

PURDUE
EXTENSION



**PLANT AND PEST
DIAGNOSTIC
LABORATORY**

2016 Summary Report

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Introduction

The Plant and Pest Diagnostic Laboratory (PPDL) in the Department of Botany and Plant Pathology at Purdue University is an interdisciplinary laboratory dedicated to providing accurate and rapid identification of plant diseases, insects, weeds and cultural problems. We serve as a source of unbiased information regarding pest management strategies, provide diagnostics training and participate in the National Plant Diagnostic Network (NPDN), a consortium of Land Grant University diagnostic Laboratories established to protect our nation's plant biosecurity infrastructure.

Extension Specialist Collaboration

The PPDL benefits greatly from the diagnostic expertise provided by specialists in other departments (Fig. 2 and Table 1). As in past years, faculty and staff from the Departments of Botany & Plant Pathology, Agronomy, Entomology, Horticulture & Landscape Architecture, and Forestry & Natural Resources very generously provided assistance with problems involving their specialties. This collaborative effort also provides valuable information to specialists about trends in PPDL samples to share with their stakeholders.

Sample Overview

The Purdue University Plant and Pest Diagnostic Lab provided 4104 diagnoses on 2479 samples submitted in 2016 (Tables 2 and 3), with 12% of our samples originating from outside Indiana (Fig. 1). Green industry professionals submitted 47% of all non-regulatory samples last year, up from 36% in 2015 (Table 4).

Ornamental plants are consistently the largest category of non-regulatory samples (45% in 2016, up from 43% in 2015) highlighting the reliance of Indiana's Green Industry on the expertise provided by the PPDL (Fig. 7). A more detailed list of sample types is given in Table 5. While diseases comprised 63% of our diagnoses last year, arthropod problems and damage due to non-living (abiotic) factors such as herbicide injury and weather extremes continue to be a significant segment of the problems diagnosed (Fig. 3 and Table 2).

Aware that early diagnosis or ID can help a grower manage a problem more effectively we seek to provide reports as rapidly as possible. Figure 6 shows that 13% of clients received reports the same day the sample arrived and we provided final reports to 52% of our clients within 3 days. Samples requiring in-depth laboratory analysis naturally take longer to complete and preliminary reports are provided to update clients on sample progress.

Diagnostic Highlights and Surveys

In collaboration with our Weed Science Specialists and their lab staff the PPDL offered a new service in 2016: Identification of weeds and weed seeds resistant to Glyphosate and PPO and ALS herbicides using molecular methods. Fifty-nine samples were submitted, with 76% found to be resistant to one or more of the herbicides tested.

The PPDL continued participation in a long-term, multi-year partnership (2004-2016) with IDNR in the annual Cooperative Agriculture Pest Survey (CAPS) to test nursery samples for *Phytophthora ramorum*, causal agent of Ramorum Blight and Sudden Oak Death, a potentially devastating disease of our nursery trade and timber industry. All 397 samples from the survey tested negative for *P. ramorum* (Table 4).

Corn – *Xanthomonas vasicola* pv. *vasculorum* survey: In July 2016 a new disease of corn caused by a bacterium in the genus *Xanthomonas* was identified in Nebraska and later in eight other states. This was the first confirmed report of *Xanthomonas* sp. on corn in the United States. The specific identity of the pathogen and the extent of the problem were unknown. This led to increasing concerns that the presence of the disease could harm yields and the ability of US producers to export corn.

PPDL diagnosticians and the Extension field crops specialist (Kiersten Wise) joined several conference calls with USDA and IDNR officials to learn more about the disease and discuss options for handling Indiana's samples as part of a delimiting survey for *Xanthomonas* of corn throughout the Midwest. Based on strong past collaborations the USDA/APHIS/PPQ and the Indiana Department of Natural Resources invited the PPDL to participate in planning a survey to determine whether the new disease was present in Indiana and determine which counties

were affected. Samples were collected from 30 counties by IDNR nursery inspectors and Purdue county Extension personnel and submitted to the PPDL for analysis.

