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West Lafayette, Indiana 47907

Department of Botany & Plant Pathology • Lilly Hall of Life Sciences

P.D.Q.

PLANT DIAGNOSTICIAN'S QUARTERLY
Vol. VI No. 1 - March 1985

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The Plant Diagnostician's Quarterly (PDQ) is a non-profit publication, which serves plant pathologists in extension, regulatory and industry clinical laboratories. PDQ is published four times a year, in March, June, September, and December. Yearly subscription is $10.00.

Send manuscripts and announcements to the editor: Ethel M. Dutky, Dept. of Botany, University of Maryland, College Park, MD 20742. Send subscription payments and address corrections to the managing editor: Gail Ruhl, Dept. of Botany and Plant Pathology, Lilly Hall of Life Science, Purdue University, West Lafayette, Indiana 47907.

PDQ is an equal opportunity publication, with a policy of nondiscrimination regarding race, color, religion, age, national origin, sex and handicap.

EDITOR'S LETTER May 6, 1985

This is my first PDQ issue; most of the work was done by the feature authors and my predecessor and now co-worker as managing editor Gail Ruhl. I am having a gentle introduction to the job.

The response to our survey regarding the creation of a new APS committee for diagnostic laboratory personnel has been most favorable. The talley so far is 44 in favor and 4 opposed. Respondents from extension, private industry, regulatory and independent consulting labs were in favor of the idea. The four negative responses were also from a variety of regions and types of lab and did not appear to represent any specific type of plant pathologist.

We see many advantages to having a committee in APS, rather than remaining a subset of the extension committee. Full committee status would recognize the fact that diagnostic labs exist outside extension as part of regulatory programs, in private industry and increasingly as part of private practitioner's consulting services. We would be in a better position to do many constructive things including: 1) Propose and run symposia for national meetings; 2) Draft publications relevant to diagnostics; 3) Determine confidence levels and standards for diagnoses. We do not perceive that a separate committee would cut us off from extension; we plan to have a representative on the extension committee as well as on other relevant committees. I will report on further progress in the next PDQ issue.

BE SURE TO READ THE NEXT PAGE, AN UPDATE ON THE DIAGNOSTICIAN'S WORKSHOP. RESPOND TO RICK WUKASCH RIGHT AWAY WITH YOUR IDEAS.

Also, look at the two contestants for the new cover. Mark your preference and send it to me before June 15, 1985. Both artists are open to constructive suggestions. The cover contest ballot is the last page of PDQ; the two contestants are reproduced on pages v and vi.

I look forward to working with Gail to continue producing PDQ which is helpful to all diagnosticians. It is very nice to come into a project that is moving along with its own momentum.

Sincerely,

Ethel M. Dutky

****UPDATE****

Identification and Isolation of Plant Pathogenic Bacteria
DIAGNOSTICICANS WORKSHOP
Prior to Reno, Nevada APS meetings

DATES: August 8 and 10 (August 9 is free day to give bacterial cultures time to grow. Perhaps tours could be arranged in the Bay area).

PLACE: At the U.C. Berkeley, Dr. Milton Schroth and grad students presiding.

TOPICS: Isolation, identification, selective media, pathogenicity tests, inoculation, etc. AND whatever you feel is important. Please submit to Rick Wukasch a summary of which topics or techniques you would like covered in the workshop. Dr. Schroth welcomes this advanced input as to what our interests are. Dr. Schroth also anticipates that there will only be time for covering the bacteria, and not nematology and virology as previously indicated.

FORMAT: 50% lecture-discussion, 50% lab. Recommended that you bring APS Lab Guide for I.D. of Plant Pathogenic Bacteria (Schaad).

HOUSING: Housing either available with prior notice in residence halls at U.C. Berkeley, or on your own. Cost - $20/day single; $25/day double. Contact Rick Wukasch prior to June 1 if you require housing. Meals on cash basis at residence hall.

TRANSPORTATION: Most convenient airport nearby is Oakland; next most convenient is San Francisco. Ground transportation from Berkeley to Reno on Sunday, August 11 can be arranged if participants express interest.

COST: A fee of $50/person will be charged to cover media, plates and other expenses incurred by Dr. Schroth in setting up the workshop.

PREREGISTRATION: ONLY 25 SPACES ARE AVAILABLE, Diagnosticians only. CONTACT RICK WUKASCH, UNIVERSITY OF GUELPH AS SOON AS POSSIBLE IF INTERESTED. (519) 824-4120 EXT. 2701.

The following have reserved a place in the workshop thus far:
1) Ethyl Dutky; U of Maryland (301) 454-3816
2) Laura Sweets; Iowa State U (515) 294-1160
3) Cynthia Ash; N. Dak. State U (701) 237-7854
4) Margery Daughtrey; Cornell U - Long Island (516) 727-3595
5) Juliett Carroll; Cornell U - Ithaca (607) 256-3284
6) Paul Bachi; U Kentucky-Princeton (502) 365-3626
7) Cheryl Kaiser; U Kentucky-Lexington (606) 257-8949
8) Robert Wick; U Mass.-Waltham (617) 891-0659
9) Marlene Campbell; Prince Edward Island,Dept. of Agric. (902) 892-5465
10) John Peplinski; Penn State University (814) 865-1847
11) Tim Tidwell; Calif. Dept. of Food & Agric.-Sacramento
12) Sue Spencer; N. Carol. Dept. of Agric.-Raleigh (919) 733-6930
13) Nancy Taylor; Univ. Tenn.-Knoxville (615) 974-7138
14) Rick Wukasch; Univ. of Guelph (519) 824-4120 ext. 2701

See Next Page ⟹

WHAT WE NEED TO KNOW?

1) What topics do you want covered?

2) What special techniques do you use and could share with the group?

3) Do you require a) housing? Yes ___ No ___ What nights? _____
b) ground transportation to Reno? Yes ___ No ___

SEND THIS INFORMATION TO:

RICK WUKASCH
PEST DIAGNOSTIC AND ADVISORY CLINIC
Dept. of Environmental Science
UNIVERSITY OF GUELPH
GUELPH, Ontario
N1G 2W1

BEFORE JUNE 1, 1985

P.D.Q.

THIS IS CONTESTANT "A"

(reproduced at 75% reduction)

PD

PLANT DIAGNOTICIAN'S QUARTERLY

Date of issue

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Article title, author — pg. no.

