



[Environment Horticulture Program Research Summaries](#)

**IR-4 Environmental Horticulture Program
Flumioxazin + Pyroxasulfone (V-10233, V-10336) Crop Safety**

**Authors: Ely Vea and Cristi L. Palmer
Date: October 26, 2018**

Acknowledgements

**Susan Bierbrunner
Diane Infante**

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2015-34383-23710 with substantial cooperation and support from the State Agricultural Experiment Stations and USDA-ARS.

Table of Contents

Table of Contents	2
Table of Tables	3
Abstract	4
Introduction.....	5
Materials and Methods.....	5
Results and Summary	5
Phytotoxicity	5
Label Suggestions	11
Appendix 1: Contributing Researchers.....	12

Table of Tables

Table 1.	List of V-10233 76WG treated crops with no or minimal transitory injury.	6
Table 2.	List of V-10233 76WG treated crops with no injury at 1X but significant injury at 2X or 4X.	6
Table 3.	List of V-10233 76WG treated crops with significant injury at 1X.	6
Table 4.	List of V-10233 76WG treated crops where more information is needed.	6
Table 5.	List of V-10336 61.5WG treated crops with no or minimal transitory injury.	6
Table 6.	List of V-10336 61.5WG treated crops with no injury at 1X but significant injury at 2X or 4X.	6
Table 7.	List of V-10336 61.5WG treated crops with significant injury at 1X.	6
Table 8.	List of V-10336 61.5WG treated crops where more research is needed to clarify response.	7

Abstract

Between 2013 and 2017, IR-4 conducted fifty-one (51) trials evaluating two formulations of (flumioxazin + pyroxasulfone): V-10233 76WG (37 trials) and V-10336 61.5WG (14 trials) for crop safety. The data contained in this report was generated to register the use of this active ingredient combination with directed spray applications around ornamental horticulture plants. The rates tested were 0.35, 0.71 and 1.42 pounds active ingredient per acre (lb ai per A) as the 1X, 2X and 4X rates.

V-10336 and V-10233 were applied to 31 plant species or genera. Six species or genera (*Juglans nigra*, *Cornus* spp., *Pinus* spp., *Prunus* spp., *Quercus* spp. and *Salix* spp.) exhibited no or minimal transient injury in 3 trials across both formulations. One species *Cercis canadensis* exhibited moderate injury at all rates and stunting at 2X in a trial with V-10336 61.5WG. One genera (*Rhododendron* sp.) exhibited variable injury (none, minor or significant) at all rates with good recovery. Further testing is required before a conclusion can be made confirming crop safety on these crops.

Introduction

Non-phytotoxic and effective residual control of broadleaved weeds and grasses in the production of woody perennials can be problematic because nurseries grow many different types of plants, and not all genera or species are listed on labels. Some weeds may also be difficult to control in landscape settings for the same reason. Between 2013 and 2017, the IR-4 Project has conducted 51 trials evaluating V-10233 76WG and V-10336 61.5WG as directed spray applications on and around ornamental horticulture plants. The data contained in this summary report were generated to help register the use of a premix combination of flumioxazin + pyroxasulfone.

Materials and Methods

For V-10233, one directed spray was made at rates of 0.35, 0.71 and 1.42 lb ai/A in 2013 and 2015. One directed spray of V-10336 was made at 0.29, 0.58 or 1.15 lb ai/A in 2013 and at 0.35, 0.71 or 1.42 lb ai/A in 2015. Both formulations contained the same amount of flumioxazin but different concentrations of pyroxasulfone. A minimum of four plants (replicate treatments) were required with many researchers exceeding this minimum. Phytotoxicity was recorded using a scale of 0 to 10 (0 = No phytotoxicity; 10 = Complete kill) at approximately 1, 2, and 4, weeks after application. Plant size was also evaluated for several species at the time of the first application and again at the time of the last evaluation. The protocols used were 13-022, 16-017 and 17-017. For more detailed materials and methods, please see Protocols at <http://ir4.rutgers.edu/ornamental/OrnamentalDrafts.cfm>.

V-10233 76WG and V-10336 61.5WG were supplied to researchers (See list of researchers in Appendix 1) by Valent.

Results and Summary

Phytotoxicity

Based on the type and nature of injury seen with flumioxazin + pyroxasulfone applications in the research conducted between 2013 and 2015, 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 this product, and 4) more data is needed to make informed recommendations.

