

Report of the Plant Diagnostic Laboratory at North Dakota State University

October 1, 2004 through September 30, 2005

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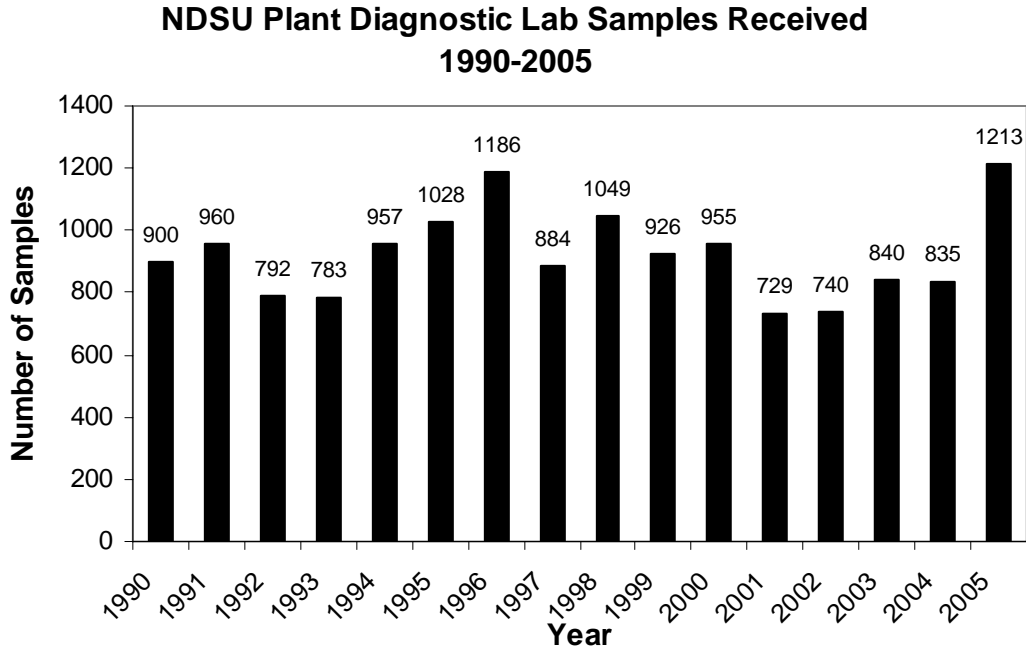
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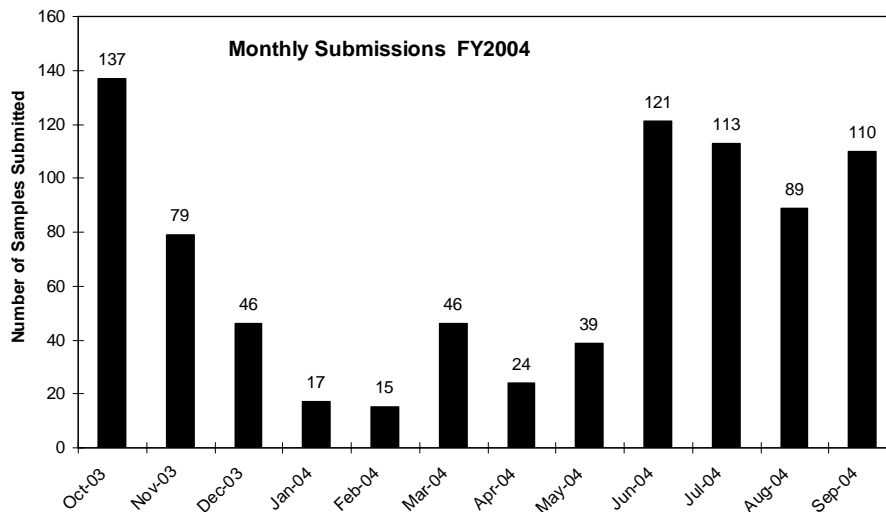
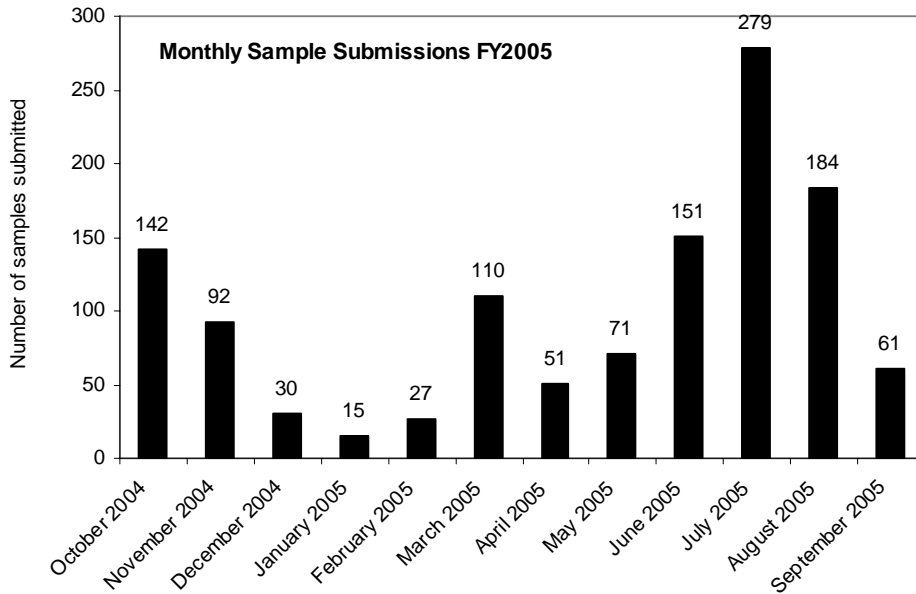
Total samples Received by Year, FY1990 through FY2005