Place name of illustrated disease and host here

illustration may change quarterly

THIS IS CONTESTANT "B"

(reproduced at about 65% reduction)

FEATURE ARTICLE

PLANT VIRUS DIAGNOSIS

Coordinated by: Jackie Mullen - Auburn University
Gail Ruhl - Purdue University

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Plant Virus Diagnosis - the current situation

Dr. Richard M. Lister

Dept. of Botany & Plant Pathology

Purdue University

edited by G. E. Ruhl

What is our purpose in plant virus diagnosis? Well, there is some degree of satisfaction purely in being able to put a name to a disease. Anyone can suspect that they have "some kind of a virus" but it takes medical skills to diagnose it as "idiopathic viremia"! More important of course, is that accurate identification of the virus or viruses involved is the cornerstone of effective control of plant virus diseases. Diagnosis can immediately suggest appropriate measures to apply for reducing disease spread and for the avoidance of future problems. Here we will briefly review the state of the art of plant virus diagnosis from this point of view, in relation to the needs of extension and advisory services for speedy, accurate and simple diagnosis. Readers interested in detailed diagnostic information should consult definitive references, such as the CMI/AAB Plant Virus Descriptions (1), or the Handbook of Comparative Diagnosis (2). Reference (3) is also a useful review of diagnostic procedures.

The trouble with viruses is that they differ from most other pathogens in being both too small to see except with an electron microscope (EM) and in being totally obligate parasites that cannot be cultured in vitro. At the same time, most are remarkably simple in construction as compared to other organisms, and many comprise only a nucleic acid genome wrapped in a protein package. The size and shape of this simple package is thus about all we have to go on in attempting quick diagnosis by appearance. Despite this, particle shape and size, as examined in the E.M., can be a most useful distinguishing feature.

Unfortunately, many viruses which are widely different as disease organisms use the same type of packaging, so that even a detailed description of the particle type - be it bacilliform, spherical, rod-shaped, rigid or flexuous - falls far short of distinguishing one virus from another. In fact, the job of describing a virus at all adequately calls for the application of numerous biological, biochemical and biophysical techniques which there simply is not time for in clinical diagnosis.

Plant viruses are best classified in an Adansonian way - that is, in relation to as many of their characteristics as possible. In plant virus classification, characteristics that seem most fundamental and unchanging are given extra weight. Thus, of the characteristics that are reasonably convenient to use by the clinical diagnostician, morphology and chemical and physical properties are regarded as more stable than host range and symptomatology, while vector relationships rank intermediate in importance. Though convenient to check, and often a very helpful criterion, symptomatology in a range of test plants (including the source host) can be misleading where (as is often true) widely different viruses cause similar symptoms, or strains of the same virus cause different symptoms. Similarly, the fact that different virus strains may have different vector relationships, while some viruses that are really quite different can be transmitted by the same vector species, somewhat downgrades vector specificity and relationship as diagnostic criteria. Fortunately however, immunological relationship ranks high in the hierarchy of important criteria for diagnosis, and serological tests are among the quickest and easiest tests to apply, especially with the advent of technologies such as ELISA (enzyme-linked immunosorbent assay), and SSEM (serologically specific electron microscopy).

Probably the best overall procedure to follow in plant virus diagnosis is to pick out those features that can be readily determined, and use them to narrow down the range of possibilities. The procedure has not been formalized in the way that taxonomic keys have been developed for other pathogens, so that sometimes virus diagnosis seems to be based on a series of inspired guesses. Actually, however, it is based on an appropriate process of elimination.

Generally, the first information available relates to the symptomatology and ecology of the disease, hopefully with some indications as to the probable mode of spread. If the virus or viruses involved can be readily transferred to test plants by sap inoculation, characteristic symptomatology and also some general physical properties such as longevity in vitro, thermal stability and dilution end point can be determined (though such properties can be of dubious value (3)). If the virus(es) can be partially purified and concentrated, some more stable physical properties such as sedimentation behavior and density can be determined in a centrifuge. Transfer back to appropriate plants, with production of characteristic disease symptoms, is required to follow Koch's postulates as nearly as can be done (culture outside of the host being impossible).

As mentioned, other useful physical attributes for diagnosis include size, shape and other particle characteristics. Given access to electron microscopy, these can readily be determined and can often place the virus in its taxonomic group, especially with rod-shaped viruses. The appearance of virus-associated inclusion bodies can also be valuable for diagnosis. Of these, the most familiar and distinctive are the pinwheels associated with potato virus Y-type viruses ("potyviruses"), produced by sectioning of lamellar structures specified by the virus. However, other kinds of characteristic inclusions occur. Even light microscopy by itself has been shown to be valuable for grouping viruses by

their characteristic inclusions, with suitable staining procedures and practice in interpretation.

With the field of possibilities narrowed down by such preliminaries, and the question of whether only one or several viruses are involved hopefully resolved, precise diagnosis by serological testing becomes feasible. This is about the level that practical plant virus diagnosis is at for the present. However, we should keep in mind that all these approaches are indirect. The essential specification of a virus is contained in its genome, in terms of the sequence(s) of nucleotides that make up its nucleic acid(s). The criteria we have mentioned each reflect only a part of the functional potential of the genome. For example, probably only about 15% of the viral genome is concerned with the immunological specificity of the tobacco mosaic virus particle. This being so, it is actually quite surprising how discriminating and meaningful this specificity can be. In relation to genome homologies per se as a guide to virus identification, diagnosis at the nucleotide sequence level on the basis of sequence homologies is technically feasible already, by testing the amount of hybridization that can occur between viral genome nucleic acid and DNA's (cDNA's) complementary to the RNA's of reference viruses. This technique of diagnosis is already being applied with viroids and may become routine in the future with viruses. Meanwhile, at another level of nucleic acid comparison, detecting the presence of dsRNA in plants can be useful, both as an indication of virus infection, and also to identify viruses. DsRNA seems to occur in plants only as part of the cycle of virus replication, so its presence specifically indicates virus infection. Moreover, the sizes and amounts of the dsRNA species found in infections are likely to be characteristic for each virus - much like a fingerprint of its replication strategy. Such "fingerprints" can readily be resolved by polyacrylamide gel electrophoresis.

