

**IR-4 Ornamental Horticulture Program  
Pendimethalin Crop Safety**

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## Abstract

Several good herbicide products are available to manage weeds in and around nursery crops. Because growers produce many different plant species and cultivars and because many new crops are grown every year, this research was undertaken to expand the three pre-emergent herbicide labels: Pendulum 2G (pendimethalin), Pennant Magnum (s-metolachlor), and Snapshot 2.5TG (trifluralin + isoxaben). This report covers only Pendulum 2G. The rates chosen for this research were 2, 4 and 8 pounds active ingredient per acre (lb ai per A) as the 1X, 2X and 4X rates. Eighty-four different species were examined. Of these, 73 exhibited no or minimal transient injury after application at all three rates. Seven crops exhibited no phytotoxicity at 2 lb ai per acre, but did have some injury at the higher rates. Four species (*Amsonia tabernaemontana*, *Epimedium x rubrum*, *Helleborus orientalis*, and *Tiarella wherryi*) exhibited phytotoxicity at even the 2 lb ai per acre rate.

## **Introduction**

Control of weeds in the production of herbaceous perennials can be problematic because nurseries grow many different types of plants and herbicide product labels do not have some of the important species grown. Three pre-emergent herbicides, Pendulum 2G, Pennant Magnum, and Snapshot 2.5TG, were chosen for 2004 and 2005 research activities into level of crop safety on over 50 different plant species. This report covers the results from Pendulum 2G.

## **Materials and Methods**

Two applications of Pendulum 2G (pendimethalin) were made approximately 30 days apart. The application rates were 2, 4, and 8 lb ai per A, plus a water treated control. A minimum of four plants (replicate treatments) 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, 4, 8, and 12 weeks after initial application. Some researchers also included readings 3 to 4 days after the initial and second applications. For more detailed materials and methods, please see Appendix 1: Protocols.

Pendulum 2G was supplied to researchers (See list of researchers in Appendix 2) by BASF.

## **Results and Summary**

### ***Efficacy***

Mather examined efficacy on large crabgrass and groundsel and determined Pendulum 2G provided effective control of large crabgrass but poor control of groundsel.

### ***Phytotoxicity***

Based on the type and nature of injury seen with Pendulum 2G applications in the research conducted in 2005, 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 this product.

In general, Pendulum 2G exhibited no or minimal negative impact on a wide range of plant species (Table 1). Seventy-four plant genera or species fell into this category. Some minimal injury may be acceptable for growers if applications are made several weeks to months in advance of crop sale particularly for woody ornamental crops. For 7 crop species, there was no or little injury exhibited at the 2 lb ai per acre rate, but significant phytotoxicity occurred at the 4 lb ai per acre rate (Table 2). It may be prudent to either conduct additional trials or place language on the label indicating applications of Pendulum 2G are considered safe at the 2 lb ai per acre rate but any higher rate may cause unacceptable injury.

Only four crops in the 2005 testing exhibited damage sufficient to recommend growers not utilize Pendulum 2G as an over-the-top treatment for pre-emergent weed control: *Amsonia tabernaemontana*, *Epimedium x rubrum*, *Helleborus orientalis*, and *Tiarella wherryi* (Table 3).

Please see Table 4 for a list of research on Pendulum 2G in 2004 and 2005 and the summary of the results received so far.

**Table 1. List of Pendulum 2G treated crops with no or minimal transitory injury.**

<i>Achillea millifolium</i>	<i>Gaura lindheimeri</i>	<i>Penstemon x Mexicali</i>
<i>Agastache aurantiaca</i>	<i>Gazania sp.</i>	<i>Penstemon sp.</i>
<i>Alchemilla mollis</i> (note Derr)	<i>Gerbera jamesonii</i>	<i>Phlox subulata</i>
<i>Amsonia hubrichtii</i>	<i>Gomphrenia globosa</i>	<i>Phormium colinsoi</i>
<i>Antennaria dioica</i> var. <i>rosea</i>	<i>Helenium autumnale</i>	<i>Polemonium boreale</i>
<i>Antennaria parvifolia</i>	<i>Helianthemum sp.</i>	<i>Primula malacoides</i>
<i>Asarum candanense</i>	<i>Heuchera sanguinea</i>	<i>Ruellia carolinensis</i>
<i>Asarum chinensis</i>	<i>Hibiscus syriacus</i>	<i>Salvia x sylvestris</i>
<i>Aster novibelgii</i>	<i>Hosta sp.</i>	<i>Santolina chamaecyparissus</i>
<i>Athyrium nipponicum</i>	<i>Iberis sp.</i>	<i>Scabiosa sp.</i>
<i>Aubrieta deltoidea</i>	<i>Kniphofia uvaria</i>	<i>Sedum sp.</i>
<i>Aubrieta sp.</i>	<i>Lantana hybrida</i>	<i>Sempervivum arachnoideum</i>
<i>Bergenia cordifolia</i>	<i>Lantana montevidensis</i>	<i>Sempervivum tectorum</i>
<i>Buddleia davidii</i>	<i>Lavandula augustifolia</i>	<i>Solidago rugosa</i>
<i>Centranthus ruber</i>	<i>Lavandula sp.</i>	<i>Solidago sempervirens</i>
<i>Chelone lyonii</i>	<i>Ligularia dentate</i>	<i>Solidago speciosa</i>
<i>Clematis sp.</i>	<i>Ligularia sp.</i>	<i>Tiarella cordifolia</i>
<i>Cuphea hyssopifolia</i>	<i>Linum perenne</i>	<i>Tiarella sp.</i>
<i>Delosperma nubigenum</i>	<i>Liriope muscari</i>	<i>Tradescantia andersoniana</i>
<i>Digitalis thapsi</i>	<i>Monarda didyma</i>	<i>Tradescantia virginiana</i>
<i>Echinacea purpurea</i>	<i>Nepeta faassenii</i>	<i>Verbena canadensis</i>
<i>Echinacea sp.</i>	<i>Opuntia Humifusa</i>	<i>Vernonia noveboracensis</i>
<i>Eupatorium purpureum</i>	<i>Origanum libanoticum</i>	<i>Veronica liwanensis</i>
<i>Eupatorium manculatum</i>	<i>Penstemon digitalis</i>	
<i>Eupatorium rugosa</i>	<i>Penstemon hartwegii</i>	

