



IR-4 Ornamental Horticulture Program Grower & Extension Survey Summary – US Respondents

The intent of the Ornamental Horticulture Survey was to poll growers, landscape care operators, researchers, extension personnel and others affiliated with this industry on needs and issues related to disease, insect, and weed management. The responses from the survey feed directly into how IR-4 allocates its research budget for ornamental horticulture projects.

Demographics of Survey Participants

The purpose for several questions in this survey was to describe the demographics of participating growers, landscape care personnel and others in the green industry. The survey participants came from across the United States with 40% originating in the Southern Region (Table 1). Fifty-six percent were growers with the next largest segment being researchers at 13% (Table 2). The operation type most represented was greenhouse followed by nursery container growers (Table 3). Those participants involved in field-grown nursery production or in the landscape represented a significant portion of the operation types. Most survey participants did select more than one operation type (data not shown).

Most respondents used chemical control while half used biological controls (Table 4). Sixty-two percent had IPM as a management style and 28% of survey participants use organic tools. Many participants did not choose a philosophy for when to apply, but those that did were more prone to make applications when needed rather than based on a calendar.

More respondents grew shrubs and trees than any other crop type (Table 5). Perennials, bedding plants and ornamental grasses also were grown by a majority. Fewer survey respondents grew foliage plants, seasonal potted plants, cut flowers, palms, and Christmas trees.

Table 1. IR-4 Region for survey participants.

Region	Count	Percent
NorthCentral	23	8%
Northeast	79	28%
Southern	115	40%
Western	70	24%
Total	279	100%

Table 2. Employment sector for survey participants (single selection option).

Segment	Count	Percent
Extension	23	8%
Government	19	7%
Grower	160	56%
Industry	13	4%
LCP	34	12%
Researcher	36	13%
Unspecified	2	1%

Table 3. Operation types (multiple selections).

Production Site	Count	Percent
Greenhouse	197	69%
Nursery Container	169	59%
Nursery Field	121	42%
Landscape	122	43%
Interiorscape	36	13%
Christmas Tree Farm	30	10%
Sod Farm	29	10%

Table 4. Disease, insect and weed management styles (multiple selections).

Management Styles	Count	Percent
Biological Control	143	50%
Chemical Control	203	71%
IPM	178	62%
Organic	81	28%
Weekly/Monthly Sprays	30	10%
Spray at Thresholds	131	46%

Table 5. Spectrum of crops grown (multiple selections).

Crop Type	Count	Percent
Bedding Plants	172	60%
Cut Flowers	71	25%
Christmas Trees	43	15%
Foliage Plants	125	44%
Perennials	188	66%
Ornamental Grasses	173	60%
Palms	58	20%
Seasonal Potted Plants	110	38%
Shrubs	198	69%
Trees	197	69%
Turf	83	29%

Research Direction/Type of Data Needed

Two questions solicited information on the general direction of research and the type of data needed in the program. The first question asked whether crop safety data was needed more than efficacy, efficacy more than crop safety, or both equally. By a wide majority, more people selected the option that both crop safety data and efficacy data were needed equally (Figure 1). The next question asked for a ranking of 16 categories based on how much the information is needed for daily operations. This ranking was on a scale of 1 (not needed) to 5 (very important). Any categories that were unranked received a '0' if at least one category was ranked in that person's survey. In general, developing new products had a higher average than expanding current products, and generating efficacy data had a higher average than crop safety data (phytotoxicity). However, there were some differences depending on discipline (Table 6). Plant pathology followed these same trends as did entomology. Weed science clearly favored developing new products with efficacy and phytotoxicity research equivalent. For plant growth regulators, the averages were very close and there were no statistical differences.

Ranking of Issues by Discipline

Each of the issues within the disciplines listed by participants was given a weighted ranking based on the order written. Each was also assigned to a group based on similar diseases, pests, or weeds. This section also examines the survey responses grouped by production site.