In testing from 2013 to 2017, V-10233 76WG and V-10336 61.5WG exhibited no or minimal negative impact on one plant genus across plants species with the exception of one crop (Tables 1 - 8). Six species or genera (*Juglans nigra*, *Cornus* spp., *Pinus* spp., *Prunus* spp., *Quercus* spp. and *Salix* spp.) exhibited no or minimal transient injury in 3 trials across both formulations. One species *Cercis canadensis* exhibited moderate injury at all rates and stunting at 2X in a trial with V-10336 61.5WG. One genera (*Rhododendron* sp.) exhibited variable injury (none, minor or significant) at all rates with good recovery. All other crops evaluated showed no injury or growth reduction, but most were only screened in 1 trial; hence further testing is required before a conclusion can be made confirming crop safety on these crops.

Please see Table 9 for a list of research and the summary of the results received for research

conducted with V-10233 76WG and V-10336 61.5WG.

Table 1. List of V-10233 76WG treated crops with no or minimal transitory injury.

None

Table 2. List of V-10233 76WG treated crops with no injury at 1X but significant injury at 2X or 4X.

None

Table 3. List of V-10233 76WG treated crops with significant injury at 1X.

None

Table 4. List of V-10233 76WG treated crops where more information is needed.

<i>Acer rubrum</i> ²	<i>Populus deltoides</i> ¹
<i>Betula nigra</i> ¹	<i>Populus tremuloides</i> ¹
<i>Cornus florida</i> ²	<i>Prunus laurocerasus</i> ¹
<i>Crataegus viridis</i> ¹	<i>Prunus serotina</i> ¹
<i>Fraxinus americana</i> ¹	<i>Quercus</i> sp. ²
<i>Hydrangea quercifolia</i>	<i>Rhododendron</i> sp.
<i>Juglans nigra</i> ²	<i>Salix gracilistyla</i>
<i>Picea abies</i> ²	<i>Salix nigra</i> ¹
<i>Pinus alba</i> ¹	<i>Taxus cuspidata</i> ²
<i>Pinus strobus</i> ¹	

¹ No injury in 1 trial

² No injury in 2 trials

Table 5. List of V-10336 61.5WG treated crops with no or minimal transitory injury.

None

Table 6. List of V-10336 61.5WG treated crops with no injury at 1X but significant injury at 2X or 4X.

None

Table 7. List of V-10336 61.5WG treated crops with significant injury at 1X.

*Cercis occidentalis*¹

¹ Single trial. More information is needed to clarify response.

Table 8. List of V-10336 61.5WG treated crops where more research is needed to clarify response.

*Acer palmatum*¹
Aesculus sp.¹
*Berberis thunbergii*¹
*Betula alba*¹
*Buxus microphylla*¹
Cornus sp.¹
*Eucalyptus henkelii*¹
*Gingko biloba*¹
*Juglans nigra*¹
*Platanus racemosa*¹
*Prunus pendula*¹
*Quercus rubra*¹
Salix sp.¹

¹ No or minor injury in 1 trial

² No injury in 2 trials

Table 9 Detailed Summary of Crop Safety Testing with Flumioxazin + Pyroxasulfone.

Notes: Table entries are sorted by crop Latin name. Only those trials with research reports received by 10/15/2018 are listed below.

