Report of the Plant Diagnostic Laboratory At North Dakota State University

October 1, 2005 through December 31, 2006

Compiled by Kasia Kinzer, NDSU Plant Diagnostician

NDSU Department of Plant Pathology

NDSU College of Agriculture, Food Systems, and Natural Resources

NORTH DAKOTA STATE UNIVERSITY
NDSU Extension Service

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Lab Personnel and Other Information

Kasia Kinzer (nee Duellman), M.S. Plant Pathology (University of Minnesota, 1996), has been the plant pest diagnostician for NDSU since May 2004.

Montgomary 'Monty' Botschner, B.A. Biology/Chemistry (Minnesota State University-Moorhead, 2000), has been the Plant Diagnostic Lab Technician since September 2004.

Great Plains Diagnostic Network

NDSU Plant Diagnostic Lab is a member of the Great Plains Diagnostic Network (GPDN), a region of the National Plant Diagnostic Network (NPDN). The National Plant Diagnostic Network was established in partnership with the Cooperative State Research, Education, and Extension Service (CSREES). It focuses on the plant disease and pest aspect of the Animal & Plant Disease and Pest Surveillance & Detection Network. The NPDN is a collective of Land Grant University plant disease and pest diagnostic facilities from across the United States. The NPDN was formed in 2002 to enhance the ability of diagnosticians around the country to more quickly diagnose potential biological threats to agriculture. These threats may be intentionally or accidentally introduced. A network of registered NPDN First Detectors is continually expanding, to enhance early detection of unusual plant problems. Suspicious samples are submitted to an NPDN diagnostic lab.

The NPDN encourages plant diagnostic labs at land grant universities around the country to use an on-line database that is administered from a central location. This database is known as the Plant Disease Identification System (PDIS). The NDSU Plant Diagnostic Lab has converted to this secure database completely by May 2006.

One advantage of the PDIS database is that sample information can be submitted by registered clients (such as extension agents and state specialists) to the NDSU Plant Diagnostic Lab digitally, and digital images can be uploaded to the database from remote sites. For public access, a public digital image library, subject to peer review, is also available to browse. The NDSU Plant Diagnostic Lab will continue to provide training and support to Extension agents and staff who want to submit and track samples using this secure, user-friendly database.

Other Activities of the NDSU Plant Diagnostic Lab

- Member, Great Plains Diagnostic Network (a region of the NPDN)
- Provide cost-effective diagnostic services to agricultural producers, the horticulture industry, homeowners, and individuals
- Maintain USDA-accreditation (obtained in Spring 2005) for testing for bacterial ring rot in seed potatoes for certification and export to Canada
- Provide seed health-related testing services for growers, certain phytosanitary and survey testing services for the North Dakota Department of Agriculture, and special testing services for research personnel
- Teach the labs of Introductory Plant Pathology each fall (three to four lab sections one day per week)
- Support the Master Gardener program and other horticultural training programs
- Support the agricultural industry by offering seminars and training
- Continue to fulfill requirements to be in compliance with the 2002 Bioterrorism Act
- Continue to fulfill requirements of grants from federal bio-surveillance funding and from the National Plant Diagnostic Network

Goals for FY2006 – The 2006 Fiscal Year In review:

1. Increase general awareness of the NDSU Plant Diagnostic Lab:
    - Total number of samples received has increased from 1,213 in FY2005 to 1,367 in FY2006. Since 2004, annual sample number continues to rise.
2. Continue to support county extension agents, and improve this support by decreasing turn-around time for samples submitted for routine diagnosis:
    - Average turn-around time (all samples) in FY2004: 10.2 days
    - Average turn-around time (all samples) in FY2005: 9.4 days
    - Average turn-around time (all samples) in FY2006: 8.9 days
3. Continue professional development in 2006:
    - Monty attended a real-time PCR workshop in January 2006; Kasia attended a mycotoxin workshop in November 2006.
4. Utilize PCR for diagnostic tests, when applicable and available:
    - Beginning in 2006, screening for *Clavibacter michagensis* subsp. *sepedonicus* is verified with gene-based PCR, using two primers.
5. Support the goals of the National Plant Diagnostic Network by implementing PDIS and training submitters on usage of the PDIS database, and by continuing to coordinate training for First Detectors:
    - PDIS is now the sole database and billing software used by the lab; prior to PDIS, the lab used a different database and separate billing software.
    - Sixteen additional first detectors were trained in FY2006, bringing the total number of First Detectors in North Dakota to 58. This is far short of a stated goal of 150 first detectors in North Dakota, so there is more work to be done in 2007.
6. Increase awareness about special services that the Plant Diagnostic Lab can offer:
    - Sample numbers have increased significantly in the Research, Seed Health, and Phytosanitary categories, compared to fiscal year 2005.

Goals and Changes for Calendar Year 2007

Future annual reports will summarize data by calendar year, rather than by fiscal year. This annual report is the transition, so data from FY2006 as well as calendar year 2006 are presented. First Detector training events will continue to be offered for county agents and other agricultural professionals who desire to become registered first detectors in the National Plant Diagnostic Network. First Detector Educator training events may begin in 2007, so county agents can then offer First Detector training to members of their respective counties. Interested county extension agents and staff will continue to receive training on how to use PDIS to submit sample information and digital images. We will continue to strive to improve the accuracy and speed of diagnosis while remaining cost-effective. Weekly reports will be made available on-line during the summer months.