**Table 2. List of Pendulum 2G treated crops with no or minimal transitory injury seen at the 1X rate, but the 2X or 4X rate did cause significant phytotoxicity**

<i>Agastache rugosa X foeniculum</i>	<i>Baptisia australis</i>	<i>Phlox paniculata</i>
<i>Armeria maritima</i>	<i>Chrysogonum virginiana</i>	
<i>Athyrium nipponicum</i>	<i>Cimicifuga racemosa</i>	

**Table 3. List of Pendulum 2G treated crops exhibiting significant injury.**

<i>Amsonia tabernaemontana</i>	<i>Helleborus orientalis</i>
<i>Epimedium x rubrum</i>	<i>Tiarella wherryi</i>

**Table 4. Detailed Summary of 2004 and 2005 Crop Safety Testing with Pendulum 2G**

Notes: Table entries are sorted by crop Latin name. All researchable studies for Pendulum 2G are included in this table. Only those that were researched in 2004 and 2005 and were received by 6/1/2006 have summaries.

PR #	Crop			Production Site	Researcher(s)	Year	Results Summary
	Common Name	Latin Name	Cultivar				
24395	Yarrow	Achillea millefolium	'Apple Blossom'	Field Container	Boydston	2005	No injury
24395	Yarrow	Achillea millefolium		Field Container	Reding	2005	No injury
24678	Hyssop species	Agastache sp.	A. rugosa X foeniculum 'Blue Fortune'	Field Container	Boydston	2005	No visible injury; the 8 lb ai per acre rate caused brittle stems that make plants susceptible to wind damage
24678	Hyssop species	Agastache sp.	A. aurantiaca 'Coronado'	Field Container	Klett	2005	No injury
24678	Hyssop species	Agastache sp.	A. aurantiaca 'Coronado'	Field Container	Klett	2005	No injury
24678	Hyssop species	Agastache sp.	'Blue Fortune'	Field Container	Mathers	2005	No injury at the 2 and 4 lb ai per acre rates; severe injury (brittle stems) at the 8 lb ai per acre rate
23745	Lady's-Mantle	Alchemilla sp.	A. mollis 'Thriller'	Field Container	Ahrens/Mervosh	2004	No significant injury
23745	Lady's-Mantle	Alchemilla sp.	A. mollis 'Thriller'	Field Container	Ahrens/Mervosh	2005	No injury
23745	Lady's-Mantle	Alchemilla sp.	A. mollis 'Auslese'	Field Container	Derr	2004	All rates caused slight injury
23745	Lady's-Mantle	Alchemilla sp.		Field Container	Klett	2004	No injury
23745	Lady's-Mantle	Alchemilla sp.		Field Container	Klett	2004	No injury
23745	Lady's-Mantle	Alchemilla sp.	A. mollis 'Auslese'	Field Container	Lieth	2004	No significant injury
23745	Lady's-Mantle	Alchemilla sp.		Field Container	Mathers	2004	No injury
23745	Lady's-Mantle	Alchemilla sp.	A. mollis 'Thriller'	Field Container	Senesac	2004	No significant injury
24680	Golden Trumpet	Allamanda sp.		Field Container	Stamps	2005	
24681	Shellplant	Alpinia zerumbet		Field Container	Stamps	2005	
23746	Bluestar	Amsonia sp.	A. tabernaemontana	Field Container	Gilliam	2004	All rates caused significant leaf burn
23746	Bluestar	Amsonia sp.	A. hubrichtii	Field Container	Neal	2004	No injury
23746	Bluestar	Amsonia sp.	A. hubrichtii	Field Container	Senesac	2004	No injury
23747	Pussy-Toes, Stoloniferous	Antennaria dioica		Field Container	Klett	2004	No injury
23747	Pussy-Toes, Stoloniferous	Antennaria dioica		Field Container	Klett	2004	No injury
23748	Pussy-Toes, Small-leaf	Antennaria parvifolia		Field Container	Neal	2005	No injury
23748	Pussy-Toes,	Antennaria parvifolia		Field Container	Senesac	2004	No injury