PR#	Product	Crop	Production Site	Researcher	State	Year	Application Type	Results
31555	V-10233 76WG	Maple (Acer sp.) A. rubrum	Field Container	Beste/Frank (NER)	MD	2013	Directed	No significant injury or growth reduction with 0.35 and 0.71, slight with 1.42 lb ai per acre applied once; no marketability reduction.
31555	V-10233 76WG	Maple (Acer sp.) Acer rubrum	Field Container	Beste/Frank (NER)	MD	2016	Directed	Significant, but acceptable, injury with complete recovery at 0.36, 0.71 and 1.42 lb ai per acre; no growth reduction; all plants saleable at end of experiment
31548	V-10233 76WG	Birch (Betula sp.) B. nigra	Field Container	Beste/Frank (NER)	MD	2013	Directed	No significant injury or growth reduction with 0.35, 0.71 and 1.42 lb ai per acre applied once; no marketability reduction.
31551	V-10233 76WG	Dogwood (Cornus sp.) C. florida	Field Container	Beste	MD	2015	Directed	No significant injury or growth reduction with 0.35, 0.71 and 1.42 lb ai per acre; no reduction in marketability.
31551	V-10233 76WG	Dogwood (Cornus sp.) C. florida	Field Container	Beste/Frank (NER)	MD	2013	Directed	Commercially acceptable injury with 0.36, 0.71 and 1.42 lb ai per acre; no reduction in growth or marketability.
31554	V-10233 76WG	Hawthorn (Crataegus sp.) C. monogyna	Field Container	Miller	WA	2017	Over-the-top*	Severe injury with 7.5, 15 and 30 oz per acre applied twice.
31554	V-10233 76WG	Hawthorn (Crataegus sp.) C. viridis	Field Container	Beste/Frank (NER)	MD	2013	Directed	No significant injury or growth reduction with 0.36, 0.71 and 1.42 lb ai per acre; no reduction in marketability.
31547	V-10233 76WG	Ash (Fraxinus sp.) F. americana	Field Container	Beste/Frank (NER)	MD	2013	Directed	No significant injury or growth reduction with 0.36, 0.71 and 1.42 lb ai per acre; no reduction in marketability
30870	V-10233 76WG	Hydrangea (Hydrangea sp.) H. quercifolia	Field Container	Mathers	OH	2017	Directed	No significant injury with 7.5, 15 and 30 oz ai per acre applied twice; no growth reduction.
30870	V-10233 76WG	Hydrangea (Hydrangea sp.) H. quercifolia 'Pee Wee'	Field Container	Beste/Frank (NER)	MD	2016	Directed	Moderate basal foliage injury with good recovery with 7.5, 15 and 30 oz per acre; no growth reduction; all plants marketable after overwinter storage.
32822	V-10233 76WG	Walnut, Black (Non-Bearing) (Juglans nigra)	Field Container	Beste/Frank (NER)	MD	2016	Directed	No significant injury or growth reduction with 0.36, 0.71 and 1.42 lb ai per acre.
32822	V-10233 76WG	Walnut, Black (Non-Bearing) (Juglans nigra)	Field Container	Senesac	NY	2017	Directed	No injury with 7.5, 15 and 30 oz ai per acre applied twice.
30941	V-10233 76WG	Spruce (Picea sp.) P. abies	Field Container	Beste	MD	2015	Directed	No injury or significant growth reduction with 0.35, 0.71 and 1.42 lb ai per acre applied once; no marketability reduction.
30941	V-10233 76WG	Spruce (Picea sp.) P. abies	Field Container	Beste/Frank (NER)	MD	2016	Directed	No injury or growth reduction with 0.36, 0.71 and 1.43 lb ai per acre applied twice; all plants marketable.
30941	V-10233 76WG	Spruce (Picea sp.) P. sitchensis	Field Container	Miller	WA	2017	Over-the-top*	Moderate to severe injury increasing with rates (7.5, 15 and 30 oz per acre applied twice).
30942	V-10233 76WG	Pine (Pinus sp.) P. alba	Field Container	Beste/Frank (NER)	MD	2016	Directed	No injury or growth reduction with 0.36, 0.71 and 1.43 lb ai per acre applied twice; all plants marketable.
30942	V-10233 76WG	Pine (Pinus sp.) P. ponderosa	Field Container	Miller	WA	2017	Over-the-top*	No injury after 1st applic with 7.5, 15 and 30 oz per acre, minor after 2nd applic; minor growth reduction with 4X.
30942	V-10233 76WG	Pine (Pinus sp.) P. strobus	Field Container	Beste	MD	2015	Directed	No injury or significant growth reduction with 0.35, 0.71 and 1.42 lb ai per acre applied once; no marketability reduction.
31557	V-10233 76WG	Cottonwood (Populus sp.) P. nigra	Field Container	Miller	WA	2017	Over-the-top*	Moderate to severe injury increasing with rates (7.5, 15 and 30 oz per acre applied twice).

