



# Environmental Horticulture Program Research Project Sheet

<https://www.ir4project.org/ehc/ehc-registration-support-research/env-hort-extension-resources/>

**Project Name:** Pre Emergent Herbicide Crop Safety–Liquid Applications

<b>New</b>	<b>Ongoing</b>	X	<b>Completed</b>		<b>Duration if ongoing or completed:</b>	2004-2021
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**Project Description:**

The Pre-Emergent Herbicide Crop Safety Project began in 2004 and has continued through 2019. While specific crops and herbicides have changed, the intent of this research has been to screen over-the-top applications of pre-emergent herbicides as plants are breaking dormancy, or beginning new growth, and then 4 to 6 weeks later once foliage is more mature. This research project sheet covers formulations applied as liquid sprays over the top of plants.

**Research Project Abstract (if available):**

**Abstract from 2018 Dimethenamid-p Crop Safety Summary**

From 2007 to 2016, IR-4 completed 504 trials on Tower EC (dimethenamid-p). The data contained in this report was generated to register uses of dimethenamid-p on and around ornamental horticulture plants with over-the-top applications. The dimethenamid-p rates in the testing program were 0.97, 1.94 and 3.88 pounds active ingredient per acre (lb ai per A) as the 1X, 2X and 4X rates. Tower EC had been applied to 146 plant genera or species. Of these, 62 plant species exhibited no or minimal transient injury after application at all three rates. Twenty crops exhibited no phytotoxicity at 0.97 lb ai per acre but did have some injury at 1.94 and 3.88 lb ai per acre. Nine crops – *Aquilegia sp.*, *Catharanthus roseus*, *Cladrastis sp.*, *Echeveria sp.*, *Echinacea sp.*, *Epilobium canum*, *Muhlenbergia dubia*, *Teucrium chamaedrys* and *Viburnum opulus* – exhibited significant phytotoxicity at even the lowest rate.

**Abstract from 2021 Indaziflam Crop Safety Summary**

From 2011 through 2020, IR-4 has completed 159 trials evaluating two granular and one liquid formulations of indaziflam for crop safety. The data contained in this report was generated to register the use of indaziflam on and around environmental horticulture plants with over-the-top applications. The rates tested were 0.045, 0.089 and 0.178 pounds active ingredient per acre (lb ai per A) as the 1X, 2X and 4X rates. The indaziflam 0.03%G formulation was applied to 17 plant genera or species, the Marengo G formulation applied to 34 crops, and the Marengo 74SC liquid formulation applied to 26 genera or species. Of these crops, 9 exhibited no or minimal transient injury after application at all three rates including *Aucuba japonica*, *Berberis sp.*, *Liriope sp.*, *Ophiopogon japonicus*, *Picea abies*, *Rhododendron sp.*, *Rosa sp.*, *Taxus media* and certain *Viburnum* species. The remaining crops evaluated have only been screened in 1 or two trials or exhibited minimal to significant injury. Further testing is required on many species before a conclusion can be made confirming crop safety.

**Target Species (Phytotoxicity, or common and Latin name of arthropod, pathogen, weed):**

Crop Safety

**Target Crops (list tested crops if ongoing or completed project)**

See “IR-4 Crop Safety to Date” below

**Target Product(s)(list tested products or numbered compounds if ongoing or completed project)**

Marengo 74SC (indaziflam)

Tower (dimethenamid-p)

**Product Registration and Research Status**

Labeled & Commercialized Wide range of ornamental horticulture crops listed	<b>Registration Status</b> <b>Barricade 65WG (prodiamine)</b> <b>Dimension 2EW (dithiopyr)</b> F6875 4SC (sulfentrazone + prodiamine) <b>Gallery SC (isoxaben)</b> <b>Marengo 74SC (indaziflam)</b>
Labeled & Commercialized Opportunity to add additional ornamental horticulture crops	



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	<b>Pennant Magnum (s-metolachlor)</b> SedgeHammer (halosulfuron) SP1770 Liquid <b>SufeGuard 51WDG (flumioxazin)</b> <b>Tower (dimethenamid-p)</b>
Labeled But NOT Commercialized	
Not yet registered or labeled	
No longer available for development	
* IR-4 Data contributed to registration decision – either adding pest to label or not pursuing further research 1 At least one crop species screened fully 2 Product not available for production ornamentals	