Figure 1. Counts on type of data to be generated.

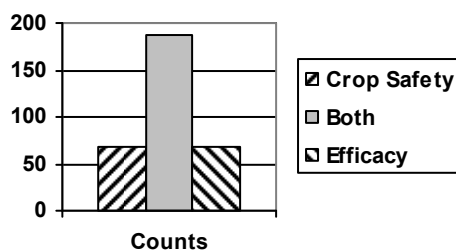


Table 6. Research direction for each discipline.

Research Direction	Disease	Pest	Weed	PGR	Ave
New Products	3.22 a	3.55 a	3.14 a	2.23 a	3.03 a
Expand Products	3.07 ab	3.06 b	2.77 a	2.32 a	2.81 b
More Efficacy	3.00 ab	3.22 ab	2.78 a	2.43 a	2.86 ab
More Phytotoxicity	2.81 b	2.71 bc	2.76 a	2.32 a	2.65 bc

* With columns, numbers followed by different letters are statistically different based on Fisher-Hayter at $p < 0.05$.

Table 7. Ranking of pests with limited management choices.

Pest Group	Weighted Ranking
Thrips	163
Mites & Spider Mites	149
Scale & Mealybugs	139
Borers & Beetles	116
Whiteflies	77
Aphids	53
White Grubs & Root Weevils	46
Other	26
Lygus	20
Fungus Gnats	18
Snails & Slugs	12
Leafminers	11
Nematodes	8
Turf Pests	8
Adelgids	7
Symphylla	7
Lepidopterans	6
Leaf Hoppers	6
Lace Bugs	5
Midges	5
Ants	3

Table 8. Ranking of diseases with limited management choices.

Disease Group	Weighted Ranking
Crown & Root Rot	112
Bacterial Diseases	107
Leaf Spots & Anthracnose	87
Pythium	73
Phytophthora	64
Powdery Mildew	53
Nematodes	43
Other	42
Downy Mildew	38
Rusts	34
Botrytis	28
Foliar Blights	25
Canker	22
Virus	21
Vascular Wilts	15
Turf Diseases	11

Entomology

When all responses were grouped together the top five pests of concern were thrips, mites & spider mites, scale & mealybug, borers & beetles, and whiteflies (Table 7 - p2). Note that the calculation for weighted ranking here removes any duplication for crop or production site.

When weighted rankings were calculated for categories of crops, the top 5 pests change slightly for each crop type (Table 10 - p3). Even so, three pest groups were present in at least four out of five crop types: thrips, mites & spider mites, scale & mealybugs.

Similarly, when the weighted rankings were calculated based on the production sites, there were some differences among the order. Table 11 (p4) only contains the primary sites listed by respondents. Three pest types were in the top five for each primary production site: thrips, mites & spider mites, scale & mealybugs.

Borers & beetles appear in the three outdoor production sites, probably because of the predominance of these insects on woody ornamental crops.

Plant Pathology

When all responses were grouped together, the top five diseases crown & root rots, bacterial diseases, leaf spots & anthracnose, *Pythium* and *Phytophthora* (Table 8 - p2). The crown & root rot group contains diseases affecting roots, crowns, and lower trunks that are clearly not caused by *Pythium* or *Phytophthora*. Note that the calculation for weighted ranking here removes any duplication for crop or production site.

When the rankings were calculated based on the crop types there were some differences among the groups (Table 12 - p4). While crown & root rots and bacterial diseases were in the top five for each crop type, leaf spots & anthracnose and powdery mildew appear in only 3 of the lists. Water mold root rots (*Pythium*, *Phytophthora*) remain issues for each of the crop types.

For the rankings grouped by production site, crown & root rots and bacterial diseases were the two top issues (Table 13 - p4).

Table 10. Top 5 issues by crop for Entomology.

