



IR-4 Environmental Horticulture Program Grower & Extension Survey Summary 2021 – US Respondents

The intent of the Environmental 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 environmental 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, but responses were not equally distributed among the four geographic regions (Table 1); the Western region had 42% of the participants followed by Southern, Northeast and North Central with 10%. Sixty percent were growers with the next largest segment being extension personnel at 13% (Table 2). The operation types most represented were producers (greenhouse, nursery container, nursery field grown); Christmas tree growers represented 10% (Table 3). Landscape care represented about 13% of the respondents.

Relatively equal numbers of respondents identified themselves as using chemical control and/or IPM (Table 4). Twenty-two percent used biological controls while 14% of survey participants used organic tools. Many participants did not choose a philosophy for when to apply, but those that did chose to make applications when needed rather than based on a calendar.

Herbaceous perennials, shrubs and trees were grown by 23 – 27% of the respondents followed closely by bedding plants and ornamental grasses (Table 5). Fewer survey respondents grew seasonal potted plants, foliage plants, cut flowers, palms, and Christmas trees.

Table 1. IR-4 Region for survey participants

Region	Count	Percent
NorthCentral	10	10%
Northeast	18	18%
Southern	29	29%
Western	42	42%
Total	99	100%

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

Segment	Count	Percent
Extension	13	13%
Government	3	3%
Grower	60	61%
Industry	8	8%
LCP	5	5%
Researcher	10	10%

Table 3. Operation types (multiple selections)

Production Site	Count	Percent
Greenhouse	26	26%
Nursery Container	25	25%
Nursery Field	17	17%
Landscape	13	13%
Interiorscape	1	1%
Christmas Tree Farm	10	10%
Sod Farm	2	2%

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

Management Styles	Count	Percent
Biological Control	22	22%
Chemical Control	34	34%
IPM	30	30%
Organic	14	14%
Weekly/Monthly Sprays	14	14%
Spray at Thresholds	23	23%

Table 5. Spectrum of crops grown (multiple selections)

Crop Type	Count	Percent
Bedding Plants	21	21%
Cut Flowers	12	12%
Christmas Trees	13	13%
Foliage Plants	16	16%
Perennials	27	27%
Ornamental Grasses	20	20%
Palms	10	10%
Seasonal Potted Plants	14	14%
Shrubs	23	23%
Trees	23	23%
Turf	5	5%

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. The option for needing both crop safety and efficacy equally was highly selected (Figure 1) with slightly more participants favoring efficacy over crop safety data.

Activities to Protect Beneficial Organisms including Pollinators

This was the third year a question was added to the survey to assess current practices used to protect beneficial organisms including pollinators during production and maintenance of plants.

There were 94 respondents to this question, and they were able to select multiple answers. The activity most employed was scouting for pest and disease hot spots and apply crop protection tools to only those areas (

Figure 2). The next selection by frequency was applying crop protection tools when no beneficial organisms are present, followed by applying an optimal rate to manage pests or diseases without harming beneficial organisms. The next highest was applying the best tool possible for crop situation knowing that some beneficial organisms

may be harmed followed by applying systemic tools when they offer greater safety than foliar tools. Of note, the option to apply only biopesticides was the least selected followed by growing crops without pollinator attractive flowers.

Among the write-ins (Table 6, p3), most were geared to beneficial organisms in general rather than targeting pollinators specifically. Of the two that were targeted specifically towards pollinators, the focus was on weed or vegetation management to improve habitat.

Figure 1. Counts for type of data to be generated

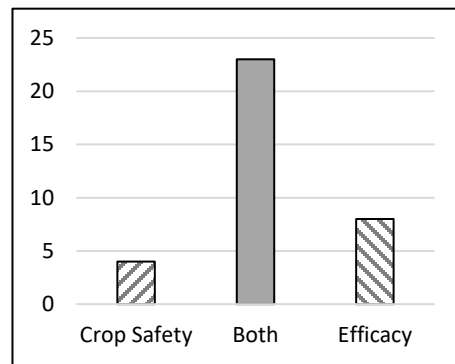


Figure 2. Activities to protect beneficial organisms including pollinators (multiple selections)