NDSU Plant Diagnostic Lab Fees*

- Routine diagnosis
  - ND Resident $15
  - Out of State $25
- Culture – Routine diagnosis fee + $10 ..... $25
- ELISA (serological test for certain viruses, fungi, or bacteria) $25
  ($10 for each additional sample, same organism)
- Dutch elm disease test $30
- Herbicide injury evaluation (visual only) $15
- Plant or insect identification $15
- Home mold identification $15
  ($30 if culturing is requested)
- Nematode screen (SCN, others) $25
- Soil Bioassays $110
  - Rhizomania (BNYVV)
  - Aphanomyces
- IFA for ash yellows phytoplasma (for research samples only) $30
- Potato tuber rot evaluation $35
  ($25 for samples under 25 lbs)
- PCR (gene-based analysis) – price varies depending on cost and availability of primers

NDSU Seed Health Testing Fees*

Canola
- Blackleg of Canola assay (2-3 lb. minimum sample) $50

Dry Edible Beans
- Dome Test for Bacterial Blight pathogens (3-5 lb. minimum sample) $50
- Anthracnose testing (3-5 lb. minimum sample) $50
- Dome + Anthracnose (5-8 lb minimum sample) $90

Potato
- Late Blight screen (min. 400 tubers) $75
- Bacterial Ring Rot of Potatoes for Canadian Export (minimum 400 tubers required; ELISA/IFA, positives verified with PCR) $150
- Virus testing on tuber sprouts (min. 600 tubers) ..... 1st Virus: $342
  ($25 each additional virus)
- Potato tissue culture 6-virus/1-bacteria screen (PVA, PVM, PVS, PVX, PVY, PLRV, and C.m.s.; E.c. by request) $10
- PSTV (no longer available, except by special arrangement) ..... NA

Pulse crops - Lentils / Chickpeas (Garbanzos) / Field Peas
- Ascochyta screening (3-5 lb. minimum sample) ..... pea/lentil: $50
  chickpea: $90
- Anthracnose screening (2-3 lb. minimum sample) $50
- Nematode seed wash $25

Small Grains
- Black Point screen (2-3 lb. minimum sample) $50
- Rust/Bunt/Smut seed wash $50

Sunflower
- Nematode seed wash $25

Special tests not listed above may be available by arrangement. Contact the lab at 701.231.7854 or email: diaglab@ndsuext.nodak.edu.

*** The fees listed here are valid through December 31, 2007.**

Sample References for Extension Personnel

Reference samples are fee waivers. Each county extension office receives four reference samples annually. These 'references' can be used to waive the following fees: routine diagnosis, culture, Dutch elm disease test, herbicide injury evaluation (visual only, if possible), plant/insect identification, home mold identification, nematode test, or routine virus test. Sorry, but the fee waiver cannot be applied to seed health testing, the potato spindle tuber viroid test, and certain other special tests. If you have any questions, please contact the lab.

Reference sample labels for 2007 will be mailed to each county extension office in spring 2007. If clients are referred to use the NDSU Plant Diagnostic Lab, and the reference fee waiver will not be applied, please be sure to prepare them for the applicable fee, which is usually $15-25. See the 'Lab Fees' section for more information.

A Guide for Estimating Turn-Around Time

Many of the samples that come into the lab are not routine. The causes of the plant problems submitted to the lab are often not the common causes that most Extension agents are familiar with. As a result, culturing is typically required to help determine or confirm the possible cause(s) of symptoms observed. Results from culturing can take from a few days to several weeks, depending on the organism being cultured.

Estimated turnaround times for samples:

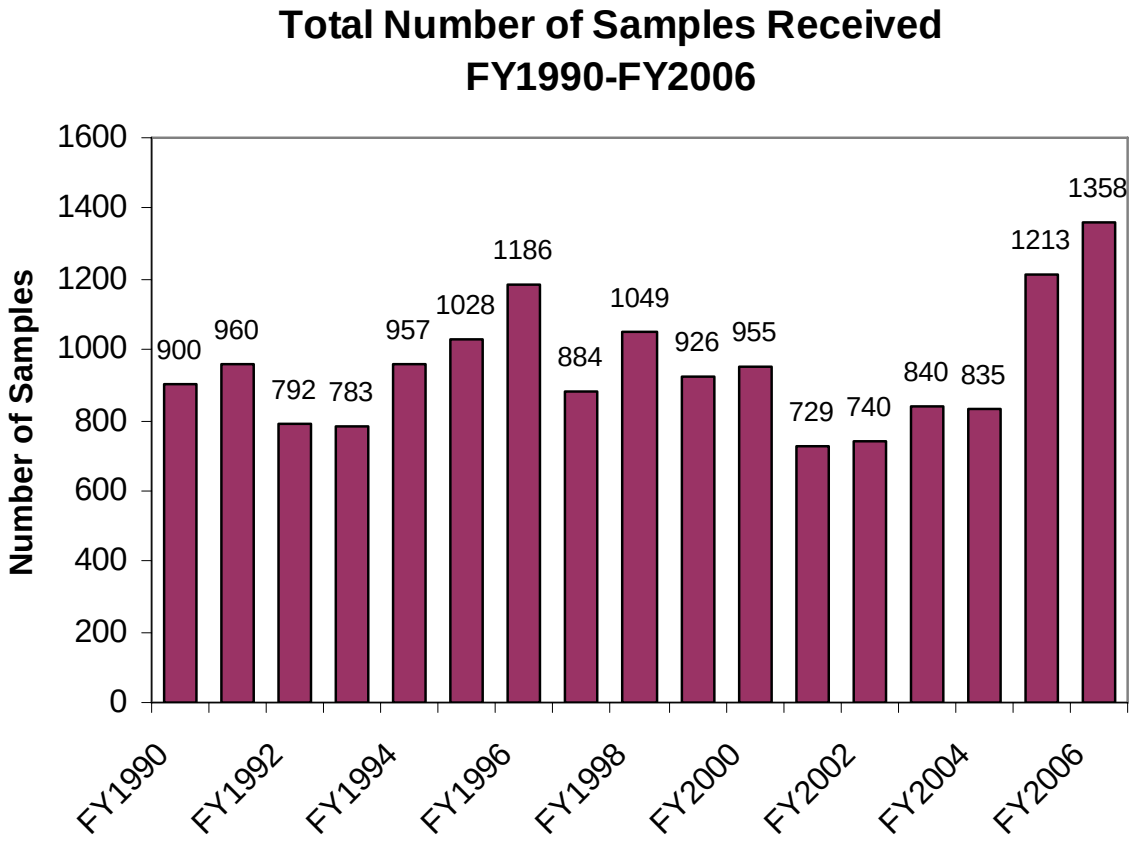
Sample Type	Estimated turnaround time
Field Crops	1 to 7 days
Tree/Shrub	1 to 7 days
ELISA testing	1 to 3 days
PCR testing	1 to 3 days
Culturing	3 to 28+ days
Nematode	1 to 7 days
Fruits/Vegetables	1 to 7 days
Ornamentals	1 to 10 days
Turf/Lawn	1 to 14 days
Plant/Insect ID	1 to 5 days
Mold ID	1 to 21 days
Seed Health	1 to 42 days
Phytosanitary	1 to 7 days

