherella x Tiarella 'Pink Fizz'	Field Container	Davis	MI	2015	Foliar	No significant injury with 13.7, 27.4 and 54.8 fl oz per acre + Capsil applied 3 times.
31733	Rosemallow (Hibiscus sp.) 'Disco Belle Mix'	Field Container	Wade	SC	2014	Foliar	No injury with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times biweekly; all plants marketable.
31733	Rosemallow (Hibiscus sp.) H. syriacus 'Azurri Blue Satin'	Field Container	Reding	OH	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal + NIS applied 3 times; all plants marketable.
31733	Rosemallow (Hibiscus sp.) 'White Wing'	Field Container	Uber	CA	2015	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31734	Hydrangea (Hydrangea sp.) 'Glowing Embers'	Field Container	Persad	OH	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal + Capsil applied twice.
31734	Hydrangea (Hydrangea sp.) H. macrophylla 'Robert'	Field Container	DeFrancesco	OR	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per acre + NIS.
31734	Hydrangea (Hydrangea sp.) H. paniculata 'Fire Light'	Field Container	Reding	OH	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal + NIS applied 3 times; all plants marketable.
31734	Hydrangea (Hydrangea sp.) 'Mac. Nikko Blue'	Field Container	Wade	SC	2014	Foliar	No injury with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times biweekly; all plants marketable.
31719	New Guinea Impatiens (Impatiens hawkeri)	Greenhouse	Davis	MI	2015	Foliar	No significant injury with 13.7, 27.4 and 54.8 fl oz per acre + Capsil applied 3 times.
31719	New Guinea Impatiens (Impatiens hawkeri) 'Divine Cherry'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31719	New Guinea Impatiens (Impatiens hawkeri) 'Divine Orange'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31720	Balsam (Impatiens sp.) 'Dark Salmon Glow'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury and more vigorous plants with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31720	Balsam (Impatiens sp.) 'Harmony Red Fire'	Greenhouse	Freiberger	NJ	2014	Foliar	Virtually no injury and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31720	Balsam (Impatiens sp.) I. walleriana 'Super Elfin Lipstick'	Greenhouse	Vafaie	TX	2015	Foliar	Moderate injury with 13.7, 27.4 and 54.8 fl oz per 100 gal + Preference after 2nd applic., with virtually complete recovery 2 weeks after 3rd applic. for 1X and 2X; no growth reduction.
32634	Garden Impatiens (Impatiens walleriana) 'Super Elfin'	Field Container	Davis	MI	2015	Foliar	No significant injury with 13.7, 27.4 and 54.8 fl oz per acre + Capsil applied 3 times.
31717	Geranium (Pelargonium sp.) 'Pink Elite'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or significant growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31717	Geranium (Pelargonium sp.) 'Pinto Premium White to Rose'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury, growth reduction or delay in blooming with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31729	Rose (Rosa sp.) 'First Impression'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
31729	Rose (Rosa sp.) 'Powerhouse'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.6, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31725	Sage, Scarlet (Salvia splendens)	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31725	Sage, Scarlet (Salvia splendens) 'Lighthouse Red'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31725	Sage, Scarlet (Salvia splendens) S. splendens 'Sally'	Greenhouse	Davis	MI	2014	Foliar	No injury with 13.76, 27.4 and 54.8 fl oz per 100 gal + Capsil applied 3 times.
31725	Sage, Scarlet (Salvia splendens) 'Vista Purple'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31726	Pansy (Viola sp.) 'Frizzy Lemonberry'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31726	Pansy (Viola sp.) 'Matrix Raspberry Sun'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31727	Pansy (Viola sp.) V. cornuta	Field Container	Reding	OH	2014	Foliar	No injury or growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal + NIS applied 3 times; all plants marketable.
31726	Pansy (Viola sp.) V. cornuta 'Sorbet XP Black Cherry'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31726	Pansy (Viola sp.) V. cornuta 'Sorbet XP Yellow Blotch'	Greenhouse	Gilrein	NY	2014	Foliar	No injury on leaves and flowers, and no growth reduction with 13.7, 27.4 and 54.8 fl oz per 100 gal applied 3 times.
31726	Pansy (Viola sp.) V. wittrockiana	Greenhouse	Davis	MI	2014	Foliar	No injury with 13.76, 27.4 and 54.8 fl oz per 100 gal + Capsil applied 3 times.
31727	Pansy (Viola sp.) V. wittrockiana	Field Container	Davis	MI	2014	Foliar	No injury with 13.76, 27.4 and 54.8 fl oz per 100 gal + Capsil applied 3 times.

## Label Suggestions

In this report, 13 species exhibited minimal or no injury after foliar sprays of cyflufenamid.

*Alyssum sp.*

*Angelonia angustifolia*

*Antirrhinum majus*

*Chrysanthemum/Dendranthema sp.*

*Dahlia sp.*

*Draceana sp.*

*Fuschia sp.*

*Hedera sp.*

*Hibiscus sp.*

*Hydrangea sp.*

*Impatiens hawkeri*

*Salvia splendens*

*Viola sp.*

There is only one species, *Impatiens walleriana*, that showed significant injury in two of three experiments.

More research is needed to understand crop safety among a wider range of crops.

## Appendix 1: Contributing Researchers

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