Diagnosticians at the PPDL examined each sample microscopically for the presence of bacterial ooze. All samples tested were negative for the presence of *Xanthomonas*. Any potentially positive samples would have received further tests both at the PPDL and at Kansas State University (the lab designated by USDA/APHIS to officially diagnose this new disease). The bacterium was later identified by the USDA as *Xanthomonas vasicola* pv. *vasculorum* (Xvv) and it was determined that the disease was “not of quarantine significance for domestic or international trade”.

Because the PPDL rapidly tested all Indiana samples in-state the Indiana State Plant Health Director (Megan Abraham) and Indiana State Plant Regulatory Officer (Gary Simon) were able to quickly assess the situation in Indiana and state with confidence that Xvv was not detected in Indiana, thus reducing concerns about this disease related to corn export. Kiersten Wise, Gail Ruhl and Tom Creswell also produced an informational Research Update publication about the disease for distribution to growers and county Extension Educators.

Tomato – Bacterial Spot - *Xanthomonas* spp. survey: Through a Specialty Crop Block Grant from the Indiana State Dept. of Agriculture the PPDL collaborated with Dan Egel at SWPAC to survey commercial tomato grower’s fields for bacterial spot disease. The goal of the 2-year research project is to better characterize the predominant species and strains of *Xanthomonas* present to assist with making management recommendations. Bacterial strains isolated from 29 Tomato samples with symptoms of bacterial leaf spot or fruit spot (caused by *Xanthomonas* spp.) were identified by biochemical analysis (Biolog) and by DNA analysis. Strains were further characterized by a collaborator at the University of Florida, Gainesville.

Exotic Corn Pathogens Survey: The PPDL participated for the 4th year (2013-2016) with the IDNR in an IN CAPS survey for Exotic Corn Pathogens. All 226 corn samples examined by the PPDL were diagnosed as ‘not detected’ visual/microscopic for the presence of *Peronosclerospora maydis* (Java Downy Mildew) *P. philippinensis* (Philippine Downy Mildew) and *Sclerophthora rayssiae* (Brown Stripe Downy Mildew).

Data gathered from IDNR/PPDL CAPS surveys are uploaded to the National Agricultural Pest Information System (NAPIS) database system and the NPDN national data repository. This effort in documenting reliable diagnostic information helps researchers and regulatory agencies guide future research and monitoring efforts.

Journal Publications:

Abbasi, M., Aime, M.C., Ruhl, G.E. and Creswell, T.C. 2016. First report of Rust Disease Caused by *Coleosporium apocynaceum* on *Amsonia* 'Blue Ice' in Indiana. Plant Disease <http://dx.doi.org/10.1094/PDIS-01-16-0019-PDN>

Webb, C. A., Speers, C., Ruhl, G., and Creswell, T. 2016. First Report of Bacterial Leaf Spot Caused by *Pseudomonas cichorii* on Sweet Basil (*Ocimum basilicum*) in Indiana. Plant Disease <http://dx.doi.org/10.1094/PDIS-06-15-0634-PDN>.

Ruhl, G., Romberg, M., Bissonnette, S., Plewa, D., Creswell, T., and Wise, K. 2016. First Report of Tar Spot on Corn caused by *Phyllachora maydis* in the United States. Plant Disease <http://dx.doi.org/10.1094/PDIS-12-15-1506-PDN>.

Liu, H., Tolin, S., Bush, E., Creswell, T., Hansen, M.A. and Wang, X. 2016. First Report of *Tomato spotted wilt virus* on *Pittosporum tobira* in the United States. Plant Disease. 100:538. <http://dx.doi.org/10.1094/PDIS-06-15-0681-PDN>

Abbasi, M., Aime, M.C., Ruhl, G.E. and Creswell, T.C. 2016. First report of the Smut Fungus *Ustilago sieglingiae* on Purple Sandgrass (*Triplasis purpurea*) from Indiana. Plant Disease. 100:536 <http://dx.doi.org/10.1094/PDIS-06-15-0619-PDN>

Creswell, T. C., Ruhl, G. E., Aime, M. C., Beckerman, J. L., and Abbasi, M. 2016. First report of rust disease of Bradford Pear caused by *Gymnosporangium clavipes*. Plant Disease 100:860 <http://dx.doi.org/10.1094/PDIS-10-15-1125-PDN>.

