



[Environment Horticulture Program Research Summaries](#)

IR-4 Environmental Horticulture Program Prodiamine + Isoxaben Crop Safety

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Date: 11/16/2023**

Acknowledgements

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This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award numbers 2015-34383-23710, 2017-34383-27100, 2019-34383-29973, 2020-34383-32455 and 2021-34383-34848 with substantial cooperation and support from the State Agricultural Experiment Stations and USDA-ARS.

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Abstract

Prodiamine + Isoxaben (Gemini G) is a herbicide combination developed by ICL Specialty Fertilizers for pre-emergent control of grasses and broadleaf weeds on environmental horticulture crops. The IR-4 Project completed 85 crop safety trials on 29 environmental horticulture plant species or genera between 2017 and 2022. In these trials, five species (*Campanula sp.*, *Euonymus alatus*, *Nepeta x fassiana*, *Quercus virginiana*, *Rosa sp.*) exhibited no injury after over-the-top applications in a minimum of 3 trials; *E. alatus* and *N. fassiana* can be added to a list of tolerant plants in the new label for this product. Three species (*Phlox paniculata*, *Sedum acre*, *Sedum rupestre*) exhibited damage at the 1X rate sufficient to recommend growers not utilize Gemini G as an over-the-top treatment for pre-emergent weed control.

Introduction

Prodiamine + isoxaben (Gemini G) is a herbicide combination developed by Everris dba ICL Specialty Fertilizers for pre-emergent control of grasses and broadleaf weeds on environmental horticulture crops. The IR-4 Project completed 85 crop safety trials on 29 environmental horticulture plant species or genera between 2017 and 2023.

Materials and Methods

Gemini G (prodiamine + isoxaben) was applied over-the-top twice at 6 weeks intervals. The application rates were 200, 400 and 800 lb product/A. A minimum of four plants per three blocks or ten plants per completely randomized design were required with many researchers exceeding this minimum. Phytotoxicity was recorded on a scale of 0 to 10 (0 = no phytotoxicity; 10 = complete kill) at 1, 2, and 4 weeks after initial application. To view the more detailed materials and methods in the protocol 17-010, 18-012, 21-013, 22-017 and 23-017. Please see <https://www.ir4project.org/ehc/ehc-registration-support-research/env-hort-researcher-resources/#Protocols> to view and download protocols.

Gemini G was supplied to researchers (See list of researchers in Appendix 1) by ICL Specialty Fertilizers.

Results and Summary

Phytotoxicity

Based on the type and nature of injury seen with the protocol treatments, 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 Gemini G, and 4) more data are needed to make informed recommendations.

Gemini G exhibited no or minimal negative impact on five species with over-the-top applications (Table 1). Some minimal injury may be acceptable for growers, if applications are made several weeks to months in advance of crop sale particularly for woody perennial crops. Three species tested exhibited damage at the 1X rate sufficient to recommend growers not utilize Gemini G as an over-the-top treatment for pre-emergent weed control (Table 3). For 19 genera / species, more information is needed either because only 1 or 2 trials were conducted or because consistent results were not achieved across research sites (Table 4, Table 5).

Please see Table 7 for a list of individual trial summaries for Gemini G.

Table 1. List of Gemini G treated crops with no or minimal transitory injury.

<i>Campanula sp.</i>	<i>Quercus virginiana</i>
<i>Euonymus alatus</i>	<i>Rosa sp.</i>
<i>Nepeta x fassiana</i>	

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

Calamagrostis acutiflora
Hemerocallis sp.

Table 3. List of Gemini G treated crops with significant injury at 1X.

<i>Phlox paniculata</i>	<i>Sedum rupestre</i>
<i>Sedum acre</i>	

Table 4. List of Gemini G treated crops where more information is needed.

<i>Acer rubrum</i>	<i>Echinacea sp.</i>	<i>Tagetes erecta</i>
<i>Andropogon gerardii</i>	<i>Hydrangea macrophylla</i> ¹	
<i>Digitalis sp.</i>	<i>Juncus effusus</i>	

Table 5. List of Gemini G treated crops with less than 3 trials.

