2007 IR-4 Ornamental Horticulture Survey

The intent of the Ornamental Horticulture Survey is 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. The 2007 survey is the third time the industry has been polled by IR-4, and participation from growers and members of the ornamental horticulture community has increased each time.

Table 1. Comparison of Survey Participants in the 2005, 2006, and 2007 Surveys.

Year	Growers	Landscape Care Personnel	Researchers	Extension	Government	Allied Industry	Total Responses
2005	99	--	--	37	--	--	126
2006	225	19	33	37	--	9	325
2007	342	49	28	29	11	27	486

In addition to choosing one general affiliation, survey participants are asked to select their operation type(s), identify the plant materials with which they work, and provide their approach(es) to disease, insect and weed management.

General Results

As in previous surveys, participants were asked to provide their top three disease, insect, and weed issues. For 2007, the question was written "For the following questions, consider your product arsenal and provide answers based on where you have limited product choices." This was an attempt to filter out those chronic problems which have a constant impact on crops or maintained plants but where multiple control options are available.

2007 Top Diseases

Each of the diseases or pathogens listed by participants was given a weighted ranking based on the order written. Each was also assigned to a disease group such as *Botrytis*, Crown & Root Rot, Leaf Spots & Anthracnose and *Phytophthora*. The top diseases listed by survey participants are shown in Table 2.

Table 2. Top Five Disease Groups Identified in the 2007 Survey

Disease Group	Weighted Ranking
Powdery Mildew	318
Leaf Spots & Anthracnose	318
Phytophthora	259
Crown & Root Rot	237
Botrytis	235

2007 Top Insects

Similar to the disease groups, each of the insects or mites listed by participants was given a weighted ranking based on the order written. Each was also assigned to an insect group such as Aphids, Borers & Beetles, Scale & Mealybugs, and Thrips. The top insect groups listed by survey participants are shown in Table 3. Mites & Spider Mites, Aphids, Thrips, and Scale & Mealybugs are the top five insect groups.

Table 3. Top Seven Insect Groups Identified in the 2007 Survey

Insect Group	Weighted Ranking
Mites & Spider Mites	436
Aphids	335
Thrips	326
Scale & Mealybugs	322
Whiteflies	216
Borers & Beetles	191
White Grubs & Root Weevils	170

2007 Top Weeds

Each of the weeds listed by participants was given a weighted ranking based on the order written. Each was also assigned to a weed grouping. The top weed groups listed by survey participants are shown in Table 4. Broadleaf weeds was the largest category followed by grasses, sedge & nutsedge, liverworts, moss & algae, and horsetails. Because the broadleaf weed category contains a wide variety of plants including perennials, summer annuals and winter annuals, Table 5 shows the top ten weeds across the nation. Bittercress, spurge, and oxalis were the most prominent.

Table 4. Top Five Weed Groups Identified in the 2007 Survey

Weed Group	Weighted Ranking
Broadleaf	1252
Grass	281
Sedge & Nutsedge	220
Liverworts & Moss & Algae	132
Horsetails	77

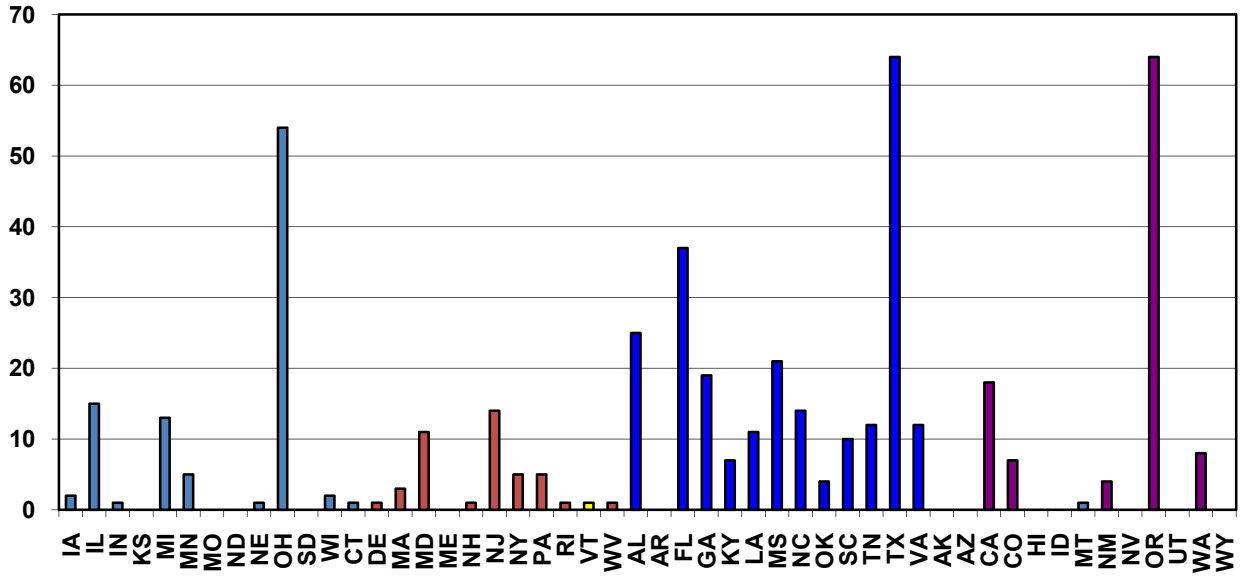
Table 5. Top Ten Weeds Identified in the 2007 Survey