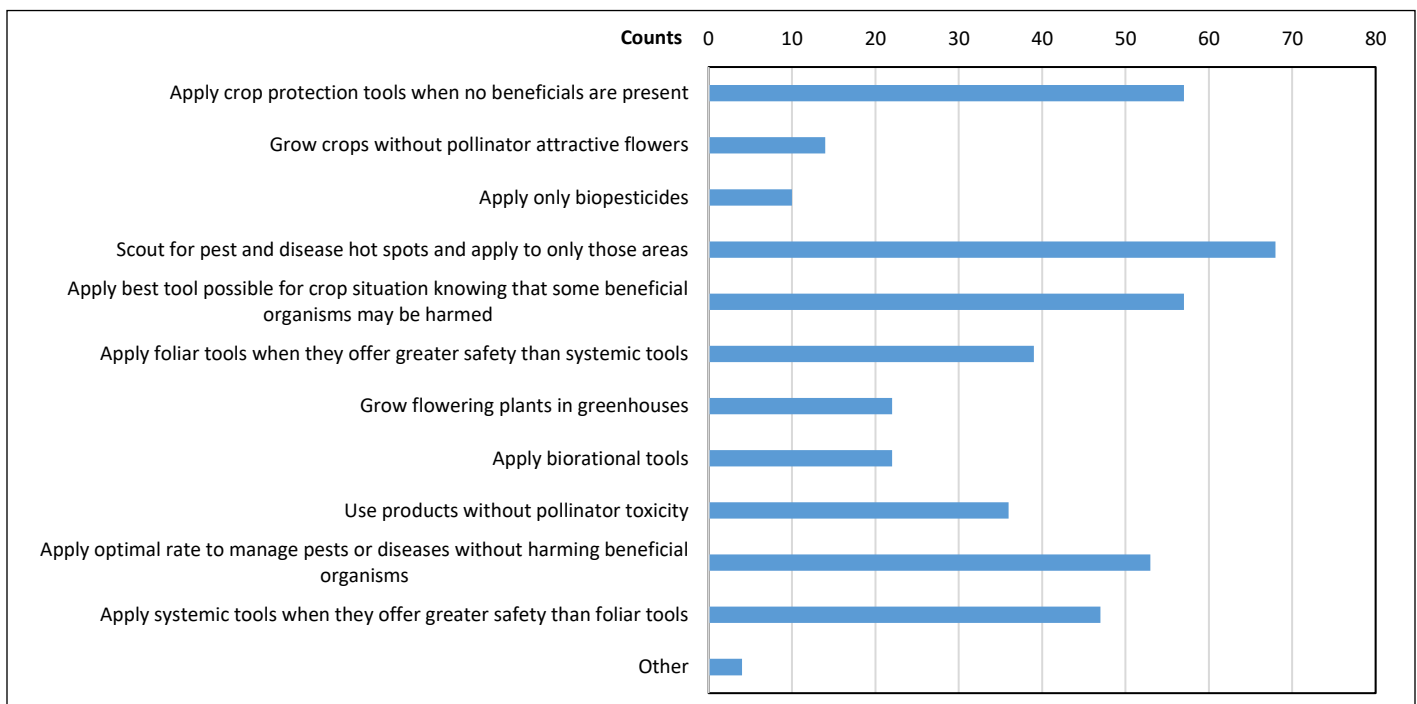


Table 6. Comments included related to protecting beneficial organisms including pollinators

Additional Activities Use to Protect Beneficial Organisms
Right plant in right place!
Use only pesticidal products without residual activities (either topical or systemic) and time their applications so that they are not being applied during or shortly after pollinator foraging or releases of beneficial insects and mites
would like to try soil injected systemic
avoid drift to flowering plants nearby

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.

Entomology

When all responses were grouped together the top five pests of concern were mites & spider mites, scale & mealybugs, thrips, aphids, and borers & beetles (Table 7, p3). Note that the calculation for weighted ranking here removes any duplication for crop or production site.

When the weighted rankings were calculated based on the production sites, there were some differences among the order, but 4 of the top 5 were similar (Table 10, p5). Four pest types were in the top five for each primary production site: aphids, mites & spider mites, scale & mealybugs, and thrips. For the primary sites, borers & beetles was the fifth pest group, while for Christmas tree farms, midges were the fifth.

When weighted rankings were calculated for categories of crops, the top 5 pests were somewhat different for each crop type (Table 13, p6). Three pest groups were present in all five crop types: thrips and mites & spider mites. Aphid and Scale & Mealybugs were present in four of the five crop types.

The specific pests mentioned most frequently included thrips (25), mealybugs (16), and spider mites (13) (Table 16, p7)

Table 7. Ranking of pests with limited management choices.