	Bedding Plants & Seasonal Potted Plants	Cut Flowers	Ornamental Grasses	Foliage & Perennial Plants	Shrubs, Trees, Palms & Christmas Trees
1	Thrips (105)	Thrips (56)	Thrips (24)	Thrips (79)	Scale & Mealybugs (113)
2	Whiteflies (50)	Mites & Spider Mites (11)	Mites & Spider Mites (10)	Mites & Spider Mites (51)	Borers & Beetles (102)
3	Mites & Spider Mites (36)	Whiteflies (10)	Scale & Mealybugs (7)	Scale & Mealybugs (34)	Mites & Spider Mites (92)
4	Aphids (26)	Fungus Gnats (7)	Aphids (4) Borers & Beetles (4)	Whiteflies (23)	White Grubs & Root Weevils (37)
5	Scale & Mealybugs (17)	Leafminers (5)	Fungus Gnats (4) Nematodes (4)	Aphids (16)	Thrips (37)

Water molds were in the top five lists for each production site. While nematodes appeared to be problematic for outdoor production, powdery mildew was of concern for greenhouse producers.

Weed Science

Although there were some variations between rankings whether the responses are grouped together or separated by crop or production site, there was a general trend among the three areas. The top weed type of concern was broadleaf weeds, followed by sedge & nutsedge and then by grass and liverworts & moss & algae (Table 9, Table 14 - p4, Table 15 - p4).

A more detailed look at the weeds respondents included in the survey is warranted (Table 16 - p5). The top weed mentioned was nutsedge followed closely by liverworts. Four broadleaf weeds were included frequently: oxalis, spurge, bittercress, and eclipta.

Table 9. Ranking of weeds with limited management choices.

Weed Group	Weighted Ranking
Broadleaf	265
Sedge & Nutsedge	75
Grass	58
Liverworts & Moss & Algae	56
Other	40
Horsetails	25
Vine	13
Non-grass Monocots	12
Turf weeds	2
Woody	1

Table 11. Top 5 issues by production site for Entomology.

	Greenhouse	Nursery Container	Nursery Field	Landscape
1	Thrips (281)	Thrips (171)	Thrips (146)	Scale & Mealybugs (114)
2	Mites & Spider Mites (139)	Scale & Mealybugs (129)	Mites & Spider Mites (85)	Thrips (90)
3	Scale & Mealybugs (121)	Mites & Spider Mites (128)	Scale & Mealybugs (71)	Mites & Spider Mites (86)
4	Whiteflies (81)	Borers & Beetles (93)	Borers & Beetles (70)	Borers & Beetles (74)
5	Borers & Beetles (69)	Aphids (49)	Aphids (30)	Whiteflies (30)

Table 12. Top 5 issues by crop for Plant Pathology.

	Bedding Plants & Seasonal Potted Plants	Cut Flowers	Ornamental Grasses	Foliage & Perennial Plants	Shrubs, Trees, Palms & Christmas Trees
1	Crown & Root Rot (52)	Crown & Root Rot (19)	Bacterial Diseases (13)	Bacterial Diseases (50)	Bacterial Diseases (66)
2	Pythium (46)	Bacterial Diseases (12)	Leaf Spots & Anthracnose (12)	Crown & Root Rot (33)	Leaf Spots & Anthracnose (66)
3	Bacterial Diseases (36)	Pythium (11)	Crown & Root Rot (8)	Powdery Mildew (31)	Crown & Root Rot (63)
4	Powdery Mildew (33)	Downy Mildew (7)	Phytophthora (7)	Nematodes (28)	Phytophthora (47)
5	Phytophthora (28)	Nematodes (7)	Rusts (7)	Pythium (24)	Pythium (24)

Table 13. Top 5 issues by production site for Plant Pathology.