Weed	Weighted Ranking
Bittercress	175
Spurge	156
Oxalis	153
Nutsedge	150
Liverwort	84
Crabgrass	60
Grasses	53
Groundsel	47
Thistle	42
Chickweed	38

Geography of participants.

Different environmental conditions lead to different disease pressures, insect infestations, and weed presence. With the variety of environments across the US, it would not be unreasonable to expect different answers from the different regions as to which problems lack adequate control measures. Thirty-seven states were represented in the 2007 survey (Figure 1). Three states contributed more than 30% of the responses: Ohio, Oregon and Texas. The high numbers of surveys from these states were the direct result of concerted efforts of the researchers and extension personnel in those states.

Figure 1. Number of Surveys from Each State in 2007.



Disease groups needing more tools were fairly similar across the regions (Table 6) according to growers and landscape care operators. *Botrytis*, Powdery Mildew and *Phytophthora* appeared in all four regions. Leaf Spots & Anthracnose appeared in top 5 list of three of the regions, as did Crown & Root Rot. Bacterial Diseases and *Pythium* each appeared in one region.

Table 6. Top Five Disease Groups Separated by Geography.

	Disease/Pathogen (Weighted Ranking)			
Region	North Central	Northeast	Southern	Western
1	Powdery Mildew (72)	Powdery Mildew (43)	Leaf Spots & Anthracnose (144)	Phytophthora (77)
2	Botrytis (53)	Leaf Spots & Anthracnose (28)	Powdery Mildew (98)	Powdery Mildew (71)
3	Pythium (32)	Botrytis (20)	Phytophthora (79)	Leaf Spots & Anthracnose (65)
4	Crown & Root Rot (31)	Crown & Root Rot (19)	Crown & Root Rot (74)	Botrytis (52)
5	Phytophthora (30)	Phytophthora (15)	Botrytis (74)	Bacterial Diseases (43)

The top three insect groups for the North Central, the Northeast, and the Western regions were virtually the same: Aphids, Mites & Spider Mites, and Thrips (Table 7). The Southern region also had

these three insect groups within the top five, but the one listed the most by growers and landscape care operators was Scale & Mealybugs. The two coleopteran groups (Borers & Beetles and White Grubs & Root Weevils) were important to the Northeast and Western regions, while Whiteflies fell within the top five for the North Central and Southern regions.

Table 7. Top Five Insect Groups Separated by Geography.

	Insect/Mite (Weighted Ranking)			
Region	North Central	Northeast	Southern	Western
1	Mites & Spider Mites (78)	Aphids (47)	Scale & Mealybugs (168)	Mites & Spider Mites (100)
2	Thrips (62)	Mites & Spider Mites (39)	Mites & Spider Mites (155)	Aphids (75)
3	Aphids (50)	Thrips (26)	Aphids (134)	Thrips (63)
4	Fungus Gnats (41)	White Grubs & Root Weevils (20)	Thrips (106)	White Grubs & Root Weevils (51)
5	Whiteflies (38)	Borers & Beetles (13)	Whiteflies (101)	Borers & Beetles (33)

The weed lists for each region are similar but there are a few distinctions among the regions (Table 8). Oxalis and bittercress appear in the lists for each region. In the North Central region, thistles appear prominently, while spurge and nutsedge are significant problems for the Southern region. Liverworts remain an issue for the northwest.