Area	Characteristic	Pro	Con
Availability & effectiveness of alternative management tools	Additional research could yield data favorable for further label expansion	x	
Damage potential of target			
Performance and crop safety of proposed products (from other systems)			
Compatibility with IPM, resistance management programs			
Economics			
Geographic distribution			
Manufacturer interest in labeling products			
Other			
Comments:			

IR-4 Crop Safety Trials to Date
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 ( <i>red text</i> ). A rating of 1 or 2 is considered commercially acceptable and those with more than 3 trials are complete ( <i>green text</i> ). 'Labeled' indicates that IR-4 generated data in at least one trial and that this crop is listed on the label. For crop/product combinations that are blank, IR-4 has not screened this combination.

Plant Group	Crop	Marengo 74SC (Indaziflam)	Tower (Dimethenamid-p)
Broadleaf Evergreen Tree/Shrub	Manzanita (Arctostaphylos sp.)		2.5 (2 - 3) n2 Labeled
	Boxwood, Littleleaf (Buxus microphylla)		4.0 (4 - 4) n1
	Boxwood (Buxus sp.)	2.0 (1 - 3) n3	1.0 (1 - 1) n3 Labeled
	Bottlebrush (Callistemon sp.)		1.4 (1 - 2) n5 Labeled
	Camellia (Camellia sp.)		1.0 (1 - 1) n4 Labeled
	Ceanothus, Maritime (Ceanothus maritimus)		1.7 (0 - 4) n3 Labeled
	Cotoneaster (Cotoneaster dammeri )		2.5 (1 - 4) n2 Labeled
	Distylium (Distylium sp.)		2.7 (2 - 3) n3
	Wintercreeper (Euonymus fortunei)		1.3 (1 - 2) n3 Labeled
	Spindle Tree, Japanese (Euonymus japonicus)		1.3 (1 - 2) n3 Labeled
	Gardenia (Gardenia sp.)		1.0 (1 - 1) n2 Labeled
	Inkberry (Ilex glabra)		1.0 (1 - 1) n3 Labeled
	Holly (Ilex sp.)	3.0 (1 - 4) n3 Labeled	1.2 (1 - 2) n6 Labeled
	Holly, Blue (Ilex x meserveae)		3.0 (3 - 3) n1
	Doghobble (Leucothoe sp.)		1.7 (1 - 2) n3 Labeled
	Loropetalum (Loropetalum sp.)		1.2 (1 - 2) n5 Labeled
	Sacred Bamboo (Nandina domestica)		2.0 (1 - 4) n4 Labeled
	Olive, Holly (Osmanthus heterophyllus)		1.5 (1 - 2) n2 Labeled
	Chokeberry (Photinia sp.)		2.0 (1 - 3) n4 Labeled
	Andromeda, Fetterbush (Pieris sp.)		1.0 (1 - 1) n3 Labeled