Rivera, Y., Salgado-Salazar, C., Creswell, T. C., Ruhl, G. E., and Crouch, J. A. 2016. First report of downy mildew of caused by *Peronospora* sp. on Agastache in the United States. Plant Disease <http://dx.doi.org/10.1094/PDIS-10-15-1119-PDN>.

J. Beckerman, H. Nisonson, N. Albright, D, and T. Creswell. First Report of *Pythium aphanidermatum* Crown and Root Rot of Industrial Hemp in the United States. Plant Disease - in press.

M. Abbasi, M.C. Aime, T.C. Creswell and G.E. Ruhl, Purdue Univ. and S. Wright, Missouri Dept. of Conservation. First report of rust disease caused by *Cronartium quercuum* on Chinquapin oak. Plant Disease – in press.

Extension Bulletins written or revised in 2016

Philip Marshall, Megan Abraham, and Vince Burkle, Indiana Department of Natural Resources; Matthew Ginzel, Cliff Sadof, Gail Ruhl, and Tom Creswell, Purdue University. *Thousand Cankers Disease: Indiana Walnut Trees Threatened*. ID-478-W. <https://www.extension.purdue.edu/extmedia/BP/ID-478-W.pdf>

Kiersten Wise, Gail Ruhl and Tom Creswell. Diseases of Corn – Tar Spot, BP-90-W. <https://www.extension.purdue.edu/extmedia/BP/BP-90-W.pdf>

Kiersten Wise, Tom Creswell and Gail Ruhl. Diseases of Corn – Research Update: A New Bacterial Disease of Corn in the United States. Aug. 2016

<https://ag.purdue.edu/btny/ppdl/Pages/HOT2016/HOT09162016.pdf>

Midwest Vegetable Production Guide for Commercial Growers 2017, ID-56

<https://ag.purdue.edu/btny/midwest-vegetable-guide/Pages/default.aspx>

Midwest Fruit Pest Management Guide 2017, ID-465

<https://ag.purdue.edu/hla/Hort/Documents/ID-465.pdf>

2017 Corn & Soybean Field Guide, ID-179

<https://ag.purdue.edu/agry/dtc/Pages/CSFG.aspx>

Extension and Teaching Activities

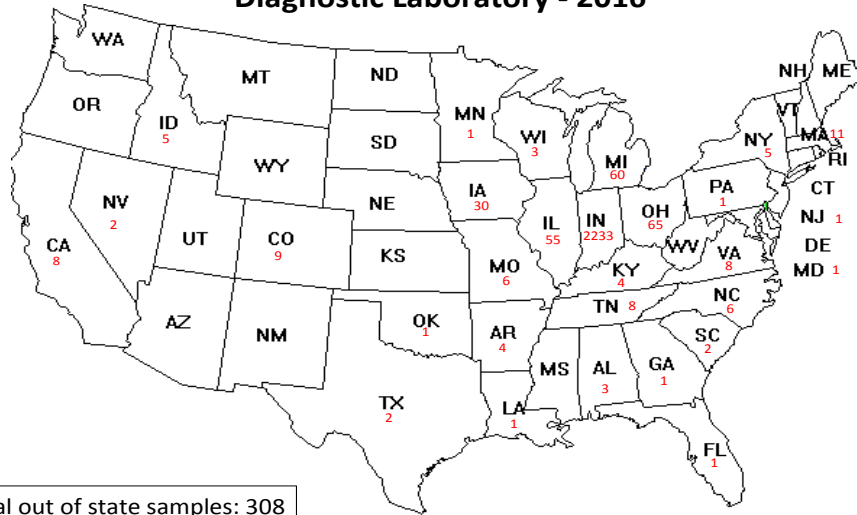
Horticultural Inspection Society (HIS) 2016 Multi-State Inspection Training – Collaboration with IDNR

- Gail Ruhl, Tom Creswell (PPDL) and Cliff Sadof (Entomology) were invited by the IDNR to present a three hour hands-on diagnostics workshop for the Central Chapter of the Horticultural Inspection Society (HIS) , a group of 32 Nursery Inspectors from 12 states. <<http://nationalplantboard.org/hiscc/>> The workshop received rave reviews from inspectors as a high-quality program that disseminated pertinent diagnostic information to promote high standards of plant inspection work.

