Annual Report
2002

Purdue University Cooperative Extension Service

Table of Contents

ACKNOWLEDGMENTS

Purdue's Plant and Pest Diagnostic Lab is recognized as a source of unbiased, quality, diagnostic information. This recognition, earned over the years, is a result of the hard work and dedication of those many individuals who have given of their time to the P&PDL.

I would like to give special thanks to the Diagnosticians and volunteer Faculty and Staff who are the heart of the P&PDL. I appreciate the many hours that you spend looking at and discussing samples and writing management options. The concern that you have for each sample and client are what make the P&PDL successful.

Thank you to the computer support specialists who keep us 'on-line' and to our secretary whose patience and friendly phone etiquette provides a welcome introduction to our clientele.

To the administration at Purdue University, I thank you for your previous support and implore you to continue the support that is vital to maintain our excellence as a premier multidisciplinary diagnostic facility.

Gail E. Ruhl
Interim Director, P&PDL

"…to enable people to improve their lives and communities through learning partnerships that put knowledge to work" (Extension mission as per the National Association of State Universities and Land Grant Colleges, 2001)

2002
Annual Report of the
Plant and Pest Diagnostic Laboratory

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MISSION

The Plant and Pest Diagnostic Laboratory (P&PDL) at Purdue University is an interdisciplinary laboratory, first established in 1990 with funding from the Crossroads initiative. The mission of the P&PDL is to provide accurate and rapid identification of plants, pests, and plant problems; suggest management strategies, when requested; and serve as a source of unbiased information for plant and pest related problems.

The Laboratory provides technical expertise to specialists and county extension educators of the Purdue University Cooperative Extension Service (CES) and the University's research faculty and staff; to the Director of the Entomology and Plant Pathology Division of the Indiana Department of Natural Resources (IDNR) and associated inspectors; as well as routine pest and plant problem diagnoses for private businesses and citizens of Indiana.

STAFF

Prior to September 1, 2002, the P&PDL was staffed with a full-time Director, secretary/ receptionist and one and a half plant disease diagnosticians provided by the Dept. of Botany and Plant Pathology. Due to State budget constraints, on September 1, 2002, the P&PDL lost its monetary support for the position of a full time Director. Gail Ruhl, Senior Plant Disease Diagnostician, accepted the responsibility to serve for one year as interim part-time Director.

Other Purdue faculty and staff from the departments of Agronomy, Botany and Plant Pathology, Entomology, Forestry and Natural Resources, and Horticulture and Landscape Architecture serve as diagnosticians for the P&PDL on a part time basis as a portion of their total commitment to their respective departments. Staffing responsibilities in the P&PDL and the department to which they belong, are listed below:

Botany and Plant Pathology	
Director (prior to Sept. 1, 2002)	Peggy Sellers
Interim Director (as of Sept. 1, 2002)	Gail Ruhl
Secretary	Janet Whaley
Disease diagnosis and control	Gail Ruhl, Karen Rane
Weed identification, control, and diagnosis of herbicide injury on field crops	Glenn Nice
Computer support	Robert Mitchell
Entomology	
Invertebrate and other pest identification and control	Timothy Gibb
Horticulture	
Identification of horticultural plants and plant problems	B. Rosie Lerner
Agronomy	
Fertility, soil and environmentally related problems of corn	Robert Nielsen, Greg Willoughby
Turfgrass management	Zac Reicher, Glenn Hardebeck
Forestry and Natural Resources	
Tree identification	Rita McKenzie

The P&PDL is fortunate to have the support and assistance of numerous faculty and staff in the School of Agriculture. During 2002, 24 additional faculty and staff members assisted with sample diagnoses **(Table 1)**. The P&PDL also employs a student hourly worker throughout the year to help with sample distribution, filing and other general duties in the laboratory.

Table 1. Departmental faculty and staff that assisted with diagnoses of samples submitted to the *Plant and Pest Diagnostic Laboratory* during 2002.[1]

Faculty/Staff	Number of Diagnoses	Faculty/Staff	Number of Diagnoses
Agronomy	**90 (4%)**	**Entomology**	**390 (16%)**
E. Christmas	6	L. Bledsoe	3
G. Hardebeck[2]	40	R. Foster	5
K. Johnson	2	**T. Gibb**	260
R. Nielsen	2	L. Mason	1
Z. Reicher	9	J. Obermeyer	13
J. Volenec	2	C. Sadof	108
Willoughby	29		
		Forestry & Natural Resources	**2 (*%)**
Botany & Plant Pathology	**1782 (73%)**	J. McKenna	1
		R. McKenzie	1
S. Abney	3		
T. Bauman	4		
P. Harmon	2	**Horticulture & Landscape Architecture**	**164 (7%)**
D. Huber	2		
R. Latin	17	B. Bordelon	15
C. Lembi	23	M. Dana	27
G. Nice	69	P.A. Hammer	20
P. Pecknold	13	**R. Lerner**	54
K. Rane	877	B. Moser	23
G. Ruhl	738	S. Weller	25
P. Sellers	29		
G. Shaner	5	**Indiana Wildlife Services**	**6 (*%)**
		J. Loven	6
		Total Diagnoses	**2434**

[1] The total number of diagnoses exceeds the total number of samples due to multiple problems/diagnoses per sample. More than one person may assist with a diagnosis.
[2] Names in bold type were designated by departments as 2002 P&PDL diagnosticians.
* Less than 1%

ADVISORY COMMITTEES

The inter-departmental nature of the P&PDL demands frequent and free-flowing exchange of information among the participating departments. This communication takes place on at least three different levels.

The Steering Committee

The Steering Committee provides a forum to discuss matters that relate to the daily operation of the P&PDL. Input from the diagnosticians is considered essential for smooth functioning of the Lab. The Committee meets as needed and reports periodically to the Operations Committee. The Committee is chaired by the Director of the P&PDL and is composed of diagnosticians, the Director and the secretary.

The Operations Committee

The Operations Committee provides a forum for discussion of operational matters and facilitates communication among diagnosticians and other specialists. The Committee meets twice yearly or as needed and reports periodically to the Management and Policy Committee. The Committee is chaired by the Director of the P&PDL and is composed of the Steering Committee, one Extension specialist from each participating department and the Department Head charged with administrative overview of the laboratory. Departmental Extension Specialists are appointed on a three-year rotating basis.

The Management and Policy Committee

The Management and Policy Committee provides administrative overview for the P&PDL. The Committee is composed of the Heads of the participating Departments and administrators from the Cooperative Extension Service and the Agricultural Experiment Station. The Committee is chaired by the Director of the Cooperative Extension Service. The Committee meets annually or as needed.