<i>Allamanda cathartica</i> ¹	<i>Hydrangea arborescens</i>	<i>Pelargonium x domesticum</i> ¹
<i>Baptisia sp.</i>	<i>Hydrangea quercifolia</i> ¹	<i>Sedum hybridum</i>
<i>Duranta erecta</i>	<i>Muhlenbergia capillaris</i> ¹	<i>Sporobolus heterolepis</i> ¹
<i>Eragrostis curvula</i>	<i>Paeonia lactiflora</i>	<i>Stipa sp.</i>

¹For these plants, the one or two trials presented here indicate no phytotoxicity or slight, transient injury

²Listed on label as one of crops where Gemini should not be used.

Table 6. Average Crop Safety Rating after Broadcast Applications of Prodiamine + Isoxaben

Crop Latin Name	Gemini Granular (prodiamine + isoxaben)
<i>Acer rubrum</i>	2.0 (1 - 5) n4
<i>Allamanda sp.</i>	1.0 (1 - 1) n2
<i>Andropogon gerardii</i>	2.0 (1 - 4) n3
<i>Baptisia sp.</i>	2.0 (2 - 2) n1
<i>Calamagrostis acutiflora</i>	2.0 (1 - 3) n3
<i>Campanula sp.</i>	1.7 (1 - 3) n3
<i>Digitalis sp.</i>	2.7 (1 - 4) n3
<i>Distylium sp.</i>	1.0 (1 - 1) n1
<i>Duranta erecta</i>	2.0 (1 - 3) n2
<i>Echinacea sp.</i>	2.0 (1 - 3) n3
<i>Eragrostis curvula</i>	1.5 (1 - 2) n2
<i>Euonymus alatus</i>	1.3 (1 - 2) n3
<i>Hamelia patens</i>	1.0 (1 - 1) n1
<i>Hemerocallis sp.</i>	1.8 (1 - 3) n4
<i>Hydrangea macrophylla</i>	3.0 (1 - 4) n5
<i>Hydrangea sp.</i>	1.4 (1 - 3) n5
<i>Juncus effusus</i>	2.0 (1 - 3) n3
<i>Muhlenbergia capillaris</i>	2.0 (2 - 2) n2
<i>Nepeta x faassenii</i>	2.0 (1 - 3) n3
<i>Paeonia lactiflora</i>	3.0 (1 - 5) n2
<i>Pelargonium x domesticum</i>	1.0 (1 - 1) n2
<i>Phlox paniculata</i>	3.7 (3 - 5) n7
<i>Quercus virginiana</i>	1.0 (1 - 1) n3
<i>Rosa sp.</i>	1.7 (1 - 2) n3
<i>Sedum acre</i>	3.3 (1 - 5) n3
<i>Sedum hybridum</i>	2.0 (1 - 3) n2
<i>Sedum rupestre</i>	3.3 (1 - 4) n4
<i>Sporobolus heterolepis</i>	2.0 (1 - 3) n2
<i>Stipa sp.</i>	5.0 (5 - 5) n1
<i>Tagetes erecta</i>	2.3 (1 - 4) n3

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

Table 7. Detailed Summary of Crop Safety Testing with Gemini G (Prodiamine + Isoxaben).