PR #	Crop			Production Site	Researcher(s)	Year	Results Summary
	Common Name	Latin Name	Cultivar				
	Small-leaf						
24684	Thrift, Sea Pink	<i>Armeria maritima</i>	'Splendens'	Field Container	Boydston	2005	No injury
24684	Thrift, Sea Pink	<i>Armeria maritima</i>	'Splendens'	Field Container	Gilliam	2005	No injury
24684	Thrift, Sea Pink	<i>Armeria maritima</i>	'Dusseldorf'	Field Container	Lieth	2005	No injury at the 2 lb ai per acre rate; the 8 lb ai per acre rate reduced plant growth
23749	Canadian Ginger	<i>Asarum canadense</i>	A. chinensis	Field Container	Mathers	2004	No injury
23749	Canadian Ginger	<i>Asarum canadense</i>	A. chinensis	Field Container	Neal	2005	No injury
23749	Canadian Ginger	<i>Asarum canadense</i>		Field Container	Senesac	2005	No significant injury
25019	Butterfly	<i>Asclepias tuberosa</i>		Field Container	Stamps	2005	
24393	Aster, New York	<i>Aster novi-belgii</i>	'Sailor Boy'	Field Container	Beste/Frank	2005	
24393	Aster, New York	<i>Aster novi-belgii</i>	'Professor Anton Kippenberg'	Field Container	Boydston	2005	No injury
24393	Aster, New York	<i>Aster novi-belgii</i>		Field Container	Simmons	2005	No significant injury
24693	Fern, Lady	<i>Athyrium nipponicum</i>		Field Container	Derr	2005	All rates caused no visible injury but reduced shoot weight
24693	Fern, Lady	<i>Athyrium nipponicum</i>	'Pretum'	Field Container	Mathers	2005	No significant injury at the 2 lb ai per acre rate; the 4 and 8 lb ai per acre rates caused moderate to severe injury (frond scorching)
23750	Rock Cress	<i>Aubrieta</i> sp.		Field Container		2004	
23750	Rock Cress	<i>Aubrieta</i> sp.		Field Container	Klett	2004	No injury
23750	Rock Cress	<i>Aubrieta</i> sp.		Field Container	Klett	2004	No injury
23750	Rock Cress	<i>Aubrieta</i> sp.	'White Gem'	Field Container	Lieth	2004	All rates caused no injury but reduced plant width
23750	Rock Cress	<i>Aubrieta</i> sp.	A. deltoidea 'Whitwell Gem'	Field Container	Neal	2004	No significant injury
23751	Blue False Indigo	<i>Baptisia australis</i>		Field Container	Derr	2004	All rates caused slight injury
23751	Blue False Indigo	<i>Baptisia australis</i>		Field Container	Gilliam	2004	No injury at the 2 and 4 lb ai per acre rates; slight injury at the 8 lb ai per acre rate
23751	Blue False Indigo	<i>Baptisia australis</i>		Field Container	Klett	2004	No injury
23751	Blue False Indigo	<i>Baptisia australis</i>		Field Container	Klett	2004	No injury
23751	Blue False Indigo	<i>Baptisia australis</i>		Field Container	Neal	2004	No injury
23751	Blue False Indigo	<i>Baptisia australis</i>		Field Container	Senesac	2005	No injury
24694	Heart-leaved Bergenia	<i>Bergenia cordifolia</i>	'Rotblum'	Field Container	Lieth	2005	No injury
24694	Heart-leaved Bergenia	<i>Bergenia cordifolia</i>	New Hybrid bergenia	Field Container	Neal	2005	No injury
24386	Butterfly Bush	<i>Buddleia davidii</i>	'White Profusion'	Field Container	Beste/Frank	2005	No significant injury
24386	Butterfly Bush	<i>Buddleia davidii</i>	'Pink Delight'	Field Container	Boydston	2005	No injury
24386	Butterfly Bush	<i>Buddleia davidii</i>		Field Container	Simmons	2005	No significant injury
24695	Jupiter's Beard	<i>Centranthus ruber</i>		Field Container	Reding	2005	No injury



PR #	Crop			Production Site	Researcher(s)	Year	Results Summary
	Common Name	Latin Name	Cultivar				
23752	Turtlehead, Snakehead	Chelone sp.	C. lyonii 'Hot Lips'	Field Container	Derr	2004	All rates caused slight injury
23752	Turtlehead, Snakehead	Chelone sp.	C. lyonii 'Hot Lips'	Field Container	Neal	2004	No injury
23752	Turtlehead, Snakehead	Chelone sp.	C. lyonii 'Hot Lips'	Field Container	Senesac	2004	No significant injury
23753	Golden Star	Chrysogonum sp.	C. virginianum 'Alan Bush'	Field Container	Derr	2004	All rates caused slight injury
23753	Golden Star	Chrysogonum sp.	C. virginianum 'Alan Bush'	Field Container	Neal	2004	No injury at the 2 and 4 lb ai per acre rates; very slight injury at 8 lb ai per acre
23753	Golden Star	Chrysogonum sp.	C. virginianum 'Alan Bush'	Field Container	Senesac	2005	No significant injury
23754	Bugbane & Cohosh, Black	Cimicifuga racemosa		Field Container	Neal	2005	No injury at the 2 and 4 lb ai per acre rates; moderate injury at 8 lb ai per acre
24822	Clematis	Clematis sp.	'Midnight Showers'	Field Container	Mathers	2005	No injury
25295	Mexican Heather, False Heather, Elfin Herb	Cuphea hyssopifolia		Field In-Ground	Chen	2005	No significant injury
24824	Hardy Ice Plant, Yellow Ice Plant	Delosperma nubigenum		Field Container	Boydston	2005	No visible injury; significantly lower plant width at 4 and 8 lb ai per acre but plants are saleable
24696	Foxglove	Digitalis sp.	D. thaspi 'Foxy'	Field Container	Boydston	2005	No injury
24696	Foxglove	Digitalis sp.	D. thaspi 'Spanish Peaks'	Field Container	Klett	2005	No significant injury
24696	Foxglove	Digitalis sp.	D. thaspi 'Spanish Peaks'	Field Container	Klett	2005	No significant injury
24391	Purple Coneflower	Echinacea sp.	E. purpurea 'Magnus'	Field Container	Boydston	2005	No injury
24391	Purple Coneflower	Echinacea sp.	E. purpurea 'Magnus'	Field Container	Derr	2005	No injury
24391	Purple Coneflower	Echinacea sp.	'Magnus'	Field Container	Gilliam	2005	No injury
24391	Purple Coneflower	Echinacea sp.		Field Container	Simmons	2005	No significant injury
23755	Barrenwort	Epimedium sp.	E. x rubrum	Field Container	Ahrens/Mervosh	2005	Slight injury at 2 lb ai per acre; the 4 and 8 lb ai per acre rates caused significant injury and reduced plant vigor
23755	Barrenwort	Epimedium sp.	E. x rubrum	Field Container	Senesac	2005	Slight injury at 2 lb ai per acre; the 4 and 8 lb ai per acre rates caused significant injury
23756	Joepy weed, Spotted	Eupatorium maculatum	'Gateway'	Field Container	Ahrens/Mervosh	2005	No injury
23758	Joepy weed, Sweetscented	Eupatorium purpureum	'Gateway'	Field Container	Neal	2005	No injury
23758	Joepy weed, Sweetscented	Eupatorium purpureum		Field Container	Senesac	2004	No injury