Table 8. Top Ten Weeds Separated by Geography.

	Weed (Weighted Ranking)			
Region	North Central	Northeast	Southern	Western
1	Oxalis (27)	Oxalis (20)	Spurge (103)	Liverwort (34)
2	Thistle (19)	Bittercress (16)	Bittercress (84)	Bittercress (33)
3	Canada Thistle (17)	Crabgrass (12)	Nutsedge (67)	Oxalis (25)
4	Yellow nutsedge (14)	Grasses (8)	Oxalis (48)	Groundsel (23)
5	Liverwort (13)	Marestail (7)	Crabgrass (36)	Fireweed (19)
6	Bittercress (12)	Groundsel (7)	Grasses (25)	Horsetail (15)
7	Nutsedge (11)	Chickweed (6)	Nutgrass (25)	Nutsedge (14)
8	Dandelion (10)	Clover (6)	Dallisgrass (23)	Thistle (14)
9	Groundsel (10)	Thistle (5)	Chickweed (21)	Yellow nutsedge (13)
10	Common Groundsel (9)	Spurge (4)	Eclipta (19)	Pearlwort (12)

Perspective on Managing Diseases, Insects and Weeds

The perspective on managing pests impacts the type of tools available to control diseases, insects, and weeds. If the tools available are limited, such as by an operation integrating biological control methods with more traditional chemical tools, the survey participants may have different perspectives on which pests need more tools. Approximately, 43% of the participants chose more one management type: 17% selected all three management types; 26% chose 2 of the three; 21% chose one; and 35% declined to choose a management type.

More participants identified themselves using IPM or traditional methods over organic methods to manage pests (Table 9).

There was very little difference among top disease choices among the three management perspectives. *Botrytis*, Crown & Root Rot, Leaf Spots & Anthracnose, *Phytophthora* and Powdery Mildew were the top disease groups (Table 10).

Table 9. Comparison of Pest Management Types in the 2006 and 2007 Surveys.

Management Type	2006	2007
IPM	91	281
Organic	22	108
Traditional	105	300

Table 10. Comparison of Disease Group Differences by Pest Management Types.

	Traditional	IPM	Organic
1	Powdery Mildew (199)	Powdery Mildew (176)	Powdery Mildew (49)
2	Leaf Spots & Anthracnose (151)	Phytophthora (145)	Crown & Root Rot (49)
3	Phytophthora (148)	Leaf Spots & Anthracnose (130)	Botrytis (40)
4	Botrytis (137)	Crown & Root Rot (120)	Leaf Spots & Anthracnose (38)
5	Crown & Root Rot (120)	Botrytis (119)	Phytophthora (35)

For insect groups, the top four chosen (Aphids, Mites & Spider Mites, Scale & Mealybugs, and Thrips) were the same for IPM, Organic, and Traditional pest management perspectives (Table 11). Those who with traditional or IPM perspectives selected whiteflies and those with organic perspective selected White Grubs & Root Weevils.

Table 11. Comparison of Insect Group Differences by Pest Management Types.

	Traditional	IPM	Organic
1	Mites & Spider Mites (237)	Mites & Spider Mites (225)	Aphids (70)
2	Aphids (202)	Aphids (189)	Mites & Spider Mites (61)
3	Thrips (167)	Thrips (141)	Thrips (53)
4	Scale & Mealybugs (150)	Scale & Mealybugs (138)	Scale & Mealybugs (51)
5	Whiteflies (109)	Whiteflies (99)	White Grubs & Root Weevils (31)

For weeds, the top 10 weeds do have some differences for IPM, Organic, and Traditional participants, but in general the lists are very similar (Table 12).

The general conclusion is that management perspective has little impact on participant impression for those disease, insect, and weed problems lacking enough viable management tools.

Table 12. Comparison of Weed Differences by Pest Management Types.