A historical perspective of samples received by the lab is presented in the graph below. The 16-year average is 922 samples.



Monthly Sample Submission

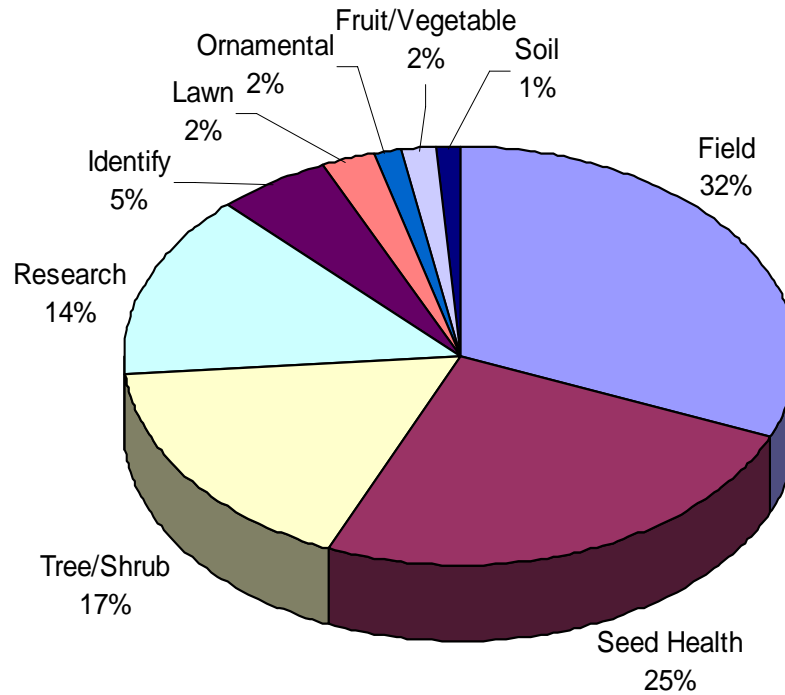
Monthly submission rates of samples to the Plant Diagnostic Lab vary by time of year. Plant diagnostic services comprise the bulk of the samples submitted during the summer months, and the fees are kept low to encourage use of the lab. Seed health testing services dominate over the winter months. Costs for seed health testing services are generally higher than routine plant diagnostic services, because labor requirements and other inputs for these tests are usually higher. For comparison, the monthly submissions for FY2004 are shown in the lower graph. FY2005 had significant increases in sample submission in July and August, most likely due to the increased disease pressure that crops faced in summer of 2005.



Samples Received – By Sample Type

A total of 1213 samples were submitted in FY2005, and the largest category was field crops, as the pie chart below summarizes. This pattern is similar to prior years, where field crops make up 40% to 56% of submitted samples. Seed Health samples are consistently the next largest group, followed by Tree/Shrub samples.