Currently however, immunological properties are the simplest and most widely used of the "stable" characteristics for diagnosis. Immunological tests are all based on the precipitin reaction that occurs when an antigen (virus) reacts with its specific antibody - raised, for example, by injection to rabbits. Such tests depend either on direct visualization of this reaction, or on indirect checks that it has taken place. Typically, in plant virus diagnosis so far, precipitation has been directly visualized in tubes or in gels. Gel diffusion tests especially are widely used, for example in certification schemes for vegetative plant material. In the most common procedure, antibody and test extract are allowed to diffuse fom adjacent wells made in agar films on plastic or glass. A positive reaction is indicated by a line or lines of precipitate occurring between the wells. The behavior of the precipitin lines can indicate relationships and the presence of complexes of differently - diffusing antigens. This sort of test can be used with crude extracts, without need for any preliminary purification steps.

The main problem with gel diffusion tests is relatively low sensitivity - you have to see the precipitate. Also, rod-shaped particles don't diffuse well in agar and have to be broken up first chemically or by ultrasonication. More sensitive procedures enhance visualization of the precipitin reaction by binding antibody or antigen onto much larger particles, such as latex particles, bentonite or tanned red cells. These methods, especially latex flocculation tests, have also been applied on a large scale, for example in seed potato certification. They can be 1000 x more sensitive than gel diffusion tests, and are about as sensitive as any tests available, including standard ELISA procedures.

Another way of making it easier to see that the precipitin reaction has taken place is simply to magnify things. This is done by electron microscopy in

the test called immunosorbent electron microscopy (ISEM), which is quite a widely used diagnostic aid. E M grids pretreated with specific antibody can be used to selectively bind virus particles from crude sap samples. Diagnosis is simply a matter of the relative presence or absence of particles as viewed in the E M. This technique can be 1000 x more sensitive than ordinary electron microscopy with nontreated grids. An extension of this procedure is to treat the particles already bound to a grid with further antiserum, which sticks specifically to them - a technique called "decoration". Tissue sections can also be treated with antibody conjugated to an electron-opaque material such as ferritin. Virus can then be specifically located in the tissue by the presence of the bound ferritin. This approach is similar to that used in virus detection by fluorescent antibody, whereby the virus antigen is located in tissue sections by reacting with fluorescently-labelled antibody, and then locating the fluorescence by fluorescent light microscopy.

ELISA is actually a very similar procedure to this. Here, antibody is conjugated with a suitable enzyme. The enzymes used, typically alkaline phosphatase or horseradish peroxidase, can be detected far more sensitively than the precipitin reaction can be seen, so the test is extremely sensitive - often 1000 x more sensitive that gel diffusion tests. The basic procedures involved were developed in the early 1970's, and applied to practical problems in medical immunology shortly afterwards. Application to plant viruses followed, and this has been an incredible growth area in relation to plant virus diagnosis. Outstanding examples of its use include the screening of thousands of trees for citrus tristeza in Israel and widespread use in Europe for potato virus testing, running into hundreds of thousands of plants.

The most common ELISA procedure for plant viruses is the "double antibody sandwich test". Antigen (virus) is captured by a layer of virus-specific

antibody coating the wells of specially - designed plastic (usually polystyrene) plates. The attached virus is then detected by its ability to bind further virus-specific antibody, which this time has been "labelled" by chemically conjugating it to an enzyme. Unbound materials are washed away by rinsing after each step. Since the construction of the whole "sandwich" is dependent on its "filling" (virus), the presence and amount of enzyme captured, measured by adding the appropriate substrate, is in turn a measure of the amount of virus present in the test extract. The enzyme-substrate reactions used produce either colored or fluorescent products. Reaction intensity (proportional to the amount of virus present) can be observed directly or measured numerically in a colorimeter or fluorimeter. Since this procedure involves detecting a virus "directly" with its "own" labelled antibody, it is referred to as a "direct" ELISA procedure.

As with gel diffusion tests and SSEM, an advantage of ELISA is that crude sap extracts can be tested. ELISA can also be used directly with rod-shaped particles. In fact, from the numerous applications made so far, it seems that whenever it is possible to secure an antiserum, ELISA should be usable in diagnosis. The test can be automated to a greater or less extent - according to taste and requirements - and equipment for this is coming on the market rapidly. Data can be collected and fed into a computer for storage and analysis.

Double sandwich ELISA often seems more strain-specific than precipitin tests, and this can be an advantage in discriminating between viruses. The increased specificity seems to be due to slight damage to the antibody during the process of chemically conjugating it with enzyme. The damaged antibody only binds well to closely-related virus particles. To overcome such specificity, where it is a problem (as in wide-ranging screening tests), several procedures avoiding chemical damage of the virus-specific antibody are possible. These are

the so-called "indirect" procedures, making use of labelled anti-antibody (antispecies antibody). In one, the wells are simply coated with the test extracts, and the virus antibody then allowed to react. Capture or non-capture of virus antibody - respectively indicating the presence or absence of virus in the extract - is then detected by adding enzyme-labelled antirabbit antibody ("second antibody"), made for example by injecting goats with rabbit immunoglobulin. This "second antibody" will bind to any rabbit antibody bound by the virus.

The ultimate in immunological specificity is attained by the use of monoclonal antibodies, which seem likely to become the most important types used in the future. Antisera as typically raised in animals, to even the simplest antigen, is a complex mixture of many kinds of antibody molecules, each tailored so as to react with a certain kind of antigenic determinant site. The relative amounts of such molecules present in a serum is variable, so that one antiserum made to a particular virus may react only very specifically, whereas another may react more widely to related strains. This is one reason why serological relationships as determined in different laboratories may differ. In developing monoclonal antibodies, single spleen cells from antigen-sensitized mice are used to establish tissue cultures after being fused with hybridoma cells. Each individual cell and its progeny generate one kind of antibody molecule only. The "immortal" monoclones selected as producing the kinds of antibody needed can be cultured indefinitely, providing an inexhaustible supply of either highly specific or broadly-reacting antibody, as required.

A recent development in ELISA is the use of protein-binding membranes such as nitrocellulose, instead of polystyrene plates. This procedure, known as "dot-" or "spot-immunobinding", permits use of very small amounts of sample, and

adds to the convenience of the test. It is quite similar to the dot-blotting procedures used for checking nucleic acid hybridization with c-DNA probes.

The technology of all such diagnostic techniques is developing very rapidly, partly because they are also relevant to the needs of clinical medicine. In that area, test kits are widely used, and one development promising to be useful to clinical plant pathologists is the potential for ELISA kits comprising all the materials required for diagnosing specified viruses or other plant pathogens. Several are already being marketed commercially, and the future availability of such test kits will no doubt depend on the perceived needs for them, as defined by those responsible for plant disease diagnosis.