	Traditional	IPM	Organic
1	Bittercress (96)	Bittercress (84)	Nutsedge (24)
2	Oxalis (76)	Nutsedge (70)	Bittercress (16)
3	Nutsedge (66)	Oxalis (60)	Liverwort (15)
4	Spurge (66)	Spurge (53)	Thistle (12)
5	Liverwort (40)	Liverwort (42)	Crabgrass (12)
6	Crabgrass (39)	Grasses (32)	Oxalis (12)
7	Thistle (28)	Crabgrass (29)	Canada Thistle (12)
8	Grasses (27)	Thistle (25)	Sedge (9)
9	Groundsel (23)	Canada Thistle (23)	Nutgrass (9)
10	Nutgrass (22)	Purslane (22)	Grasses (8)

Type of Operation

Over 60% of the 486 participants selected more than one operation type. The majority of survey participants selected greenhouse and nursery as their operation types (Table 13). The selection of multiple operation types could lead to complicated interpretation of the diseases, insects, and weeds provided.

Powdery Mildew is the top disease listed for Greenhouses, Interiorscapes, Nurseries and Landscapes (Table 14). Although the order varies among the operation type, *Botrytis*, Leaf Spots & Anthracnose and *Phytophthora*, appear in the top five. Crown & Root Rot is in the list for greenhouses, nurseries, and landscapes, with virus diseases listed for interiorscapes.

Table 13. Comparison of Operation Types in the 2006 and 2007 Surveys.

Operation Type	2006	2007
Greenhouse	167	353
Nursery	148	332
Landscape	47	168
Interiorscape	6	46
Christmas Tree Farm	11	29
Sod Farm [z]	--	21

[z] In 2006, the sod farm operation type was not listed on the survey.

Table 14. Comparison of Disease Group Differences by Operation Types.

	Greenhouse	Interiorscape	Nursery	Landscape
1	Powdery Mildew (199)	Powdery Mildew (15)	Powdery Mildew (176)	Powdery Mildew (49)
2	Leaf Spots & Anthracnose (151)	*Botrytis* (12)	*Phytophthora* (145)	Crown & Root Rot (49)
3	*Phytophthora* (148)	*Phytophthora* (10)	Leaf Spots & Anthracnose (130)	*Botrytis* (40)
4	*Botrytis* (137)	Crown & Root Rot (10)	Crown & Root Rot (120)	Leaf Spots & Anthracnose (38)
5	Crown & Root Rot (120)	Virus (6)	*Botrytis* (119)	*Phytophthora* (35)

Mites & Spider Mites, Thrips, and Scale & Mealybugs appear in the top five lists for each operation type (Table 15). Aphids and White Grubs & Root Weevils appear in three each, while whiteflies is important to greenhouses and interiorscapes.

Table 15. Comparison of Insect Group Differences by Operation Types.

	Greenhouse	Interiorscape	Nursery	Landscape
1	Mites & Spider Mites (281)	Scale & Mealybugs (29)	Mites & Spider Mites (269)	Mites & Spider Mites (103)
2	Thrips (252)	Mites & Spider Mites (19)	Aphids (199)	Aphids (73)
3	Aphids (233)	Thrips (12)	Scale & Mealybugs (171)	Scale & Mealybugs (72)
4	Whiteflies (169)	Whiteflies (10)	White Grubs & Root Weevils (127)	Thrips (52)
5	Scale & Mealybugs (136)	White Grubs & Root Weevils (6)	Thrips (116)	White Grubs & Root Weevils (40)

Very few people who work with interiorscapes provided responses for specific weeds where they have limited product choices, so interiorscapes are not included in Table 16. For those who work with greenhouses and nurseries, bittercress, spurge, oxalis, liverwort, nutsedge, and grasses were listed in the top ten weeds. For landscapes, nutsedges/nutgrass, grasses, and bittercress were the top problematic weeds.

Table 16. Comparison of Weeds by Operation Types.

	Greenhouse	Nursery	Landscape
1	Bittercress (121)	Bittercress (120)	Nutsedge (43)
2	Oxalis (104)	Spurge (112)	Nutgrass (21)
3	Spurge (93)	Oxalis (79)	Bittercress (21)
4	Liverwort (57)	Nutsedge (69)	Dallisgrass (20)
5	Grasses (46)	Liverwort (48)	Crabgrass (19)
6	Nutsedge (43)	Crabgrass (36)	Chickweed (16)
7	Thistle (31)	Grasses (36)	Thistle (16)
8	Chickweed (31)	Groundsel (33)	Sedge (13)
9	Groundsel (27)	Thistle (31)	Spurge (13)
10	Crabgrass (26)	Yellow Nutsedge (29)	Groundsel (12)

Plant Materials

In addition to requesting participants provide information on their operation type and disease, insect, and weed management type, participants were asked to select the general crops or plants they grown and/or maintain. In 2007, the list of crops or plants from which to choose expanded to include additional categories (Table 17).