Submissions by Sample Type FY2005



Samples per Diagnosis Category

Sample Type	Diagnosis Category								
	Total	Bacteria	Fungi	Virus	Insect	Herbicide Injury	Env. Stress	Nutrient Stress	All Other*
Field	382	92	95	18	3	56	18	12	88
Seed Health	301	13	3	2	0	0	0	0	283
Tree/Shrub	210	6	28	0	23	13	16	5	119
Research	173	2	1	47	0	0	0	0	123
Identify (plants, insects, home mold)	65	0	19	0	3	0	0	0	43
Lawn	30	0	20	0	0	0	5	0	5
Ornamental	19	0	6	1	1	0	2	0	9
Fruit/Veg.	19	0	5	0	2	1	4	0	7
Soil	14	0	7	0	0	0	0	0	7
TOTAL	1213	113	184	68	32	70	45	17	684

* Diagnoses in the All Other category include negative data for specific tests, which account for most of the diagnoses in this category (particularly for Seed Health and Research sample types). This diagnosis category also includes items such as insufficient samples, plant identifications, and problems with unknown causes.

General Statistics – FY200

Method of Diagnosis		Average turn-around (days)	
Culture	148	Routine Diagnosis*	7.03
Visual	381	Culture	17.76
Microscope	90	ELISA	6.55
ELISA	382	Seed Health	17.83
Special Test	188	Research	5.14
Other	24	Special	27.85
Plants for identification	32	*Compare to 2004 (9.8); 1991 (11.5); 1990 (4.6); 1989 (7.9); 1988 (2.8)	
Insects for identification	6		
Fungi/mold for identification	27		
Source of Samples			
Mail	269		
Walk-in	944		
Insufficient, decayed, or dead material	30		

Many of the samples that come into the lab are not necessarily routine. The causes of the plant problems submitted to the lab are often not the routine causes that most Extension educators are familiar with. As a result, culturing is typically required to help determine the cause. Results from culturing can take as long as several weeks, depending on the organism being cultured. Seed health samples have high turnaround times because most of the seed health tests require from 10 days to 8 weeks to complete.

Samples by location

The primary purpose of the NDSU Plant Diagnostic Lab is to serve residents of North Dakota. Out-of-state residents also submit samples, but they are charged a higher fee for routine diagnoses. For routing diagnoses, submitters are encouraged to use their respective land grant university diagnostic labs. For seed health testing, samples from out of state are not penalized with additional charges. In North Dakota, county agents are granted four 'reference samples' which are evaluated at no charge by the lab (see *Reference Samples* section under the Lab Fees heading for more information).

The table below summarizes where samples originate by county (for North Dakota), by state, and by country, for FY2005.

By County (North Dakota only)	
Adams	5
Barnes	5
Benson	2
Bottineau	5
Bowman	2
Burke	5
Burleigh	16
Cass	435
Cavalier	7
Dickey	8
Divide	51
Dunn	1
Eddy	5
Emmons	9
Foster	3
Golden Valley	2
Grand Forks	12
Grant	1
Griggs	2
Hettinger	12
Kidder	1
Lamoure	6
Logan	5
McHenry	7
McIntosh	4
McKenzie	2
McLean	22
Mercer	3
Morton	1
Mountrail	2
Nelson	3
Oliver	0
Pembina	21
Pierce	8
Ramsey	5

By county, continued	
Ransom	7
Renville	5
Richland	30
Rolette	3
Sargent	2
Sheridan	1
Sioux	0
Slope	14
Starke-Billings	17
Steele	2
Stutsman	8
Towner	21
Traill	5
Walsh	41
Ward	30
Wells	9
Williams	6
By State	
Arizona	1
California	3
Idaho	1
Iowa	1
Massachusetts	1
Michigan	41
Minnesota	202
Montana	1
Nebraska	40
New Hampshire	10
Nevada	3
North Dakota	898
South Dakota	3
Texas	3
Wyoming	1
By Country (other than US)	
Canada	3