Plant Group	Crop	Marengo 74SC (Indaziflam)	Tower (Dimethenamid-p)
Broadleaf Evergreen Tree/Shrub	Indian Hawthorn ( <i>Raphiolepis indica</i> )		1.5 (1 - 3) n4 Labeled
	Azalea & Rhododendron ( <i>Rhododendron</i> sp.)	2.5 (1 - 4) n2 Labeled	
	Azalea ( <i>Rhododendron</i> sp.)		2.0 (2 - 2) n1
	Ternstroemia ( <i>Ternstroemia</i> sp.)		<b>1.3 (1 - 2) n3</b>
Broadleaf Evergreen/Deciduous Tree/Shrub	Abelia ( <i>Abelia</i> sp.)		1.2 (1 - 2) n5 Labeled
	Barberry ( <i>Berberis</i> sp.)		1.7 (1 - 4) n6 Labeled
	Ceanothus ( <i>Ceanothus</i> sp.)		1.0 (1 - 1) n1 Labeled
	Cotoneaster ( <i>Cotoneaster</i> sp.)		2.0 (1 - 3) n4 Labeled
	Privet ( <i>Ligustrum</i> sp.)		2.3 (1 - 3) n3 Labeled
	Honeysuckle ( <i>Lonicera</i> sp.)		<b>2.0 (1 - 3) n3</b>
	Magnolia ( <i>Magnolia</i> sp.)		1.0 (1 - 1) n3 Labeled
	Wall Germander ( <i>Teucrium chamaedrys</i> )		<b>2.7 (1 - 5) n3</b>
Bulbs & Corms	Elephant's-Ear, Angel-Wings ( <i>Caladium</i> sp.)	<b>1.0 (1 - 1) n2</b>	1.0 (1 - 1) n1 Labeled
	Crocus ( <i>Crocus</i> sp.)	<b>1.3 (1 - 2) n3</b>	
	Dahlia ( <i>Dahlia</i> sp.)	<b>1.0 (1 - 1) n2</b>	<del>4.0 (4 - 4) n1</del>
	Chequered Lily ( <i>Fritillaria meleagris</i> )	2.0 (2 - 2) n1	
	Gladiolus ( <i>Gladiolus</i> sp.)	<b>1.0 (1 - 1) n2</b>	
	Daylily ( <i>Hemerocallis</i> sp.)		1.4 (1 - 2) n8 Labeled
	Hyacinth ( <i>Hyacinthus</i> sp.)	<b>1.3 (1 - 2) n3</b>	
	Iris ( <i>Iris</i> sp.)		1.8 (0 - 3) n4 Labeled
	Lilium Asiatic Hybrids ( <i>Lilium Asiatic Hybrids</i> )	2.0 (2 - 2) n1	
	Daffodil ( <i>Narcissus</i> sp.)	<b>1.5 (1 - 2) n2</b>	1.0 (0 - 2) n4 Labeled
Tulip ( <i>Tulipa</i> sp.)	<b>2.0 (1 - 3) n2</b>	<b>1.5 (0 - 3) n4</b>	
Cactus & Succulents	Agave ( <i>Agave</i> sp.)		2.3 (2 - 3) n3 Labeled
	Aloe ( <i>Aloe</i> sp.)		<b>2.7 (2 - 4) n3</b>

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Cactus & Succulents	Pygmyweed (Crassula sp.)		3.3 (3 - 4) n3
	Echeveria (Echeveria sp.)		3.7 (3 - 4) n3
	Golden Barrel Cactus (Echinocactus grusonii)		1.3 (1 - 2) n3
	Globe Cactus (Mammillaria sp.)		2.0 (1 - 4) n3
	Stonecrop (Sedum sp.)		3.3 (2 - 4) n3 Labeled
Deciduous Tree/Shrub/Vine	Maple, Boxelder (Acer negundo var. negundo)		1.3 (1 - 2) n3 Labeled
	Maple, Japanese (Acer palmatum)		1.0 (1 - 1) n2 Labeled
	Maple, Red (Acer rubrum)		2.0 (2 - 2) n3 Labeled
	Maple (Acer sp.)		1.8 (1 - 4) n4 Labeled
	Buckeye, Ohio (Aesculus glabra)		1.0 (1 - 1) n2
	Alder (Alnus sp.)		2.0 (1 - 3) n3
	Serviceberry, Canadian (Amelanchier canadensis)		2.0 (1 - 3) n3
	Chokeberry, Black (Aronia melanocarpa)		3.0 (3 - 3) n3
	Japanese Barberry (Berberis thunbergii)		5.0 (5 - 5) n1
	Birch, River (Betula nigra)		1.0 (1 - 1) n5 Labeled
	Butterfly Bush (Buddleia davidii)		2.0 (1 - 4) n3 Labeled
	Pecan (Non-Bearing) (Carya illinoensis)		1.5 (1 - 2) n2 Labeled
	Blue Beard, Blue Spirea (Caryopteris x clandonensis )		1.0 (1 - 1) n3 Labeled
	European Chestnut (Castanea sativa)		2.7 (1 - 4) n3
	Wild Lilac (Ceanothus x pallida)		1.0 (1 - 1) n3 Labeled
	Yellowwood (Cladrastis sp.)		2.7 (2 - 4) n3
	Leather Flower (Clematis sp.)		1.2 (1 - 2) n5 Labeled
	Sweet Pepperbush, Summersweet (Clethra alnifolia)		2.7 (1 - 4) n3
	Dogwood, Silky (Cornus amomum)		2.0 (2 - 2) n1 Labeled