Notes: Table entries are sorted by crop Latin name. Only those trials with research reports received by 11/1/2023 are listed below.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
32929	Maple, Red (<i>Acer rubrum</i>) Red Maple	Field Container	Beste	MD	2017	Broadcast	Unacceptable injury or death with 200, 400 and 800 lb per acre within a month after application.
32929	Maple, Red (<i>Acer rubrum</i>)	Field Container	Marble	FL	2017	Broadcast	No significant injury or growth reduction with 200, 400 and 800 lb per acre applied twice.
32929	Maple, Red (<i>Acer rubrum</i>)	Field Container	Mathers	OH	2018	Broadcast	No injury and growth reduction with 200, 400 and 800 lb per acre applied twice.
32929	Maple, Red (<i>Acer rubrum</i>)	Field Container	Senesac	NY	2017	Broadcast	No injury with 200, 400 and 800 lb per acre applied twice.
32913	Allamanda (<i>Allamanda</i> sp.) <i>A. cathartica</i> 'Golden Butterfly'	Field Container	Marble	FL	2017	Broadcast	No injury or growth reduction with 200, 400 and 800 lb per acre applied twice.
32913	Allamanda (<i>Allamanda</i> sp.)	Field Container	Rivera	PR	2022	Broadcast	No injury or impact on plant growth with 200, 400, 800 lb per acre.
34958	Big Blue Stem (<i>Andropogon gerardii</i>)	Field Container	Moretti	OR	2022	Broadcast	No injury or plant volume reductions from two applications at 200, 400 or 800 lb/a.
34958	Big Blue Stem (<i>Andropogon gerardii</i>)	Field Container	Reding	OH	2022	Broadcast	Slight to severe chlorosis increasing with rate (200, 400, 800 lb per acre). While there was no significant impact on height, plants appeared thinner and of lesser quality, and seed heads developed more quickly.
34958	Big Blue Stem (<i>Andropogon gerardii</i>)	Field Container	Witcher	TN	2022	Broadcast	No injury or plant growth reductions from two applications at 200, 400 or 800 lb/a.
34794	Wild Indigo (<i>Baptisia</i> sp.) <i>B. australis</i>	Field Container	Moretti	OR	2022	Broadcast	Minor to moderate injury after first application at 200, 400 or 800 lb/a. Injury gone by second application and no injury seen from any treatment after second application. Plant volume numerically higher with all rates compared to nontreated.
34960	Feather Reed Grass (<i>Calamagrostis acutiflora</i>)	Field Container	Derr	VA	2022	Broadcast	Very slight injury with 1.3, 2.6, and 5.2 lb ai per acre.
34960	Feather Reed Grass (<i>Calamagrostis acutiflora</i>) 'Karl Foerser	Field Container	Moretti	OR	2022	Broadcast	Minor to no injury and no plant volume reductions from two applications at 200, 400 or 800 lb/a.
34960	Feather Reed Grass (<i>Calamagrostis acutiflora</i>) 'Avalanche'	Field Container	Reding	OH	2022	Broadcast	Minor to severe chlorosis increasing with rate (200, 400 800 lb per acre). There was a significant reduction in height with all treatments, but plants appeared commercially acceptable.
32925	Bellflower (<i>Campanula</i> sp.)	Field Container	Larson	WA	2021	Broadcast	No injury with 200, 400 and 800 lb per acre applied twice.
32925	Bellflower (<i>Campanula</i> sp.) <i>C. posharkyana</i> , 'Blue Waterfall'	Field Container	Reding	OH	2017	Broadcast	No injury with 200, 400 and 800 lb per acre after 1st applic, moderate after 2nd applic with complete recovery; no growth reduction; all plants marketable.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
32925	Bellflower (Campanula sp.) C. portenschlagiana 'Birch Hybrid'	Field Container	Senesac	NY	2017	Broadcast	No injury with 200, 400 and 800 lb per acre applied twice.