2002 COMMITTEE STRUCTURE

The Steering Committee: Peggy Sellers (Chair, Director of P&PDL prior to Sept. 1, 2002), Gail Ruhl (Chair, Interim Part Time Director of P&PDL as of Sept. 1, 2002), Janet Whaley (Secretary), Gail Ruhl and Karen Rane (Plant disease diagnosis and control), Glenn Nice (Weed identification and control, and diagnosis of herbicide injury on field crops), Tim Gibb (Arthropod identification and control), B. Rosie Lerner (Identification of horticultural plants), Greg Willoughby (Fertility and soil-related problems of field crops), Zac Reicher (Turf-grass Management.), Rita McKenzie (Forestry), Terry McCain (Data base programming, management and web page designer prior to Sept. 1, 2002), Bob Mitchell (Data base programming, web page management and computer support as of Sept. 1, 2002)

The Operations Committee: Peggy Sellers (Chair, Director of P&PDL prior to Sept. 1, 2002), Gail Ruhl (Chair, Interim Part Time Director of P&PDL as of Sept. 1, 2002), Steering Committee members, Ray Martyn [Department Head (administrative overview)], Keith Johnson (Agronomy), Greg Shaner (Botany and Plant Pathology), Rick Foster (Entomology), Rita McKenzie (Forestry and Natural Resources), Allen Hammer (Horticulture and Landscape Architecture)

The Management and Policy Committee: Dave Petritz (Chair, Director of CES), Tom Jordan (Assistant Director of CES & Agriculture and Natural Resources), Marshal Martin (Associate Director of Agriculture Research Programs), Craig Beyrouty (Head, Department of Agronomy), Ray Martyn (Head, Department of Botany and Plant Pathology), Steve Yaninek (Head, Department of Entomology), Ed Ashworth (Head, Department of Horticulture), Dennis LeMaster (Head, Department of Forestry and Natural Resources), and Peggy Sellers (Director of P&PDL prior to Sept. 1, 2002), Gail Ruhl (Interim Part Time Director of P&PDL as of Sept. 1, 2002)

FINANCIAL SUPPORT

In 1990 the Crossroads initiative provided funding to establish an interdisciplinary diagnostic laboratory, the P&PDL. Although each diagnostician is paid from a departmental budget, the general operating expense budget has been supported annually by the Director of the Cooperative Extension Service. Due to budget constraints, the Director provided only half of the previous year's operating budget for 2002, and there will be no CES support of the operating expense budget in 2003. The operating budget for the P&PDL in 2003 will come from the service fees charged for sample diagnosis **(Table 2)**.

LABORATORY OPERATIONS

County offices of the Cooperative Extension Service (CES) are provided with a supply of sample submission forms, alcohol vials and mailing boxes to facilitate the submission of plant specimens and insects to the P&PDL. Submission forms are available to private businesses and citizens through CES offices and the P&PDL office. Forms may also be downloaded from the P&PDL web page. Submission forms are filled out at the time that a sample is brought to the laboratory or prior to sample shipment by mail.

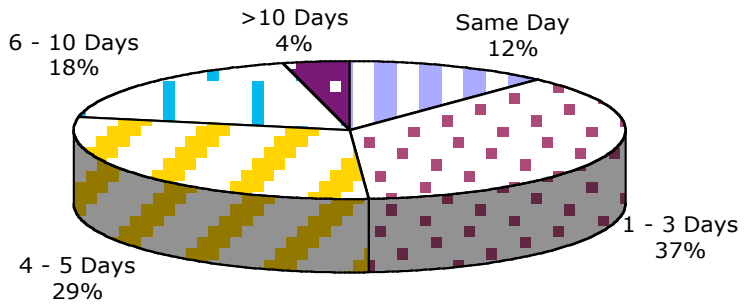
Diagnosis Process

Information from the sample submission form is logged into the P&PDL computer database and the sample is assigned a unique number. Samples are then distributed to the appropriate diagnostician. If the diagnosis will require pathogen isolation or some other lengthy procedure (determined by the diagnostician), a preliminary reply, including a tentative diagnosis and projected final completion date, is returned to the client. When the diagnosis has been completed the identification and management recommendations (when requested) are entered into the database, printed, and the final response along with any supporting information is returned to the client and/or submitter via electronic mail and/or FAX, and US mail (as requested by the submitter on the submission form).

Turn-around time

Turn-around time is the length of time between when a sample is received and when the final diagnosis is returned. Approximately half of the samples received in 2002 were answered within 3 days or less, with twelve percent of those answered on the same day they were received **(Figure 1)**. Diagnoses for the majority (78%) of samples submitted were completed within five working days. Rapid turn-around time, coupled with thorough, accurate diagnoses have earned the P&PDL a national reputation for excellence.

Figure 1. Turn-around time for all samples received in 2002*



* Turn-around time is the number of working days between receipt of samples and date of final reply completion.

Fees

Service fees of $11.00 (in-state) and $22.00 (out-of-state) are charged for processing all samples **(Table 2)**. There is an additional fee of $25.00 for serological testing and bacterial identification using the BIOLOG system. To provide for contract work or exceptionally time-consuming diagnosis there is a fee of $22.00/hour. Fees incurred for samples that are referred to the departments of Entomology and Horticulture and Landscape Architecture for nematode analysis or analysis of artificial potting media, respectively, are not tracked by the P&PDL.

A limited number of educational “Dave” samples are provided to county Educators at the Director of Extension’s expense. This practice was instituted as a way to assist new Educators in the diagnostics learning process. Educators must get pre-approval from the Director of the P&PDL prior to submission of “Dave” samples to ensure appropriate submissions.

Table 2. Fees assessed by the Plant and Pest Diagnostic Laboratory in 2002.

Service	Fee	No. of Samples	Income
Routine diagnosis			
In State	$11.00	1001	$11,011.00
Out of State	$22.00	388	$8,536.00
Serological Testing (additional charge)	$25.00	29[1]	$725.00
Educational "Dave" Samples for Educators[2]	$11.00	13	$143.00
Fee Waived			
• Electronic submissions (Digital Diagnostics Project)	N/A	262	$0.00
• Insufficient sample/resubmission	N/A	129	$0.00
TOTAL		1793	$20,415.00

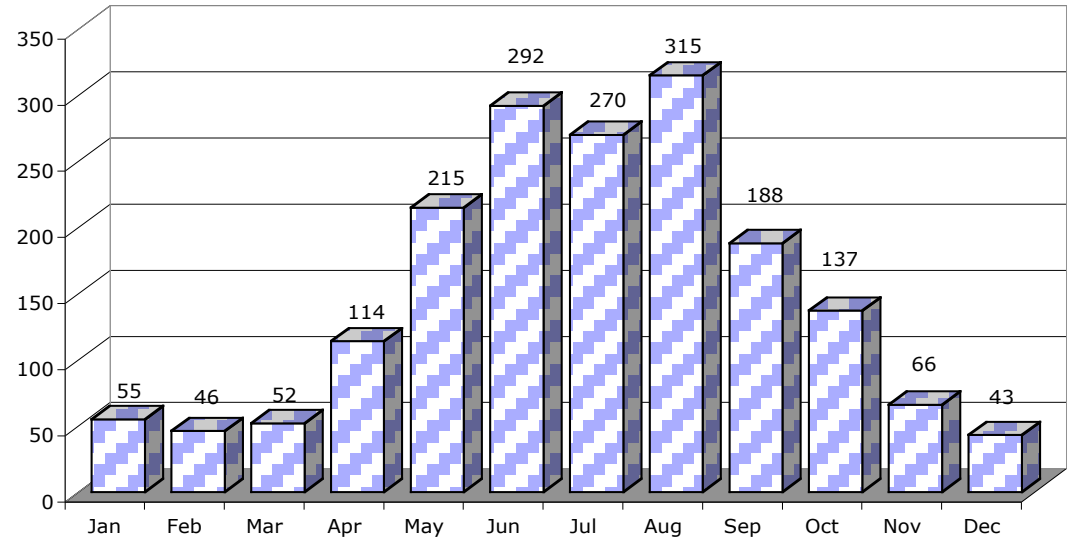
[1] Not included in the total. Already counted as a sample under routine diagnosis.
[2] Charge to Dr. David Petritz