Plant Group	Crop	Marengo 74SC (Indaziflam)	Tower (Dimethenamid-p)
Deciduous Tree/Shrub/Vine	Dogwood, Flowering ( <i>Cornus florida</i> )		3.0 (2 - 4) n3 <i>Labeled</i>
	Dogwood, Kousa ( <i>Cornus kousa</i> )		1.2 (0 - 2) n5 Labeled
	Dogwood, Red Osier ( <i>Cornus sericea</i> )		3.0 (1 - 5) n3 <i>Labeled</i>
	Hawthorn ( <i>Crataegus</i> sp.)		2.0 (1 - 3) n3 Labeled
	Enkianthus ( <i>Enkianthus</i> sp.)		4.0 (4 - 4) n1
	Burning Bush ( <i>Euonymus alatus</i> )		1.0 (1 - 1) n1 Labeled
	Forsythia ( <i>Forsythia</i> sp.)		1.3 (1 - 2) n4 Labeled
	Dwarf Fothergilla ( <i>Fothergilla gardenii</i> )		1.0 (1 - 1) n2 Labeled
	Ash, Green ( <i>Fraxinus pennsylvanica</i> )		2.0 (2 - 2) n1 Labeled
	Ash ( <i>Fraxinus</i> sp.)		1.0 (1 - 1) n1 Labeled
	Locust ( <i>Gleditsia</i> sp.)		1.0 (1 - 1) n2 Labeled
	Toyon ( <i>Heteromeles arbutifolia</i> )		3.0 (3 - 3) n1
	Hydrangea ( <i>Hydrangea</i> sp.)		2.0 (2 - 2) n2
	Candytuft ( <i>Iberis</i> sp.)		3.0 (1 - 4) n3
	Virginia Sweetspire ( <i>Itea virginica</i> )		2.7 (1 - 4) n3
	Walnut, Black (Non-Bearing) ( <i>Juglans nigra</i> )		1.5 (1 - 2) n4 Labeled
	Japanese Rose ( <i>Kerria japonica</i> )		1.5 (1 - 2) n2
	Crape Myrtle ( <i>Lagerstroemia indica</i> )		1.8 (1 - 3) n4 Labeled
	Apple ( <i>Malus</i> sp.)		1.0 (1 - 1) n4 Labeled
	Mock Orange ( <i>Philadelphus</i> sp.)		1.7 (0 - 3) n3
Oak, Sawtooth ( <i>Quercus acutissima</i> )		2.3 (2 - 3) n3 Labeled	
Oak, Nuttall ( <i>Quercus nuttallii</i> )		3.0 (2 - 4) n2 <i>Labeled</i>	

Plant Group	Crop	Marengo 74SC (Indaziflam)	Tower (Dimethenamid-p)
Deciduous Tree/Shrub/Vine	Oak, Red (Quercus rubra)		2.0 (2 - 2) n1 Labeled
	Oak (Quercus sp.)		3.0 (1 - 4) n4 Labeled
	Island Gooseberry (Ribes viburnifolium)		3.0 (3 - 3) n1
	Rose (Rosa sp.)		1.2 (1 - 2) n6 Labeled
	Bridal-Wreath (Spiraea sp.)		2.0 (1 - 4) n5 Labeled
	Camellia, Mountain (Stewartia sp.)		1.0 (1 - 1) n1
	Lilac (Syringa sp.)		3.0 (3 - 3) n1
	Viburnum, Possumhaw; Smooth Witherod (Viburnum nudum )		2.8 (2 - 4) n4 Labeled
	Euopean Cranberry Bush (Viburnum opulus)		2.0 (1 - 3) n3
	Japanese Snowball (Viburnum plicatum)		1.2 (1 - 2) n6 Labeled
	Arrowwood (Viburnum sp.)		1.5 (1 - 3) n4 Labeled
	Laurustinus; Spring Boquet (Viburnum tinus)		1.5 (1 - 3) n4 Labeled
	Wisteria (Wisteria sp.)		1.0 (1 - 1) n3 Labeled
	Japanese Zelkova (Zelkova serrata)		1.3 (1 - 2) n3
Fern	Fern, Asparagus (Asparagus densiflorus)		2.0 (2 - 2) n1
	Fern, Shaggy Shield (Dryopteris cycadina)		2.3 (2 - 3) n3
	Fern, Autumn (Dryopteris erythrosora)		2.3 (1 - 3) n3
	Fern, Royal (Osmunda regalis)		3.0 (3 - 3) n1
Hardy Ground Cover Foliage	Lilyturf, Big Blue (Liriope muscari)		1.0 (1 - 1) n1 Labeled
	Catnip (Nepeta cataria)		2.7 (1 - 4) n3 Labeled
	Mondo Grass; Lilyturf; Ker-Gawl (Ophiopogon sp.)		1.0 (1 - 1) n4 Labeled
Herbaceous Flowering Plant	Lily-Of-The-Nile (Agapanthus sp.)		1.3 (1 - 2) n3 Labeled
	Hummingbird Trumpet (Epilobium canum)		2.0 (0 - 4) n2 Labeled