Samples per County and Sample Type

Location	Sample Type (research samples not included)										Total
	Field Crop	Seed Health	Tree or Shrub	Lawn	Orna-mental	Fruit or Vegetable	Plant ID	Insect ID	Mold ID	Soil	
Adams	0	0	3	1	0	0	0	1	0	0	5
Barnes	3	0	2	0	0	0	0	0	0	0	5
Benson	2	0	0	0	0	0	0	0	0	0	2
Bottineau	3	2	0	0	0	0	0	0	0	0	5
Bowman	0	0	0	0	0	0	2	0	0	0	2
Burke	2	0	2	0	0	0	0	0	1	0	5
Burleigh	2	0	9	4	1	0	0	0	0	0	16
Cass	62	38	117	10	13	7	3	4	2	0	435
Cavalier	4	0	0	1	0	0	2	0	0	0	7
Dickey	2	0	2	0	1	0	3	0	0	0	8
Divide	4	46	1	0	0	0	0	0	0	0	51
Dunn	0	0	1	0	0	0	0	0	0	0	1
Eddy	2	0	3	0	0	0	0	0	0	0	5
Emmons	5	0	4	0	0	0	0	0	0	0	9
Foster	1	1	0	1	0	0	0	0	0	0	3
Golden Valley	1	0	0	0	0	0	1	0	0	0	2
Grand Forks	5	0	3	1	2	0	0	0	1	0	12
Grant	0	0	0	0	0	0	1	0	0	0	1
Griggs	1	0	1	0	0	0	0	0	0	0	2
Hettinger	9	0	0	0	0	0	3	0	0	0	12
Kidder	1	0	0	0	0	0	0	0	0	0	1
Lamoure	3	0	0	0	0	0	3	0	0	0	6
Logan	5	0	0	0	0	0	0	0	0	0	5
McHenry	0	0	6	0	0	0	0	1	0	0	7
McIntosh	2	0	1	1	0	0	0	0	0	0	4
McKenzie	2	0	0	0	0	0	0	0	0	0	2
McLean	2	15	5	0	0	0	0	0	0	0	22
Mercer	0	0	0	0	0	0	0	3	0	0	3
Morton	0	0	1	0	0	0	0	0	0	0	1
Mountrail	0	1	0	0	0	0	1	0	0	0	2
Nelson	1	0	0	2	0	0	0	0	0	0	3
Oliver	0	0	0	0	0	0	0	0	0	0	0
Pembina	8	12	1	0	0	0	0	0	0	0	21
Pierce	6	1	1	0	0	0	0	0	0	0	8
Ramsey	0	0	5	0	0	0	0	0	0	0	5
Ransom	7	0	0	0	0	0	0	0	0	0	7
Renville	5	0	0	0	0	0	0	0	0	0	5
Richland	24	0	2	0	0	0	0	0	3	1	30
Rolette	3	0	0	0	0	0	0	0	0	0	3
Sargent	0	0	2	0	0	0	0	0	0	0	2
Sheridan	1	0	0	0	0	0	0	0	0	0	1
Sioux	0	0	0	0	0	0	0	0	0	0	0
Slope	0	14	0	0	0	0	0	0	0	0	14

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Location	Sample Type (research samples not included)										
	Field Crop	Seed Health	Tree or Shrub	Lawn	Orna-mental	Fruit or Vegetable	Plant ID	Insect ID	Mold ID	Soil	Total
Starke-Billings	6	0	2	1	0	0	0	0	0	7	17
Steele	1	0	1	0	0	0	0	0	0	0	2
Stutsman	3	0	2	0	0	0	3	0	0	0	8
Towner	2	17	1	0	0	1	0	0	0	0	21
Traill	3	0	2	0	0	0	0	0	0	0	5
Walsh	7	29	1	3	0	1	0	0	0	0	41
Ward	6	17	5	0	2	0	0	0	0	0	30
Wells	3	0	2	1	1	2	0	0	0	0	9
Williams	1	2	1	0	0	1	1	0	0	0	6
Other States											
Arizona	0	1	0	0	0	0	0	0	0	0	1
California	0	2	0	0	0	0	0	0	1	0	3
Idaho	1	0	0	0	0	0	0	0	0	0	1
Iowa	0	0	1	0	0	0	0	0	0	0	1
Massachusetts	0	0	1	0	0	0	0	0	0	0	1
Michigan	0	41	0	0	0	0	0	0	0	0	41
Minnesota	155	16	6	3	0	3	6	0	7	6	202
Montana	1	0	0	0	0	0	0	0	0	0	1
Nebraska	0	39	0	0	0	0	0	0	0	0	39
New Hampshire	0	0	10	0	0	0	0	0	0	0	10
Nevada	4	0	0	0	0	0	0	0	0	0	4
South Dakota	1	1	1	0	0	0	0	0	0	0	3
Texas	0	3	0	0	0	0	0	0	0	0	3
Wyoming	1	0	0	0	0	0	0	0	0	0	1
Outside USA											
Canada	0	3	0	0	0	0	0	0	0	0	3