	Greenhouse	Nursery Container	Nursery Field	Landscape
1	Crown & Root Rot (147)	Crown & Root Rot (129)	Crown & Root Rot (95)	Crown & Root Rot (90)
2	Bacterial Diseases (142)	Bacterial Diseases (128)	Bacterial Diseases (92)	Bacterial Diseases (85)
3	Pythium (103)	Leaf Spots & Anthracnose (74)	Phytophthora (52)	Leaf Spots & Anthracnose (42)
4	Powdery Mildew (69)	Phytophthora (69)	Pythium (45)	Nematodes (40)
5	Leaf Spots & Anthracnose (66)	Pythium (56)	Nematodes (35)	Phytophthora (38)

Table 14. Top 5 issues by crop for Weed Science.

	Bedding Plants & Seasonal Potted Plants	Cut Flowers	Ornamental Grasses	Foliage & Perennial Plants	Shrubs, Trees, Palms & Christmas Trees
1	Broadleaf (64)	Broadleaf (29)	Broadleaf (65)	Broadleaf (100)	Broadleaf (178)
2	Liverworts & Moss & Algae (11)	Sedge & Nutsedge (8)	Liverworts & Moss & Algae (23)	Liverworts & Moss & Algae (46)	Sedge & Nutsedge (55)
3	Sedge & Nutsedge (9)	Vine (3)	Grass (14)	Sedge & Nutsedge (15)	Liverworts & Moss & Algae (32)
4	Grass (8)		Sedge & Nutsedge (7)	Grass (12)	Horsetails (20)
5	Vine (6)		Vine (5)	Vine (6)	Grass (16)

Table 15. Top 5 issues by production site for Weed Science.

	Greenhouse	Nursery Container	Nursery Field	Landscape
1	Broadleaf (277)	Broadleaf (328)	Broadleaf (187)	Broadleaf (176)
2	Liverworts & Moss & Algae (109)	Liverworts & Moss & Algae (104)	Liverworts & Moss & Algae (84)	Sedge & Nutsedge (53)
3	Sedge & Nutsedge (74)	Sedge & Nutsedge (79)	Sedge & Nutsedge (70)	Liverworts & Moss & Algae (29)
4	Grass (14)	Grass (43)	Grass (27)	Grass (19)
5	Vine (12)	Vine (20)	Horsetails (24)	Vine (16)

Table 16. Specific issues for each weed group.

Weed Group	Weed	Weighted Score
Broadleaf	3 seeded mercury	3
Broadleaf	Amaranth (pigweed)	2
Broadleaf	american burnweed in containers	6
Broadleaf	Burn Weed	
Broadleaf	bindweed	1
Broadleaf	Bittercress	22
Broadleaf	bittercress on snapdragons	
Broadleaf	bittercress pre emergent control	
Broadleaf	Blackberries (too concerned about drift onto field crops)	2
Broadleaf	broadleaf weeds	3
Broadleaf	Buttonweed	11
Broadleaf	Virginia Button Weed	
Broadleaf	Chickweed	8
Broadleaf	Clover	4
Broadleaf	cottonwood	1
Broadleaf	Dayflower	3
Broadleaf	Dichondra	1
Broadleaf	Dollar weed	3
Broadleaf	doveweed	2
Broadleaf	Eclipta	21
Broadleaf	eclipta, ground and container	
Broadleaf	euphorbia	3
Broadleaf	False Dandelion	1
Broadleaf	Field bindweed	3
Broadleaf	fireweed	3
Broadleaf	Foxtail - various	1
Broadleaf	Galinsoga	8
Broadleaf	galinsoga on snapdragons	
Broadleaf	ground ivy	5
Broadleaf	Ground ivy (Creeping Charlie)	
Broadleaf	common groundsel	4
Broadleaf	Groundsel in field and container	
Broadleaf	Hairy Bittercress	4
Broadleaf	Herbicides for large leaf weeds with post emerge activity over the top on ornamentals	3
Broadleaf	Hoary cress	2
Broadleaf	Khaki weed	7
Broadleaf	khakiweed Alternanthera pungens	
Broadleaf	Mugwort-Aremesia vulgaris	2
Broadleaf	mulberry weed/hairy crabweed in containers	1
Broadleaf	Mustard	1
Broadleaf	need spray applied herbicides over the top (Tower)-pre	2
Broadleaf	Northern willow herb	2
Broadleaf	Oxalis	39
Broadleaf	Oxalis and Bittercress	