These are just guidelines and they are based on one sample. If multiple samples are received from the same submitter, these estimates would need to be adjusted accordingly. Actual turnaround time depends on several factors, such as number of samples; availability of expert consultants; knowledge of the crop; type of problem suspected; priority (triage; e.g. commercial vs. noncommercial); and so on. The lab generally adopts a 'first-come-first-served' policy, but under certain circumstances, some samples, particularly commercial ones or those suspected to be infected by a 'high risk' pest (as defined by the National Plant Diagnostic Network), may be given priority. Certain seed health samples have long turnaround times because some of the tests require up to 6 weeks to complete. For seed health testing, plan accordingly.

Lab Statistics

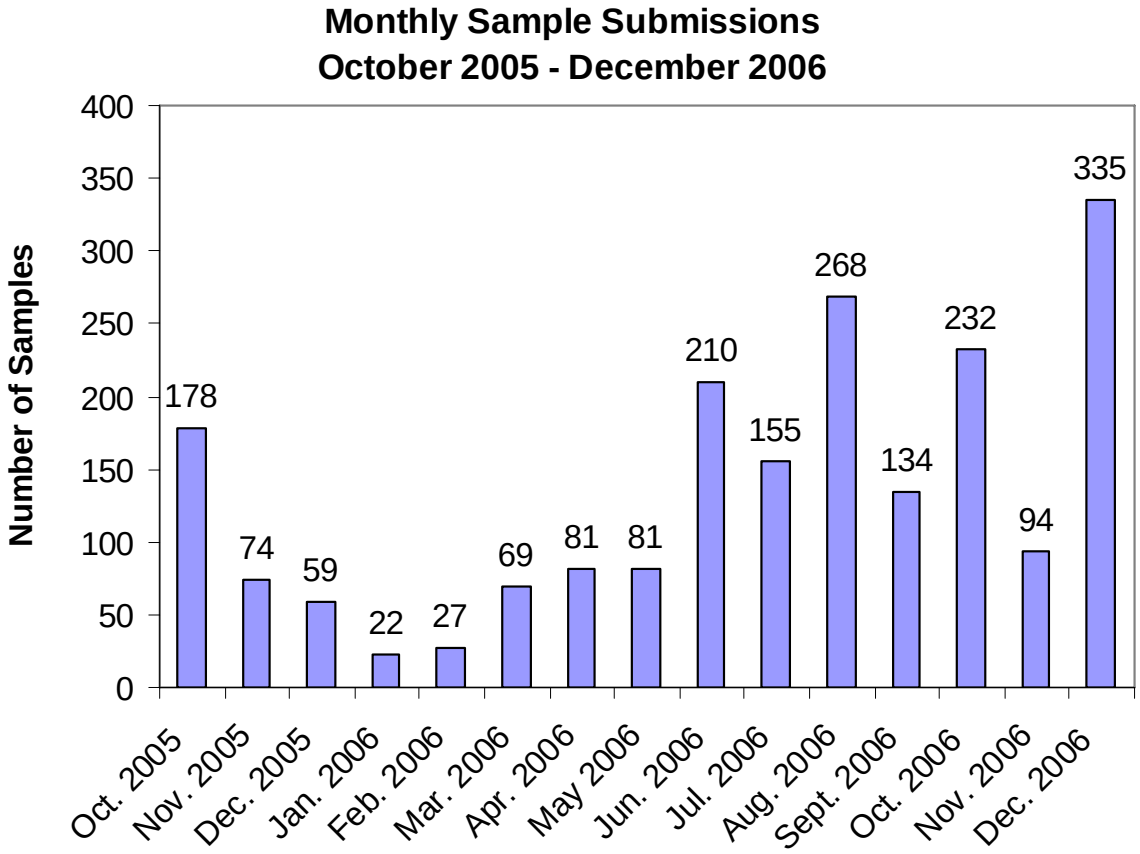
Total samples Received by Year, FY1990 through FY2006

A historical perspective of samples received by the lab is presented in the graph below. The 17-year average is 950 samples per fiscal year (October 1 through September 30). Total sample number per fiscal year (Oct-Sept) has been on the rise for the past two years. This trend is in large part due to an increase in a type of phytosanitary testing that we perform to screen for specific nematodes in pea and other pulse crops destined for other countries.



Monthly Sample Submission Oct 2005 – Dec 2006

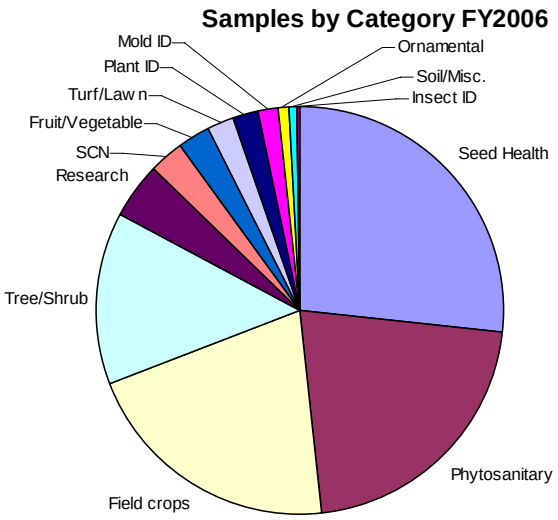
Monthly submission rates of samples to the Plant Diagnostic Lab vary by time of year. Plant diagnostic services comprise the bulk of the samples submitted during the summer months, and the fees are kept low to encourage use of the lab. Seed health testing, phytosanitary testing services, and research samples dominate during the winter months.