Dutch Elm Disease – by county

Dutch elm disease continues to infect American elm trees throughout the state. Although Dutch elm disease testing data from the lab is presented here, these data cannot indicate whether incidence has risen or lowered since not all samples suspected to be infected with Dutch elm disease are sent here for testing. Symptoms of Dutch elm disease are fairly diagnostic, but only a laboratory test can confirm the presence of the Dutch elm disease pathogen.

Keeping American elm trees healthy is the best defense against infection. Adequate watering and fertilization is important, but just as important, and possibly even more critical, are the following recommendations: 1) avoid application of broadleaf herbicides that contain dicamba near the rootzone of the trees; 2) avoid any other herbicide damage to the leaves or roots of the trees; and 3) avoid mechanical damage to the trunk or roots of the trees (mowers and weed whackers can cause problems). These measures, however, only reduce the possibility of infection; they don't eliminate the possibility completely.

Fungicide injections may also be helpful to protect a tree against infection, but such treatments are costly and must be repeated every couple of years. Consequently, fungicide injections are usually only economically justified for trees of high value. Such injections are primarily a protective measure, before a tree becomes infected. Some fungicides, however, may be able to eradicate the disease if the infection has not progressed very far. In such cases, the tree has a better chance of survival if the fungicide injection is combined with proper pruning to remove infected limbs. These 'curative' treatments can also negatively affect the tree (phytotoxicity). Good luck is also involved, since such treatments are not always effective.

Some American elm cultivars and several elm hybrids have demonstrated tolerance or even possibly resistance to Dutch elm disease. Homeowners should talk to their county agent or to NDSU extension specialists to find which cultivars, hybrids, or varieties of elm have performed well in ND.

Dutch Elm Disease Identification By County

County, Number submitted	Dutch Elm Disease Samples Submitted		
	Positive	Not Detected	Insufficient sample
Cass	1	2	0
Eddy	0	2	0
McIntosh	1	0	0
Sargent	0	2	0
Total:	2	6	0

Samples Processed: Plant, Diagnosis, # cases

The table below summarizes the diagnoses of the lab and the corresponding number of samples, by plant type or sample category. In FY2005, a total of 1213 samples, including research samples, were received and 1193 of these were processed (a diagnosis or other result was generated). Research samples are not included in the table below.

Field		
Host	Diagnosis	# of Cases
Alfalfa	Insufficient sample	2
Barley	Pyrenophora graminea – barley leaf stripe	2
	Herbicide injury	1
	Unknown cause	1
Bean	Cultural	1
	Fusarium	3
	Herbicide Injury	4
	No Herbicide Injury	1
	Other	2
	Pseudomonas	1
	Insufficient sample	2
	Unknown	1
Borage	Sclerotinia sclerotiorum	1
Canola	(see rapeseed)	
Corn	Storage molds	5
	Drought stress	1
	Nutrient stress	1
	Herbicide Injury	5
Flax	Nutrient stress	1
	No Herbicide Injury	1
	Unknown cause	1
Lentil	Anthracoze	1
Oat	Nitrogen deficiency	1
	Unknown cause	1
Onion	Environmental	1
	Penicillium sp.	1
	Soft rot	1
Other Field Crop	Environmental, probable high salts	1
Pea	Bacterial blight	2
	Fusarium spp.	2
	No pathogen detected	1
	Other	3
	Pseudomonas pisi	1