DIAGNOSES AND SAMPLES

Monthly Activity

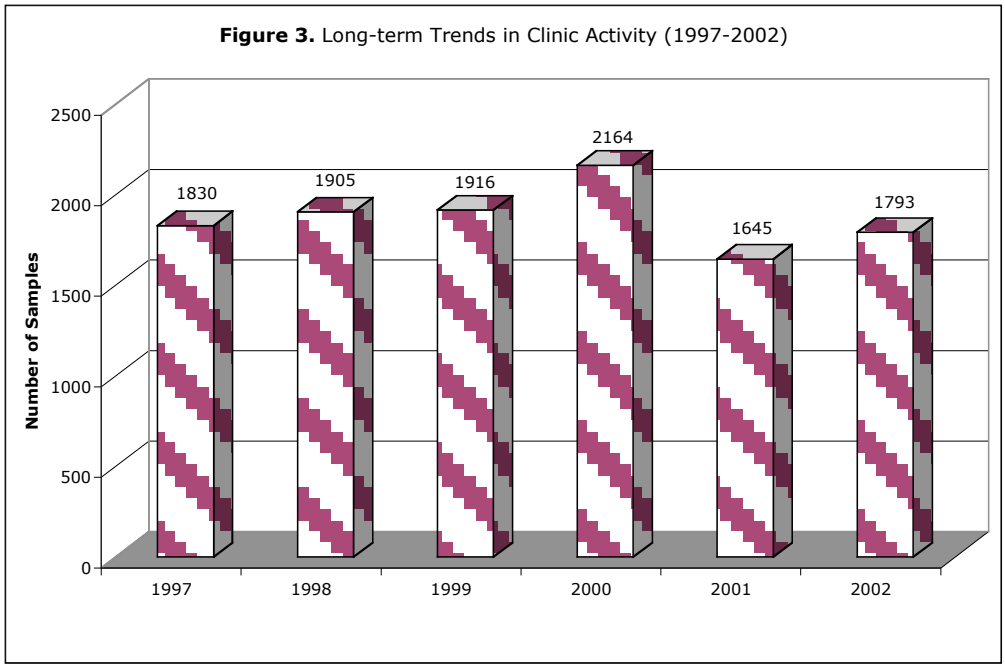
During 2002, the Laboratory diagnosed a total of 1793 samples, of which 275 were submitted electronically as digital images and 389 were delivered personally to the office. June, July and August were the three months of greatest activity in the P&PDL based on the number of samples submitted in 2002 **(Figure 2).** Nearly half of the year's samples were processed in the laboratory during these three months.

Figure 2. Number of samples received per month during 2002.



Long-Term Trends/Commodities Diagnosed

A review of annual sample submissions over the past five years indicates a relative stability in the numbers of samples submitted for diagnosis during rather stressful economic conditions **(Figure 3)**. However, it is clearly documented in **Table 3** that a shift in proportion of commodity group submission types has occurred since 1997. In 1997 agronomic crops comprised 28% of the samples submitted to the P&PDL while in 2002 only 10% of the total number of samples submitted to the lab were agronomic samples. In contrast the number of ornamental submissions increased by 13% in the five years between 1997 and 2002.



In summary, problems and questions dealing with ornamental plants comprised the largest proportion (58%) of samples submitted during 2002, followed by agronomic crops (10%) and insects infesting homes and other buildings (9%). The remaining 23% of the samples were distributed between various commodity groups **(Table 3)**.

Table 3. Samples sorted by commodity group

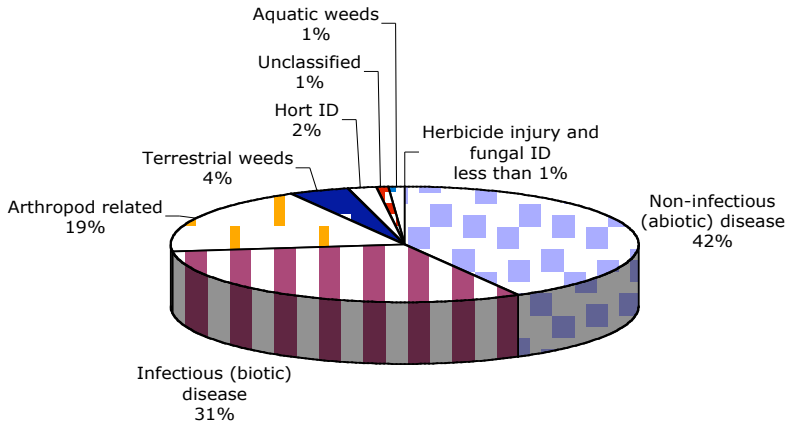
	2002		1997	
Commodity	**Number of Specimens**	**%[1]**	**Number of Specimens**	**%[1]**
Agronomic	**184**	**10**	**505**	**28**
Alfalfa/Clover	9	*		
Corn	78	4		
Oats/Wheat	13	1		
Soybeans	82	4		
Pasture	2	*		
Fruit	**66**	**4**	**59**	**3**
Small Fruit	20	1	25	1
Tree Fruit	46	3	34	2
Ornamentals	**1036**	**58**	**827**	**45**
Flowers	348	20	217	12
Interior Plants	17	1	34	2
Grnd Cvrs/Vines	53	3	28	2
Shrubs	166	9	131	7
Trees	452	25	417	23
Specialty Crops	**39**	**2**	**34**	**2**
Field	5	*		
Hort	34	2		
Turfgrass/Yard	**128**	**7**	**73**	**4**
Vegetables	**120**	**7**	**149**	**8**
Miscellaneous	**220**	**12**	**183**	**10**
Animal/Human	25	1	15	*
Aquatic	23	1	N/A	N/A
Home/Bldg	156	9	83	5
Other	6	*	60	3
Stored Foods	7	*	7	*
Unclassified	3	*	18	*
Total Specimens	**1793**	**100**	**1830**	**100**

[1] Percent of total samples submitted during the year
* Less than 1%

Type of Diagnosis

Many of the samples received multiple diagnoses due to more than one causal agent. However, the primary agents, determined by the type of diagnosis made, were mostly noninfectious (abiotic) disorders (42%), followed by infectious diseases (31%), arthropods (19%), plant identification (7%), and herbicide injury (<1%) **(Figure 4)**.