Samples Received By Sample Category Oct 2005 – Dec 2006

A total of 1,358 samples were submitted in FY2006, and the largest category was seed health testing, as the pie chart below summarizes. This pattern is different from prior years, where field crops typically made up the largest category, from 40% to 56% of submitted samples. Phytosanitary samples are the next largest group for FY2006. The increase in phytosanitary samples is due to more requests for a test that screens for various nematodes in pulse crops (such as pea, lentil, and garbanzo/chick pea) destined for other countries (such as India). Seed health samples are also on the rise, due to an increase in screening for the potato bacterial ring rot pathogen (*Clavibacter michiganensis* subsp. *sepedonicus*) in seed potato for certification or export. Two separate potato-testing labs in North Dakota (NDSU Plant Diagnostic Lab and the North Dakota State Seed Department) are accredited by the USDA to perform potato bacterial ring rot testing for export.

Submission by category FY2006		
Category	**# of samples**	**% of total**
Field crops/Seed Health	402	60.82%
Phytosanitary	155	23.45%
Vegetables	57	8.62%
Left Blank	23	3.48%
Trees/Shrubs	9	1.36%
Soil	7	1.06%
Mold ID	4	0.61%
Miscellaneous	2	0.30%
Fruit/Vegetable	1	0.15%
Other$Weed	1	0.15%
Total	661	100%



Submission by category FY2006		
Category	**# of Samples**	**% of total**
Seed Health	364	26.8%
Phytosanitary	294	21.7%
Field crops	281	20.7%
Tree/Shrub	187	13.8%
Research	60	4.4%
SCN	36	2.7%
Fruit/Vegetable	35	2.6%
Turf/Lawn	31	2.3%
Plant ID	25	1.8%
Mold ID	22	1.6%
Ornamental	11	0.8%
Soil/Misc.	7	0.5%
Insect ID	5	0.4%

Submission by Service Requested, Oct 2006-Dec 2006		
Category	**# of samples**	**Percent of total**
Disease ID	401	60.67%
Nematode ID/Analysis	183	27.69%
Other	57	8.62%
Multiple Services Needed	11	1.66%
Left Blank	7	1.06%
Plant/Weed ID	2	0.30%
Total	661	100%

Samples per Diagnosis Category Oct 2005 – Dec 2006

Sample Type	Total Diagnoses	Fungi/Mold	Bacteria	Viruses	Arthropods	Nematodes	Herbicide Injury	Abiotic	All Other*
Seed Health/Phytosan.	1053	12	530	48	0	463	0	0	0
Field Crops	388	114	69	30	11	2	60	77	25
Tree/Shrub	226	59	2	3	53	0	10	91	8
Research	303	0	248	55	0	0	0	0	0
I.D. requests	61	22	0	0	10	0	0	0	Plants: 29
Turf/Lawn	34	16	0	0	2	0	1	9	6
Ornamental	17	7	0	0	2	0	0	3	5
Fruit/Veg.	25	11	0	1	0	0	4	4	5
Nematode/Soil/Misc	61	1	0	0	0	52	0	2	6
Total Diagnoses	2168	242	849	137	78	517	75	186	22

* Diagnoses in the All Other category include items such as insufficient samples and problems with unknown causes.

Samples by location Oct 2005 – Dec 2006

The primary purpose of the NDSU Plant Diagnostic Lab is to serve residents of North Dakota. Out-of-state residents also submit samples, but an out-of-state surcharge typically applies. For routine diagnoses, submitters are encouraged to use their respective land grant university plant diagnostic labs. For seed health testing, samples from out of state are not penalized with additional charges. In North Dakota, county extension offices are granted a limited amount of fee waivers for the diagnostic lab.

The table below summarizes where samples originated by county, state, and country, for samples received between October 1, 2005 and December 31, 2006. Research samples and seed health/phytosanitary samples are included in the data.

Samples received by location		
State or Country	**County**	Number of Samples
North Dakota	Not Reported	74
North Dakota	Adams	30
North Dakota	Barnes	6
North Dakota	Benson	2
North Dakota	Bottineau	7
North Dakota	Bowman	24
North Dakota	Burke	0
North Dakota	Burleigh	38
North Dakota	Cass	682
North Dakota	Cavalier	2
North Dakota	Dickey	18
North Dakota	Divide	58
North Dakota	Dunn	0
North Dakota	Eddy	0
North Dakota	Emmons	4
North Dakota	Foster	2
North Dakota	Golden Valley	1
North Dakota	Grand Forks	25
North Dakota	Grant	1
North Dakota	Griggs	2
North Dakota	Hettinger	13
North Dakota	Kidder	10
North Dakota	Lamoure	9
North Dakota	Logan	3
North Dakota	McHenry	6
North Dakota	McIntosh	3
North Dakota	McKenzie	3
North Dakota	McLean	63
North Dakota	Mercer	2
North Dakota	Morton	5
North Dakota	Mountrail	32
North Dakota	Nelson	2
North Dakota	Oliver	1
North Dakota	Pembina	18
North Dakota	Pierce	1
North Dakota	Ramsey	4
North Dakota	Ransom	7
North Dakota	Renville	5
North Dakota	Richland	21
North Dakota	Rolette	3
North Dakota	Sargent	6
North Dakota	Sheridan	4
North Dakota	Sioux	0
North Dakota	Slope	19
North Dakota	Starke-Billings	10
North Dakota	Steele	6
North Dakota	Stutsman	21
North Dakota	Towner	11
North Dakota	Traill	12
North Dakota	Walsh	22
North Dakota	Ward	59
North Dakota	Wells	9
North Dakota	Williams	38
Colorado	Not reported	3
Maryland	Not reported	1
Massachusetts	Not reported	1
Michigan	Not reported	92
Minnesota	Not reported	317
Montana	Not reported	3
Nebraska	Not reported	110
New Jersey	Not reported	1
North Carolina	Not reported	5
Oregon	Not reported	10
South Dakota	Not reported	4
Texas	Not reported	2
Virginia	Not reported	1
Wisconsin	Not reported	23
Wyoming	Not reported	5
Canada	Not reported	24