Weed Group	Weed	Weighted Score
Broadleaf	Oxalis inside greenhouses, under the benches	
Broadleaf	oxalis post-emergence	
Broadleaf	Perennial weeds	3
Broadleaf	phyllanthus in containers	2
Broadleaf	Prostrate knotweed	2
Broadleaf	Puncture Vine	3
Broadleaf	Purslane	4
Broadleaf	Queen Anne's Lace	7
Broadleaf	Rorippa sylvestris	3
Broadleaf	Smart weed (mediocre and shortlived control)	4
Broadleaf	Smartweed	
Broadleaf	Prostrate Spurge	38
Broadleaf	spurge in containers and field post emergent	
Broadleaf	Spotted Spurge	
Broadleaf	Spurge	
Broadleaf	spurge in field & container	
Broadleaf	spurge in liriopie	
Broadleaf	Thistle	9
Broadleaf	Thistle in containers	
Broadleaf	thistle in pots (recent clearcut nearby) hard to kill while young	
Broadleaf	Tropical Spiderwort	3
Broadleaf	wild carrot mixed with triazine resistant weeds	3
Broadleaf	wild licorice	3
Grass	Bamboo	3
Grass	Bermudagrass	7
Grass	Burmudagrass	
Grass	Cogon grass	3
Grass	Crabgrass	6
Grass	Dallis grass	7
Grass	Goosegrass	3
Grass	grass	1
Grass	Grasses in Ornamental Grasses	2
Grass	native bent grass	2
Grass	Poa annua	3
Grass	Poa grass in ornamental container crops	2
Grass	Quackgrass	3
Grass	Tall fescue	3
Grass	Torpedograss	6
Grass	torpedograss in landscape and turfgrass	3
Horsetails	Equisetum	17
Horsetails	Field hoarse tail Equisetum arvense -outdoor beds	
Horsetails	Field horsetail- Equisetum arvense	
Horsetails	Horsetail	
Horsetails	Kyllinga	2
Horsetails	Mares Tail	6
Liverworts & Moss & Algae	Liverwort	47

Weed Group	Weed	Weighted Score
Liverworts & Moss & Algae	liverwort control at time of sale/small bits here & there	
Liverworts & Moss & Algae	liverwort control on ground mats and in containers	
Liverworts & Moss & Algae	Liverwort in container crops	
Liverworts & Moss & Algae	Liverwort in liners and Forest seedling greenhouse crops	
Liverworts & Moss & Algae	Liverwort on plugs (greenhouse)	
Liverworts & Moss & Algae	Moss	1
Liverworts & Moss & Algae	moss on soil in potted perennials	3
Liverworts & Moss & Algae	pearlwort	5
Non-grass Monocots	Garlic in lawn	2
Non-grass Monocots	Onions in lawn	3
Non-grass Monocots	Wild garlic	7
Other	Annual weeds (all species)	3
Other	anything is a greenhouse pot	3
Other	Bare ground control, pre and post	2
Other	general postemergence control	1
Other	greenhouse weeds generally	3
Other	In greenhouses	3
Other	need postemergence applied herbicides	3
Other	over the top grass and weed control	3
Other	overspraying evergreens for understory weeds	1
Other	preemergence weed control in propagation	2
Other	Various	1
Other	Weed control under poly	3
Other	Weeds	3
Other	weeds around field trees	3
Other	Weeds in or under greenhouse benches	3
Other	weeds underbenches in greenhouse	3
Sedge & Nutsedge	Nutgrass	10
Sedge & Nutsedge	Nutgrass (post emergent)	
Sedge & Nutsedge	Nutgrass in flower beds	
Sedge & Nutsedge	Nutsedge	41
Sedge & Nutsedge	postemergence control of nutsedge	
Sedge & Nutsedge	Purple Nutsedge	6
Sedge & Nutsedge	purple nutsedge in bedding plants and daylily	
Sedge & Nutsedge	Sedges	2
Sedge & Nutsedge	Cyperus esculentus	20
Sedge & Nutsedge	Yellow nutsedge	
Sedge & Nutsedge	Yellow nutsedge in containers	
Turf weeds	Virginia buttonweed in St. Augustinegrass during warm temperatures	2
Vine	Celastrus (bittersweet) growing up trunks of trees	3
Vine	Dodder	6
Vine	Dodder/ red thread	
Vine	Morning glory	4
Vine	morning glory in delphiniums and limonium	
Woody	Aspen Seedlings	1