REFERENCES

1. CMI/AAB Descriptions of Plant Viruses. Commonwealth Agricultural Bureaux and the Association of Applied Biologists, 1978.

2. Handbook of Comparative Diagnosis: Plant Virus Infections. ed. Edouard Kurstak. Elsevier/North Holland. 1981.

3. Hamilton, R.I., J.R. Edwardson, R.I.B. Francki, H.T. Hsu, R. Hall, R. Koenig and R.G. Milne. 1981. Guidelines for the Identification and Characterization of Plant Viruses. J. Gen. Virol. 54, 223-241.

March 1985

Virology Techniques Presently Used for Virus Identification in Plant Problem Diagnosis

Coordinated by Jackie Mullen - Auburn University

Virus diagnoses are made by many pathologists, virologists, diagnostic labs, clinics, state regulatory agriculture departments, private consultants and consulting labs. On what basis are these diagnoses made? More specifically, Gail and I wanted to address the question of what techniques are presently used by (1) university diagnostic clinics, state regulatory pathologists, and private consultants and consulting firms.

Of the 32 respondents to our recent virology questionnaire, 21 responses were received from university diagnostic labs or clinics; 3, from state agriculture departments, 2, from university research virology labs, 4, from private firms (2 were involved with diagnoses and 2 were research-oriented), and 1, from a county extension agent, and 1 from a private consultant. We were very pleased with the response we received and wish to extend a big "thank you" to all those who took time and effort in sending us information (see list below).

While our major concern was "what is being done with virus disease diagnosis in diagnostic labs today", we gained considerable helpful and instructive information and encouragement from those research virologists, state regulatory labs, private firms and other interested individuals who responded.

I tried to include all information pertinent to the topic and questions. In some instances I paraphrased comments and in others I quoted the respondent directly. I realize that a few comments may be redundant as answers to one question sometimes overlapped into another question area.

In an attempt to describe the total approach to virus diagnosis in certain diagnostic labs, I included an entire answer from the particular lab. Again I realize that there is some repetition of comments and techniques here, but I wanted to convey the total approach of these labs (Maryland, Kentucky, Georgia, Florida DPI, Montana, Paul Ecke Inc., Yoder Bros., Alberta).

Names & Address of Respondents

University and/or CES Plant Pathologists or Diagnosticians in the U.S. and Canada.

Alabama	Jackie Mullen CES - Extension Hall Plant Diagnostic Lab, Auburn University, Auburn, AL 36849
Delaware	Bob Mulrooney University of Delaware Newark, DE 19717-1303
Georgia	Marianne Waindle Plant Disease Clinic University of Georgia Athens, GA 30602
Florida	Tom Kucharek Plant Pathology Dept. Florida Plant Disease Clinic University of Florida Gainesville, FL 32611
Indiana	Gail Ruhl Purdue Plant Diagnostic Clinic Dept. of Botany & Plant Pathology Purdue University West LaFayette, IN 47907
Kansas	Jane A. Houfek Plant Disease Diagnostic Lab Throckmorton Hall Kansas State University Manhattan, KS 66506

Kentucky	Paul R. Bachi Plant Disease Diagnostic Lab West Kentucky Research & Education Center P. O. Box 469 Princeton, KY 42445
	Cheryl A. Kaiser Plant Disease Diagnostic Lab C.E.S. University of Kentucky Lexington, KY 40546
Maryland	Ethel M. Dutky Plant Diagnostic Lab Dept. of Botany University of Maryland College Park, MD 20742
New York	Juliet E. Carroll Insect & Plant Disease Diagnostic Lab Plant Science Bldg. Cornell University Ithaca, NY 14853
	Margery Daughtrey Diagnostic Lab for Commercial Ornamental Production Long Island Horticulture Research Lab Cornell University Riverhead, New York 11901
Oklahoma	Mark Andrews Plant Disease Diagnostic Lab Oklahoma State University Stillwater, OK 74078
Ontario, Canada	Rick Wukasch Pest Diagnostic & Advisory Clinic University of Guelph Ontario, Canada N1G2W1
Pennsylvania	John D. Peplinski Plant Disease Clinic 211 Buckout Laboratory University Park, PA 16802
Nebraska	Luanne V. Coziahr Plant Disease Diagnostic Clinic University of Nebraska Lincoln, NA 68583

North Dakota	Cindy Ash Plant Pest Diagnostic Lab North Dakota State University Fargo, N.D. 58105
Tennessee	Elizabeth A. Long Nancy J. Taylor Extension Entomology & Plant Pathology University of Tennessee P. O. Box 1071 Knoxville, TN 37901-1071
Utah	S. V. Thomson Plant Disease Diagnostic Clinic Utah State University Logan, UT 84322
Virginia	Mary Ann Hansen Plant Disease Clinic Dept. of Plant Pathology, Physiology and Weed Science Virginia Polytechnic Institute and State University Blacksburg, VA 24061
Wisconsin	Mary Francis Heimann, O.S.F. Plant Disease Clinic University of Wisconsin-Extension 432 North Lake St. Madison, WI 53706
Washington	Otis Maloy CES Agricultural Sciences Bldg. Washington State University Pullman, Washington 99164

University-Associated Research Virologists

Montana	Thomas W. Carroll Plant Virology Laboratory Department of Plant Pathology Montana State University Bozeman, Montana 59717-0002
Alberta, Canada	R. J. Howard Regional Crop Lab Alberta Horticulture Research Center Brooks, Alberta Alberta, Canada TOJOJO

County Extension Agents

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Thomas Kowolsick
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Riverhead, NY 11901

State Dept. of Agriculture

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Ohio

Paul Kauffman
Ohio Dept. of Agriculture
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Reynoldsburg, OH 43068

Private Consultants

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Harlan E. Smith
Smith's Plant Health
2700 Bryon Place
Alexandria, VA 22302

Private Laboratories Involved with Diagnosis

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Boligala C. Raju
Yoder Bros., Inc.
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Alva, FL 33920

Illinois

Steven Cline
Alvey Laboratory
1511 E. Main St.
Belleville, IL 62222

Ohio

Jim Chatfield
Chemlawn Diagnostic Laboratories
Delaware, Ohio 43058

California

Jan Hall
Paul Ecke Research Laboratory
Paul Ecke Poinsettias
P. O. Box 488
Encinitas, CA 92024

1. Name and briefly describe the techniques used to identify viruses and virus diseases. Where convenient or appropriate, site article or reference source which describes the technique. How often is this technique used. (Please include all techniques used.)