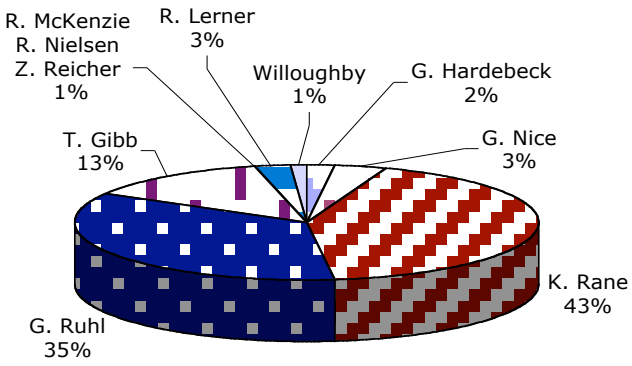
Figure 4. Proportion of primary diagnoses in 2002



Diagnoses per Diagnostician

A comparison of the proportion of total diagnoses made according to diagnostician is given in **Figure 5**.

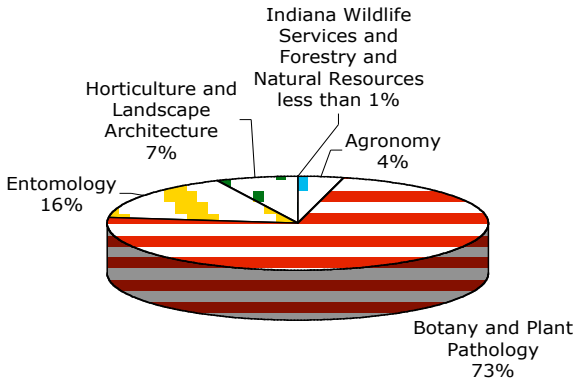
Figure 5. Percentage of diagnoses made by each P&PDL diagnostician in 2002



Diagnoses per Department

A comparison of the proportion of total diagnoses made according to participating departments is given in **Figure 6**.

Figure 6. Proportion of total diagnoses made by faculty and staff in participating departments* in 2002



* See Table 1

Commodity Group Causal Agents

The number and proportion of samples with abiotic (noninfectious) and biotic (infectious disease, arthropod and weed) problems by commodity groups are presented in **Table 4**.

Table 4. Types of Primary Problems Diagnosed on Selected Commodity Groups[1]

Commodity	Number of samples	Abiotic Problems		Biotic Problems					
				Disease		Arthropods		Weeds	
		Number	%[2]	Number	%	Number	%	Number	%
Animal/Human	25	-	-	-	-	30	(17)	-	-
Agronomic Crops	184	63	(34)	91	(49)	6	(3)	16	(9)
Flowers	348	174	(50)	148	(43)	18	(5)	10	(3)
Fruits, small	20	14	(70)	-	-	1	(5)	3	(15)
Fruits, tree	46	18	(39)	21	(46)	59	(11)	-	-
Ground covers/Vines	53	8	(15)	33	(62)	6	(11)	9	(17)
Home/Building	156	-	-	-	-	167	(7)		
Interior Plants	17	9	(53)	5	(29)	1	(6)	4	(24)
Shrubs	166	89	(54)	46	(28)	19	(11)	13	(8)
Specialty Crops	39	14	(36)	17	(44)	3	(8)	-	-
Stored Foods	7	-	-	-	-	7	(<1)	-	-
Trees	452	270	(60)	94	(21)	66	(15)	18	(4)
Turfgrass/yard	128	35	(27)	24	(19)	9	(7)	45	(35)
Vegetables	120	55	(46)	60	(50)	5	(4)	3	(3)

[1] Sample numbers do not equal the number of diagnoses because not all samples represented problems (e.g. horticultural plant and weed identification, etc.)

[2] Numbers in parentheses are the proportion of the total number of samples for that commodity group.

SAMPLE ORIGIN

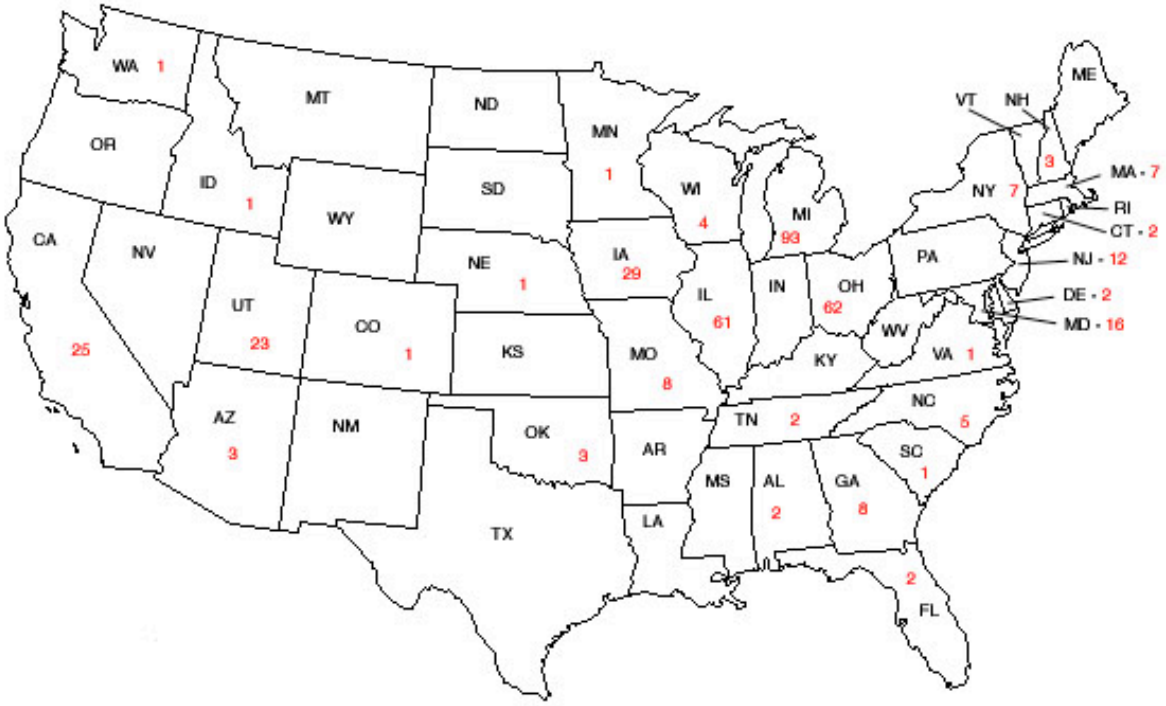
The Laboratory is primarily intended to serve residents of Indiana, however, due to the P&PDL's national reputation, diagnostic services were also provided for 386 samples submitted from 29 other states during 2002.
(Table 5; Figure 7)

Table 5. Out of State Submissions to the P&PDL in 2002.