PR #	Crop			Production Site	Researcher(s)	Year	Results Summary
	Common Name	Latin Name	Cultivar				
24698	Thoroughwort	Eupatorium sp.	E. rugosum 'Chocolate'	Field Container	Boydston	2005	No injury
24698	Thoroughwort	Eupatorium sp.	E. rugosa 'Chocolate'	Field Container	Mathers	2004	No injury
24385	Gaura	Gaura lindheimeri	'Pink Fountain'	Field Container	Boydston	2005	No injury
24699	Gazania	Gazania linearis	Colorado Gold	Field Container	Neal	2005	No injury
24701	Transvaal Daisy	Gerbera sp.	G. jamesonii 'Lambada'	Field Container	Lieth	2005	No injury or growth suppression
24702	Globe Amaranth	Gomphrena sp.	G. globosa	Field Container	Gilliam	2005	No injury
23759	Common sneezeweed	Helenium autumnale		Field Container	Klett	2004	No injury
23759	Common sneezeweed	Helenium autumnale		Field Container	Klett	2004	No injury
23759	Common sneezeweed	Helenium autumnale		Field Container	Lieth	2004	No significant injury
23759	Common sneezeweed	Helenium autumnale		Field Container	Senesac	2005	No injury
24703	Sun Rose, Rock Rose	Helianthemum sp.	'Belgravia Rose'	Field Container	Lieth	2005	No injury
23760	Sunflower, Willowleaf	Helianthus salicifolius		Field Container	Senesac	2005	No injury
24704	Sunflower	Helianthus sp.	'First Light'	Field Container	Mathers	2005	No injury
24704	Sunflower	Helianthus sp.		Field Container	Stamps	2005	
23762	False Sunflower, Smooth Oxeye	Heliopsis helianthoides		Field Container	Boydston	2005	No injury
23762	False Sunflower, Smooth Oxeye	Heliopsis helianthoides		Field Container	Neal	2004	No injury
23763	Hellebore, Christmas rose, Lenten Rose	Helleborus niger		Field Container		2004	
23763	Hellebore, Christmas rose, Lenten Rose	Helleborus niger		Field Container	Mathers	2004	All rates caused unacceptable phytotoxicity (cupped leaves)
25790	Hellebore, Christmas rose, Lenten Rose	Helleborus niger		Field Container	Senesac	2005	No injury
24705	Coral Bells, Alumroot	Heuchera sanguinea	'Crimson Curls'	Field Container	Boydston	2005	No injury at 2 and 4 lb ai per acre; significant stunting at 8 lb ai per acre
24705	Coral Bells, Alumroot	Heuchera sanguinea		Field Container	Klett	2005	No significant injury
24705	Coral Bells, Alumroot	Heuchera sanguinea		Field Container	Klett	2005	No significant injury
24705	Coral Bells,	Heuchera sanguinea	'Firefly'	Field Container	Lieth	2005	No injury or growth suppression

PR #	Crop			Production Site	Researcher(s)	Year	Results Summary
	Common Name	Latin Name	Cultivar				
	Alumroot						
25787	Rose-Of-Sharon, Althaea	Hibiscus syriacus	'Splash Pinot Nior'	Field Container	Senesac	2005	No injury
24399	Lily, Plantain	Hosta fortunei		Field Container	Boydston	2005	No injury
24826	Candytuft	Iberis sp.	'Snowflake'	Field Container	Lieth	2005	No injury
23764	Poker Plant, Red-Hot-Poker	Kniphofia sp.	'Flamenco'	Field Container	Boydston	2005	No injury
23764	Poker Plant, Red-Hot-Poker	Kniphofia sp.		Field Container	Derr	2005	All rates caused no visible injury but reduced shoot weight
23764	Poker Plant, Red-Hot-Poker	Kniphofia sp.		Field Container	Gilliam	2005	No injury
23764	Poker Plant, Red-Hot-Poker	Kniphofia sp.	K. uvaria	Field Container	Klett	2004	No injury
23764	Poker Plant, Red-Hot-Poker	Kniphofia sp.	K. uvaria	Field Container	Klett	2004	No injury
23764	Poker Plant, Red-Hot-Poker	Kniphofia sp.	K. uvaria	Field Container	Lieth	2004	No significant injury
23764	Poker Plant, Red-Hot-Poker	Kniphofia sp.		Field Container	Mathers	2004	No injury
23764	Poker Plant, Red-Hot-Poker	Kniphofia sp.	'Pfitzer's Hybrid'	Field Container	Neal	2005	No injury
23764	Poker Plant, Red-Hot-Poker	Kniphofia sp.		Field Container	Stamps	2005	
25442	Shrub Verbena	Lantana sp.	L. hybrida 'New Gold'	Field In-Ground	Chen	2005	No injury
24679	Shrub Verbena	Lantana sp.	L. montevidensis	Field Container	Lieth	2005	No injury or plant growth suppression
23765	English Lavender	Lavandula angustifolia		Field Container	Klett	2004	No injury
23765	English Lavender	Lavandula angustifolia		Field Container	Klett	2004	No injury
23765	English Lavender	Lavandula angustifolia		Field Container	Lieth	2004	No significant injury
23765	English Lavender	Lavandula angustifolia		Field Container	Mathers	2004	No injury
23765	English Lavender	Lavandula angustifolia		Field Container	Neal	2004	No injury
23765	English Lavender	Lavandula angustifolia		Field Container	Senesac	2004	No injury
24400	Lavender	Lavandula sp.		Field Container	Gilliam	2004	No injury
23766	Golden Rockets	Ligularia stenocephala	L. dentata 'Dark Leaf'	Field Container	Boydston	2005	No injury
23766	Golden Rockets	Ligularia stenocephala	L. dentata	Field Container	Mathers	2004	No injury
23766	Golden Rockets	Ligularia stenocephala	'The Rocket'	Field Container	Senesac	2005	No injury
23767	Blue flax	Linum perenne L. ssp. Perenne		Field Container	Klett	2004	No injury
23767	Blue flax	Linum perenne L. ssp. Perenne		Field Container	Klett	2004	No injury