Among the 32 respondents, 28 were mostly involved with diagnostic work and 4 were research facilities either associated with a university (1) or a private firm (2). Among the 28 diagnostic facilities (24 diagnostic labs or clinics, 1 private consultant, 1 county agent, 2 privately owned companies, and 3 state department of agriculture), 24 were diagnostic labs or clinics associated with a university. Among these 24 labs, 16 or 67% reported that most of their virus diagnoses were based on symptomatology and that a small number of samples were referred each year to a virologist for accurate virus identification. Four diagnostic labs reported that they diagnose many samples using symptomatology and one other virus identification technique. The Kansas lab and the Pennsylvania lab uses host range indicator plants for a small proportion of their virus diagnoses. At the Lexington, Kentucky lab, ELISA (see ELISA procedure "ELISA as used for plant virus detection and assay" by R. M. Lister which was submitted by Gail Ruhl, Purdue, p. 11) is used once or twice a year for Barley Yellow Dwarf identification. At Purdue, symptomatology is used routinely with EM leaf dips being used to detect certain viruses ((1) wheat spindle streak and wheat streak in wheat and (2) tobacco mosaic and double streak virus in tomato). Only one university-related diagnostic lab (Florida) reported that they routinely use several virus identification techniques in addition to symptomatology (100%). Inclusion body staining is used in 100% of the viral diagnoses; serology is used for 50% of the viral diagnoses; EM, ELISA, and pathogenicity tests were reported to each be used in less than 10% of the virus diagnostic work.

Among the state depts. of agriculture, Florida and California are both involved with extensive work in the area of virus identification. See the 2 tables below for techniques and references used in these regulatory labs. The % given indicates what proportion of the total virus diagnoses depend on the particular technique.

California Dept. of Food & Agriculture:

Technique & Brief Description	Reference	% of Use on Total Virus Disease Diagnoses
1. EM dip negative stain - Cut leaf dipped in drop of PTA stain on EM grid.		50
2. Host Range - Mechanical inoculation of host range plants.		5
3. Double Diffusion - Antiserum and plant sap diffusion through agar.		5
4. EM Sectioning - Samples fixed and imbedded in plastic then sectioned and examined on EM.		1
5. ELISA - Sample and specific antiserum reacted on a plastic plate and visualized with an enzymatic color change.		50

Florida Dept. of Agriculture & Consumer Services:

	Technique & Brief Description	Reference	%
1.	Symptomatology - For obvious viral diseases, i.e., DMV of Aroids, CMV of Geranium, etc.		100
2.	Inclusion body staining - Azure A and orange-green stains. Most used technique.	R.C. Christie & J.R. Edwardson. Light and Electron Microscopy of Plant Virus Inclusions. Monograph No. 9. IFAS, U.F.	90
3.	Electron microscopy - primarily for rod-shaped viruses. Not as useful for spherical viruses.		70
4.	Serology - includes immunodiffusion and ELISA.	Wisler, G.C., F.W. Zettler, and D.E. Purcifull. 1982. A serodiagnostic technique for detecting Cymbidium mosaic and Odontoglossum ringspot viruses. Phytopathology 72: 835-837. Purcifull, D.E. and D.L. Batchelor. 1977. Immunodiffusion Tests with Sodium Dodecyl Sulfate (SDS)-Treated Plant Viruses and Plant Viral Inclusions. Bulletin 788, March 1977, Agricultural Experiment Stations, University of Florida, Gainesville.	40

Technique & Brief Description	Reference	%
5. Host plant bioassay - especially for citrus virus indexing. For miscellaneous viruses for which other tests may fail, still resembles a viral symptom.	Falk, B.W., and D.E. Purcifull. 1983. Development and application of an ELISA test to index lettuce seeds for lettuce mosaic virus in Florida. Plant Disease 67:413-416.	20

Among the 4 private labs that responded, 2 (Alvey and Chemlawn) were predominantly concerned with diagnostic work and at these 2 labs symptomatology was the basis for 99-100% of the diagnoses. The Paul Ecke Research Lab and the Yoder Bros., Inc. lab were concerned with research. The techniques, references and percentages used in these 2 labs are reported below.

Paul Ecke Research Lab:

Technique & Brief Description	Reference	%
1. Indicator plants		5
2. ELISA	Clark, M.F., and A.N. Adams. J. Gen. Virol. 34:473-483.	95

Yoder Bros. Lab:

Technique & Brief Description	Reference	%
1. Electrophoresis - Agarose gels are prepared & plant samples are loaded - Chrysanthemum Stunt viroid.		25 Chrysanthemum Stunt

Technique & Brief Description	Reference	%
2. Grafting - Chrysanthemum indicator plants.	Raju and Olson, Plant Disease 1985 Feature Article (In Press).	Chrysanthemum Stunt
3. ELISA - Viral antibodies produced in rabbits and alkaline phosphatase used as enzyme.	"	Aspermy Virus and Chrysanthemum Virus B; Carnation mottle virus, necrotic fleck virus and etched ring virus; Hibiscus chlorotic ring spot virus.

Thomas Carroll, a virologist at Montana State University, contributed the following information in the table below. His virology lab conducts virus identification tests on all suspect virus samples routinely referred from the Montana Plant Disease Clinic of J. R. Riesselman.