Plant Group	Crop	Marengo 74SC (Indaziflam)	Tower (Dimethenamid-p)
Herbaceous Flowering Plant	Woodland Sage ( <i>Salvia x sylvestris</i> )		1.8 (1 - 3) n5 Labeled
	Naupaka; Fan-flower ( <i>Scaevola</i> sp.)		<b>2.0 (1 - 4) n3</b>
Herbaceous Flowering Plant - Annual	Periwinkle, Madagascar ( <i>Catharanthus roseus</i> )		<b>4.0 (3 - 5) n3</b>
	Cosmos ( <i>Cosmos</i> sp.)		<b>3.0 (3 - 3) n1</b>
	Lantana ( <i>Lantana</i> sp.)		1.0 (1 - 1) n5 Labeled
	Zinnia ( <i>Zinnia</i> sp.)		<b>4.0 (4 - 4) n1</b>
Herbaceous Flowering Plant - Annual/Biennial/Peren	Delosperma ( <i>Delosperma</i> sp.)		2.2 (1 - 3) n5 Labeled
Herbaceous Flowering Plant - Perennial	Columbine ( <i>Aquilegia</i> sp.)		<b>3.0 (1 - 5) n5</b> <i>Labeled</i>
	Milkweed ( <i>Asclepias</i> sp.)		2.5 (1 - 4) n4 Labeled
	Aster ( <i>Aster</i> sp.)	<b>5.0 (5 - 5) n1</b>	2.0 (2 - 2) n1
	Chocolate Flower/Lyreleaf Greeneyes ( <i>Berlandiera lyrata</i> )		<b>4.0 (3 - 5) n2</b>
	Chrysanthemum, Garden ( <i>Chrysanthemum/Dendranthema</i> sp.)		1.8 (1 - 3) n5 Labeled
	Hardy Mum ( <i>Chrysanthemum/Dendranthema x morifolium</i> )		<b>3.0 (2 - 5) n3</b> <i>Labeled</i>
	Eastern Purple Coneflower ( <i>Echinacea purpurea</i> )		2.0 (2 - 2) n1
	Purple Coneflower ( <i>Echinacea</i> sp.)		<b>2.7 (1 - 4) n3</b>
	Dogtooth Violet; Yellow Trout Lily ( <i>Erythronium americanum</i> )	2.0 (2 - 2) n1	
	Beeblossom, Lindheimer's ( <i>Gaura lindheimeri</i> )		<b>1.5 (1 - 3) n4</b>
	Coral Bells ( <i>Heuchera sanguinea</i> )		<b>2.3 (1 - 3) n4</b>
	Rosemallow ( <i>Hibiscus</i> sp.)		2.0 (1 - 3) n7 Labeled
	Plantain Lily ( <i>Hosta</i> sp.)		<b>2.0 (2 - 2) n2</b>
	Max Chrysanthemum ( <i>Leucanthemum maximum</i> )		<b>2.0 (2 - 2) n3</b>
Peony ( <i>Paeonia</i> sp.)		2.0 (1 - 4) n3 Labeled	