PPDL staff members participate annually in a variety of educational events and programs. In 2016 these events included:

- A one day PPDL orientation/training for new ANR Extension Educators
- SpringFest at the West Lafayette campus
- Indiana Crop Improvement Assoc. (ICIA)/IDNR Phytosanitary Certification Field Inspector Training
- Indiana Green Expo
- Indiana Arborist Association meetings
- Indiana Professional Lawn and Landscape Association training events
- Master Gardner training on disease diagnostics
- Garden Center Training on plant diseases
- Webinars for Extension Educators
- PK-12 Outreach (4-H Career Round-up; SpringFest; Wea Ridge Kindergarten Classes, Happy Hollow 4th grade, HASTI, FFA)
- Turf and Landscape Field Day (Daniels Turf Center)
- Home and Patio Show, PPDL exhibit at MG Booth, State Fair Grounds
- The Indiana State Fair: Diagnostics and PPDL display at Ag Hort Building
- Guest lectures and lab exercises for HORT 420, AGR 290 and BTNY 301
- ANR Educator Retreat –Turkey Run State Park
- Purdue Crop Management Workshop
- Diagnostics training for visiting scientists from Herat University, Afghanistan

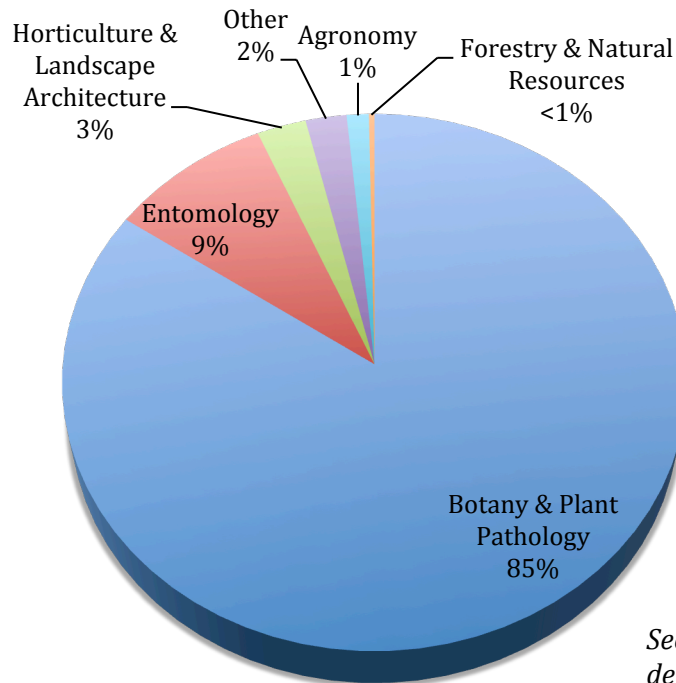
Fig. 1 Origin of samples received by the Plant and Pest Diagnostic Laboratory - 2016



Total out of state samples: 308
(12% of total samples)

4 Photo only samples came from outside USA

Fig. 2 - Departments Assisting with Sample Diagnosis - 2016



See Table 1 for detailed information.

Table 1. Departmental faculty and staff that assisted with sample diagnoses - 2016^[1]

Faculty/Staff	Number of Samples Diagnosed	Faculty/Staff	Number of Samples Diagnosed
Agronomy	37	Entomology	292
Jim Camberato	14	Larry Bledsoe	34
Keith Johnson	19	Jamal Faghihi	19
Bob Neilson	4	Rick Foster	25
Other	3	Tim Gibb	84
		John Obermeyer	28
Botany & Plant Pathology	2761	Cliff Sadof	98
		Other	4
Janna Beckerman	16		
Tom Creswell	1095		
Dan Egel	7	Horticulture & Landscape Architecture	89
Rick Latin	7		
Travis Legleiter	118	Kyle Daniel	31
Deb Lubelski	7	Rosie Lerner	19
Gail Ruhl	1435 ^[2,3,4]	Liz Maynard	5
Ian Thompson	4	Aaron Patton	23
Kiersten Wise	4	Other	11
Julie Young	59		
Other	9		
		Non-Purdue Specialist	79
Forestry & Natural Resources	10	Jan Byrne, MSU ^[2]	55
		APHIS	5
Lindsey Purcell	10	Other	19