32924	Foxglove (Digitalis sp.)	Field Container	Larson	WA	2021	Broadcast	No injury with 200, 400 and 800 lb per acre applied twice.
32924	Foxglove (Digitalis sp.) D. purpurea 'Candy Mountain'	Field Container	Reding	OH	2017	Broadcast	No injury with 200, 400 and 800 lb per acre after 1st applic, unacceptable with 2X and 4X; 2X and 4X plants unmarketable.
32924	Foxglove (Digitalis sp.) 'Dalmatian Purple'	Field Container	Senesac	NY	2017	Broadcast	Moderate injury with 200 and 400, severe with 800 lb per acre applied twice
34804	Distylium (Distylium sp.) 'Linebacker'	Field Container	Marble	FL	2022	Broadcast	No injury from 200, 400, or 800 lb/a.
34805	Golden Dewdrops (Duranta erecta) 'Cuban Gold'	Field Container	Moretti	OR	2022	Broadcast	Minor to severe injury after first of two applications at 200, 400 or 800 lb/a. Injury nearly gone by second application and minor to no injury seen after second application. No plant volume reductions from any rate.
34805	Golden Dewdrops (Duranta erecta) 'Aurea Yellow'	Field Container	Robinson	OH	2022	Broadcast	No injury from two applications at 1.3, 2.6, or 5.2 lb ai/a
32923	Purple Coneflower (Echinacea sp.) 'Cheyenne Spirit'	Field Container	Derr	VA	2017	Broadcast	No injury or growth reduction with 200, 400 and 800 lb per acre applied twice.
32923	Purple Coneflower (Echinacea sp.) E. purpurea 'Hot Summer'	Field Container	Marble	FL	2017	Broadcast	No injury or growth reduction with 200 and 400, minor injury and significant growth reduction with 800 lb per acre, applied twice.
32923	Purple Coneflower (Echinacea sp.)	Field Container	Mathers	OH	2017	Broadcast	Minor to moderate initial injury with complete recovery at end of trial with 200, 400 and 800 lb per acre applied twice; no growth reduction.
34961	Weeping Lovegrass (Eragrostis curvula)	Field Container	Marble	FL	2022	Broadcast	No injury from 200, 400, or 800 lb/a.
34961	Weeping Lovegrass (Eragrostis curvula)	Field Container	Witcher	TN	2022	Broadcast	No injury from two applications at 200, 400 or 800 lb/a. Final average plant height and width was significantly lower higher rate.
32922	Burning Bush (Euonymus alatus)	Field Container	Aulakh	CT	2022	Broadcast	Negligible crop injury from two applications at 200, 400 or 800 lb/a.
32922	Burning Bush (Euonymus alatus)	Field Container	Larson	WA	2021	Broadcast	No injury with 200, 400 and 800 lb per acre applied twice.
32922	Burning Bush (Euonymus alatus) 'Compacta'	Field Container	Senesac	NY	2017	Broadcast	Minor injury with 200, 400 and 800 lb per acre applied twice.
34809	Scarlet bush, Mexican Firebush (Hamelia patens) Glabra 'H. Firebush'	Field Container	Marble	FL	2022	Broadcast	No injury from 200, 400, or 800 lb/a.
32921	Daylily (Hemerocallis sp.) 'Stella d' Oro'	Field Container	Beste	MD	2017	Broadcast	Slight initial injury with quick recovery at 200, 400 and 800 lb per acre applied twice; no growth reduction; all treated plants marketable.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
32921	Daylily (Hemerocallis sp.) 'Stella d'Oro'	Field Container	Derr	VA	2017	Broadcast	No injury or growth reduction with 200, 400 and 800 lb per acre applied twice.
32921	Daylily (Hemerocallis sp.) Hemerocallis x 'Monie' Starburst R Susie	Field Container	Nackley	OR	2017	Broadcast	Minor to moderate injury increasing with rates (200, 400 and 800 lb per acre) applied twice; no growth reduction.
32921	Daylily (Hemerocallis sp.) 'Happy Returns'	Field Container	Reding	OH	2017	Broadcast	No injury or growth reduction with 200, 400 and 800 lb per acre applied twice; all plants marketable.