Technique & Brief Description	Refeence	%
1. ISEM (serologically Specific Electron Microscopy) - Serological trapping of virus particles on a filmed grid which is examined with the electron microscope.	Brlansky, R.H. and Derrick, K.S. 1979. Detection of seed-borne plant viruses using serologically specific electron microscopy. Phytopathology 69:96-100	75

Technique & Brief Description	Reference	% of Use on Total Virus Disease Diagnoses
2. Double Diffusion Tests in Agar - Ouchterlony test in plates where a precipitation zone occurs when antigen and antibody meet in optimum proportions.	Matthews, R.E.F. 1970. Plant Virology, Academic Press, N.Y. pp. 475-506.	10
3. Negative stain Leaf-Dip - Electron microscopic examination of virus particles from leaf pieces which have been dipped in negative stain.		5
4. direct ELISA (enzyme-linked immunosorbent assay) - A direct double antibody sandwich method of serologically trapping virus and quantitatively detecting its present through an enzyme substrate reaction.	Clark, M.F., and Adams, A.N. 1977. Characteristics of the microplate method of enzyme-linked immunosorbant assay for the detection of plant viruses. J. Gen. Virology 34:375-483. Lommel, S.A., McCain, A.H. and Morris, T.J. 1982. Evaluation of indirect enzyme-linked immunorsorbant assay for the detection of plant viruses. Phytopathology 72:1018-1022.	5

Technique & Brief Description	Reference	%
5. Thin Sectioning - Examination of thin sectioned material using the transmission electron microscope.		5

In addition to the virology tests described and referenced above, the following tests and techniques were reported to be used in the locations indicated. I included information from some labs to illustrate the overall structure of virus identification protocol used in these specific diagnostic labs.

M. Waindle, Georgia Diagnostic Lab:

Technique & Brief Description	Reference	%
1. Local Lesion Assay - Half-leaves of several assay hosts are rubbed with a buffered solution of plant sap and observed for local lesions after 4-10 days. Plants used are tobacco, tomato, soybean, corn, bean, peas, and suspect host.		0.1
2. Scanning EM - Plant sap is stained (negative) and observed for particles with the SEM.		0.01

C. Kaiser, Lexington-Kentucky Diagnostic Lab:

Technique & Brief Description

1. ELISA - This test is used annually for barley yellow dwarf virus of small grains. We set up one or two target dates, asking agents to send samples by those dates. Samples are run in a batch. Any suspected BYDV plants received prior to the dates are frozen & saved. Plants received after the dates are diagnosed visually. I can't give you a % (probably 95% of BYDV suspected plants end up being run at this time).
2. Indicator Plants - Used for TMV (specifically on tomato; tobacco is used as the indicator, generally B21). Used to check for TMV on orchid. Chaenopodium is used as the indicator. Occasionally for other virus problems.
3. Visual - Used in the majority of situations - mainly for Tobacco viruses (99.9% are diagnosed this way), Bean Yellow Mosaic, rose viruses, TEV on pepper, spindle streak on wheat, etc.
4. EM - Occasionally we ask our electron microscopist to do a leaf dip and check for flexible rods. This is done more often with wheat viruses but has been done once or twice with other hosts such as orchid. She may ckeck a total of 4-5 samples a year for us.
5. Inclusion Bodies - I use this for TMV with some confidence. I am currently working on this technique so I can check for CMV, TEV and hopefully Bean Yellow Mosaic as well. This might be used a few times in a season for TMV.

C. Ash, North Dakota State Diagnostic Lab:

1. Epidermal Strips of Trichomes and Light Microscopy - Used to a limited extent to check for characteristic viral crystals in the trichomes of tomato plants which have TMV symptoms.

E. M. Dutkey, Maryland Diagnostic Lab:

	Technique & Brief Description	Reference	%
1.	Leaf dip - Sap put on a grid, shadowed & exam. w/ trans. electron microscope.	Done by research virologist tech. in the dept.	90
2.	Indicator plant series - Leaf tissue, or sap, in a series of "indicator plants" with an abrasive to wound the cells.	Done by research virology tech. in Botany.	10
3.	Serologically enhanced leaf dip - Sap is treated with serum prior to shadowing- so an outline is produced.	Done by grad. student.	1
4.	Double gel diffusion serology	Done as avail. of sera allows.	1
5.	ELISA	Done by USDA researchers.	1

R. J. Howard, Brooks, Alberta:

	Technique & Brief Description	Reference	%
1.	ELISA - for PVX		<1
	PVS		<1
	PVY		<1
	Leaf roll (PLRV)		95
	PSTV		5
2.	Indicator plant - TMV (Tobacco local lesion host)		1

ELISA as used for plant virus detection and assay

Richard M. Lister
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(Our procedures at Purdue are based on experience with protocols devised by Clark and Adams and others. There are many procedural variants, and many variations in detail are possible, especially in reactant incubation times and temperatures, and choice of enzyme and substrate - see references.

A. Basic Double-antibody-sandwich Procedure

1. Add 200 ul of immunoglobulin (Ig) diluted in "coating buffer" (see "buffers" below) to the wells of the carrier plate (e.g. the "MicroELISA®" plate or Gilford Cuvette-pak format). Incubate *2-4 hours at 30-37°. The coated plate, shaken out and rinsed (see below) can be stored under air-tight cover at room temperature, refrigerated, or frozen, for long periods before use.

2. Wash 3-4 times by flooding with PBS-Tween. To remove suspended solids more effectively, we use an initial wash which is dumped immediately before proceeding with 3 washes, leaving PBS-Tween in wells for 2-3 minutes each time. We use a squeeze-bottle, and angle the plate to avoid cross-contamination. Finally, shake and blot by tapping plate on a paper towel to remove residual buffer and bubbles. Various automatic washers are available, which may improve uniformity.

3. Add 200 ul aliquots of the test samples diluted in "antigen buffer" to duplicate (or triplicate) wells. Test samples may be crude unfiltered green extracts. Leave at refrigerator temperatures (4-6°) overnight or at 30-37° for 4-6 hours. Include buffer checks, healthy extract checks and antigen standards in each set of tests.

4. Wash as in (2).

5. Add 200 ul enzyme-labelled Ig (= conjugate), diluted in "conjugate buffer", to each well. Incubate 3-6 hours at 30-37° (or at 4-6° overnight), or the time indicated from previous trials.

6. Wash plates as in (4).

7. Add 200 ul freshly-prepared p-nitrophenyl phosphate (assuming conjugate is with alkaline phosphatase) at 0.6-1 mg/ml in "substrate buffer" to each well. Incubate at room temperature for 20 minutes - 1 hour (30 minutes is common, depending on density required and background reaction; reaction is linear for several hours). Some "blank" unused wells should receive substrate for colorimetry reference.

8. Add 50 ul 3M NaOH to each well to stop reaction, and mix by appropriate shaking. Also add appropriate NaOH to reference substrates. If a rapid

reader is available, it is not necessary to stop the reaction, which can be read at intervals until appropriate levels are reached.

9. Assess results:

   a) visually, preferably over a light box.

   b) by absorbance at 405 nm using reference substrate. An arbitrary value (frequently 2 x the mean control value, or 3 x, or 2 standard deviations, etc.) is regarded as "positive".