State	Homeowner	Commercial	Other	Total
Alabama		2		2
Arizona		3		3
California		24	1	25
Colorado	1			1
Connecticut		1	1	2
Delaware		2		2
Florida		2		2
Georgia		6	2	8
Idaho		1		1
Illinois	4	54	3	61
Iowa		28	1	29
Massachusetts		7		7
Maryland		16		16
Michigan		93		93
Minnesota		1		1
Missouri		8		8
North Carolina		5		5
Nebraska		1		1
New Hampshire		3		3
New Jersey		12		12
New York		7		7
Ohio		62		62
Oklahoma		3		3
South Carolina		1		1
Tennessee	1	1		2
Utah		23		23
Virginia		1		1
Washington		1		1
Wisconsin		4		4
Totals	6	372	8	386*

* Two additional miscellaneous samples submitted

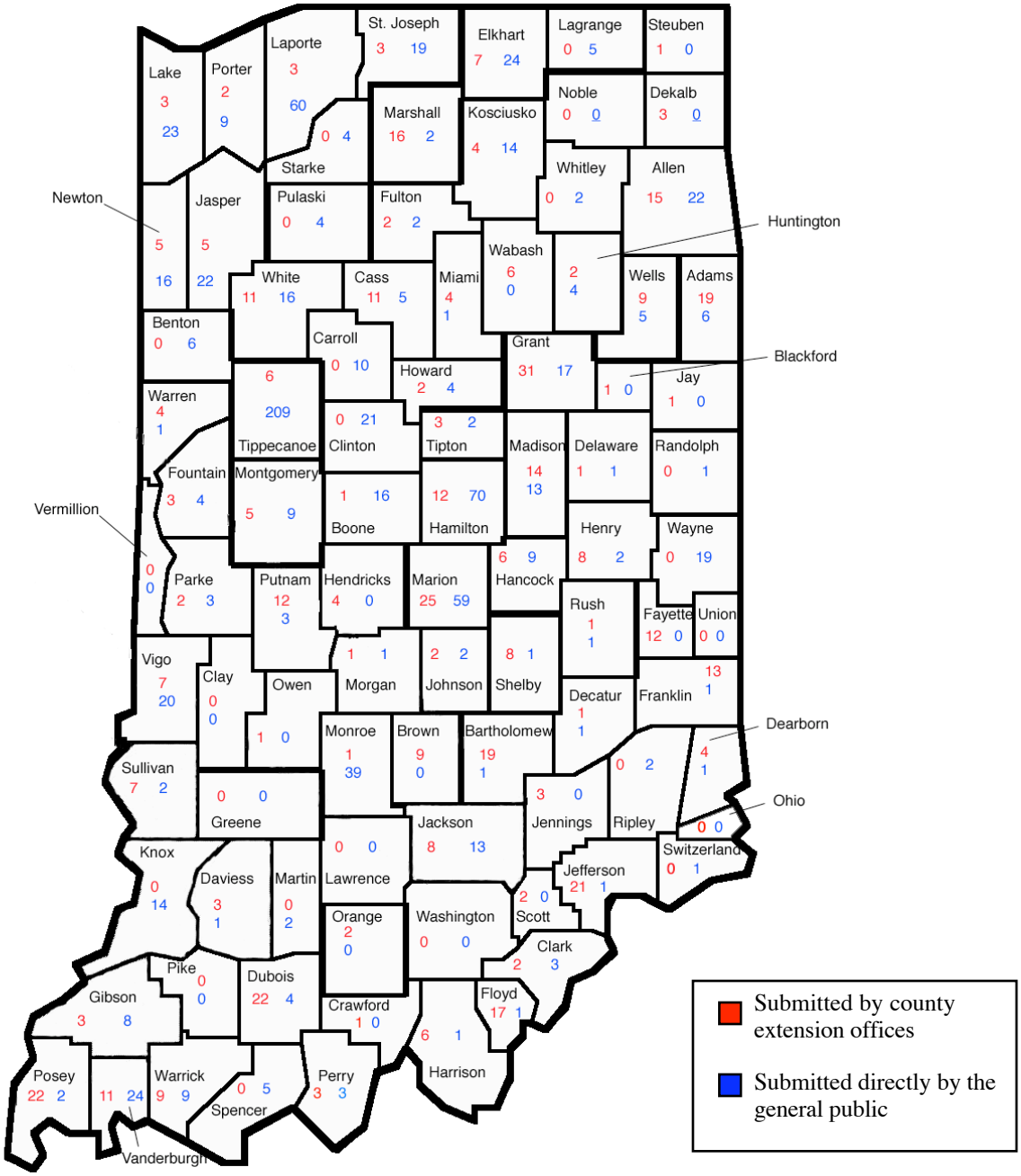
Figure 7. Distribution of samples received from outside Indiana by the Plant and Pest Diagnostic Laboratory in 2002.



Submitters

With the obvious exception of Tippecanoe county, distribution of samples from within the State was correlated to population distribution when mapped as either samples submitted from CES Educators or as samples submitted directly by the public **(Figure 8)**.

Figure 8. Distribution of samples submitted directly from Purdue Cooperative Extension Offices and directly from the general public in 2002.



As noted on **Tables 6 and 7**, the majority (64%) of the commercial samples submitted by Indiana clientele were sent directly to the P&PDL by the commercial clients rather than submitted via their county extension educators (26%). In comparison, however, homeowners submitted the majority of their samples through their county extension educator (61%) rather than submitting them directly (18%) to the P&PDL.

Table 6. Samples submitted in 2002 by Indiana CES[1] for various clientele

County	CES	Homeowner	Commercial	Total
Adams	3	2	14	19
Allen	1	10	4	15
Bartholomew	2	17		19
Blackford		1		1
Boone	1			1
Brown	3	5	1	9
Cass		9	2	11
Clark		2		2
Crawford	1			1
Daviess		3		3
Dearborn		2	2	4
Decatur			1	1
Dekalb	1	2		3
Delaware		1		1
Dubois	3	14	5	22
Elkhart	3	3	1	7
Fayette		11	1	12
Floyd	1	10	6	17
Fountain	1		2	3
Franklin	2	10	1	13
Fulton		2		2
Gibson		3		3
Grant	2	27	2	31
Hamilton	3	9		12
Hancock		3	3	6
Harrison			6	6
Hendricks		3	1	4
Henry	1	7		8
Howard		1	1	2
Huntington			2	2
Jackson			8	8
Jasper		4	1	5
Jay		1		1
Jefferson		18	3	21
Jennings	1	1	1	3
Johnson		2		2

Table 6 continued. Samples submitted in 2002 by Indiana CES[1] for various clientele

County	CES	Homeowner	Commercial	Total
Lake		2	1	3
LaPorte		2	1	3
Madison	2	12		14
Marion	6	2	17	25
Marshall	3	10	3	16
Miami		4		4
Monroe		1		1
Montgomery		1	4	5
Morgan			1	1
Newton		2	3	5
Orange	1	1		2
Owen		1		1
Parke		1	1	2
Perry		3		3
Porter	1	1		2
Posey	3	15	4	22
Putnam	2	3	7	12
Rush			1	1
Saint Joseph	1	2		3
Scott		1	1	2
Shelby	2	4	2	8
Steuben		1		1
Sullivan	4	3		7
Tippecanoe	1	5		6
Tipton		1	2	3
Vanderburgh	2	6	3	11
Vigo	2	4	1	7
Wabash		6		6
Warren		3	1	4
Warrick	3	4	2	9
Wells		7	2	9
White		8	3	11
Totals	64	301 (61%)	128 (26%)	493