PR #	Crop			Production Site	Researcher(s)	Year	Results Summary
	Common Name	Latin Name	Cultivar				
23767	Blue flax	Linum perenne L. ssp. Perenne		Field Container	Lieth	2004	No injury
23767	Blue flax	Linum perenne L. ssp. Perenne		Field Container	Neal	2004	No injury
23767	Blue flax	Linum perenne L. ssp. Perenne		Field Container	Senesac	2004	No significant injury
11455	Lilyturf, Big Blue;Giant	Liriope muscari	'Big Blue'	Field In-Ground	Chen	2005	No significant injury
24388	Bee Balm	Monarda didyma	'Cambridge Scarlet'	Field Container	Beste/Frank	2005	No injury
24388	Bee Balm	Monarda didyma	'Gardeview Scarlet'	Field Container	Boydston	2005	No injury
24388	Bee Balm	Monarda didyma		Field Container	Simmons	2005	Slight injury (chlorosis) but all plants marketable
23769	Catmint	Nepeta x faasseni		Field Container	Derr	2004	All rates caused slight injury
23769	Catmint	Nepeta x faasseni		Field Container	Gilliam	2004	No injury
23769	Catmint	Nepeta x faasseni		Field Container	Klett	2004	No injury
23769	Catmint	Nepeta x faasseni		Field Container	Klett	2004	No injury
23769	Catmint	Nepeta x faasseni		Field Container	Lieth	2004	No injury
23769	Catmint	Nepeta x faasseni		Field Container	Mathers	2004	No injury
23769	Catmint	Nepeta x faasseni		Field Container	Neal	2004	All rates caused significant injury
23769	Catmint	Nepeta x faasseni		Field Container	Senesac	2004	No injury
23770	Devil's-tongue prickly pear	Opuntia humifusa		Field Container	Senesac	2005	No injury
24709	Hopflower Oregano	Origanum libanoticum		Field Container	Klett	2004	No injury
24709	Hopflower Oregano	Origanum libanoticum		Field Container	Klett	2005	No significant injury
24709	Hopflower Oregano	Origanum libanoticum		Field Container	Klett	2005	No significant injury
24397	Beard-Tongue	Penstemon sp.	'Husker Red'	Field Container	Beste/Frank	2005	No injury
24397	Beard-Tongue	Penstemon sp.	P. hartwegii 'Scarlet Queen'	Field Container	Boydston	2005	No injury
24397	Beard-Tongue	Penstemon sp.	P. digitalis	Field Container	Derr	2005	No injury
24397	Beard-Tongue	Penstemon sp.	P. x mexicali 'Red Rocks'	Field Container	Lieth	2005	No injury or plant growth suppression
24397	Beard-Tongue	Penstemon sp.	'Husker Red'	Field Container	Neal	2004	No injury
24397	Beard-Tongue	Penstemon sp.		Field Container	Simmons	2005	No injury
24712	Pentas	Pentas sp.		Field Container	Stamps	2005	
24485	Phlox, Perennial	Phlox paniculata	'Bright Eyes'	Field Container	Boydston	2005	All rates caused brittle stems susceptible to wind damage
24398	Creeping Phlox, Moss Pink	Phlox subulata	'Emerald Cushion Pink'	Field Container	Beste/Frank	2005	slight injury but all marketable