Pest Group	Weighted Ranking
Mites & Spider Mites	61
Scale & Mealybugs	53
Thrips	38
Aphids	34
Borers & Beetles	23
Lepidopterans	7
Gall Insects	6
Adelgids	6
Midges	6
Symphyla	6
Turf Pests	5
Whiteflies	4
White Grubs & Root Weevils	4
Fruit & Nut Pests	3
Flies, Sawflies & Fungus Gnats	3
Vegetable Pests	3
Lygus	3
Nematodes	2
Other	2
Leafminers	2
Ants	2
Snails & Slugs	1

Plant Pathology

When all responses were grouped together, the top five diseases included crown & root rots, Phytophthora & Pythium, leaf spots & anthracnose, bacterial diseases, and powdery mildew (Table 8, p4). 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.

For the rankings grouped by production site, bacterial diseases, crown & root rots, and nematodes appeared in all four production sites. (Table 11, p5). Both leaf spots & anthracnose and *Phytophthora* & *Pythium* categories appeared in three of the four production sites.

When the rankings were calculated based on the crop types there were some differences among the groups (Table 14, p6). No disease groups appeared consistently across crop types. Root problems were raised in all crop types except for Ornamental Grasses, whether root disease was caused by oomycete organisms or non-oomycetes such as *Fusarium*. The most consistent foliar diseases across all crop types were powdery mildew and leaf spots & anthracnose.

The specific diseases mentioned most frequently include *Phytophthora* (32), *Fusarium* (22) and powdery mildew (14) (24) (Table 17, p8)

Weed Science

When all responses were grouped together, the top five weeds included Broadleaf Summer Annuals, Liverworts & Moss & Algae, Grass, Broadleaf Perennials, and Sedge & Nutsedge (Table 9, p4). Note that the calculation for weighted ranking here removes any duplication for crop or production site.

When the rankings were separated by production site, broadleaf summer annuals, grass, and liverworts & moss & algae ranked in the top five weed types (Table 12, p6)

When separated by crop category, there was no clear consensus, although broadleaf summer annuals, grasses, liverworts & moss & algae and sedges & nutsedge appeared in the majority (Table 15, p5).

The specific weeds mentioned most included liverwort (18) and wild carrot (12) (Table 18 p10).

Table 8. Ranking of diseases with limited management choices.

Disease Group	Weighted Ranking
Crown & Root Rot	54
Phytophthora & Pythium	43
Leaf Spots & Anthracnose	32
Bacterial Diseases	31
Powdery Mildew	26
Foliar Blights	24
Nematodes	22
Downy Mildew	12
Canker	12
Virus	9
Rusts	9
Vegetable Diseases	8
Botrytis	7
Turf Diseases	4
Vascular Wilts	2
Other	2

Table 9. Ranking of weeds with limited management choices.

Weed Group	Weighted Ranking
Broadleaf - Summer Annual	34
Liverworts & Moss & Algae	28
Grass	22
Broadleaf - Perennial	16
Sedge & Nutsedge	16
Broadleaf - Biennial	12
Broadleaf	10
Broadleaf - Winter Annual	9
Horsetail & Similar Weeds	9
Other	8
Comment	8
Broadleaf - Winter Annual/Biennial	6
Vine - Perennial	5
Insect	3
Non-grass Monocots	3
Vine - Winter/Summer Annual	2
Broadleaf - Annual/Perennial	2

Table 10. Top 5 issues by production site for Entomology.

	Greenhouse	Nursery Container	Nursery Field	Landscape
1	Mites & Spider Mites (110)	Mites & Spider Mites (111)	Borers & Beetles (95)	Mites & Spider Mites (53)
2	Thrips (87)	Borers & Beetles (102)	Mites & Spider Mites (69)	Borers & Beetles (40)
3	Borers & Beetles (74)	Thrips (80)	Thrips (67)	Thrips (30)
4	Scale & Mealybugs (50)	Scale & Mealybugs (53)	Scale & Mealybugs (24)	Scale & Mealybugs (26)
5	Aphids (26)	Aphids (28)	White Grubs & Root Weevils (17)	Whiteflies (15)

Table 11. Top 5 issues by production site for Plant Pathology.