PR#	Product	Crop	Production Site	Researcher	State	Year	Application Type	Results
31557	V-10233 76WG	Cottonwood (Populus sp.) P. tremuloides	Field Container	Beste/Frank (NER)	MD	2016	Directed	No injury or growth reduction with 7.5, 15 and 30 oz per acre applied twice.
31557	V-10233 76WG	Cottonwood (Populus sp.) P/ deltooides	Field Container	Beste/Frank (NER)	MD	2013	Directed	Slight, commercially acceptable injury with 0.36, 0.71 and 1.42 lb ai per acre; no reduction in growth or marketability.
31550	V-10233 76WG	Plum (Prunus sp.) P. laurocerasus 'Otto Luyken'	Field Container	Beste/Frank (NER)	MD	2013	Directed	No significant injury or growth reduction with 0.36, 0.71 and 1.42 lb ai per acre; no reduction in marketability.
31550	V-10233 76WG	Plum (Prunus sp.) P. serotina	Field Container	Beste/Frank (NER)	MD	2016	Directed	No significant injury or growth reduction with 0.36, 0.71 and 1.43 lb ai per acre applied twice.
32823	V-10233 76WG	Oak (Quercus sp.)	Field Container	Beste	MD	2015	Directed	No significant injury or growth reduction with 0.35, 0.71 and 1.42 lb ai per acre applied once; no marketability reduction.
32823	V-10233 76WG	Oak (Quercus sp.)	Field Container	Beste/Frank (NER)	MD	2016	Directed	No significant injury or growth reduction with 0.36, 0.71 and 1.42 lb ai per acre.
32754	V-10233 76WG	Oak (Quercus sp.) Q. falcate	Seedbed	Beste	MD	2015	Soil applied broadcast*	Slight injury (delay in emergence, growth reduction) with 0.14 lb ai per acre applied preemergence, unacceptable injury with 0.29 and 0.43 lb.
32754	V-10233 76WG	Oak (Quercus sp.) Q. palustris	Seedbed	Beste	MD	2016	Soil applied broadcast*	No injury or growth reduction with 2, 2.5 and 3 oz per acre applied broadcast PRE 10 days after seeding; excellent weed control.
32754	V-10233 76WG	Oak (Quercus sp.) Q. phellos	Seedbed	Beste	MD	2015	Soil applied broadcast*	Slight injury (delay in emergence, growth reduction) with 0.14 lb ai per acre applied preemergence, unacceptable injury with 0.29 and 0.43 lb.
32754	V-10233 76WG	Oak (Quercus sp.) Q. phellos	Seedbed	Beste	MD	2016	Soil applied broadcast*	No injury or growth reduction with 2, 2.5 and 3 oz per acre applied broadcast PRE 10 days after seeding; excellent weed control.
30875	V-10233 76WG	Azalea (Rhododendron sp.)	Field Container	Marble	FL	2017	Directed	Minor to moderate initial injury increasing with rates (7.5, 15 and 30 oz per acre applied twice), with plants recovering after each applic; no growth reduction.
30875	V-10233 76WG	Azalea (Rhododendron sp.) 'Conversation PC'	Field Container	Beste/Frank (NER)	MD	2016	Directed	Moderate injury to basal leaves with good recovery, and no effect on growth or flower production with 0.31, 0.71 and 1.43 lb ai per acre applied twice; commercially acceptable plants at end of trial.
30875	V-10233 76WG	Azalea (Rhododendron sp.) 'Hino-crimson'	Field Container	Beste	MD	2015	Directed	Slight initial injury with complete recovery with 0.35, 0.71 and 1.42 lb ai per acre; no reduction in growth or marketability.
32824	V-10233 76WG	Willow (Salix sp.)	Field Container	Miller	WA	2017	Over-the-top*	Moderate injury and growth reduction with 7.5, 15 and 30 oz per acre applied twice.
32824	V-10233 76WG	Willow (Salix sp.) S. gracilistyla 'Mt. Asama'	Field Container	Senesac	NY	2017	Directed	No injury with 7.5, minor with 15, and moderate with 30 oz ai per acre applied twice.
32824	V-10233 76WG	Willow (Salix sp.) Salix nigra	Field Container	Beste/Frank (NER)	MD	2016	Directed	No injury or growth reduction with 7.5, 15 and 30 oz per acre; all plants marketable.
31592	V-10233 76WG	Japanese Yew (Taxus cuspidata) 'Capitata'	Field Container	Beste/Frank (NER)	MD	2013	Directed	No injury or growth reduction with 0.36, 0.71 and 1.42 lb ai per acre; no reduction in marketability.
31592	V-10233 76WG	Japanese Yew (Taxus cuspidata) 'Hicksii'	Field Container	Senesac	NY	2017	Directed	No injury with 7.5, 15 and 30 oz ai per acre applied twice.
32707	V-10336 61.5WG	Maple (Acer sp.) A. palmatum	Field Container	Uber	CA	2013	Directed	No injury or growth reduction with 7.5, 15 and 30 oz per acre.