PR #	Crop			Production Site	Researcher(s)	Year	Results Summary
	Common Name	Latin Name	Cultivar				
24398	Creeping Phlox, Moss Pink	Phlox subulata	'Emerald Blue'	Field Container	Boydston	2005	No injury
24430	Creeping Phlox, Moss Pink	Phlox subulata	'Candy Strip'	Field In-Ground	Chen	2005	No injury
24398	Creeping Phlox, Moss Pink	Phlox subulata		Field Container	Simmons	2005	Slight injury but all plants marketable
24713	New Zealand Flax	Phormium sp.	P. colinsoi	Field Container	Lieth	2005	No injury; significant increase in plant growth at 4 and 8 lb ai per acre
24713	New Zealand Flax	Phormium sp.		Field Container	Stamps	2005	
23771	Jacob's Ladder	Polemonium sp.	P. boreale 'Heavenly Habit'	Field Container	Boydston	2005	Single application at all rates had no impact, but second application did cause minor stunting.
23771	Jacob's Ladder	Polemonium sp.	P. boreale	Field Container	Mathers	2004	No injury
24715	Primrose, Fairy	Primula malacoides		Field Container	Lieth	2005	No injury but there was some plant growth suppression
25303	Mexican Petunia	Ruellia carolinensis	R. brittoniana 'Katie'	Field In-Ground	Chen	2005	No significant injury
24387	Sage, Ramona	Salvia sylvestris	'Marcus'	Field Container	Boydston	2005	No injury
24717	Lavender cotton	Santolina chamaecyparissus	'Compacta'	Field Container	Lieth	2005	No injury; significant increase in plant growth
24488	Pincushion Flower	Scabiosa sp.	'Butterfly Blue'	Field Container	Boydston	2005	No injury
24389	Stonecrop	Sedum sp.	'Autumn Joy'	Field Container	Boydston	2005	No injury
24389	Stonecrop	Sedum sp.		Field Container	Simmons	2005	No significant injury
23774	Hen and chicks	Sempervivum arachnoideum		Field Container	Mathers	2004	No injury
23774	Hen and chicks	Sempervivum arachnoideum		Field Container	Senesac	2004	No injury
23773	Hen and chicks	Sempervivum tectorum	'Cobweb'	Field Container	Ahrens/Mervosh	2005	No significant injury
23773	Hen and chicks	Sempervivum tectorum		Field Container	Klett	2004	No injury
23773	Hen and chicks	Sempervivum tectorum		Field Container	Klett	2004	No injury
23773	Hen and chicks	Sempervivum tectorum		Field Container	Lieth	2004	No significant injury
23773	Hen and chicks	Sempervivum tectorum		Field Container	Mathers	2004	No injury
23777	Goldenrod, Wrinkleleaf	Solidago rugosa		Field Container	Lieth	2004	No significant injury
23777	Goldenrod, Wrinkleleaf	Solidago rugosa		Field Container	Neal	2004	No injury
23777	Goldenrod, Wrinkleleaf	Solidago rugosa		Field Container	Reding	2005	No injury
23778	Goldenrod, Seaside	Solidago sempervirens		Field Container	Senesac	2004	No injury

PR #	Crop			Production Site	Researcher(s)	Year	Results Summary
	Common Name	Latin Name	Cultivar				
24718	Goldenrod	Solidago sp.		Field Container	Stamps	2005	
23779	Goldenrod, Showy	Solidago speciosa		Field Container	Klett	2004	No injury
23779	Goldenrod, Showy	Solidago speciosa		Field Container	Klett	2004	No injury
23780	Foamflower, Heartleaf	Tiarella cordifolia		Field Container	Klett	2004	No injury
23780	Foamflower, Heartleaf	Tiarella cordifolia		Field Container	Klett	2004	No injury
23780	Foamflower, Heartleaf	Tiareella cordifolia		Field Container	Mathers	2004	No injury
23780	Foamflower, Heartleaf	Tiareella cordifolia	T. wherryi	Field Container	Neal	2004	All rates caused significant injury
23780	Foamflower, Heartleaf	Tiareella cordifolia		Field Container	Senesac	2005	Injury apparent after second application; 4 and 8 lb ai per acre rates exhibited moderate injury
25781	Foamflower, False Miterwort	Tiareella sp.	T. wherryi	Field Container	Neal	2004	
24721	Spiderwort	Tradescantia virginiana	Spiderwort 'Osprey'	Field Container	Boydston	2005	No injury
24720	Spiderwort	Tradescantia x andersoniana		Field Container	Derr	2005	No injury
24720	Spiderwort	Tradescantia x andersoniana	'Sweet Kate'	Field Container	Mathers	2005	No injury
25308	Vervain	Verbena sp.	V. canadensis 'Homestead Purple'	Field In-Ground	Chen	2005	No significant injury
24685	Vervain	Verbena sp.	V. canadensis 'Homestead Purple'	Field Container	Neal	2005	No injury
23781	Ironweed, New York	Vernonia noveboracensis		Field Container	Neal	2004	No injury
23781	Ironweed, New York	Vernonia noveboracensis		Field Container	Senesac	2004	No injury
24722	Turkish veronica	Veronica liwanensis		Field Container	Boydston	2005	All rates caused no injury but reduced plant width; all treated plants were saleable

## Label Suggestions

It is suggested that all 73 crop genera or species exhibiting no injury in these experiments be added to the Pendulum 2G label under the Perennials header.

It is also suggested that growers be cautioned not to use Pendulum 2G on the following four crops: *Amsonia tabernaemontana*, *Epimedium x rubrum*, *Helleborus orientalis*, and *Tiarella wherryi*.

## **Appendix 1: Protocol**



**PHYTOTOXICITY TO HERBACEOUS PERENNIAL PLANTS WITH PRE-EMERGENT  
APPLICATIONS OF PENDULUM, PENNANT MAGNUM AND SNAPSHOT**

Date: 12/04

Ornamental Protocol Number: 001

General label directions: Refer to product labels.

Research program:

Pest(s)/Plants – As attached.

Pesticide (common name and trade name) – Refer to treatment list shown below.

For label, material & if needed spray oil surfactant contact:

BASF, Kathie Kalmowitz, 919-785-9659, email: [kalmowk@basf-corp.com](mailto:kalmowk@basf-corp.com) (Pendulum)

Dow AgroSciences, Mike Melichar, 317-337-4982, [mwymelichar@dow.com](mailto:mwymelichar@dow.com) (Snapshot)

Syngenta, Dave Ross, 336-632-6411, [david.ross@syngenta.com](mailto:david.ross@syngenta.com) (Pennant Magnum)

Experimental design:

Plot size: Must be adequate to reflect actual use condition.

Replicates Minimum of 3 replications (preferably 4) with 3 of each species per pot per replicate

Controls: Untreated controls to be included in all experiments.