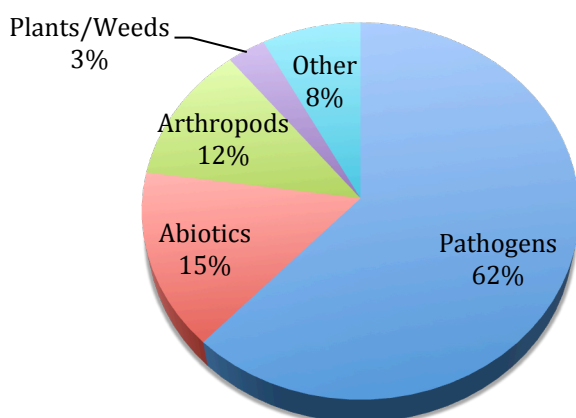
[1] Names in **BOLD** are Department Diagnostic Liaisons.

[2] 397 *Phytophthora ramorum* nursery survey samples.

[3] 93 Corn Phytosanitary field survey samples.

[4] 61 Corn Xanthomonas field survey samples.

Fig 3. Diagnoses by Category - 2016



See Table 2 for detailed information.

Table 2. Diagnoses Sorted by Category - 2016

Category	Number of Diagnoses	% of Total
Pathogens	2545	62%
Fungi	2107	51%
Viruses	236	6%
Bacteria	202	5%
Abiotics	624	15%
Cultural/Environmental	277	7%
Chemical/Herbicide Injury	115	3%
Nutritional	69	2%
Other	163	4%
Arthropods	490	12%
Insects	292	7%
Mites	113	3%
Nematodes	79	2%
Other	6	<1%
Plants/Weeds	124	3%
Other	321	8%
Totals: (Each Sample May Have Multiple Diagnoses)	4104	100%

Sample Type	Number of Samples	% of Total
Non-regulatory samples	1812	73%
Regulatory/survey samples	667	27%
Total number of samples	2479	100%

Affiliation	Number of samples	% of Total
Commercial	1163	47%
Garden Center/Greenhouse/Nursery	326	13%
Agribusiness	260	10%
Landscaper/Lawn & Tree Care	161	6%
Grower/Farmer	118	5%
Crop Consultant	87	4%
Extension Educator	85	3%
Arborist	53	2%
Golf Course	45	2%
Pest Control	23	1%
Other	5	<1%
Non-Commercial	649	26%
Homeowner	268	11%
Extension Educator	219	9%
Researcher/Specialist	162	7%
Regulatory/Survey	667	27%
IDNR (SOD <i>P.ramorum</i> nursery Survey)	397	16%
IDNR/ICIA (Phytosanitary certification field inspection)	93	4%
IDNR (Nursery inspection)	77	3%
IDNR (Corn Xanthomonas field Survey)	61	2%
Office of the Indiana State Chemist	39	2%
Totals:	2479	100%