	Pythium	1
	Rhizoctonia solani	1
	Deteriorated sample	1
	Insufficient sample	1
Potato	Colletotrichum – black dot	3
	Environmental	1
	Fusarium sp.	1
	Negative late blight (Phytophthora infestans)	1
	No storage rots detected	5
	Other	1
	Pinkeye – physiological?	1
	Potato tuber rots – various pathogens	76
	Rhizoctonia	2
Rapeseed	Fusarium	1
	Herbicide injury	3
	Phoma	1
	Sclerotinia	1
	Unknown cause	1
Sorghum	Cause unknown (no pathogens detected)	1
Soybean	Animal damage	1
	Cercospora	1
	Colletotrichum truncatum	1
	Diaporthe sp.	1
	Environmental	4
	Fusarium sp.	12
	Growth Regulator Herbicide injury	15
	Insufficient sample	2
	Iron chlorosis	6
	Macrophomina – charcoal rot	2
	Negative BPMV	1
	Negative SMV	1
	No pathogen detected	2
	Other	1
	Phomopsis	1
	Phytophthora sp.	2
	Possible bacterial blight	1
	Possible herbicide injury	2
	Pseudomonas	1
	Pythium	1
	Sclerotinia – white mold	1
	Septoria	1
	Unknown cause	3
Sugarbeet	Aphanomyces	2
	Environmental	1
	Fusarium sp.	7
	Growth regulator herbicide injury	8
	Other herbicide injury	1
	Negative BNYVV	23
	No pathogen detected	4

	Other	2
	Positive BNYVV	8
	Pythium	7
	Rhizoctonia solani (mature roots)	3
Sunflower	Apical chlorosis (bacterial)	1
	Contarinia schulzi – sunflower midge	1
	Deteriorated sample	1
	Growth regulator herbicide injury	3
	Other herbicide injury	2
	Other	2
	Physical injury	1
	Plasmopara – downy mildew	10
	Sunflower bud moth	1
	Unknown cause	1
Wheat	Alternaria (black point)	2
	Bipolaris sorokiniana	1
	Cultural	1
	Deteriorated sample	1
	Environmental injury	4
	Fusarium head blight	10
	Glumeblotch	1
	Helminthosporium sp.	1
	Herbicide injury	10
	No pathogen detected	1
	Nutrient stress	3
	Other	1
	Puccinia striiformis (stripe rust)	1
	Unknown cause	4
	Wheat Streak Mosaic Virus	7
	Xanthomonas – bacterial leaf streak	6
Wheat – Durum	WSMV	1
	Armyworm	1
	Nutrient stress	1
	Unknown cause	1

Fruit		
Host	Diagnosis	# of Cases
Apple	Cold injury	1
	Eriophyid mite	1
	Venturia inaequalis – apple scab	1
	Unknown	1
Grape	Downy mildew	1
	Mechanical injury	1
Plum	Unknown cause	1
Raspberry	Anthracnose	1
	Negative Verticillium	2
	Possible root weevil	1

Strawberry	Environmental	1
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Home

Host	Diagnosis	# of Cases
Home mold	Alternaria	1
	Aspergillus	1
	Chaetomium	4
	No mold detected	6
	Stachybotrys	6
	Unidentified mold contaminant	4

Identify

Host	Diagnosis	# of Cases
Insect	Dermacentor variabilis – dog tick	1
	Not Ixoides scapularis - deer tick	1
	Petrova species – pitch moth	1
	Insufficient sample	3
Fungi/Molds	Fusarium moniliforme	1
	Morrel	1
	Slime mold	1
	No mold detected	1
	Insufficient sample	1
Plant	Acer ginnalla x A. tataricum - Amur maple	1
	Ambrosia artemisiifolia	1
	Apocynun androsaemifolium	1
	Artemesia biennis	1
	Bittersweet	1
	Borage family	1
	Camelina microcarpa	1
	Carum carvi - wild caraway	1
	Cicuta maculata L.	1
	Curly dock	
	Dogwood	1
	Draba nemorsa - yellow whitlowort	1
	Echinochloa crusgalli	1
	Festuca spp.	1
	Fumaria officinalis - fumitory	1
	Galinsoga parviflora - fringed quickweed	1
	Glechoma hederacea	1
	Hawthorn	1
	Helianthus maximiliani	1
	Insufficient sample	1
	Matricaria	1
	Insufficient sample	2
	Not blue mustard	1
	Not identified	1
	Oenothera biennis	1
	Poaceae family	3
	Polygonum aviculare - prostrate knotweed	1
	Polygonum coccineum	1

Wild parsnip	1
	1

Lawn/Turf		
Host	Diagnosis	# of Cases
Kentucky Bluegrass	Ascochyta leaf blight	1
	Bipolaris sorokiniana	1
	Colletotrichum	1
	Corticium	1
	Cultural	1
	Environmental stress	4
	Erysiphe	1
	Fairy Ring Fungi	2
	Fusarium graminearum	2
	Fusarium nivale	1
	Leptosphaeria korrae	1
	Melting out	1
	No pathogen detected	1
	Physical injury	1
	Pythium	2
	Rhizoctonia	3
	Septoria	1
	Slime mold	1
Other Lawn type	Environmental	1
	Nigrospora	1
	No pathogen detected	2