PR#	Product	Crop	Production Site	Researcher	State	Year	Application Type	Results
31549	V-10336 61.5WG	Horse Chestnut (Aesculus sp.)	Field Container	Mathers (OSU)	OH	2013	Directed	No injury with 7.5, 15 and 30 oz per acre.
30859	V-10336 61.5WG	Barberry (Berberis sp.) B. thunbergii 'Rose Glow'	Field Container	Beste	MD	2015	Directed	No significant injury or growth reduction with 0.35, 0.71 and 1.42 lb ai per acre by the end of trial; no reduction in marketability.
32708	V-10336 61.5WG	Birch (Betula sp.) B. alba	Field Container	Uber	CA	2013	Directed	Minor injury with complete recovery at 7.5, 15 and 30 oz per acre; no growth reduction.
30860	V-10336 61.5WG	Boxwood (Buxus sp.) B. microphylla 'Winter Gem'	Field Container	Beste	MD	2015	Directed	No significant injury or growth reduction with 0.36, 0.71 and 1.42 lb ai per acre by the end of trial; no reduction in marketability
31558	V-10336 61.5WG	Red Bud, Western (Cercis reniformis) C. occidentalis	Field Container	Uber	CA	2013	Directed	Moderate injury with 7.5, 15 and 30 oz per acre; significant stunting at 2X.
32709	V-10336 61.5WG	Dogwood (Cornus sp.) 'Galilean'	Field Container	Mathers (OSU)	OH	2013	Directed	No injury with 7.5, 15 and 30 oz per acre.
31552	V-10336 61.5WG	Gum (Eucalyptus sp.) E. henkelii	Field Container	Uber	CA	2013	Directed	No injury or growth reduction with 7.5, 15 and 30 oz per acre.
31553	V-10336 61.5WG	Maidenhair Tree (Ginkgo biloba)	Field Container	Uber	CA	2013	Directed	Slight injury, no growth reduction with 7.5, 15 and 30 oz per acre.
31560	V-10336 61.5WG	Walnut, Black (Non- Bearing) (Juglans nigra)	Field Container	Mathers (OSU)	OH	2013	Directed	No injury with 7.5, 15 and 30 oz per acre.
31559	V-10336 61.5WG	Plane Tree, Sycamore (Platanus sp.) P. racemosa	Field Container	Uber	CA	2013	Directed	Slight injury, no growth reduction with 7.5, 15 and 30 oz per acre.
32710	V-10336 61.5WG	Plum (Prunus sp.) P. pendula 'Rosea'	Field Container	Mathers (OSU)	OH	2013	Directed	No injury with 7.5, 15 and 30 oz per acre.
31556	V-10336 61.5WG	Oak (Quercus sp.) Q. rubra'	Field Container	Mathers (OSU)	OH	2013	Directed	No injury with 7.5, 15 and 30 oz per acre.
31561	V-10336 61.5WG	Willow (Salix sp.) 'Prairie Cascade'	Field Container	Mathers (OSU)	OH	2013	Directed	No injury with 7.5, 15 and 30 oz per acre.

* Over-the-top or Soil applied broadcast results not included in Tables 1-8.

Label Suggestions

Six species or genera (*Juglans nigra*, *Cornus* spp., *Pinus* spp., *Prunus* spp., *Quercus* spp. and *Salix* spp.) exhibited no or minimal transient injury in 3 trials across both formulations. However, no conclusions can be made at this time for either formulation.

Appendix 1: Contributing Researchers

Dr. Ed Beste	University of Maryland LESREC – Salisbury Facility 27664 Nanticoke Road Salisbury, MD 21801
Dr. Ray Frank (retired)	6916 Boyers Mill Road New Market, MD 21774
Dr. Hannah Mathers	The Ohio State University Dept. Hort. and Crop Science 2001 Fyffe Ct. Columbus, OH 43210
Dr. Chris Marble	University of Florida Mid-Florida Research and Education Center 2725 S. Binion Rd. Apopka, FL 32703
Dr. Andy Senesac	Long Island Horticultural Research Laboratory 39 Sound Avenue Riverhead, NY 11901
Mr. Buzz Uber	Crop Inspection Service 31130 Hilltop Drive Valley Center, CA 92082