32911	Bigleaf Hydrangea (Hydrangea macrophylla) 'Nikko Blue'	Field Container	Beste	MD	2017	Broadcast	Moderate injury at 200, 400 and 800 lb per acre applied twice; all treated plants commercially unmarketable.
32911	Bigleaf Hydrangea (Hydrangea macrophylla)	Field Container	Nackley	OR	2017	Broadcast	Minor to moderate injury increasing with rates (200, 400 and 800 lb per acre) after 2nd applic; no significant growth reduction.
32911	Bigleaf Hydrangea (Hydrangea macrophylla) 'Endless Summer'	Field Container	Neal	NC	2017	Broadcast	Unacceptable injury (chlorotic and necrotic buds) and reduction of canopy volume with 200, 400 and 800 lb per acre applied twice.
32911	Bigleaf Hydrangea (Hydrangea macrophylla) 'Let's dance Rythmic Blue'	Field Container	Reding	OH	2017	Broadcast	No injury or growth reduction with 200, 400 and 800 lb per acre applied twice; all plants marketable.
32911	Bigleaf Hydrangea (Hydrangea macrophylla) 'Paraplu'	Field Container	Senesac	NY	2017	Broadcast	Minor injury with 200, moderate with 400, and severe with 800 lb per acre applied twice.
32912	Hydrangea (Hydrangea sp.) H. macrophyll 'Dooley'	Field Container	Derr	VA	2017	Broadcast	No injury or growth reduction with 200, 400 and 800 lb per acre applied twice.
32912	Hydrangea (Hydrangea sp.) H. macrophylla 'Nikko Blue'	Field Container	Gilliam	AL	2017	Broadcast	No significant injury or growth reduction with 200, 400 and 800 lb per acre applied twice.
32912	Hydrangea (Hydrangea sp.) H. quercifolia	Field Container	Marble	FL	2017	Broadcast	No injury or growth reduction with 200, 400 and 800 lb per acre applied twice.
32912	Hydrangea (Hydrangea sp.) H. quercifolia	Field Container	Mathers	OH	2017	Broadcast	Acceptable injury with 200 and 400, unacceptable with 800 lb per acre applied twice; minor growth reduction with 4X.
32912	Hydrangea (Hydrangea sp.) H. arborescens, 'Invincibelle Spirit II'	Field Container	Reding	OH	2017	Broadcast	No injury or growth reduction with 200, 400 and 800 lb per acre applied twice; all plants marketable.
34963	Common Rush (Juncus effusus)	Field Container	Derr	VA	2022	Broadcast	Very slight transient injury with 1.3, 2.6 and 5.2 lb ai per acre.
34963	Common Rush (Juncus effusus) 'Big Twister'	Field Container	Mathers	OH	2022	Broadcast	Moderate injury 4 and 6 weeks after application from 1.3, 2.6, or 5.2 lb ai/a. Injury persisted at 1 and 2 weeks after second application, but disappeared from lower two rates 4 weeks after second application. Moderate injury from high rate still existed
34963	Common Rush (Juncus effusus) 'Big Twister'	Field Container	Moretti	OR	2022	Broadcast	Minor to no injury from two applications at 200, 400 or 800 lb/a. Plant volume data variable and non-significant.
34964	Muhly, Hairyawn (Muhlenbergia capillaris)	Field Container	Derr	VA	2022	Broadcast	Very minor injury with 1.3, 2.6, and 5.2 lb ai per acre.
34964	Muhly, Hairyawn (Muhlenbergia capillaris)	Field Container	Moretti	OR	2022	Broadcast	Minor to no injury and no plant volume reductions from two applications at 200, 400 or 800 lb/a.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
32920	Nepeta (Nepeta x faassenii) 'Walker's Low'	Field Container	Beste	MD	2017	Broadcast	No injury with 200, 400 and 800 lb per acre applied twice; minor growth reduction with 4X; all plants marketable.
32920	Nepeta (Nepeta x faassenii)	Field Container	Larson	WA	2021	Broadcast	No injury with 200, 400 and 800 lb per acre applied twice.