	Greenhouse	Nursery Container	Nursery Field	Landscape
1	Crown & Root Rot (61)	Bacterial Diseases (46)	Crown & Root Rot (33)	Crown & Root Rot (34)
2	Bacterial Diseases (46)	Crown & Root Rot (45)	Bacterial Diseases (33)	Nematodes (20)
3	Powdery Mildew (41)	Leaf Spots & Anthracnose (33)	Phytophthora & Pythium (27)	Bacterial Diseases (20)
4	Phytophthora & Pythium (30)	Powdery Mildew (31)	Leaf Spots & Anthracnose (23)	Phytophthora & Pythium (15)
5	Nematodes (29)	Nematodes (28)	Nematodes (22)	Leaf Spots & Anthracnose (12) Downy Mildew (12)

Table 12. Top 5 issues by production site for Weed Science

	Greenhouse	Nursery Container	Nursery Field	Landscape
1	Liverworts & Moss & Algae (71)	Liverworts & Moss & Algae (62)	Liverworts & Moss & Algae (50)	Liverworts & Moss & Algae (27)
2	Broadleaf - Summer Annual (43)	Grass (31)	Grass (31)	Horsetail & Similar Weeds (18)
3	Grass (28)	Broadleaf - Summer Annual (29)	Broadleaf - Summer Annual (21)	Grass (18)
4	Broadleaf - Winter Annual/Biennial (15)	Horsetail & Similar Weeds (18)	Broadleaf - Perennial (12)	Broadleaf - Summer Annual (15)
5	Sedge & Nutsedge (13)	Broadleaf - Winter Annual/Biennial (15)	Broadleaf (10)	Sedge & Nutsedge (12) Broadleaf - Winter Annual/Biennial (12)

Table 13. Top 5 issues by crop category for Entomology.

	Bedding Plants & Seasonal Potted Plants	Cut Flowers	Ornamental Grasses	Foliage & Perennial Plants	Shrubs, Trees & Palms	Christmas Trees
1	Thrips (28)	Thrips (13)	Mites & Spider Mites (3)	Thrips (34)	Scale & Mealybugs (27)	Aphids (19)
2	Aphids (13)	Scale & Mealybugs (8)	Thrips (3)	Mites & Spider Mites (23)	Mites & Spider Mites (26)	Mites & Spider Mites (12)
3	Mites & Spider Mites (9)	Aphids (5)	Aphids (2)	Scale & Mealybugs (19)	Borers & Beetles (21)	Scale & Mealybugs (10)
4	Scale & Mealybugs (9)	Mites & Spider Mites (4)		Aphids (5)	Thrips (14)	Midges (6)
5	Borers & Beetles (4) Whiteflies (4)	Nematodes (2)		Borers & Beetles (4)	Gall Insects (6) Symphylla (6)	Gall Insects (5)

Table 14. Top 5 issues by crop category for Plant Pathology.

	Bedding Plants & Seasonal Potted Plants	Cut Flowers	Ornamental Grasses	Foliage & Perennial Plants	Shrubs, Trees & Palms	Christmas Trees
1	Crown & Root Rot (14)	Crown & Root Rot (16)	Leaf Spots & Anthracnose (3)	Bacterial Diseases (16)	Bacterial Diseases (21)	Phytophthora & Pythium (19)
2	Powdery Mildew (11)	Nematodes (6)	Rusts (1)	Crown & Root Rot (15)	Crown & Root Rot (20)	Leaf Spots & Anthracnose (16)
3	Bacterial Diseases (10)	Powdery Mildew (5)		Powdery Mildew (13)	Leaf Spots & Anthracnose (20)	Foliar Blights (11)
4	Downy Mildew (6)	Leaf Spots & Anthracnose (3)		Nematodes (11)	Phytophthora & Pythium (14)	Crown & Root Rot (5)
5	Phytophthora & Pythium (6)	Virus (3)		Phytophthora & Pythium (11)	Canker (12) Powdery Mildew (12)	Rusts (1)

Table 15. Top 5 issues by crop category for Weed Science.

	Bedding Plants & Seasonal Potted Plants	Cut Flowers	Ornamental Grasses	Foliage & Perennial Plants	Shrubs, Trees & Palms	Christmas Trees
1	Liverworts & Moss & Algae (12)	Broadleaf - Summer Annual (5)	Liverworts & Moss & Algae (10)	Liverworts & Moss & Algae (24)	Liverworts & Moss & Algae (19)	Broadleaf - Perennial (14)
2	Broadleaf - Summer Annual (7)	Broadleaf - Winter Annual (5)	Grass (5)	Broadleaf - Summer Annual (17)	Grass (15)	Broadleaf - Biennial (12)
3	Comment (5)	Liverworts & Moss & Algae (3)	Broadleaf (3)	Sedge & Nutsedge (8)	Broadleaf - Summer Annual (14)	Grass (10)
4	Sedge & Nutsedge (5)	Sedge & Nutsedge (3)	Broadleaf - Winter Annual/Biennial (3) Sedge & Nutsedge (3)	Horsetail & Similar Weeds (6)	Broadleaf - Winter Annual/Biennial (6)	Broadleaf - Summer Annual (6)
5	Broadleaf - Winter Annual/Biennial (3)	Broadleaf - Annual/Perennial (2)	Horsetail & Similar Weeds (3)	Grass (5)	Horsetail & Similar Weeds (6) Sedge & Nutsedge (6) Broadleaf - Perennial (6)	Horsetail & Similar Weeds (6)