Sample Type by County in North Dakota Oct 2005 – Dec 2006

	Sample Category										
County	Seed Health	Phytosanitary	Field Crop	Tree or Shrub	Lawn	Ornamental	Fruit or Vegetable	Plant ID	Insect ID	Mold ID	Soil/Nematode
Adams	6	18	6	2	0	0	0	2	0	0	0
Barnes	0	0	4	3	0	0	0	0	0	0	0
Benson	0	0	2	1	0	0	0	0	0	0	0
Bottineau	0	0	9	0	0	0	0	0	0	0	0
Bowman	0	25	1	3	1	0	0	2	1	0	0
Burke	0	0	0	0	0	0	0	0	0	0	0
Burleigh	0	32	5	4	1	0	0	0	0	0	0
Cass	70	90	95	83	12	12	14	5	0	10	22
Cavalier	0	0	1	0	0	0	0	0	1	0	0
Dickey	0	0	5	6	0	0	2	1	0	0	1
Divide	0	59	1	0	0	0	0	0	0	0	0
Dunn	0	0	0	0	0	0	0	0	0	0	0
Eddy	0	0	0	0	0	0	0	0	0	0	0
Emmons	0	0	3	1	0	0	0	0	0	0	0
Foster	0	0	0	0	0	0	0	3	0	0	0
Golden Valley	0	0	0	1	0	0	0	0	0	0	0
Grand Forks	5	0	9	11	0	0	0	0	0	3	0
Grant	0	0	0	1	0	0	0	0	0	0	0
Griggs	0	0	2	0	1	0	0	0	0	0	0
Hettinger	0	0	4	4	0	0	2	2	2	0	0
Kidder	1	0	12	3	0	0	0	0	0	0	0
Lamoure	0	0	4	3	0	1	0	2	0	1	0
Logan	0	1	1	1	0	0	0	0	0	0	0
McHenry	0	0	1	3	0	0	0	0	2	0	0
McIntosh	0	0	3	1	0	0	0	0	0	0	0
McKenzie	0	0	1	2	0	0	0	0	0	0	0
McLean	1	59	3	0	0	0	0	0	0	0	0
Mercer	0	0	0	0	2	0	0	1	0	0	0

	Sample Category (Research and survey samples not included)										
County	Seed Health	Phytosanitary	Field Crop	Tree or Shrub	Lawn	Ornamental	Fruit or Vegetable	Plant ID	Insect ID	Mold ID	Soil/Nematode
Morton	0	0	0	1	3	0	1	0	0	0	0
Mountrail	0	29	4	1	0	0	0	0	0	0	0
Nelson	1	0	0	0	0	0	0	1	0	0	0
Oliver	0	0	0	1	0	0	0	0	0	0	0
Pembina	12	0	4	2	0	0	0	1	0	0	0
Pierce	0	0	1	0	0	0	0	0	0	0	0
Ramsey	0	0	4	1	0	0	0	0	0	0	0
Ransom	0	0	5	0	1	2	0	0	0	0	0
Renville	1	0	0	4	0	0	0	0	0	0	0
Richland	0	0	13	2	0	0	0	3	0	1	7
Rolette	0	0	2	2	0	0	0	0	0	0	0
Sargent	1	0	3	3	0	0	0	0	0	0	0
Sheridan	0	0	1	4	0	0	0	0	0	0	0
Sioux	0	0	0	0	0	0	0	0	0	0	0
Slope	9	0	1	0	0	0	0	0	0	0	0
Starke-Billings	0	0	1	6	1	0	0	0	0	0	3
Steele	0	0	2	4	0	0	0	0	0	1	0
Stutsman	0	12	5	2	1	0	0	2	0	0	0
Towner	7	0	3	0	2	0	0	0	0	0	0
Traill	0	0	7	6	1	0	0	0	0	0	0
Walsh	11	0	11	1	0	0	0	0	0	0	1
Ward	4	45	3	5	1	0	0	0	0	1	0
Wells	0	0	5	3	0	0	0	1	0	0	0
Williams	18	17	1	2	0	0	0	0	0	1	0
Not Reported	11	55	2	6	0	0	0	1	1	0	0

Out-of-State Samples by Type Oct 2005 – Dec 2006

	Sample Category (Research and survey samples not included)										
State	Seed Health	Phytosanitary	Field Crop	Tree or Shrub	Lawn	Ornamental	Fruit or Vegetable	Plant ID	Insect ID	Mold ID	Soil/Nematode
Colorado	3	0	0	0	0	0	0	0	0	0	0
Maryland	1	0	0	0	0	0	0	0	0	0	0
Massachusetts	0	0	0	1	0	0	0	0	0	0	0
Michigan	92	0	0	0	0	0	0	0	0	0	0
Minnesota	119	0	151	32	6	3	7	4	2	4	17
Montana	1	1	0	2	0	0	0	0	0	0	3
Nebraska	113	0	1	0	0	0	0	0	0	0	0
Oregon	12	0	0	0	0	0	0	0	0	0	0
South Dakota	2	0	1	1	0	0	0	0	0	0	0
Texas	1	0	2	0	0	0	0	0	0	0	0
Virginia	0	0	0	0	0	0	0	0	1	0	0
Wisconsin	23	0	0	0	0	0	0	0	0	0	0
Wyoming	0	0	0	1	0	0	0	0	0	0	4
Not Stated	0	0	3	1	0	0	0	0	0	0	0

Out-of-Country Sample Type Oct 2005 – Dec 2006

	Sample Type (research samples not included)										
Country	Seed Health	Phytosanitary	Field Crop	Tree or Shrub	Lawn	Ornamental	Fruit or Vegetable	Plant ID	Insect ID	Mold ID	Soil/Nematode
Canada	32	0	0	0	0	0	0	0	0	0	0

Dutch Elm Disease – By ND County Oct 2005 – Dec 2006

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 from one year to the next 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 by experienced tree health professionals, 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, offered by Dr. James Walla (NDSU research pathologist): 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 serious 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 reportedly 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 and it is not yet apparently fully understood why.