32920	Nepeta (Nepeta x faassenii)	Field Container	Senesac	NY	2017	Broadcast	Minor injury with 200 and 400, moderate with 800 lb per acre applied twice.
32919	Peony, Common Garden (Paeonia lactiflora)	Field Container	Larson	WA	2021	Broadcast	No injury with 200, 400 and 800 lb per acre applied twice.
32919	Peony, Common Garden (Paeonia lactiflora) 'Sarah Bernhardt'	Field Container	Reding	OH	2021	Broadcast	Minor injury to death increasing with rate. Growth stunted at all rates (200, 400 and 800 lbs/acre)
32927	Regal Geranium (Pelargonium x domesticum) 'Regal Candy - red'	Field Container	Reding	OH	2017	Broadcast	No injury or growth reduction with 200, 400 and 800 lb per acre applied twice; all plants marketable.
32927	Regal Geranium (Pelargonium x domesticum) 'Salmon'	Field Container	Senesac	NY	2019	Broadcast	No injury or stunting with 200, 400 and 800 lb per acre applied twice.
32918	Phlox, Fall (Phlox paniculata) 'Bright Eyes'	Field Container	Doohan	OH	2018	Broadcast	No significant injury with 200, severe with 400 and 800, lb per acre applied twice; growth reduction at 2X and 4X.
32918	Phlox, Fall (Phlox paniculata) 'Festival'	Field Container	Fraelich	GA	2022	Broadcast	Minor but transient leaf injury with 100 and 200 lb per acre with no significant impact on growth, but moderate injury and a significant growth reduction with 400 lb per acre.
32918	Phlox, Fall (Phlox paniculata)	Field Container	Mathers	OH	2017	Broadcast	Acceptable injury with 200, unacceptable with 400 and 800 lb per acre applied twice; moderate growth reduction with 2X and 4X.
32918	Phlox, Fall (Phlox paniculata) 'Cotton Candy'	Field Container	Nackley	OR	2017	Broadcast	Moderate to severe injury increasing with rates (200, 400 and 800 lb per acre) applied twice; moderate growth reduction with 4X.
32918	Phlox, Fall (Phlox paniculata) 'Party Punch'	Field Container	Reding	OH	2017	Broadcast	Unacceptable injury and growth reduction with 200, 400 and 800 lb per acre applied twice; all plants unmarketable.
32918	Phlox, Fall (Phlox paniculata) 'Red Riding Hood'	Field Container	Reding	OH	2022	Broadcast	Moderate to severe impact, including mortality, increasing with rate (200, 400, 800 lb per acre). In addition to distorted leaves, significant reductions in height and weight occurred.
32918	Phlox, Fall (Phlox paniculata) 'Fashion Early Flamingo'	Field Container	Senesac	NY	2022	Broadcast	Severe injury with all rates (2.5, 5.0, 10.0 lb ai per acre).
32928	Oak, Southern Live (Quercus virginiana)	Field Container	Gilliam	AL	2017	Broadcast	No injury or growth reduction with 200, 400 and 800 lb per acre applied twice.
32928	Oak, Southern Live (Quercus virginiana)	Field Container	Marble	FL	2017	Broadcast	No injury or growth reduction with 200, 400 and 800 lb per acre applied twice.
32928	Oak, Southern Live (Quercus virginiana)	Field Container	Senesac	NY	2017	Broadcast	No injury with 200, 400 and 800 lb per acre applied twice.
32917	Rose (Rosa sp.) 'BaImir Easy Elegance® Kashmir Rose'	Field Container	Nackley	OR	2017	Broadcast	Minor injury with complete recovery with 200, 400 and 800 lb per acre applied twice; no significant growth reduction.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
32917	Rose (Rosa sp.) Red Knockout Rose	Field Container	Neal	NC	2017	Broadcast	No injury with 200, 400 and 800 lb per acre after 1st applic.; 18-25% initial injury with complete recovery after 2nd applic. No growth reduction.
32917	Rose (Rosa sp.) Rosa x 'Horcoherent' (OSO Easy Peachy Cream)	Field Container	Senesac	NY	2017	Broadcast	No injury with 200, 400 and 800 lb per acre applied twice.