[1] CES = Cooperative Extension Service County Offices

Table 7. Samples submitted in 2002 directly by Indiana general public

County	Purdue Not-Educator	Homeowner	Commercial	Other	Total
Adams			6		6
Allen			20	2	22
Bartholomew			1		1
Benton		1	5		6
Boone		1	15		16
Carroll		5	4	1	10
Cass		3	2		5
Clark		1		2	3
Clinton		6	13	2	21
Daviess			1		1
Dearborn			1		1
Decatur			1		1
Delaware			1		1
Dubois			4		4
Elkhart		2	22		24
Floyd		1			1
Fountain		1	3		4
Franklin			1		1
Fulton			2		2
Gibson			8		8
Grant			16	1	17
Hamilton		8	61	1	70
Hancock		2	6	1	9
Harrison			1		1
Henry		1	1		2
Howard			4		4
Huntington			3	1	4
Jackson			3	10	13
Jasper		2	20		22
Jefferson			1		1
Johnson		2			2
Knox	2		12		14
Kosciusko		1	13		14
LaGrange		5			5
Lake		14	8	1	23
LaPorte	14	1	35	10	60
Madison		2	11		13
Marion	11	17	24	7	59
Marshall			2		2

Table 7 continued. Samples submitted in 2002 directly by Indiana general public

County	Purdue Not-Educator	Homeowner	Commercial	Other	Total
Martin			2		2
Miami			1		1
Monroe	7	9	23		39
Montgomery		1	7	1	9
Morgan			1		1
Newton		2	13	1	16
Parke		1	2		3
Perry			2	1	3
Porter		1	8		9
Posey		1	1		2
Pulaski			4		4
Putnam			2	1	3
Randolph		1			1
Ripley		1	1		2
Rush			1		1
Saint Joseph		1	16	2	19
Shelby			1		1
Spencer			4	1	5
Starke			4		4
Sullivan			2		2
Switzerland				1	1
Tippecanoe	64	53	72	20	209
Tipton			2		2
Vanderburgh			23	1	24
Vigo			20		20
Wabash		1			1
Warren		1			1
Warrick		1	8		9
Wayne		1	18		19
Wells		2	3		5
White		5	11		16
Whitley		1	1		2
Totals	98	162 (18%)	584 (64%)	68	912

The most frequent users (73%) of the P&PDL in 2002 were the general public (commercial and non-commercial) who directly submitted 1300 samples for diagnosis **(Table 8)**. County extension educators submitted only 493 samples (27%). In fact, archived P&PDL annual reports document that this has been the trend for the past nine years. County Extension Educators have not been the most frequent P&PDL users since 1993.

Clientele Groups

Samples were submitted to the P&PDL by homeowners, farmers, dealer/industry representatives, consultants, greenhouse growers, golf course superintendents, landscapers, pest control operators, lawn and tree care specialists, garden center and nursery personnel, University employees and others. **(Table 8)** The majority of samples submitted to the P&PDL in 2002, by a single clientele group, came from homeowners (26%), followed by greenhouse growers (20%). A comparison of 2002 data with 1997 data clearly illustrates a shift in some of our clientele groups over the past five years. Greenhouse growers submitted 14% more samples in 2002 than in 1997 while dealer/industry reps submitted 7% less samples in 2002. The increase in greenhouse samples is in part due to referrals sent to the P&PDL from a commercial serological testing service based in Elkhart, Indiana. Commercial greenhouse clientele, pleased with the multidisciplinary aspect of our lab and the diagnostic accuracy and expediency of replies, have become repeat submitters over the past several years. The decrease in samples submitted by dealer/industry reps could be due to an increased use of their own company diagnostic facilities. It is also feasible that our Extension training sessions and literature have provided the private sector with the tools they need to become better diagnosticians.

Table 8. Affiliation of persons submitting samples to the Plant and Pest Diagnostic Laboratory Comparison of 2002 & 1997

Affiliation	Submitted by CES[1]			Submitted by Public			Total[3]		Percentage[4]	
	Physical Samples		Digital[2] Samples	Physical Samples		Digital Samples				
	2002	1997	2002	2002	1997	2002	2002	1997	2002	1997
Homeowner	136	179	158	169	210	1	464	389	26%	21%
Farmer	21	57	23	48	35	-	92	92	5%	5%
Dealer/Industry Rep	-	13	1	160	286	-	161	299	9%	16%
Consultant	1	1	1	40	97	1	43	98	2%	5%
Greenhouse	27	11	-	333	89	-	360	100	20%	6%
Lawn/Tree Care	2	-	1	126	116	-	129	116	7%	6%
Landscaper	4	2	1	79	67	-	84	69	5%	4%
Nursery	6	6	1	43	35	-	50	41	3%	2%
Garden Center	1	-	1	15	18	-	17	18	1%	1%
Golf Course	2	1	-	29	12	-	31	13	2%	1%
Pest Control Operator	3	2	4	56	29	-	63	31	3%	2%
Purdue/Not Educator[5]	-	1	4	85	190	10	99	191	6%	11%
Other (Misc. & Commercial)[6]	11	11	20	104	247	1	136	258	8%	14%
Extension (no client)	17	115	47	-	-	-	-	115	-	6%
Total	231	399	262	1287	1431	13	1793	1830	100%	100%
Proportion of submitted samples[7]	**(22%)**			**(78%)**						
	493 (27%)			**1300 (73%)**						

[1] CES = Cooperative Extension Service County Office
[2] These digitals were electronically submitted as a part of the P&PDL Digital Diagnostics Project
[3] These figures are the sums of the four un-shaded columns or two shaded columns (reading across)
[4] Percentage of total samples received by affiliation
[5] Research, Grounds, State Chemist Office, ADDL, White River Gardens, Faculty & Staff
[6] IDNR, AGDIA, Depts. of Ag, public schools
[7] Proportion of samples submitted by CES vs. proportion of samples submitted by public in 1997 and 2002

AN INFORMATION SOURCE

The P&PDL staff not only provide accurate and timely identification of plants and pests, diagnose plant problems, and suggest management strategies, but also serve as a resource of information for plant and pest-related problems. The team conducts diagnostic training activities provides educational opportunities, and cooperates with university personnel to provide accurate and up-to-date information to clientele.

Webpage

The Virtual Plant and Pest Diagnostic Laboratory, the P&PDL World Wide Web Home Page, (URL: http://www.ppdl.purdue.edu) was put "on-line" in June of 1995. The creation of this web page was the result of "brainstorming" sessions among the P&PDL staff, and was maintained by Terry McCain up until September 2002. The web server, now maintained by Bob Mitchell, IT manager for the Dept. of Botany and Plant Pathology, is an invaluable educational tool accessible not only to the citizens of Indiana, but throughout the United States and the world. The page not only provides a "picture of the week", up-to-date information on "What's Hot" in the P&PDL and links to informational sources but also provides access to seven years of archived web page information. There is a keyword searchable database of past questions and answers, the current questions and answers (many include pictures), and a link to an electronic mail form so visitors can send questions to the lab. Web server statistics for the Plant and Pest Diagnostic Laboratory reported an average of 1,603 requests per day for P&PDL web pages from January 1 through December 31, 2002.

Electronic Update

As a way of maintaining communication among CES county educators specialists, and other interested persons, an electronic update is sent periodically to listserve subscribers during the growing season. These updates include descriptions of the types of samples submitted along with suggestions for diagnosis and management. In addition, the Update attempts to provide information on plant problems that are common throughout the state.