Some American elm cultivars and several elm hybrids have demonstrated tolerance or even possible 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 Samples by County

County, Number submitted	**FY2004**		**FY2005**		**Oct '05 – Dec '06**	
	Positive	Not Detected	Positive	Not Detected	Positive	Not Detected
Benson	0	1	--	--	--	--
Cass	2	0	1	2	3	0
Eddy	2	0	0	2	--	--
LaMoure	--	--	--	--	1	0
McKenzie	--	--	--	--	2	0
McIntosh	--	--	1	0	--	--
Ottertail	--	--	--	--	0	1
Sargent	0	1	0	2	--	--
Ward	--	--	--	--	0	1
Wells	3	0	--	--	--	--
Total:	**7**	**2**	**2**	**6**	**6**	**2**

Seed health samples Oct 2005 – Dec 2006

Samples for seed health testing are usually submitted during the winter months, typically beginning in September. The number of samples submitted for potato bacterial ring rot (BRR), potato viruses, nematode seed wash (screening for nematodes on seed of pulse crops and sunflower), dome (bacterial foliar blights on dry bean), anthracnose, and other seed health tests are summarized in the table below.

Seed health testing summary FY2006	
Test Type	Number of samples submitted for requested test
BRR	500
Potato viruses	48
Nematode – pulse crops and sunflower	469
Dome (bacterial, dry bean)	30
Anthracnose (dry bean, pulse crops)	5
Ascochyta (pulse crops)	6
Other	2

Samples Processed: Host, Diagnosis, # cases

The table below summarizes the diagnoses of the lab and the corresponding number of samples, by plant type or sample category. Research samples are not included in the table below. Level of confidence is not indicated.

Host	Diagnosis	# of Cases
	Field Crops	
Alfalfa	Alfalfa rust (*Uromyces striatus)*	1
	Alfalfa weevil	1
Amaranth	Anthracnose (*Colletotrichum* species)	1
	Insufficient sample	1
Asparagus	Animal injury	1
Barley	Bacterial leaf streak (*Xanthomonas*)	1
	Barley loose smut (*Ustilago nuda*)	1
	BYDV	1
	Drought stress	1
	High temperature injury	1
	Nutrient imbalance	1
	WSMV	1
	Other or Unknown	1
Bean; Dry	Alternaria leaf spot	1
	Bacterial brown spot (*Pseudomonas*)	1
	Environmental stress	1
	Herbicide injury	1
	Zinc deficiency	1
	Insufficient sample	1
Calendula	Rhizoctonia root rot	1
Canola	(see rapeseed)	
Corn	Bacterial stalk rot	1
	Charcoal rot	1
	Cladosporium (mold)	1
	Common corn rust (*Puccinia sorghi*)	1
	Common corn smut (*Ustilago maydis*)	1
	Drought stress	3
	Environmental stress	3
	Herbicide injury	5
	Nutrient imbalance/deficiency	2

	Salt injury	1
	Sunscald	1
	Insufficient sample	1
	Unknown or Other	4
Crambe	Insufficient sample	1
False flax, small-seeded	Pythium root rot	1
	Insufficient sample	1
Lentil	Aschochyta	1
	Fusarium root rot	1
Onion	Frost injury	2
	Other	2
Other Field Crop	Environmental stress	1
	Herbicide injury	1
	Nutrient imbalance/deficiency	1
Pea	Herbicide injury	2
Potato	Bacterial soft rot (*Erwinia* species)	33
	Black dot (*Colletotrichum coccodes*)	2
	Environmental stress	1
	Fusarium dry rot (*Fusarium* species)	27
	Fusarium dry rot (*F. sambucinum*)	1
	High temperature damage	1
	Nutrient imbalance	2
	Physiological disorder	8
	Late blight (*Phytophthora infestans*)	8
	Leak (*Pythium debaryanum*)	9
	Pink rot (*Phytophthora erythroseptica*)	10
	Silver scurf (*Helminthosporium solani*) – not detected	1
	Tuber rots (organisms not indicated)	33
	White mold (*Sclerotinia sclerotiorum*)	1
	Insufficient sample	1
	Other	3
Rapeseed	Environmental stress	3
	Insufficient sample	1
Soybean	Anthracnose (*Colletotrichum truncatum*)	1
	Charcoal rot (*Macrophomina phaseolina*)	4
	Diaporthe stem rot, blight, or canker	4

	Environmental stress	8
	Fusarium root rot	11
	Herbicide injury	18
	Iron deficiency/chlorosis	4
	Moisture stress	1
	Physiological response	2
	Rhizoctonia blight	1
	Soil compaction	1
	Soybean cyst nematode – positive	12
	Soybean cyst nematode – negative	33
	Soybean mosaic virus – negative	1
	Downy mildew (*Peronospora manshurica*)	1
	Two-spotted spider mite	5
	Insufficient sample	1
	Other (diagnosis not indicated)	19
	Unknown	4
Sugarbeet	*Aphanomyces cochlioides*	3
	Alternaria blight	3
	Environmental stress	1
	Fusarium dry rot/root rot	3
	Fusarium yellows	1
	Herbicide injury	6
	Pythium species	1
	Rhizoctonia solani	7
	Rhizomania (BNYVV) – negative	3
	Rhizomania (BNYVV) – positive	5
	Nutrient imbalance/deficiency	1
	Sugarbeet cyst nematode – out-of-state samples, negative	7
	Inconclusive	2
Sunflower	Banded sunflower moth (*Cochylis hospes)*	1
	Environmental stress	8
	Frost injury	1
	Herbicide injury	15
	Poor pollination	1
	Pythium root rot (greenhouse)	1
	Rhizopus head rot	1

	Scorch	2
	Wireworm (not speciated)	1
	Insufficient sample	2
Wheat (spring or wheat not indicated)	Black point (*Alternaria* species)	1
	Drought stress	1
	Environmental stress	2
	Herbicide injury	1
	Nigrospora blight	1
	Nitrogen deficiency	1
	Wheat stem maggot	1
	Wheat Streak Mosaic Virus – negative	2
	Wheat Streak Mosaic Virus – positive	11
	Other	3
Wheat – Spring	Bird cherry-oat aphid	1
	Drought stress	3
	Environmental stress	2
	Fusarium root rot	1
	Herbicide injury	11
	Crown and root rot (*Bipolaris sorokiniana)*	1
	Karnal bunt (*Tilletia indica*) – not detected	1
	Wheat Streak Mosaic Virus – negative	1
	Wheat Streak Mosaic Virus – positive	3
	Wireworm (*Aeolus* species)	1
	Other	2
Wheat – Winter	Environmental stress	1
	Tan spot (*Pyrenophora tritici-repentis*)	1
	Wheat Streak Mosaic Virus – positive	2
	Fruit	
Apple	Apple scab (*Venturia inaequalis*)	1
	Black rot (*Botryosphaeria obtusa*)	1
	Botryosphaeria canker (*Botryosphaeria* sp.)	1
	Fall webworm (*Hyphantria* sp.)	1
	Iron deficiency	1
	Leaf skeletonizers (Family Zygaenidae)	1
	Nutrient deficiency (boron/calcium)	1
	Scorch	1