<u>Application:</u>	<u>PENDULUM 2G</u>	<u>SNAPSHOT 2.5TG</u>	<u>PENNANT MAGNUM 7.62EC</u>
<u>Dosages</u> - 1x	2 lbs.ai/A	2.5 lbs.ai/A	2.5 lbs.ai/A
2x	4 lbs.ai/A	5.0 lbs.ai/A	5.0 lbs.ai/A
4x	8 lbs ai/A	10.0 lbs.ai/A	10.0 lbs.ai/A

Active Ingredient: Pendulum (pendimethalin), Pennant Magnum (s-metolachlor), Snapshot (isoxaben+trifluralin).

Volume - Minimum of 20 gal/A for liquid applications.

Timing - 2 applications, 30 Days Spray Interval. Make first application within 7 days of potting. Evaluate crop at 7, 14, 30 days after each application.

Reports:

Method of application: Treatments should be made over the top of the plants using application equipment consistent with conventional commercial equipment. Report completely on experimental design and method of application. Report liner size, plant size height x width, and growth stage before each treatment and at evaluation dates.

Weather – Maintain temperature and precipitation (including irrigation) data.

Soil type – Identify soil type used in experimental area.

Product – When submitting data, include EPA registration number of product used.

Efficacy – Data should include both actual counts and percent control as well as an indication that infestation was light, heavy, etc. Record all application and evaluation dates.

Phytotoxicity – Record phytotoxicity data at all rates. Use a 0-10 scale. 0 = No Phytotoxicity 10 = complete kill.

Please direct questions to: Ely Vea, 308 Aston Forest Lane, Crownsville, MD 21032, Phone & FAX#: 410-923-488, E-mail: [evvea@comcast.net](mailto:evvea@comcast.net).

## Phytotoxicity to herbaceous perennial plants with pre-emergent applications of Pendulum, Pennant Magnum, and Snapshot

**Ornamental Protocol Number: 05-001**

**Objective:** Determine phytotoxicity of Pendulum, Pennant Magnum, and Snapshot to unlabelled perennial plants commonly grown in nurseries.

### Experimental Design:

**Plot Size:** Must be adequate to reflect actual use conditions.

**Replicates:** Minimum of 3 replications (preferably 4) with 3 plants per replicate

**Application Instructions:** Two applications made approximately 4 weeks apart with the first application within 7 days of potting. Plant materials must have broken dormancy prior to first application. For liquid applications, use a minimum of 20 gal per acre. Applications should be made over the top of the plants using application equipment consistent with conventional commercial equipment. Please see table below for instructions for post-application irrigation.

**Plant Materials:** See attached list of plant materials. Plants grown in field containers are preferred to in-ground.

**Evaluations:** Record phytotoxicity on a scale of 0 to 10 at 7, 14, and 28 days after each application. If phytotoxicity is observed in treated plants, take pictures comparing treated and untreated plant material.

**Recordkeeping:** Keep detailed records of weather conditions including temperature and precipitation, soil-type or soil-less media, application equipment, irrigation, liner size, plant height & width, and plant growth stage at application and data collection dates.

### Treatments:

Product	Rate	Post-Application Irrigation Instructions
Pendulum 2G (pendimethalin)	2.0 lb ai/A	
	4.0 lb ai/A	
	8.0 lb ai/A	
Pennant MAGNUM 7.62EC (s-metalochlor)	2.5 lb ai/A	Follow with sufficient overhead irrigation to wash Pennant Magnum from the foliage to reduce the chance of injury
	5.0 lb ai/A	
	10.0 lb ai/A	
Snapshot 2.5TG (isoxaben+trifluralin)	2.5 lb ai/A	Follow with sufficient overhead irrigation to wash Snapshot from the foliage to reduce the chance of injury
	5.0 lb ai/A	
	10.0 lb ai/A	
Untreated	--	--

### For labels, materials, and any required adjuvants contact:

Pendulum - BASF, Kathie Kalmowitz, 919-785-9659, email: [kalmowk@basf-corp.com](mailto:kalmowk@basf-corp.com)

Pennant Magnum - Syngenta, Dave Ross, 336-632-6411, [david.ross@syngenta.com](mailto:david.ross@syngenta.com)

Snapshot - Dow AgroSciences, Mike Melichar, 317-337-4982, [mwmelichar@dow.com](mailto:mwmelichar@dow.com)

### Reports:

Report must include a brief summary paragraph of results, a summary table with appropriate statistical analyses, a section on experimental design and materials and methods, with raw data and recordkeeping information as listed above included as appendices. If pictures were taken, please include them.

An electronic report is preferred but not required. If the report is provided electronically, the basic report can be sent in MS Word or WordPerfect, the recordkeeping information as pdf or other electronic documents, and the raw data in MS Excel or other suitable program such as ARM.

**Please direct questions to:** Cristi Palmer, IR-4 HQ, Rutgers University, 681 US Hwy 1 S, North Brunswick, NJ 08902-3390, Phone 732-932-9575 x629, [palmer@aesop.rutgers.edu](mailto:palmer@aesop.rutgers.edu) OR Ely Vea, 308 Aston Forest Lane, Crownsville, MD 21032, Phone & FAX#: 410-923-488, E-mail: [evvea@comcast.net](mailto:evvea@comcast.net).