Plant Group	Crop	Marengo 74SC (Indaziflam)	Tower (Dimethenamid-p)
Herbaceous Flowering Plant - Perennial	Beard-Tongue (Penstemon sp.)		1.8 (0 - 3) n4 Labeled
	Phlox, Fall (Phlox paniculata)		4.0 (4 - 4) n1
	Cinquefoil (Potentilla sp.)		1.8 (1 - 4) n5 Labeled
	Black-Eyed Susan (Rudbeckia hirta)		3.0 (3 - 3) n1
	Coneflower (Rudbeckia sp.)		4.0 (3 - 5) n2
	Woodland Sage (Salvia nemorosa)		3.0 (2 - 4) n5 Labeled
	Goldenrod (Solidago sp.)		3.5 (3 - 4) n2
Herbaceous Perennials	Lavender (Lavandula sp.)		1.8 (1 - 3) n5 Labeled
	Nepeta (Nepeta x faassenii)		2.8 (1 - 4) n4 Labeled
Narrowleaf Evergreen Tree/Shrub	Fir, Fraser (Abies fraseri)		1.7 (1 - 3) n3 Labeled
	Cedar, Atlas (Cedrus atlantica)	1.0 (1 - 1) n1	
	Japanese Cedar (Cryptomeria japonica)	2.0 (1 - 3) n2	2.0 (1 - 4) n3 Labeled
	Cypress (Cupressus sp.)		1.0 (1 - 1) n3
	Leyland Cypress (Cuprocyparis leylandii)		1.3 (1 - 2) n3 Labeled
	Juniper, Chinese Pyramid (Juniperus chinensis)	1.0 (1 - 1) n1	
	Juniper, Common (Juniperus communis)	1.0 (1 - 1) n2	
	Juniper, Creeping or Trailing (Juniperus horizontalis)	1.0 (1 - 1) n2	
	Juniper (Juniperus sp.)		1.0 (1 - 1) n8 Labeled
	Juniper, Chinese (Juniperus x media)	1.0 (1 - 1) n1	
	Spruce, Norway (Picea abies)	1.3 (1 - 2) n3	2.0 (1 - 3) n2 Labeled
	Spruce, White; Cat (Picea glauca)		1.0 (1 - 1) n1 Labeled
	Spruce, Colorado (Picea pungens)		1.0 (1 - 1) n1 Labeled
Pine, Austrian (Pinus nigra)	1.0 (1 - 1) n2		

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Narrowleaf Evergreen Tree/Shrub	Pine (Pinus sp.)		1.0 (0 - 2) n7 Labeled
	Pine, Eastern White (Pinus strobus)	1.0 (1 - 1) n2	
	Pine, Loblolly (Pinus taeda)		1.5 (1 - 2) n2 Labeled
	Fir, Douglas (Pseudotsuga menziesii)		1.5 (0 - 4) n4 Labeled
	Bald Cypress (Taxodium distichum)		2.0 (2 - 2) n1 Labeled
	Yew (Taxus sp.)		1.3 (1 - 2) n4 Labeled
	Red Cedar, Western (Thuja plicata)		1.5 (1 - 2) n4
	Red Cedar, Arborvitae (Thuja sp.)		2.0 (2 - 2) n1
	Hemlock, Eastern (Tsuga canadensis)	1.0 (1 - 1) n1	
	Hemlock, Western (Tsuga heterophylla)		2.0 (0 - 4) n2 Labeled
	Hemlock (Tsuga sp.)		2.3 (1 - 3) n3 Labeled
Ornamental Grass	Sedge, Grassland (Carex divulsa)		1.7 (1 - 2) n3 Labeled
	Indian Woodoats (Chasmanthium latifolium)		2.3 (1 - 4) n4
	Muhly, Hairawn (Muhlenbergia capillaris)		1.5 (1 - 2) n2
	Pine Muhly (Muhlenbergia dubia)		3.3 (2 - 5) n3
Palm	Palm, King (Archontophoenix cunninghamiana)		1.0 (1 - 1) n1
	Palm, Coconut (Cocos sp.)		1.0 (1 - 1) n1
	Dwarf Palmetto (Sabal minor)		1.0 (1 - 1) n3
	Palm, Chinese Windmill (Trachycarpus fortunei)	1.0 (1 - 1) n1	1.0 (1 - 1) n1
	Palm, Washington Fan (Washingtonia robusta)		2.0 (2 - 2) n1
Tropical Foliage Plant	Jasmine, Confederate (Trachelospermum jasminoides)		1.3 (1 - 2) n3 Labeled