If readings cannot be done immediately, samples can be stored for up to several hours, covered to prevent evaporation.

*Indirect procedure

The simplest indirect procedure is as above, but omitting the conjugated Ig. Instead, the binding of Ig or antigen is detected by use of conjugated anti-rabbit Ig from another animal. For example:

1) coat with antigen; 2) add antibody; 3) detect antibody with labelled anti-rabbit Ig (goat); 4) add substrate. 1) coat with antigen-specific antibody (ex. rabbit); 2) add antigen; 3) add antigen-specific antibody (chicken); 4) add labelled anti-chicken antibody; 5) add substrate.

*For all incubations, plates should be covered. Uniform temperature across the plate is important to avoid edge effects, which can be reduced by incubating plates in humid closed boxes or wraps (e.g. plastic bags containing a moist paper towel). Also avoid stacking plates. Temperature uniformity across the plate is more important than the temperature itself. Use the easiest temperature to control and adjust incubation time accordingly. Edge effects should not be serious, but if they are, do not use the perimeter wells, but keep them filled with water to improve uniformity.

B. Buffers. (store at 4-6°)

PBS (pH 7.4)

For 1 litre

8.0 g NaCl
0.2 g KH_2PO_4
*2.9 g $Na_2HPO_4 \cdot 12H_2O$
0.2 g KCl
0.2 g NaN_3 (poison!)

*or the equivalent molecular weight of other forms.

Note: PBS can be stored at 10 x concentration and diluted for use. (The indicated pH will be different). Avoid incorporating sodium azide in buffers that are not to be stored for long periods, especially for rinse solution, as it is poisonous and also forms explosive complexes with plumbing metals. Also, be careful when weighing azide as the powder can become airborne and breathable. No buffer containing azide should ever be mouth-pipetted.

PBS-Tween: is PBS + 0.5 ml Tween 20 per litre (0.05%).

Coating Buffer (pH 9.6)

For 1 litre

1.59 g Na_2CO_3
2.93 g $NaHCO_3$
0.2 g NaN_3*

*See above notes.

Antigen (extraction) Buffer: is PBS-Tween containing 2% PVP (20 g/l). This is a general-purpose extraction buffer and may be varied for optimum extraction of the virus of interest. The PVP is designed to reduce effects of polyphenolics and tannins that occur in many plants. Where these are not a problem, it may be best left out. Other buffers should be experimented with for uniform, efficient extraction.

Conjugate Buffer: is PBS-Tween containing 2% PVP and 0.2% (2.0 g/l) ovalbumin to inhibit non-specific binding.

Substrate Buffer (pH 9.8)

For 1 litre

97 ml Diethanolamine
800 ml H_2O
0.2 g NaN_3

Add part of H_2O, then add concentrated HCl to give pH 9.8, and dilute with H_2O to final volume.

C. Preparation of Ig.

a. Purification of Ig. (Other recognized procedures may be used instead).

1. To 2.0 ml antiserum add 8.0 ml distilled H_2O.

2. Add 10 ml saturated ammonium sulfate solution dropwise with stirring at room temperature. (or add 10 ml of 36% w/v sodium sulfate solution likewise).

3. Leave 20-60 minutes at room temperature.

4. Centrifuge at room temp (6-8000 g, 10 min.) to collect precipitate. (Re-precipitate, or wash 1 x in 18% sodium sulfate).

5. Dissolve precipitate in 2 ml 1/2-strength PBS.

6. Dialyze 3 times against 1 litre 1/2-strength PBS. (stages 7-9 are not essential. If 7-9 omitted, use ordinary PBS for stages 5 and 6).

7. Filter through 3-5 ml DE22 cellulose, pre-equilibrated in 1/2-strength PBS, in a small chromatographic column. (Note: filtration through DE22 is not essential, but it removes albumins etc., presence of which will otherwise reduce the efficiency of enzyme labelling of the Ig. Similarly, separation of specific Ig by affinity chromatography may be useful to improve sensitivity as well as specificity).

8. Wash Ig through DE22 with 1/2-strength PBS.

9. Monitor effluent at 280 nm and collect first protein fraction to elute. It should come out completely in less than 2 x the volume of the applied sample. This is the Ig.

10. Measure OD_{280} and adjust strength of Ig to read approximately 1.4 OD (about 1 mg/ml).

11. Ideally, store in silicone-treated glass tubes at -20°. The silicone is to prevent loss by adsorption. We have also stored at 4-6° in untreated tubes successfully for many months with azide as a preservative.

b. Conjugation of enzyme with Ig

1. Dissolve precipitate directly in 2 ml (= 2 mg) purified Ig.

2. Dialyze thoroughly 3 times against 500-1000 ml PBS to remove ammonium sulfate if present.

3. Add undegraded glutaraldehyde solution (EM grade), with a mechanical pipette, to 0.06% final concentration; mix well. Various concentrations have been used. General rule seems to be lower concs. are less damaging and may lead to less specificity.

4. Leave 4 hours at room temperature. A pale yellow-brown color may develop.

5. Dialyze 3 times against 1000 ml PBS to remove glutaraldehyde. Can include azide in final 1000 ml PBS, or add with BSA in next step.

6. Add an equal volume of 10 mg/ml bovine serum albumin (+ 0.04% azide) and store at 4-6°. Shelf life is many months.

D. Materials and Equipment Items

(Note: the sources suggested are purely optional.)

1. Antisera with good specific titers. Recommendation is 1:500 or better, with 1:8 or less non-specific activity. (Non-specific activity can be cross-absorbed by using healthy sap to dilute the conjugate, or for treatment of the antiserum before separating the Ig.)

2. Saturated ammonium or sodium sulfate solution. Should be saturated at the temperature of use.

3. DEAE cellulose. Carefully follow suppliers instructions regarding preparation for use.

4. Alkaline phosphatase, type VII, Sigma Chemical Co., P. O. Box 14508, St. Louis, MO 63178. Can be obtained in sealed bottle of 1 mg or 5 mg enzyme suspension.

5. P-nitrophenyl phosphate, disodium (= substrate), Sigma. Available as 5 mg or 40 mg tablets. (Various enzymes and substrates can be used).