	Sunscald	1
Grape	Black rot (*Guignardia bidwellii*)	3
	Fusarium root rot	1
	Winter injury	1
	Unknown	1
	Other	1
Strawberry	Fusarium root rot	1
	Winter injury	1
	Unknown	1
Watermelon	Alternaria leaf blight	1
	Unknown	1
Home Environment		
Home mold	Black mold (*Stachybotrys* sp.)	6
	Cladosporium species	2
	Dematiaceous hyphomycetes	7
	Not detected	1
	Other	5
Identification Requests		
Insect	Confused flour beetle	1
(scientific names are omitted since the database that we use is not complete)	Red turnip beetle	1
	Red flour beetle	1
	Achemon sphinx	1
	Bombardier beetle	1
	Ladybird beetle larvae	2
	Leaf beetle (*Galeruca* species?)	1
	Spittle bug	1
	Membracid tree hopper	1
Fungi/Molds	*Peziza* species	1
Plant	Amaranths (family *Amaranthaceae*)	2
	Apple of Peru (*Nicandra physalodes*)	1
	Biennial wormwood (*Artemisia biennis*)	1
	Black henbane (*Hyoscyamus niger*)	1
	Common evening primrose (*Oenothera*)	1
	Common milkweed	1
	Hairy coneflower (*Rudbeckia hirta*)	1
	Lambsquarters (*Chenopodium album*)	1

	Large crabgrass (*Digitaria sanguinalis*)	1
	Leafy spurge (*Euphorbia esula*)	1
	Moss	1
	Motherwort (*Leonurus cardiaca*)	2
	Nightshade (*Solanum* species)	1
	Perennial sowthisthle (*Sonchus* sp.)	1
	Purple Loosestrife (*Lythrum salicaria*)	1
	Sedges (family *Cypreraceae*)	1
	Sweet clover (*Melilotus officinalis*)	1
	Speedwell; purslane (*Veronica* sp.)	1
	Wild cucumber (*Echinocystis lobata*)	1
	Other/not specified in database	7
	Unknown	1
Lawn/Turf		
Mixed species	Ascochyta blight (*Ascochyta* species)	1
	Ants	1
	Bipolaris sorokiniana	1
	Environmental stress	3
	Fusarium blight (*Fusarium* species)	3
	Leaf rust (*Puccinia* species)	2
	Necrotic ring spot (*Leptosphaeria* sp.)	1
	Nutrient deficiency	1
	Soil compaction	1
	Summer patch (*Magnaporthe* probable)	1
	Thatch layer – excessive	1
	Unknown	4
	Insufficient sample	2
Kentucky Bluegrass	Ascochyta leaf blight	1
	Bipolaris sorokiniana	1
	Environmental stress	1
	Gray snow mold (*Typhula* sp.)	1
	Herbicide injury	1
	Leptosphaeria korrae – suspected	1
	Summer patch (*Magnaporthe* probable)	2
	Thatch layer – excessive	2
	White grubs	1

Bentgrass	Take all (*Gaeumannomyces* sp.)	1
Ornamental		
Africana violet	No arthropod or pathogen detected	1
Coral bells	Scorch	1
Daylily	Western flower thrips – suspected	1
Geranium	Root rot (unidentified agent)	1
Gladiolus	Western flower thrips – suspected	1
Money plant	Colletotrichum stem decay	1
	Fusarium crown rot (*Fusarium* sp.)	1
Peony	Environmental stress	2
Poinsettia	No pathogen detected	1
Purple coneflower	Various fungi detected on sample:	1
	Alternaria species, *Fusarium* species; symptom: damping-off	
Rose	Rost rust (likely *Phragmidium* species)	1
Snow-on-the-mountain	Root rot (unidentified agent)	1
Tree and Shrub		
Arborvitae/Cedar	Environmental stress	1
Ash – Green	Anthracnose – *Gnomoniella fraxini*	4
	Ash flower gall mite	1
	Ash plant bug	1
	Ash yellows phytoplasma – suspected	2
	Ash rust	2
	Bark beetles	1
	Environmental stress	2
	Eriophyid gall mite	1
	Herbicide injury	2
	Insect injury (unidentified)	1
	Lecanium scales	1
	Nutrient imbalance/deficiency	2
	Scorch	1
	Spider mite injury	1
	Wood boring beetles	1
	Woodpecker injury	1
Ash – Black	Cottony ash psyllid	2
	Tortricid leafrollers	1

Boxelder	Cottony maple scale	1
	Environmental stress	1
Buckthorn	Oat crown rust	2
Chokecherry	Environmental stress	1
	Peach leaf curl	1
	Rhizoctonia crown rot	1
	Root rot (unidentified agent)	1
	Woodpecker injury	1
Cotoneaster	Insect damage (unidentified)	1
	Oystershell scale	2
	Insufficient sample	1
Cottonwood	Crown rot (unidentified fungus)	1
Crabapple	Apple scab (*Venturia inaequalis*)	1
	Mechanical injury	2
	Poor root development	1
Currant	Root rot (unidentified agent)	2
	Scale insects	1
Elm	Bacterial wet wood – suspected	1
	Elm black spot (*Stegophora ulmea*)	1
	Dutch elm disease – negative	3
	Dutch elm disease – positive	6
	Herbicide injury	2
	Mechanical injury	1
	Root problems (unspecified)	1
	Virus-like symptoms	1
	Woolly elm aphid (*Eriosoma americanum*)	1
Hollyhock	Hollyhock rust (*Puccinia malvacearum*)	1
Honey Locust	Cottony maple scale	2
Juniper	Cedar-apple rust (*Gymnosporangium* sp.)	1
	Environmental stress	2
Linden	Environmental stress	1
	Iron deficiency	1
	Other	1
Maple – Norway	Environmental stress	1
Maple – Silver	Anthracnose	1
	Cottony maple scale	2
	Drought stress	1