Approximately 84% of the participants selected multiple crops or plants. 75% of participants which selected an herbaceous crop selected multiple herbaceous crops. 70% of participants who selected an herbaceous crop also chose a minimum of one woody crop. 73% of participants who selected a woody crop selected multiple woody crops. 76% of participants who selected a woody crop also chose a minimum of one herbaceous crop. In other words, there is quite a bit of cross-over in plant selections and in what participants chose as important diseases, insects and weeds without enough usable tools.

Table 17. Comparison of Crops Grown or Plants Maintained in the 2006 and 2007 Surveys.

Crops	2006	2007
Bedding Plants	79	264
Cut Flowers	19	64
Christmas Trees	--	39
Foliage Plants	--	187
Ornamental Grasses	--	266
Palms	--	110
Potted Plants	101	243
Shrubs	115	304
Trees [z]		280
Turf	--	96

[z] In 2006, shrubs and trees were grouped together and the other plant types were not included.

For non-ornamental grass herbaceous crops, the top two diseases were consistent among crops: powdery mildew and *Botrytis* (Table 18). For woody ornamental crops, the top three diseases (leaf

spots& anthracnose, *Phytophthora* and powdery mildew) vary in order among the crops but are consistently present for Christmas trees, palms, shrubs and trees (Table 18).

Table 18. Top Five Disease Groups Identified by Growers and LCPs Separated by Crop

	Disease Group (Weighted Ranking)				
Crop	**Bedding Plants**	**Cut Flowers**	**Foliage Plants**	**Ornamental Grasses**	**Potted Plants**
Survey Count	191	25	137	206	181
1	Powdery Mildew (149)	Powdery Mildew (28)	Powdery Mildew (123)	Powdery Mildew (149)	Powdery Mildew (140)
2	Botrytis (137)	Botrytis (17)	*Botrytis* (70)	Leaf Spots & Anthracnose (132)	*Botrytis* (116)
3	Crown & Root Rot (81)	Crown & Root Rot (10)	Leaf Spots & Anthracnose (64)	Phytophthora (108)	Crown & Root Rot (90)
4	*Pythium* (69)	*Phytophthora* (9)	*Phytophthora* (62)	*Botrytis* (106)	*Pythium* (82)
5	Leaf Spots & Anthracnose (69)	*Pythium* (7)	Crown & Root Rot (61)	Crown & Root Rot (97)	Leaf Spots & Anthracnose (81)

	Disease Group (Weighted Ranking)				
Crop	**Christmas Trees**	**Palms**	**Shrubs**	**Trees**	**Turf**
Survey Count	13	75	232	209	54
1	Leaf Spots & Anthracnose (21)	Leaf Spots & Anthracnose (60)	Powdery Mildew (168)	Leaf Spots & Anthracnose (185)	Turf Diseases (41)
2	*Phytophthora* (9)	*Phytophthora* (54)	Leaf Spots & Anthracnose (166)	Powdery Mildew (154)	Powdery Mildew (38)
3	Powdery Mildew (6)	Powdery Mildew (40)	*Phytophthora* (161)	*Phytophthora* (131)	Leaf Spots & Anthracnose (37)
4	*Botrytis* (6)	Downy Mildew (26)	Crown & Root Rot (94)	Crown & Root Rot (81)	*Phytophthora* (26)
5	Turf Diseases (3)	Crown & Root Rot (26)	*Botrytis* (84)	Bacterial Diseases (60)	Crown & Root Rot (15)

The top five insect groups for herbaceous crops were very consistent: mites & spider mites, scale & mealybugs, thrips, and whiteflies all appeared in the top five (Table 19). For cut flowers, the insect selected for the remaining plants, aphids, was replaced with fungus gnats. For woody ornamentals, two insect groups appeared for Christmas trees, palms, shrubs, and trees: mites & spider mites and scale & mealybugs (Table 19).