Table 16. Specific issues for each pest group.

Pest Group	Pest	Weighted Ranking
Adelgids	Adelgid	2
	Adelgid , Noble	2
	Hemlock Woolly Adelgid	2
Ants	Ants, Argentina	2
Aphids	Aphid, hemp	3
	Aphids	11
	Aphids, conifers	6
	Aphids, Tulip	2
	Balsam twig aphid	3
	Green aphids	2
	root aphids	7
Borers & Beetles	Beetles	3
	Borers	2
	Chinese rose beetle	3
	Flatheaded borer	1
	Flea beetle	2
	Magnolia trunk collar borer	3
	Red-headed flea beetle	4
	Shothole borers (Xyleborus and Xyleborinus)	1
	Southern pine beetle on pines	1
	Three line potato beetle on Coleus, Magnolia	1
	Twig weevil, Christmas trees	2
Flies, Sawflies & Fungus Gnats	Fungus gnats	3
Fruit & Nut Pests	Leaf footed bug on pomegranates	3
Gall Insects	Gall midges	2
	Gall wasps	1
	Shoot gall midge, norway spruce	3
Leafminers	Leafminer	2
Lepidopterans	Caterpillar	1
	fall cankerworm	3
	Gypsy moths	3
Lygus	Lygus	3
Midges	Douglas fir needle midge	3
	needle midge	3
Mites & Spider Mites	Aloe mites	3
	Blister mites, Pyrus	3
	Broad and russet mites	2
	Broad mite, begonia	3
	Bulb mite	3
	Eriophyid mite	5
	Eriophyid mite rotation	2
	Eriophyid mites, aloe	2
	Eriophyid mites, true fir	3
	Mites	9
	Mites, Nandina	2
	Mites, Palms	1
	Mites, phlox	3
	mites, Salvia	1
	Rose rosette Eriophyid mite	3
Spider mite	13	

Pest Group	Pest	Weighted Ranking
Mites & Spider Mites	Two spotted spider mites	3
Nematodes	Nematode	2
Other	spotted lantern fly	2
Scale & Mealybugs	Armored scale	3
	Citrus Mealybug	2
	Citrus mealybug, Ipomea	3
	Elongate hemlock scale	10
	Japanese maple scale	6
	Mealybug	16
	Scale	5
	scale on magnolia, little gem	3
	Scale, woodies	2
	scale/mealybugs	1
	tulip scale on magnolia grandiflora	2
Snails & Slugs	African snail	1
Symphylla	Symphylans	6
Thrips	Thrips	25
	Thrips control on both organic and nonorganic	3
	Various thrips	3
	Western flower thrips	3
	Western flower thrips (incl outdoor use)	3
	Western Flower Thrips, Asiatic, Oriental Lily	1
Turf Pests	Billbugs	3
	mole crickets	2
Vegetable Pests	Russet mites on tomatoes	3
White Grubs & Root Weevils	Chafer grubs / perennials (pots/field)	1
	Root weevil	1
	white grubs	2
Whiteflies	Whiteflies	4

Table 17. Specific issues for each disease group

Disease Group	Disease/Pathogen *	Weighted Ranking
Bacterial Diseases	Agrobacterium	2
	Bacteria	7
	Bacterial leaf spot	8
	Bacterial rot	2
	Erwinia	3
	Fire blight	3
	Pseudomonas	1
	Xanthomonas, ivy	3
Xanthomonas, salvia	2	
Botrytis	Botrytis	3
	Botrytis, cut flower storage	2
	Botrytis, Greenhouse seedlings	2
Canker	Canker	3
	Canker (Nectria)	3
	Phoma	3
	Phomopsis	3
Crown & Root Rot	Annosus Root Rot	2
	Basal Rot, Daffodils	3
	Fusarium	22