Issues for Each Discipline arranged by Crop

Table 17. Top 5 issues by discipline for Bedding Plants & Seasonal Potted Plants.

	Entomology	Plant Pathology	Weed Science
1	Thrips (105)	Crown & Root Rot (52)	Broadleaf (64)
2	Whiteflies (50)	Pythium (46)	Liverworts & Moss & Algae (11)
3	Mites & Spider Mites (36)	Bacterial Diseases (36)	Sedge & Nutsedge (9)
4	Aphids (26)	Powdery Mildew (33)	Grass (8)
5	Scale & Mealybugs (17)	Phytophthora (28)	Vine (6)

Table 18. Top 5 issues by discipline for Cut Flowers.

	Entomology	Plant Pathology	Weed Science
1	Thrips (56)	Crown & Root Rot (19)	Broadleaf (29)
2	Mites & Spider Mites (11)	Bacterial Diseases (12)	Sedge & Nutsedge (8)
3	Whiteflies (10)	Pythium (11)	Vine (3)
4	Fungus Gnats (7)	Downy Mildew (7)	
5	Leafminers (5)	Nematodes (7)	

Table 19. Top 5 issues by discipline for Ornamental Grasses

	Entomology	Plant Pathology	Weed Science
1	Thrips (24)	Bacterial Diseases (13)	Broadleaf (65)
2	Mites & Spider Mites (10)	Leaf Spots & Anthracnose (12)	Liverworts & Moss & Algae (23)
3	Scale & Mealybugs (7)	Crown & Root Rot (8)	Grass (14)
4	Aphids (4) Borers & Beetles (4)	Phytophthora (7) Rusts (7)	Sedge & Nutsedge (7)
5	Fungus Gnats (4) Nematodes (4)		Vine (5)

Table 20. Top 5 issues by discipline for Foliage & Perennial Plants

	Entomology	Plant Pathology	Weed Science
1	Thrips (79)	Bacterial Diseases (50)	Broadleaf (100)
2	Mites & Spider Mites (51)	Crown & Root Rot (33)	Liverworts & Moss & Algae (46)
3	Scale & Mealybugs (34)	Powdery Mildew (31)	Sedge & Nutsedge (15)
4	Whiteflies (23)	Nematodes (28)	Grass (12)
5	Aphids (16)	Pythium (24)	Vine (6)

Table 21. Top 5 issues by discipline for Shrubs, Trees, Palms and Christmas Trees.

	Entomology	Plant Pathology	Weed Science
1	Scale & Mealybugs (113)	Bacterial Diseases (66)	Broadleaf (178)
2	Borers & Beetles (102)	Leaf Spots & Anthracnose (66)	Sedge & Nutsedge (55)
3	Mites & Spider Mites (92)	Crown & Root Rot (63)	Liverworts & Moss & Algae (32)
4	White Grubs & Root Weevils (37)	Phytophthora (47)	Horsetails (20)
5	Thrips (37)	Pythium (24)	Grass (16)