Extension Activities

The director (with additional help from other staff members) actively represented the P&PDL with a display during the Indiana Horticulture Congress, Indiana Flower and Patio Show and Indiana State Fair. The director and other staff of the P&PDL gave presentations or workshops to a variety of audiences throughout the state. For example, some of the programs included County Educator Meetings, Master Gardener Programs, Turf and Ornamentals Workshops, Pesticide Applicator Training, ICIA Field Inspector Training, Plant Science Workshop, 4-H Round-Up, Purdue Garden Day, Bug Bowl, Advanced Master Gardener Training, Certified Crop Advisor Training, County Educator Training, and commercial grower and association meetings.

Of special note, this past year the **P&PDL staff developed a unique game show format** to train County ANR Educators on plant and pest identifications and plant problem diagnoses of concern to homeowners. The session was called **Game Show Diagnostics** and the entire day was presented as interactive sessions, with no actual formal presentations by speakers. For the morning sessions, educators were divided into four groups to rotate to four different "game shows" every 30 minutes. The game show training modules included:

1. **Hollywood Squares** (taught by Karen Rane and Gail Ruhl) focused on teaching disease diagnosis and control recommendations for ornamental plants.
2. **Weedopoly** (taught by Rosie Lerner and Glenn Nice) focused on weed identification and control.
3. **Quiz Bowl** (taught by Tim Gibb and Glenn Hardebeck) focused on insect identification and control and pests of turf and turf problems and management options.
4. **Jeopardy** (taught by Peggy Sellers and Cliff Sadof) focused on plant and pests and management options.

The afternoon sessions were presented as a team effort by all the 'game show hosts' listed above. **'Name that Image'** focused on the use of digital images to identify plants and insects and diagnose plant problems. **Quiz Bowl** focused on summarizing all previously covered topics and using that information to problem solve using new examples.

DIGITAL DIAGNOSTICS PROJECT SUMMARY

2002 was the final year for the pilot project, *Digital Diagnostics: A New Tool for Distance Education in Indiana,* funded in 2000 by Purdue's 21st Century Extension Initiative. Cooperators of this project included selected Purdue Extension field staff as well as campus-based P&PDL Diagnosticians. *Digital Diagnostics for Indiana* was initiated to enhance the diagnostic capabilities of the Purdue University Plant and Pest Diagnostic Laboratory (P&PDL) by providing county educators with a means of collecting digital images and transmitting them to the P&PDL for rapid diagnosis. The following is the final project summary, prepared by Peggy Sellers, former P&PDL Director and project supervisor:

Digital Diagnostics:
New Tool for Distance Education in Indiana
Project Summary
Prepared by Peggy Sellers
March 2000 – August 2002

Digital Diagnostics for Indiana was initiated to enhance the diagnostic capabilities of the Purdue University Plant and Pest Diagnostic Laboratory (P&PDL), one of the premier diagnostic facilities in the country. By providing a means of collecting and transmitting digital images from county Extension Educators and other clients throughout the state, the staff of the P&PDL can respond to the needs of the citizens of Indiana more efficiently.

The objectives of the project were to:

- provide a standard method of submitting digital samples to the P&PDL,
- provide diagnostic imaging equipment to all county extension offices in Indiana,
- train field staff in the use of image capturing devices and the delivery method,
- provide continuing education through the establishment of an on-line digital library,
- evaluate and compare the accuracy and turn-around time of diagnoses of digital vs. actual samples,
- assess the impact of this project on the clients, the extension field staff, and the P&PDL.

Standardized Submission Method
A website was developed to support the project. A standard web-based method of submitting digital samples to the Plant and Pest Diagnostic Lab was developed, tested, and is being used by county Extension Educators.

Diagnostic Imaging Equipment to County Extension Offices
Cooperators for this pilot project were selected that included Extension Specialists and Extension Educators throughout the state. Initially, 15 digital imaging sites were established throughout the state. These locations were determined based on geographic location, nature of crops grown, ANR field staff interest and background, and the number of samples they previously submitted to the P&PDL.

Because of the demonstrated ease of use and affordable cost, the following equipment was purchased and distributed to the initial digital imaging sites.

- FD88 Sony Mavica Digital Cameras
- MM99 Universal Microscope Adapters
- Meiji EMZ-5TR Trinocular Dissecting Microscopes with Zoom Optics (0.7x to 4.5x); 10x eyepieces; Dual illumination
- Meiji ML2100 Trinocular Compound Microscope; 4x, 10x, 40x, 100x objectives; 10x eyepieces

While the initial goal of the project was to provide digital imaging equipment to all county extension offices, the grant was not fully funded. However, an additional six counties received digital imaging equipment from project funds. Many counties that did not receive digital imaging equipment have purchased the same or similar equipment so that they were able to participate in the project by submitting digital samples for diagnosis. Input from pilot project cooperators has been a critical element in the development of the diagnostic project. Cooperators have been very helpful in identifying the most efficient way to meet their clients' needs.

Training for Field Staff
A training session is planned for September 27, 2000 during the ANR Staff Development Training. Approximately 50 county educators participated in a recent training session to familiarize staff with the digital equipment, techniques, goals and status of the project. The training was open to any educator interested in the project and many attendees were not part of the pilot project. Training on the use of equipment and digital sample submission protocols is on-going and handled on an as-needed individual basis.

The development of training materials to demonstrate standard protocols is underway. Most recently, we have been concentrating on maximizing the efficiency of digital sample submission. A limited number of hand-on training sessions have been conducted, however, training on the use of equipment and digital sample submission protocols is ongoing electronically. In addition, two Extension publications have been prepared: *WS-26-W, Guidelines for Submitting Digital Plant Images for Identification: Grass Identification* and *WS-27-W, Guidelines for Submitting Digital Plant Images for Identification: Broadleaf Identification*.

On-line Digital Library
A digital image library has been developed and is available via the website. The addition of images and corresponding information to the digital image library is and will be an ongoing endeavor.

Accuracy and Impact Assessment
In July 2000 a test was conducted to assess the skills of staff using the equipment. For this test, a plant sample with a known problem was collected, divided and sent to each field staff participating in the project. Cooperators were asked to take digital images (macro and micro) and simulate asking for diagnostic help by sending the images as email attachments to the P&PDL. This test provided information that was beneficial for designing appropriate training materials and workshops.

The majority of communication of cooperators was done via electronic mail and telephone. During 2001, county Educators submitted 325 digital samples via our web-based system. Approximately 15% of those digitals samples submitted were unable to be diagnosed because of poor quality of digital images. About 17% of the digitals samples were sufficient for a confirmed diagnosis; the majority of which were insect identifications. Nearly one-half of the samples were diagnosed with a 'most-likely' level of certainty; the majority of which were noninfectious disorders or plant diseases. Many of the digital samples were also submitted as actual samples to determine the accuracy of identification and diagnosis of the digital samples.
The level of certainty did not increase when noninfectious disorders were submitted as actual samples. However, in most cases, 'most-likely' infectious disease diagnoses from digitals were then 'confirmed' with actual samples.

