Environment Horticulture Program Research Summaries

IR-4 Environmental Horticulture Program
Flumioxazin + Prodiamine Crop Safety

Authors: Cristi L. Palmer
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Susan Bierbrunner
Ely Vea

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Abstract

Fuerte (flumioxazin + prodiamine) has been registered in the United States since 2018. Starting in 2020, the IR-4 Project has been screening additional crops for their tolerance to over the top applications. During 2018 to 2022, 51 crop safety trials on 22 environmental horticulture plant species or genera were conducted. In general, Fuerte exhibited no or minimal negative impact in these trials. Seven plant species or genera fell into this category as did 12 additional crops so far with just 1 or 2 trials completed. For two crop species, there was no or little injury exhibited at the 1X or 2X rates, but significant phytotoxicity occurred at 4X.

Introduction

Fuerte (flumioxazin + prodiamine) has been registered in the United States since 2018. Starting in 2020, the IR-4 Project has been screening additional crops for their tolerance to over the top applications. During 2018 to 2022, 51 crop safety trials on 22 environmental horticulture plant species or genera were conducted.

Materials and Methods

Fuerte (flumioxazin + prodiamine) was applied as an over the top treatment twice at approximately 6 week intervals. The application rates were 100, 200, and 400 lb product per acre (2.75, 5.5 an d11.0 lb ai per acre), 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 8 weeks after initial application. For IR-4 testing, the following protocols were used: 20-013 and 21-013. For more detailed materials and methods, including application rates for various products, please visit https://www.ir4project.org/ehc/ehc-registration-support-research/env-hort-researcher-resources/#Protocols to view and download these protocols.

Fuerte (flumioxazin + prodiamine) was supplied to researchers (See list of researchers in Appendix 1) by OHP.

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 SP3014, and 4) more data are needed to make informed recommendations.

Phytotoxicity

In general, Fuerte exhibited no or minimal negative impact on a wide range of plant species or genera Table 1, Table 6). Seven plant species or genera fell into this category as did 12 additional crops so far with just 1 or 2 trials completed. For two crop species, there was no or little injury exhibited at the 1X or 2X rates, but significant phytotoxicity occurred at 4X (Table 2).

Please see Table 7 for a summary of the individual trial results.

Table 1. List of flumioxazin + prodiamine treated crops with no or minimal transitory injury.

Abelia sp. [2]	*Pinus strobus* [2]	*Viburnum sp.* [1]
Buxus sp. [2]	*Rosa sp.* [2]	
Ilex verticillata [3]	*Spirea japonica* [3]	

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

Liriope spicata
Spiraea japonica

Table 3. List of flumioxazin + prodiamine treated crops with significant injury at 1X.

None

Table 4. List of flumioxazin + prodiamine treated crops with variable response.

None

Table 5. List of flumioxazin + prodiamine treated crops where more information is needed.

Cercis canadensis [1]	*Cornus sericea* [2]	*Picea glauca 'Conica'* [1]
Cercis occidentalis [1]	*Cotoneaster sp.* [1]	*Pinus nigra* [1]
Cornus alternifolia [1]	*Ligustrum sp.* [1]	*Vinca major* [1]
Cornus kousa [1]	*Magnolia grandiflora*	*Vinca minor* [2]
Cornus florida [1]	*Myrica cerifera* [3]	

[1] No injury in 1 or 2 trials
[2] Registered already
[3] Listed as sensitive on label

Table 6. Average crop safety rating after over the top applications of flumioxazin + prodiamine

Crop	Rating with Over the Top Broadcast Applications
Abelia sp.	1.3 (1 - 2) n3
Buxus sp.	1.0 (1 - 1) n4
Cercis canadensis	2.0 (1 - 3) n2
Cercis occidentalis	1.0 (1 - 1) n1
Cornus alternifolia	1.0 (1 - 1) n1
Cornus florida	1.5 (1 - 2) n2
Cornus kousa	1.0 (1 - 1) n2
Cornus sericea	1.5 (1 - 2) n2
Cotoneaster sp.	1.0 (1 - 1) n2
Ilex verticillata	1.3 (1 - 2) n3
Ligustrum sp.	1.0 (1 - 1) n1
Liriope spicata	2.3 (1 - 3) n3
Magnolia grandiflora	2.5 (1 - 4) n2
Myrica cerifera	2.5 (1 - 4) n2
Picea glauca 'Conica'	1.0 (1 - 1) n2
Pinus nigra	1.0 (1 - 1) n2
Pinus strobus	1.0 (1 - 1) n3
Rosa sp.	2.0 (1 - 3) n3
Spiraea japonica	1.7 (1 - 3) n3
Viburnum sp.	1.3 (1 - 2) n4
Vinca major	1.0 (1 - 1) n2
Vinca minor	1.0 (1 - 1) n2

Average rating on a scale of 1 – 5 with 1 = 0 to about no injury and 5 = severe injury and mortality; minimum to maximum rating; number of trials. A rating of 3 or higher is considered commercially unacceptable.