**Fig. 4 - Five Year Sample Trend
2012-2016**

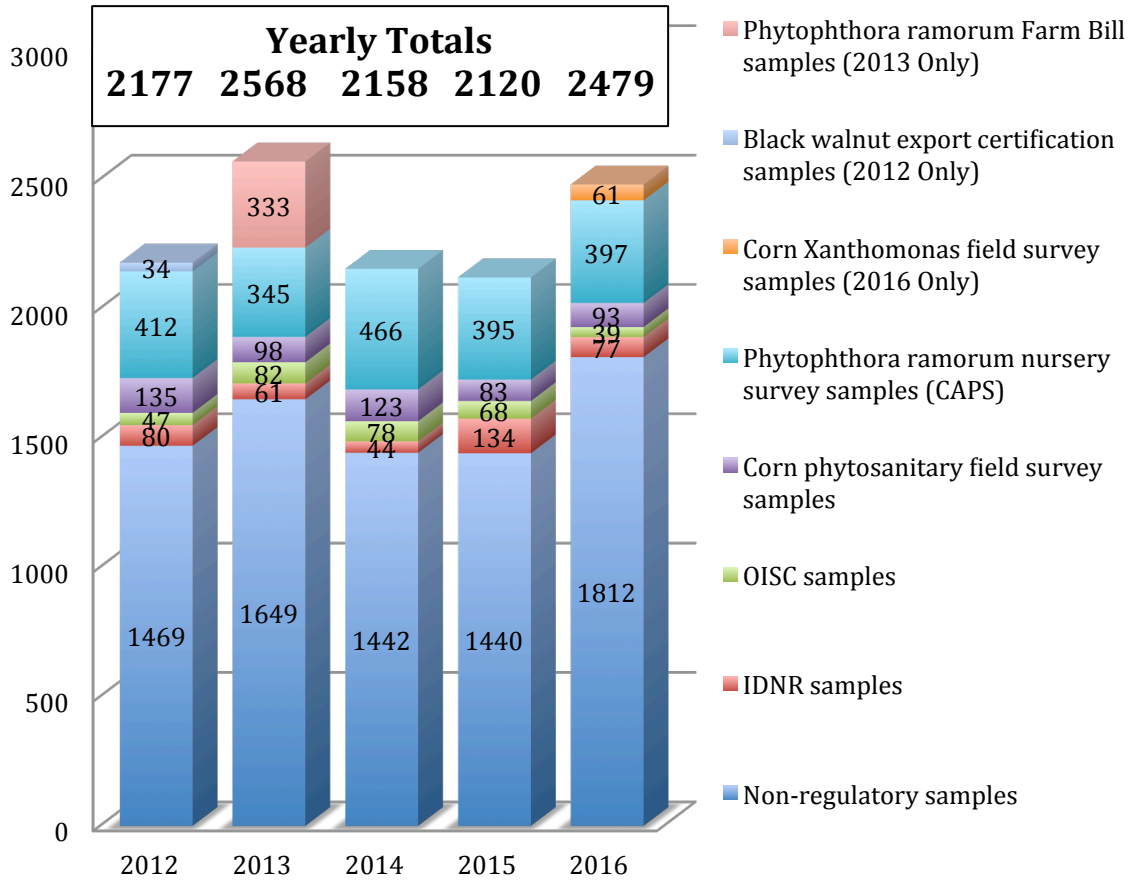


Fig. 5 - Monthly Totals - 2016

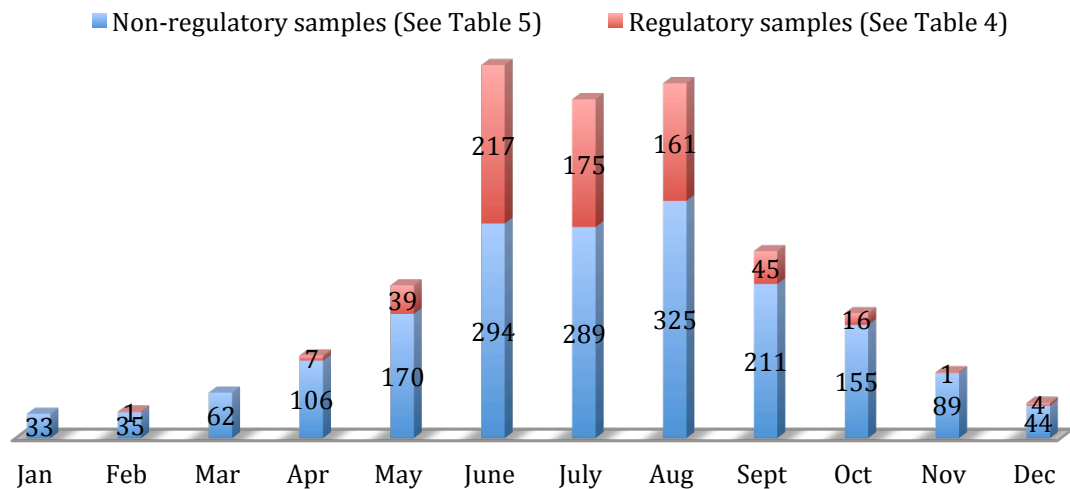
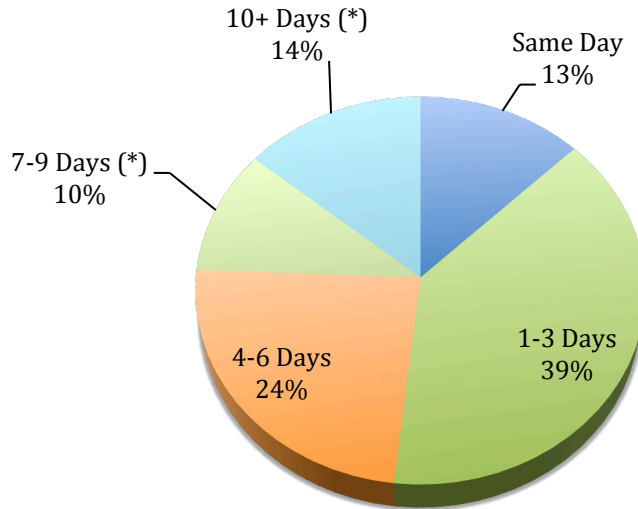
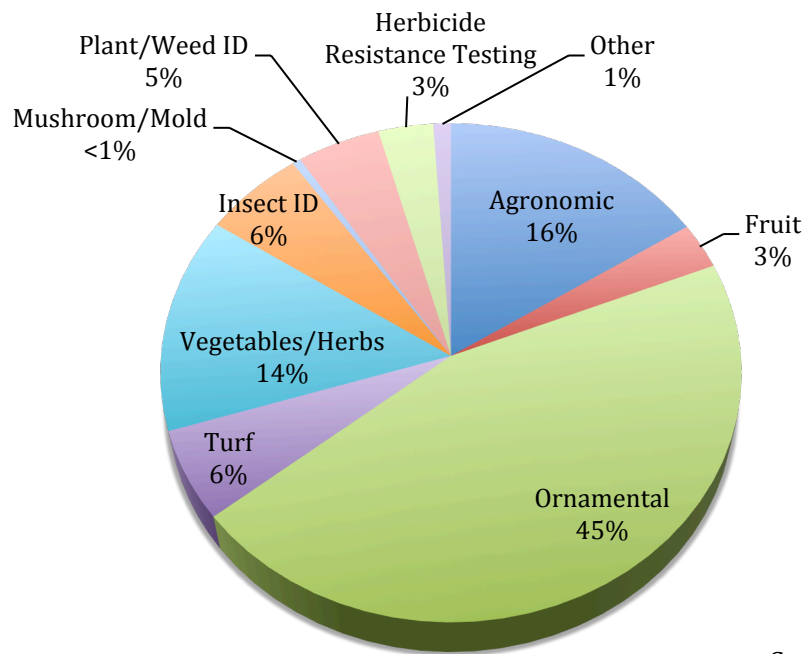


Fig. 6 - Reporting Turn-Around Time - 2016



*Molecular Identification and culturing extends sample completion time for complex samples.

Fig. 7 - Non-regulatory Sample Categories - 2016



See also Table 5

Table 5. Non-regulatory Samples by Category - 2016		
Category	Number of Samples	% of Total
Agronomic	289	16%
Soybean	118	7%
Corn	105	6%
Wheat	22	1%
Switchgrass	14	1%
Other	30	2%
Fruit	54	3%
Tree Fruit	28	2%
Small Fruit	26	1%
Ornamentals	823	45%
Woody ornamental -Deciduous	308	17%
Woody ornamental - Evergreen	223	12%
Annuals	149	8%
Perennials	143	8%
Turf	106	6%
Vegetables/Herbs	254	14%
Tomato	73	4%
Hops	45	2%
Melon	31	2%
Herbs	23	1%
Cucumber	14	1%
Other	68	4%
Miscellaneous	286	16%
Insect ID	109	6%
Plant/Weed ID	90	5%
Herbicide Resistance Testing	59	3%
(Waterhemp, Palmer Amaranth, Giant Ragweed)		
Other (Multiple Host, Aquatics)	19	1%
Mushroom/Mold	9	<1%
Total Samples:	1812	100%