Disease Group	Disease/Pathogen *	Weighted Ranking
Crown & Root Rot	Fusarium, chrysanthemum	3
	Fusarium, echinacea	3
	Fusarium, palm	2
	Fusarium, Tulip	3
	Pennicilin, Tulip	1
	Phymatotrichum	3
	Rhizoctonia	2
	Root rot	6
	Root rot, tradescantia	1
	Thielaviopsis	3
	Downy Mildew	Downy mildew
Downy Mildew, Rose		3
Foliar Blights	Blight	5
	Boxwood blight	6
	Interior Needle Blight	5
	Needle necrosis	6
	Southern blight (Sclerorium rolfsii)	2
Leaf Spots & Anthracnose	Algal Leaf spot	3
	Anthracnose	2
	Diplodia	2
	Entomosporium	2
	Needle cast	5
	Needle cast (Rhizosphaera)	3
	Needle cast, douglas fir	3
	Needle cast, swiss	3
	Septoria, wax myrtle	1
	Sooty mold	3
	Venturia	5
Nematodes	Nematode	5
	Nematode, foliar	8
	Nematode, hypericum	3
	Nematodes, Beech Leaf	6
Other	Pink blight	1
	Scab	1
Phytophthora & Pythium	Phytophthora	32
	Phytophthora palmivora	1
	Pythium	8
	Pythium, tulip	2
Powdery Mildew	Powdery Mildew	14
	Powdery Mildew, Calibrachoa	3
	Powdery Mildew, crapemyrtle	3
	Powdery Mildew, Phlox	3
	Powdery Mildew, rhododendron	3
Rusts	Rust	2
	Rust, fuschia	3
	Rust, grand fir	1
	Rust, plumeria	3
Turf Diseases	Botrytis	2
	Take-all patch	2
Vascular Wilts	Verticillium	2
Vegetable Diseases	Downy Mildew, basil for harvest	2
	Powdery Mildew, basil	3

Disease Group	Disease/Pathogen *	Weighted Ranking
Vegetable Diseases	Ramularia	3
Virus	Hop Latent Viroid	3
	Rose Rosette Virus	3
	Tomato Spotted Wilt Virus	3

*The authors standardized the format for presenting diseases and pathogens. In parentheses are Latin names, where either mentioned by survey participants or when specific diseases were mentioned to foster clarity (ie rusts). Where crops were mentioned, the disease or pathogen is listed first followed by a comma and one or more crops.

Table 18. Specific issues for each weed group.

Weed Group	Weed	Weighted Ranking
Broadleaf	Broadleaf	3
	Bindweed	3
	Field Bindweed	2
	Pilea	2
Broadleaf - Annual/Perennial	Fumaria	2
Broadleaf - Biennial	Wild Carrot	12
Broadleaf - Perennial	False Dandelion	5
	Black Swallowwort	3
	Potentilla indica	2
	Horse nettle	2
	St Johns Wort	2
	Mugwort	1
	Blackberry	1
	Broadleaf - Summer Annual	Spurge
Mulberryweed		5
Globe camomile		3
Hairy Fleabane		3
Doveweed		3
Bed Straw		3
Bedstraw, Catchweed		3
Eclipta		2
Pigweed		2
Polygonum spp		2
Prostrate Knotweed		1
Broadleaf - Winter Annual		Conyza
	Shepherds Purse	3
	Horseweed	1
Broadleaf - Winter Annual/Biennial	Bittercress	6
Comment	Weeds in greenhouse	4
	weeds in trees	3
	Weed control in plugs	1
Grass	Grass	6
	Bamboo	4
	Crabgrass	3
	Ryegrass	3
	Bermudagrass	2
	Japanese Stiltgrass	2
	Red brome	2
Horsetail & Similar Weeds	Equisetum	9
Insect	Polyphagus borer	3
Liverworts & Moss & Algae	Liverwort	18
	Nostoc Algae	6

Weed Group	Weed	Weighted Ranking
Liverworts & Moss & Algae	Swallowwort	3
	Algae	1
Non-grass Monocots	Millet, Wild-proso	3
Other	All weeds	3
	Other	3
	Other Weeds	2
Sedge & Nutsedge	Yellow Nutsedge	7
	Nutsedge	3
	Sedge	3
	Yellow Nutgrass	3
Vine - Perennial	Poison Ivy	3
	Wild grape vine	2
Vine - Winter/Summer Annual	Morning glory	2