	Environmental stress	1
	Iron deficiency/chlorosis	2
	Scorch	1
	Insufficient sample	1
Maple – Sugar	Cottony maple scale	1
	Root damage	1
Maple – unspecified	Anthracnose (*Gleosporium* or *Discula* sp.)	2
	Cottony maple scale	1
	Environmental stress	1
	Eriophyid gall mite	1
	Maple bladdergall mite	1
	Mechanical injury	1
	Phyllosticta leaf spot	2
	Root injury	1
	Scorch	1
	Other	1
Oak – Bur	Anthracnose (*Gnomonia* species)	2
	Cynipid gall wasp	1
	Environmental stress	2
	Oak wilt – not detected	1
Other	Powdery mildew (*Microsphaera* sp.)	1
Pine	Animal injury	1
	Diplodia tip blight (*Sphaeropsis* sp.)	2
	Drought stress	2
	Insect injury	1
	Mechanical injury	1
	“Normal” fall needle drop	1
	Salt injury	2
	Sirococcus needle blight	1
	Zimmerman pine moth	1
Poplar	Bacterial wetwood – possible	1
	Environmental stress	1
Serviceberry	Environmental stress	1
Siberian pea shrub	Drought injury	1
	Insect injury	1
Spruce – Black Hills	“Normal” fall needle drop	2
	Spider mite injury	1

Spruce – Blue	Cytospora canker	1
	Drought stress	1
	Environmental stress	9
	Hail injury	1
	Herbicide injury	1
	“Normal” fall needle drop	2
	“Rhizosphaera” needle cast (not verified)	5
	Scale insects	2
	Spider mite injury	6
	Spruce needle miner	2
Spruce – White	Adelgid	1
Spruce – unspecified	Cytospora canker	2
	Drought stress	1
	Environmental stress	10
	“Normal” fall needle drop	5
	Herbicide injury	5
	Mechanical injury	2
	Planted too densely	1
	“Rhizosphaera” needle cast	3
	Salt injury	1
	Scorch	1
	Spider mite injury	4
	Spruce budworm	1
	Spruce needle miner	1
	Spruce sawfly	1
	Stigmina lautii	3
	Yellowheaded spruce sawfly	2
	Unknown	2
Summersweet	Root girdling	1
Viburnum	Eriophyid mite	1
Willow	Environmental stress	4
	Insufficient sample	1
Yew	Scorch	1
	Insufficient sample	1
Vegetable		
Cucumber	Environmental stress	1

	Fusarium crown rot – possible	1
Rhubarb	Insufficient sample	1
Tomato	Botrytis blight	1
	Environmental stress	2
	Fusarium wilt	1
	Herbicide injury	5
	Septoria leaf spot	1
	Virus symptoms (ringspots on fruit)	1

Specialists consulted

The table below is an attempt to recognize the diagnostic assistance and other contributions of various faculty and specialists to the NDSU Plant Diagnostic Lab. Due to the nature of entering these 'consultants' into the database, I may have overlooked a few people. For those who were mistakenly omitted from the list, please accept my sincere apologies.

Last Name	First Name	Department
Abdullah	Kholoud	NDSU Plant Pathology
Ali	Shaukat	NDSU Plant Pathology
Berglund	Duane	NDSU Plant Sciences
Boetel	Mark	NDSU Entomology
Bradley	Carl	NDSU Plant Pathology
Brewer	Gary	NDSU Entomology
Burlakota	Rishi	NDSU Plant Pathology
Carena	Marcelo	NDSU Plant Sciences
Christianson	Kathryn	NDSU Plant Sciences
Dai	David	NDSU Plant Sciences
Deckard	Edward	NDSU Plant Sciences
Dekeyser	Edward "Shawn"	NDSU Animal & Range Sciences
del Rio	Luis	NDSU Plant Pathology
Dexter	Alan	NDSU Plant Sciences
Fauske	Gerald	NDSU Entomology
Franzen	David	NDSU Soil Sciences
Glogoza	Phil	University of Minnesota Extension
Gudmestad	Neil	NDSU Plant Pathology
Hatterman-Valenti	Harlene	NDSU Plant Sciences
Howatt	Kirk	NDSU Plant Sciences
Johnson	Burton	NDSU Plant Sciences
Kangas	Michael	ND Dept of Forestry
Kegode	George	NDSU Plant Sciences
Khan	Mohamed	NDSU Plant Pathology
Knodel	Janet	NDSU Entomology
Knott	Justin	North Dakota Dept of Agriculture
Larson	Carrie	North Dakota Dept of Agriculture

Specialists consulted, continued:

Last Name	First Name	Department
Li	Deying	NDSU Plant Sciences
Lym	Rod	NDSU Plant Sciences
Marquardt	Steve	North Dakota State Seed Department
McKay	Kent	NDSU Extension specialist
McMullen	Marcia	NDSU Plant Pathology
Meier	Dwain	NDSU Plant Sciences
Messersmith	Cal	NDSU Plant Sciences
Miller	Jerry	USDA-ARS
Moraghan	John	NDSU Soil Sciences
Neate	Stephen	NDSU Plant Pathology
Nelson	Berlin	NDSU Plant Pathology
Overstreet	Laura	NDSU Soil Sciences
Pasche	Julie	NDSU Plant Pathology
Ramasubramaniam	Harikrishnan	NDSU Plant Pathology
Ransom	Joel	NDSU Plant Sciences
Rivera-Varas	Viviana	NDSU Plant Pathology
Samuel	Luke	NDSU Plant Sciences
Scherer	Tom	NDSU Ag & Biosys Eng
Secor	Gary	NDSU Plant Pathology
Smith	Ron	NDSU Plant Sciences
Stack	Robert	NDSU Plant Pathology
Thostenson	Andrew	NDSU Plant Sciences
Walla	Jim	NDSU Plant Pathology
Zeleznik	Joe	NDSU Plant Sciences
Zollinger	Rich	NDSU Plant Sciences