32914	Stonecrop, Moss (Sedum acre)	Field Container	Marble	FL	2019	Broadcast	No injury or significant growth reduction with 200, 400 and 800 lb per acre applied twice.
32914	Stonecrop, Moss (Sedum acre) 'Aurea'	Field Container	Neal	NC	2018	Broadcast	Severe injury and growth reduction with 200, 400 and 800 lb per acre applied twice.
32914	Stonecrop, Moss (Sedum acre) 'Goldmoss'	Field Container	Reding	OH	2021	Broadcast	Severe injury to mortality increasing with rate. Growth stunted and flower production prevented at all application rates (200,400 and 800 lbs/acre)
32915	Sedum Hybrids (Sedum hybridum)	Field Container	Larson	WA	2021	Broadcast	No injury with 200, 400 and 800 lb per acre applied twice.
32915	Sedum Hybrids (Sedum hybridum) S. hybridum	Field Container	Senesac	NY	2019	Broadcast	Minor injury with 200, moderate with 400 and 800 lb per acre applied twice; no growth reduction.
32916	Stonecrop, Jenny's (Sedum rupestre) S. rupestre 'Blue Spruce' and S. album 'Red Ice'	Field Container	Aulakh	CT	2018	Broadcast	Two trials. No injury or growth reduction with 200, 400 and 800 lb per acre applied twice on 2 species - Sedum rupestre and Sedum album.
32916	Stonecrop, Jenny's (Sedum rupestre)	Field Container	Derr	VA	2018	Broadcast	Good to excellent control increasing with rates (200, 400 and 800 lb per acre) applied twice. Moderate to severe crop shoot weight reduction.
32916	Stonecrop, Jenny's (Sedum rupestre)	Field Container	Marble	FL	2019	Broadcast	Moderate to severe injury and growth reduction increasing with rates (200, 400 and 800 lb per acre) applied twice.
32916	Stonecrop, Jenny's (Sedum rupestre) 'Angelina'	Field Container	Neal	NC	2018	Broadcast	Severe injury and growth reduction with 200, 400 and 800 lb per acre applied twice.
34965	Prairie Dropseed (Sporobolus heterolepis)	Field Container	Derr	VA	2022	Broadcast	No to very slight injury with 1.3, 2.6, and 5.2 lb ai per acre.
34965	Prairie Dropseed (Sporobolus heterolepis)	Field Container	Reding	OH	2022	Broadcast	Slight to moderate chlorosis with plant thinning as rates increased (200, 400, 800 lb per acre). There was no impact on flower development.
34696	Grass, Mexican Feather (Stipa sp.) S. tenuissima	Field Container	Marble	FL	2023	Broadcast	Slight to moderate injury with 200 and 400 lb per acre, but 800 lb per acre cause severe injury and mortality after second application.
32926	Marigold, African (Tagetes erecta)	Field Container	Marble	FL	2017	Broadcast	No to minor injury with 200, 400 and 800 lb per acre applied twice.
32926	Marigold, African (Tagetes erecta) 'Inca Yellow'	Field Container	Reding	OH	2017	Broadcast	No injury or growth reduction with 200, 400 and 800 lb per acre applied twice; all plants marketable.
32926	Marigold, African (Tagetes erecta) 'Taisha Gold'	Field Container	Senesac	NY	2017	Broadcast	Moderate injury with 200 and 400, severe with 800 lb per acre applied twice.

Label Suggestions

We recommend that the following crop, which exhibited no injury in these experiments, be added to the future Gemini G label for broadcast applications.

Euonymus alatus.

Nepeta x fassiana

We also suggest that the one plant species exhibiting significant injury with over-the-top applications be added to list of sensitive ornamental species.

Phlox paniculata

Appendix 1: Contributing Researchers

Dr. Jatinder S Aulakh	Connecticut Agricultural Experiment Station Valley Laboratory 143 Cook Hill Road, P.O. Box 228 Windsor, CT
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