Table 7. Detailed Summary of Crop Safety Testing with flumioxazin + prodiamine.

Notes: Table entries are sorted by crop Latin name. Only those trials with research reports received by 12/20/2022 are listed below.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
33657	Abelia (Abelia sp.) A. grandiflora 'Lucky Lots'	Field Container	Moretti	OR	2020	Broadcast	No injury and growth reduction with 100, 200 and 400 lb per acre applied twice.
33657	Abelia (Abelia sp.) A. x grandiflora 'Radiance'	Field Container	Senesac	NY	2021	Broadcast	Minor transient injury increasing with rate (2.75, 5.5, 11.0 lb ai per acre).
33657	Abelia (Abelia sp.) 'Rose Creek'	Field Container	Witcher	TN	2020	Broadcast	No injury and growth reduction with 100, 200 and 400 lb per acre applied twice.
33651	Boxwood (Buxus sp.) Buxus microphylla var. japonica 'Winter Gem'	Field Container	Fraelich	GA	2020	Broadcast	No injury or significant growth reduction with 100, 200 and 400 lb per acre applied twice; all treated plants marketable.
33651	Boxwood (Buxus sp.) B. microphylla japonica 'Green Beauty'	Field Container	Koivunen	CA	2020	Broadcast	No injury and significant growth reduction with 100, 200 and 400 lb per acre applied twice.
33651	Boxwood (Buxus sp.) 'Green Velvet'	Field Container	Mathers	OH	2020	Broadcast	No injury with 2.75, 5.5 and 11.0 lb ai per acre.
33651	Boxwood (Buxus sp.) B. sempervirens 'Petite Pillar'	Field Container	Moretti	OR	2020	Broadcast	No injury and growth reduction with 100, 200 and 400 lb per acre applied twice.
33668	American Redbud, Eastern Redbud (Cercis canadensis)	Field Container	Cochran	MD	2021	Broadcast	Minor to Moderate injury increasing with rate when applied 2x, six weeks apart, at 100, 200, 400 lb per acre (2.75 ai, 5.5 lb ai, and 11.0 ai)
33668	American Redbud, Eastern Redbud (Cercis canadensis)	Field Container	Neal	NC	2021	Broadcast	Virtually no injury with 100, 200 or 400 lb product per acre after one or two applications.
33669	Red Bud, Western (Cercis occidentalis)	Field Container	Moretti	OR	2021	Broadcast	No significant injury or growth reduction with 100, 200 and 400 lb per acre applied twice.
33654	Dogwood, Pagoda (Cornus alternifolia)	Field Container	Moretti	OR	2021	Broadcast	No significant injury or growth reduction with 100, 200 and 400 lb per acre applied twice.
33652	Dogwood, Flowering (Cornus florida) 'Aurea'	Field Container	Cochran	MD	2020	Broadcast	No injury when applied 2x, 6 weeks apart, at 100, 200, 400 lb per acre (2.75 ai, 5.5 lb ai, and 11.0 ai)
33652	Dogwood, Flowering (Cornus florida)	Field Container	Senesac	NY	2021	Broadcast	No to mnor transient injury dissipating by 4 WAT increasing with rate (2.75, 5.5, 11.0 lb ai per acre).
33653	Dogwood, Kousa (Cornus kousa)	Field Container	Moretti	OR	2021	Broadcast	No significant injury or growth reduction with 100, 200 and 400 lb per acre applied twice.
33653	Dogwood, Kousa (Cornus kousa)	Field Container	Neal	NC	2021	Broadcast	No injury with 100, 200 or 400 lb product per acre after one or two applications.
33655	Dogwood, Red Osier (Cornus sericea)	Field Container	Moretti	OR	2021	Broadcast	No significant injury or growth reduction with 100, 200 and 400 lb per acre applied twice.
33655	Dogwood, Red Osier (Cornus sericea)	Field Container	Senesac	NY	2021	Broadcast	No injury with 2.75 and 5.5 lb ai per acre; minor injury observed only 1 WAT with 11.0 lb ai per acre.
33665	Cotoneaster (Cotoneaster sp.)	Field Container	Mathers	OH	2020	Broadcast	Very slight injury with 2.75, 5.5 and 11.0 lb ai per acre 4 weeks after second application.