Revision Date: 1/05

Revised By: CLP

## 2005 Super A Plant List

Latin Name	Common Name	Pendulum	Pennant Magnum	Snapshot
Agastache spp.	Hyssop species	Y-24678	Y-24723	Y-24768
Agastache rupestris	Sunset Hyssop	N	Y-24724	Y-24769
Allamanda cathartica	Golden Trumpet	Y-24680	Y-24725	Y-24770
Alpinia zerumbet	Shellplant	Y-24681	Y-24726	Y-24771
Amorpha canescens	Leadplant	Y-24682	Y-24727	Y-24772
Anthurium andraeanum	Flamingo-lily	Y-24683	Y-24728	Y-24773
Armeria maritima	Thrift, Sea Pinks	Y-24684	Y-24729	Y-24774
Artemisia ludoviciana	Western Sage	N	Y-24731	Y-24776
Artemisia pontica	Artemisia	N	Y-24733	Y-24778
Artemisia schmidtiana	Silver Mound	N	Y-24730	N
Artemisia stelleriana	Beach Wormwood, Dusty Miller	N	N	Y-24777
Artemisia versicolor	Seafoam	N	Y-24734	Y-24779
Asclepias tuberosa	Butterflyweed	N	N	Y-24780
Aspidistra elatior	Cast Iron Plant	N	Y-24736	Y-24781
Aster ericoides	Aster	Y-24692	N	Y-24782
Astilbe spp.	Astilbe	N	Y	Y
Athyrium nipponicum	Ladyfern	Y-24693	Y-24738	Y-24783
Bergenia cordifolia	Heart-leaved Bergenia	Y-24694	Y-24739	Y-24784
Centranthus ruber	Jupiter's Beard	Y	Y-24740	Y-24785
Clematis spp.	Clematis	Y	Y	Y – but not C. integrifolia cerulea
Dianthus deltoides	Maiden Pink	Y	Y	Y
Delosperma nubegenum	Yellow Ice Plant	Y	Y	Y
Delphinium spp.	Larkspur	Y	N	Y
Digitalis thapsi	Foxglove	Y-24696	Y-24741	Y-24786
Echinacea spp.	Purple coneflower	Y - but not E. purpurea	Y-24742	Y-24787 - but not E. purpurea
Eupatorium spp.	Thoroughwort	Y-24698	Y-24743	Y-24788
Gazania linearis	Gazania	Y-24699	Y-24744	N
Geranium magniflorum	Geranium	N	N	Y-24790
Gerbera jamesonii	Transvaal Daisy	Y-24701	Y-24746	Y-24791
Gomphrena spp.	Globe Amaranth	Y-24702	Y-24747	Y-24792
Helianthemum nummularium	Sunrose	Y-24703	Y-24748	Y-24793
Helianthus spp.	Sunflower	Y-24704	Y-24749	Y-24794
Heuchera sanguinea	Coral Bells	Y-24705	Y-24750	Y-24795
Iberis spp.	Candytuft	Y	Y	Y
Iris spp.	Iris	Y	N	Y – but not I. pumila or I. siberica
Kniphofia uvaria	Redhot Poker	Y-24706	Y-24751	Y-24796
Lantana	Shrub Verbena	Y-24679	Y-24688	Y-24697
Mimulus × hybridus	Monkeyflower	Y-24707	Y-24752	Y-24797
Oenothera macrocarpa	Evening Primrose	Y-24708	N	Y-24798
Origanum libanoticum	Hopflower Oregano	Y-24709	Y-24754	Y-24799
Panicum virgatum	Switchgrass	Y?	Y?	Y
Penstemon x mexicali 'Red Rocks' or 'Pikes Peak Purple'	Beardtongue	N	Y-24754	Y-24799
Penstemon spp.	Beardtongue	N	Y-24755	Y-24800

Pentas spp.	Pentas	Y-24712	Y-24757	Y-24802
Phlox	Phlox	Y	N	Y-24711
Phormium spp. - dwarf hybrids	New Zealand Flax	Y-24713	Y-24758	Y-24803
Pulmonaria spp.	Lungwort	Y-24713	Y-24758	Y-24803
Primula malacoides	Fairy Primrose	Y-24715	Y-24760	Y-24805
Ruellia carolinensis	Mexican Primrose	Y-24687	Y-24691	Y-24735
Ruscus hypophyllum	Israeli Ruscus	Y-24716	Y-24761	Y-24806
Santolina chamaecyparissus	Lavender Cotton	Y-24717	Y-24762	Y-24807
Solidago spp.	Goldenrod	Y-24718	Y-24763	Y-24808
Stipa spp.	Mexican Feathergrass	Y	Y	Y
Thymus spp. (ornamental varieties only)	Thyme	Y	Y	Y
Tradescantia ohiensis	Spiderwort	Y-24719	Y-24764	Y-24809
Tradescantia x andersoniana	Spiderwort	Y-24720	Y-24765	Y-24810
Tradescantia virginiana	Spiderwort	Y-24721	Y-24766	Y-24811
Veronica liwanensis	Turkish Veronica	Y-24722	N	Y-24812
Veronica spicata	Speedwell	Y-24685	N	Y-24710
Mexican Heather	Mexican Heather	Y-24686	Y-24690	Y-24732

Y-00000 = Researchable followed by PR Number

Y = Researchable, PR Number to be assigned pending manufacturer confirmation

N = Not researchable, already on label or manufacturer declined additional data

## Appendix 2: Contributing Researchers

Dr. John Ahrens	Connecticut Agricultural Experiment Station Valley Laboratory 153 Cook Hill Road, P.O. Box 248 Windsor, CT
Dr. Ed Beste	University of Maryland LESREC – Salisbury Facility 27664 Nanticoke Road Salisbury, MD 21801 410-742-8780
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Dr. Steve Tjosvold	University of California Cooperative Extension 1432 Freedom Boulevard Watsonville, CA 95076-2796 (831) 763-8040

### **Appendix 3: Submitted Data**

Data on following pages are in order of PR number with the exception of the reports from Dr. James Altland, Dr. Charles Gilliam, Dr Hannah Mathers/Mr. Luke Case and Drs. Richard Smith and Steve Tjosvold. These reports cover multiple PR numbers and are at the beginning of this Appendix.