From January through August of 2002, 229 digital samples were submitted from county Educators via the web-based system. Sixteen percent of those were insufficient for diagnosis; 28% were sufficient for a confirmed diagnosis; 34% were diagnosis with a 'most-likely' level of certainty.

While the 'perceived' turn-around time appeared to be faster for digital samples than for actual samples, turn-around time is measured once the sample is received in the P&PDL. Therefore, a digital sample would sometimes be answered within hours of being sent, whereas an actual sample needed to be mailed first. The turn-around time of all samples is directly correlated with the availability of a given specialist to diagnosis a sample when the sample arrives. In some instances, digital samples were very helpful in suggesting appropriate actual samples to submit.

Throughout the project Educators and Project Cooperators were informally surveyed using electronic mail. To give some examples of how the digital project impacted Educators, following are some examples:

> "The capability to submit a digital image was extremely useful when a spider found in a child's closet was diagnosed within hours as a brown recluse spider. The client took measures immediately to rid the house of potentially more dangerous spiders."
>
> According to a new Educator, the ability to submit digital samples "truly made my start of my job easier. The responses were detailed enough that I could explain the solution to the client."

During this project an Educator sent digital images of an insect attacking yucca plants to the P&PDL. The culprit (yucca bug) was identified and appropriate controls were recommended. Because of this diagnosis, the Educator was able to more quickly address similar concerns by several other clients in the county. In turn, a digital image of this insect was sent to all county field staff and posted on the P&PDL website to help address this problem throughout the state more efficiently.

Future Plans

This project is a success story for Purdue Extension. Purdue now has a web-based system for submitting digital samples to the P&PDL. While digital diagnostics does not replace traditional diagnostics, it is another tool by which Educators and others can benefit from this enhanced capability of the P&PDL.

The fee for digital samples was waived during the project; however, minimal charge (similar to that of routine diagnostic charges) is currently being assessed.

This system is available to the general public. E-commerce capabilities within the University will make this system even more noteworthy.

My job responsibilities have changed and I am no longer affiliated with the P&PDL. Therefore, Gail Ruhl, Interim Director of the P&PDL, is overseeing the continuation on this project.

NATIONAL PLANT DIAGNOSTIC NETWORK

Purdue University's Plant and Pest Diagnostic Lab is now a part of the The National Plant Diagnostic Network, working with fellow diagnostic labs at land-grant universities to prepare against plant diseases and pests that might pose a threat to American agriculture.

Through the National Plant Diagnostic Network (NPDN), coordinated by the USDA, and the Cooperative State Research, Education, and Extension Service (CSREES), the plant disease and diagnostic clinics at all U.S. land-grant universities will provide pertinent information on plant diseases and pests to a national data system. The National Agricultural Pest Information System (NAPIS) located at Purdue University has been designated as the central repository for archiving select data collected from the regions. Clinics, along with the USDA, will work to strengthen communication and strategies in order to quickly identify and respond to emerging plant disease and pest problems.

Following discussions of the potential vulnerability of our agricultural crops and food system to possible bio-terrorist attacks, it was concluded that the university-based diagnostic labs were in a unique position to assist in this new Homeland Security initiative. Rather than build a new network, the existing network of diagnostic clinics will be strengthened and enhanced.

Diagnostic clinics were notified of the new plan in mid-summer 2002 and have been working to upgrade their individual labs and to strengthen their communication networks. Each university lab was assigned into a region, with one clinic being designated as the regional center. In the North Central Region, which includes Indiana, Illinois, Iowa, Ohio, Michigan, Missouri, Minnesota and

Wisconsin, Michigan State University serves as the regional center. Among other things, the regional center will coordinate communication and data reporting among the states and between the local and national level.

Our primary directive is to invest in computer and web-based digital imagery equipment that will be compatible with the new web-based diagnostic database currently under development at Kansas State University, a member of the Great Plains Plant Diagnostic Network (GPPDN). Thus, the Purdue Plant and Pest Diagnostic Lab is upgrading computer and digital camera equipment in order to be compatible with the new database. This web-based diagnostic database will be used by land-grant university diagnostic labs in the Great Plains, North Central and Eastern Regions. The Purdue Plant and Pest Diagnostic Lab has contributed many of the data fields from their diagnostic database to Kansas State University for the development phase and has been asked to serve as a pilot testing site for the database prototype.

A list of potential plant disease threats has been identified by university diagnosticians and specialists and educational efforts will be geared toward "first detectors". Typically, "first detectors" include those individuals such as county extension educators, growers, crop consultants and regulatory field inspectors, who are already scouting crops regularly for plant diseases. Indiana "first detectors" will be trained and on the lookout for symptoms of new diseases, such as soybean rust, a fungal disease not yet present in the continental United States.

As a part of the national network of plant disease diagnostic labs, the P&PDL will be better equipped to provide a rapid, effective response to new disease occurrences.

APPENDIX

Master Table. Summary of All Diagnoses by Crop Category and Causal Agent Type. 2002

Commodity Group	Number of Samples Submitted	Abiotic[1] Problems	Infectious Diseases	Herbicide Injury	Insect Injury	Insect ID	Weed & Plant ID	Fungal ID	Insufficient Sample Information	Vertebrate Related	Total Diagnoses[2]	% Diagnoses
Agronomic	**184 (10%)**										**359**	**15**
Alfalfa/Clover	9	7	7	3	4						21	1
Corn	78	42	59	15	11				13	1	141	6
Oats/Wheat	13	8	19	3					4		34	1
Soybeans	82	24	82	15	10	5	14		13		163	7
Pasture	2						2				2	*
Fruit	**66 (4%)**										**102**	**4**
Small Fruit	20	13	11	5		3	3		7		42	2
Tree Fruit	46	17	23	3		6			11		60	2
Miscellaneous	**220 (12%)**										**242**	**10**
Animal/Human	25					21			9		30	1
Aquatic	23					4	19		5	1	29	1
Home/Bldg	156					156	2		8	1	167	7
Other	6					2		2	2		6	*
Stored Foods	7					7					7	*
Unknown	3								3		3	*
Ornamentals	**1036 (58%)**										**1350**	**55**
Flowers	348	122	175	4	16	15	10		82		424	17
Interior Plants	17	8	6			3	4		6		27	1
Grnd Cvrs/Vines	53	7	45		5	8	9		8		82	3
Shrubs	166	83	65	8	12	23	13		24	1	229	10
Trees	452	252	143	16	35	70	18	4	45	5	588	24
Specialty Crops	**39 (2%)**										**57**	**3**
Field	5		5						5		10	*
Hort	34	10	15		4	4			14		47	2
Turfgrass/Yard	**128 (7%)**	33	31	2		18	45	7	32	1	**169**	**7**
Vegetables	**120 (7%)**	32	71	4	4	7	3		32		**153**	**6**
Total	**1793 (100%)**	**658 (27%)**	**757 (31%)**	**78 (3%)**	**101 (4%)**	**352 (14%)**	**142 (6%)**	**13 (1%)**	**323 (13%)**	**10 (*%)**	**2432**	**100%**

[1] Abiotic problems include cultural, environmental, soil and site related (not herbicide)

[2] The number of diagnoses may be greater than the number of samples submitted due to multiple problems diagnosed on one sample