33665	Cotoneaster (Cotoneaster sp.) C. dammeri 'Streib's Findling'	Field Container	Moretti	OR	2020	Broadcast	No injury and growth reduction with 100, 200 and 400 lb per acre applied twice.
33663	Common Winterberry (Ilex verticillata) 'Southern Gentlemen'	Field Container	Mathers	OH	2020	Broadcast	No injury with 2.75, 5.5 and 11.0 lb ai per acre.
33663	Common Winterberry (Ilex verticillata) 'Berry Poppins'	Field Container	Moretti	OR	2021	Broadcast	No significant injury or growth reduction with 100, 200 and 400 lb per acre applied twice.
33663	Common Winterberry (Ilex verticillata)	Field Container	Neal	NC	2020	Broadcast	Virtually no to minor transient injury increasing with rate (100, 200, or 400 lb product per acre) after two applications.
33656	Privet (Ligustrum sp.) L. japonicum	Field Container	Neal	NC	2021	Broadcast	Virtually no injury with 100, 200 or 400 lb product per acre after one or two applications.
33666	Liriope, Creeping (Liriope spicata)	Field Container	Moretti	OR	2021	Broadcast	Minor injury and growth reduction with 100 and 200, moderate with 400 lb per acre applied twice.
33666	Liriope, Creeping (Liriope spicata)	Field Container	Senesac	NY	2020	Broadcast	Minor to moderate injury increasing with rate (2.75, 5.5, 11.0 lb ai per acre)
33666	Liriope, Creeping (Liriope spicata)	Field Container	Witcher	TN	2020	Broadcast	No injury and growth reduction with 100, 200 and 400 lb per acre applied twice.
33667	Magnolia, Southern (Magnolia grandiflora) 'Yellow Bird'	Field Container	Mathers	OH	2020	Broadcast	Severe injury with 2.75, 5.5 and 11.0 lb ai per acre.
33667	Magnolia, Southern (Magnolia grandiflora)	Field Container	Senesac	NY	2021	Broadcast	No injury with 2.75, 5.5 and 11.0 lb ai per acre.
33664	Wax Myrtle (Myrica cerifera)	Field Container	Neal	NC	2020	Broadcast	Moderate to severe injury increasing with rate (100, 200, or 400 lb product per acre) after one application. Some reduction in injury after second application over time with 1x and 2x.
33664	Wax Myrtle (Myrica cerifera)	Field Container	Witcher	TN	2020	Broadcast	No injury and growth reduction with 100, 200 and 400 lb per acre applied twice.
33660	Spruce, Dwarf Alberta (Picea glauca 'Conica') ‘Conica’	Field Container	Mathers	OH	2021	Broadcast	No injury when applied twice, six weeks apart, at 100, 200 and 400 lb per acre (2.75, 5.5 and 11 lb ai per acre) rates.
33660	Spruce, Dwarf Alberta (Picea glauca 'Conica')	Field Container	Moretti	OR	2021	Broadcast	No significant injury or growth reduction with 100, 200 and 400 lb per acre applied twice.
33658	Pine, Austrian (Pinus nigra)	Field Container	Mathers	OH	2020	Broadcast	No injury with 2.75, 5.5 and 11.0 lb ai per acre.
33658	Pine, Austrian (Pinus nigra)	Field Container	Moretti	OR	2020	Broadcast	No injury and growth reduction with 100, 200 and 400 lb per acre applied twice.
33659	Pine, Eastern White (Pinus strobus)	Field Container	Mathers	OH	2020	Broadcast	No injury with 2.75, 5.5 and 11.0 lb ai per acre.
33659	Pine, Eastern White (Pinus strobus)	Field Container	Seefeldt	WA	2020	Broadcast	No injury and no impact on growth at 100, 200, 400 lb product per acre.
33659	Pine, Eastern White (Pinus strobus)	Field Container	Senesac	NY	2021	Broadcast	No injury with 2.75, 5.5 and 11.0 lb ai per acre.
33662	Rose (Rosa sp.) ‘Drift White’	Field Container	Mathers	OH	2021	Broadcast	No injury when applied twice, six weeks apart, at 100, 200 and 400 lb per acre (2.75, 5.5 and 11 lb ai per acre) rates.
33662	Rose (Rosa sp.) 'Grace and Grit'	Field Container	Moretti	OR	2020	Broadcast	No significant injury with 100 and 200, moderate initial injury with 400 lb per acre with complete recovery.