Ornamental		
Host	Diagnosis	# of Cases
Honeysuckle	Negative Phytophthora	3
Hydrangea	Mechanical injury	1
Impatiens	Verticillium wilt	1
	Deteriorated sample	1
Lily	Anthracoze	2
Orchid	Probable Virus	1
Other Ornamental	Phytophthora root rot	1
	No pathogen detected	1
	Other	2
Peony	Bud blast	1
Rose	Probable Diplocarpon	1
	Eriophyid mite	1
Schefflera	Root rot – unknown cause	1

Seed Health		
Host	Diagnosis	# of Cases
Bean	Dome tests (ratings: 0-3)	10
Pea	Negative stem/foliar nematode	108
Potato	Negative Bacterial Ring Rot (<i>Clavibacter michiganensis</i> subsp. <i>sepedonicus</i> , using ELISA and IFA)	167
	Negative PLRV	2
	Negative PVY	3
	PVY	1
Sunflower	<i>Aspergillus niger</i> , other storage fungi	1
	Negative <i>Ditylenchus</i> sp.	3
	No pathogen detected	3
Soil		
Soil	Negative <i>Aphanomyces</i>	2
	Positive <i>Aphanomyces</i>	4
	<i>Fusarium</i> sp.	3
	Other	5
Tree and Shrub		
Host	Diagnosis	# of Cases
Arborvitae/Cedar	Normal needle drop	1
Ash – Green	<i>Gnomoniella fraxini</i> – anthracnose	3
	Herbicide injury	2
	Ash male flower gall mite	1
	Other Eriophyid mite	1
Ash – Other	Ash yellows phytoplasma	5
	Negative Ash yellows	5
	Cottony ash psyllid	2
	Puccinia	1
	Insufficient sample	1
Cotoneaster	Unknown cause	1
Cottonwood	Frost injury	2
	Water stress	1
Currant	Negative <i>Phytophthora</i>	3
Elm	Negative Dutch elm disease	5
	Positive Dutch elm disease	2
	Inconclusive Dutch elm disease	1
	<i>Eriosoma</i> spp. – Woolly apple aphid	1
	Insufficient sample	2
Fir	<i>Rhizospaera</i> needle cast	1

Hackberry	Sooty mold	1
Honey Locust	Winter kill	1
Juneberry	Entomosporium sp.	1
Juniper	Kabatina tip blight	1
	Nutrient stress	1
	Spider mites	1
Lilac	Deteriorated sample	1
	Environmental stress	2
	Negative Phytophthora	14
	Physical injury	1
Maple	Anthracnose	1
	Bladder gall mites	1
	Herbicide injury	1
	Negative Phytophthora	23
	Iron Deficiency	3
	Scorch	1
Oak	Anthracnose	5
	Insufficient sample	3
	Negative Phytophthora	28
Other	Bladder gall mite	1
	Cottony aphid	1
	Environmental	2
	Herbicide injury	7
	Insufficient sample	2
	Powdery mildew	1
	Unknown cause	1
Pine	Diplodia	1
	Endocronartium – Western gall rust	1
	Herbicide injury	1
	Insufficient sample	1
	Normal needle drop	1
	Unknown cause	1
Poplar	Aceria - Eriophyid mite	1
	Unknown cause	1
Russian Olive	Tubercularia	1
Spruce	Cytospora	2
	Environmental	8
	Excess salts	1
	Fusarium root rot	1
	Herbicide injury	3
	Insufficient sample	2
	No pathogen detected	2
	Normal needle drop	1
	Other	1

	Physical injury	2
	Rhizosphaera needle cast	3
	Spider mites/Spider mite injury	8
	Unknown cause	1
	Yellow-headed sawfly	1
Viburnum	Eriophyid mite	1
	Negative Phytophthora	8
	Powdery mildew	1
Walnut	Anthracoese	1

Vegetable

Host	Diagnosis	# of Cases
Pepper	Deteriorated sample	1
Tomato	Environmental	1
	Insufficient sample	1
	Other	2
	Septoria	1
Pumpkin	Environmental	1