Table 19. Top Five Insect Groups Identified by Growers and LCPs Separated by Crop

	Insect Group (Weighted Ranking)				
Crop	**Bedding Plants**	**Cut Flowers**	**Foliage Plants**	**Ornamental Grasses**	**Potted Plants**
Survey Count	191	25	137	206	181
1	Thrips (177)	Thrips (32)	Mites & Spider Mites (149)	Mites & Spider Mites (214)	Mites & Spider Mites (187)
2	Mites & Spider Mites (170)	Mites & Spider Mites (22)	Aphids (122)	Aphids (182)	Thrips (163)
3	Aphids (170)	Scale & Mealybugs (14)	Thrips (97)	Thrips (143)	Aphids (135)
4	Whiteflies (130)	Whiteflies (12)	Scale & Mealybugs (97)	Scale & Mealybugs (124)	Scale & Mealybugs (106)
5	Scale & Mealybugs (99)	Fungus Gnats (12)	Whiteflies (73)	Whiteflies (115)	Whiteflies (99)

	Insect Group (Weighted Ranking)				
Crop	**Christmas Trees**	**Palms**	**Shrubs**	**Trees**	**Turf**
Survey Count	13	75	232	209	54
1	Mites & Spider Mites (13)	Scale & Mealybugs (114)	Mites & Spider Mites (267)	Mites & Spider Mites (207)	Aphids (49)
2	Thrips (12)	Mites & Spider Mites (69)	Aphids (184)	Aphids (157)	Mites & Spider Mites (48)
3	Lepidopterans (9)	Aphids (61)	Scale & Mealybugs (154)	Scale & Mealybugs (154)	Scale & Mealybugs (46)
4	Whiteflies (8)	Whiteflies (46)	White Grubs & Root Weevils (129)	Borers & Beetles (104)	White Grubs & Root Weevils (21)
5	Scale & Mealybugs (7)	Thrips (27)	Whiteflies (107)	White Grubs & Root Weevils (93)	Thrips (19)

Note: Because growers grow a number of crops, the insect groups listed may not infest the crop under which they are listed in this table. For example, scale and mealybugs are not typically major pests of turf, but growers and LCPs identified turf and various other crops ; the other crops are those impacted by scale and mealybugs.

Bittercress, oxalis, nutsedge, and spurge were prominent for herbaceous plants. Liverwort was also listed in the top 5 for bedding plants, potted plants, and ornamental grasses. Spurge, bittercress, and nutsedge were the top three weeds for palms, trees & shrubs.

Table 20. Top Five Weeds Identified by Growers and LCPs Separated by Crop

	Weed (Weighted Ranking)				
Crop	**Bedding Plants**	**Cut Flowers**	**Foliage Plants**	**Ornamental Grasses**	**Potted Plants**
Survey Count	191	25	137	206	181
1	Bittercress (67)	Oxalis (19)	Oxalis (58)	Bittercress (95)	Oxalis (70)
2	Oxalis (64)	Canada Thistle (7)	Bittercress (41)	Spurge (77)	Bittercress (56)
3	Nutsedge (43)	Malva (6)	Nutsedge (35)	Oxalis (71)	Nutsedge (51)
4	Spurge (35)	Nutsedge (5)	Spurge (27)	Nutsedge (52)	Spurge (40)
5	Liverwort (33)	Broadleaves (3)	Nutgrass (20)	Liverwort (44)	Liverwort (30)

	Weed (Weighted Ranking)				
Crop	**Christmas Trees**	**Palms**	**Shrubs**	**Trees**	**Turf**
Survey Count	13	75	232	209	54
1	Oxalis (6)	Spurge (49)	Bittercress (111)	Spurge (86)	Nutsedge (35)
2	Broadleaves (6)	Nutsedge (34)	Spurge (100)	Nutsedge (77)	Dallisgrass (20)
3	Crabgrass (4)	Bittercress (30)	Nutsedge (82)	Bittercress (71)	Nutgrass (18)
4	Dandelion (4)	Eclipta (16)	Oxalis (69)	Oxalis (41)	Crabgrass (18)
5	Canada Thistle (3)	Oxalis (14)	Liverwort (46)	Crabgrass (32)	Sedge (11)

Conclusions

When the diseases, insects, and weeds, survey participants selected as their top three problematic issues for each discipline were weighted and examined based on participant information, the most impactful was the crop(s) grown or plant materials maintained. This was not surprising because the problems occurring on a petunia grown in a plug tray are distinctly different than problems impacting a Rhododendron, for example.