33662	Rose (Rosa sp.) 'Knockout Double Red'	Field Container	Neal	NC	2020	Broadcast	Virtually no to minor transient injury increasing with rate (100, 200, or 400 lb product per acre) after two applications.
33650	Japanese Meadowsweet (Spiraea japonica) ‘Double Play Red’	Field Container	Derr	VA	2020	Broadcast	No significant injury and growth reduction with 100, 200 and 400 lb per acre applied twice.
33650	Japanese Meadowsweet (Spiraea japonica) 'Lil Sizzle'	Field Container	Moretti	OR	2020	Broadcast	No injury and growth reduction with 100, 200 and 400 lb per acre applied twice.
33650	Japanese Meadowsweet (Spiraea japonica) 'Little Princess'	Field Container	Neal	NC	2020	Broadcast	No significant injury with 100 and 200 lb per acre applied twice, minor to moderate with 400 lb per acre.
33661	Arrowwood (Viburnum sp.) V. plicatum 'Opening Day'	Field Container	Fraelich	GA	2022	Broadcast	No to very slight transient injury with 100, 200, and 400 lb ai per acre; no impact on flower number or plant growth.
33661	Arrowwood (Viburnum sp.) V. nudum 'Winterthur'	Field Container	Mathers	OH	2020	Broadcast	Very slight transient injury with 2.75, 5.5 and 11.0 lb ai per acre 2 weeks after first application.
33661	Arrowwood (Viburnum sp.) V. dentatum 'Sparkler'	Field Container	Moretti	OR	2020	Broadcast	No injury and growth reduction with 100, 200 and 400 lb per acre applied twice.
33661	Arrowwood (Viburnum sp.) V. dentatum	Field Container	Neal	NC	2021	Broadcast	Virtually no to minor transient injury increasing with rate (100, 200, or 400 lb product per acre) after two applications.
33670	Periwinkle, Big (Vinca major)	Field Container	Mathers	OH	2021	Broadcast	No injury when applied twice, six weeks apart, at 100, 200 and 400 lb per acre (2.75, 5.5 and 11 lb ai per acre) rates.
33670	Periwinkle, Big (Vinca major) 'Variegata'	Field Container	Moretti	OR	2021	Broadcast	No significant injury or growth reduction with 100, 200 and 400 lb per acre applied twice.
33671	Periwinkle, Common (Vinca minor) 'Bowles'	Field Container	Aulakh	CT	2020	Broadcast	No injury or growth reduction with 100, 200 and 400 lb per acre applied twice.
33671	Periwinkle, Common (Vinca minor) 'Bowles Blue'	Field Container	Koivunen	CA	2020	Broadcast	No injury and significant growth reduction with 100, 200 and 400 lb per acre applied twice.

Label Suggestions

Based on the current data available, it is recommended that OHP review the additional data available for Ilex verticillata and Spiraea japonica to determine whether these two crops may be removed from the sensitive plant list on the Fuerte label.

Appendix 1: Contributing Researchers

Dr. Jatinder S Aulakh	Connecticut Agricultural Experiment Station Valley Laboratory 143 Cook Hill Road, P.O. Box 228 Windsor, CT
Dr. Diana Cochran	University of Maryland Department of Horticulture and Landscape Architecture
Dr. Jeffrey Derr	Dept. of Plant Pathology, Physiology and Weed Science Virginia Polytechnic Institute and State University HRAREC, Virginia Beach, VA 23455
Mr. Ben Fraelich	USDA-ARS, CPES P.O. Box 728 Tifton, GA 31793
Dr. Marja Koivunen (*past affiliate*)	BBS Ag Research and Consulting PO Box 390 Yolo CA 95697
Dr. Hannah Mathers	Mathers Environmental Science Services, LLC Gahanna, OH 43230
Dr. Marcello Moretti	Oregon State University College of Agricultural Sciences 2750 SW Campus Way Corvallis, OR 97331
Dr. Joe Neal	North Carolina State University Department of Horticultural Science 262 Kilgore Hall Box 7609, NCSU Raleigh, NC 27694-7609
Dr. Steven Seefeldt	Washington State University 16650 State Route 536 Mount Vernon, WA 98273-9761
Dr. Andy Senesac (*retired*)	Long Island Horticultural Research Center Cornell University 3059 Sound Avenue Riverhead, NY 11901
Dr. Anthony Witcher	Tennessee State University Otis L. Floyd Nursery Research Center 472 Cadillac Lane McMinnville, TN 37110