6. Glutaraldehyde - 25% aqueous solution in ampoules electron microscope grade - Sigma.

7. Polyvinylpyrrolidone MW 40,000 (10,000 is used by some) Sigma.

8. Bovine serum albumin, crystallized, lyophilized. Sigma.

9. Tween 20 (Polyoxyethylene sorbitan monolaurate). Various.

10. Silicone coating for tubes "Sigmacote SI-1" - Sigma.

11. Egg albumin (ovalbumin crystallized - grade III) - Sigma (Grade II probably O.K. and is cheaper.)

12. Diethanolamine - liquid. Eastman Organic Chemicals.

13. Medium speed centrifuge.

14. Homogenizor - e.g. Polytron Type PT 10/35 with appropriate generator (= cutter) (10 ST or 20 ST).

15. ELISA plates - e.g. Microelisa plates: Dynatech Laboratories Inc., 900 Slaters Lane, Alexandria, Virginia 22314. We prefer the flat-bottom format.

16. Absorbances can be read in a colorimeter or in the visible light range of a spectrophotometer. Numerous rapid-sampling and reading machines have been developed. Readers, processors, recorders, pipettors etc. are changing fast. See catalogues of various suppliers for up-to-date information.

    For many purposes visual readings over a light box are adequate and comparisons could be made with standard color checks.

E. Recent reviews of ELISA.

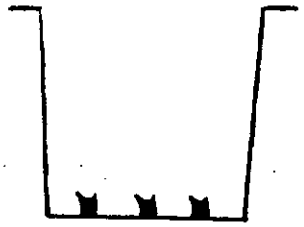
CLARK, M. F. 1981. Immunosorbentr Assays in Plant Pathology. Ann. Rev. Phytopathol. 19:83-106.

CLARK, M. F. and M. BAR-JOSEPH. 1985. Enzyme Immunosorbent Assays in Plant Virology. Methods in Virology 7:51-85.

CLARK, M. F., R. M. LISTER, and M. BAR-JOSEPH. 1985 ELISA Techniques. Methods in Enzymology: in press.

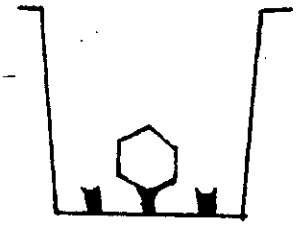
Principle of the ELISA technique
(Double sandwich procedure

1. Specific antibody adsorbed to plate coat buffer



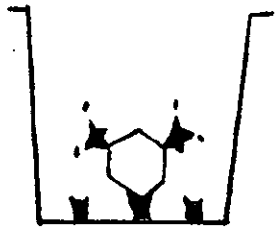
Wash PBS-Tween

2. Add test sample containing virus antigen buffer



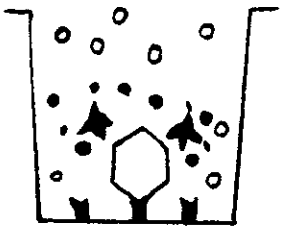
Wash PBS-Tween

3. Add enzyme-labelled specific antibody conjugate buffer



Wash PBS-Tween

4. Add enzyme substrate substrate buffer

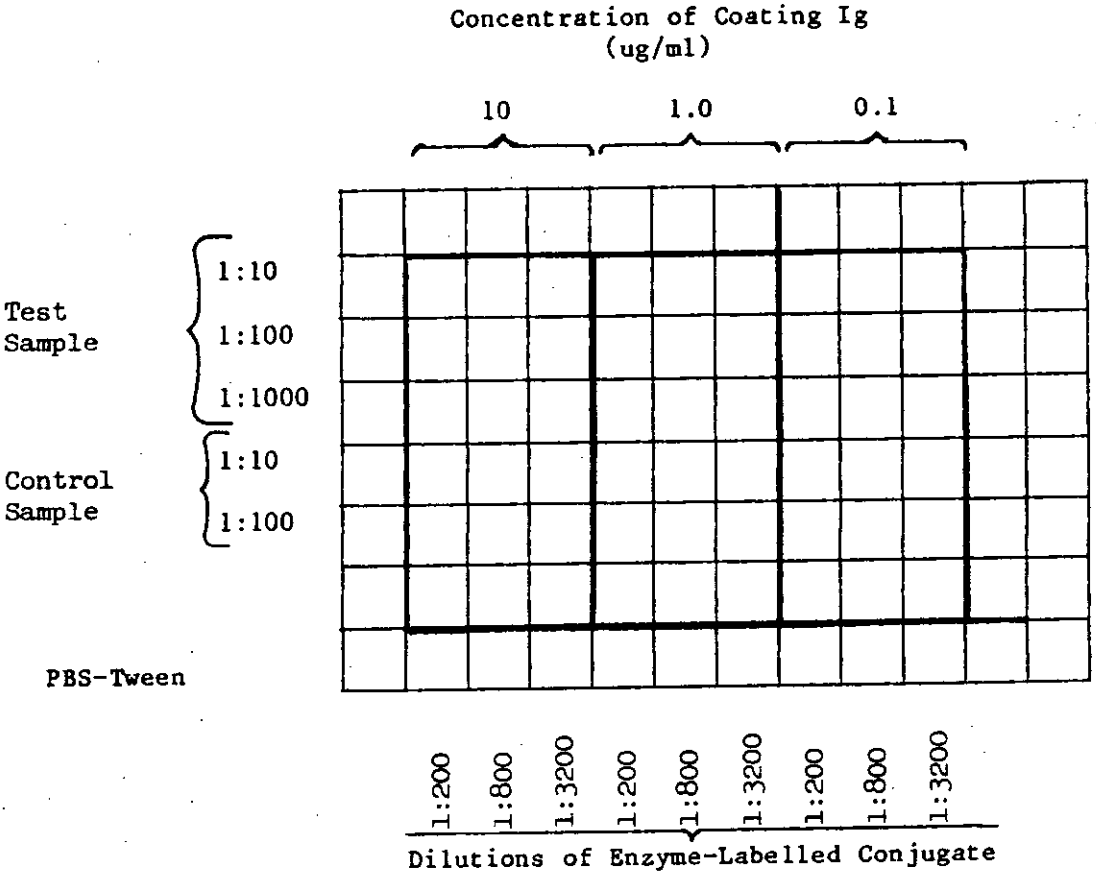


Colour intensity $\propto$ virus concentration (A_{405} nm in spectrophotometer)

(Modified from M. F. Clark and A. N. Adams)

Scheme for Determining Optimum Concentrations of Coating and Enzyme Labelled -Globulin

[Note: the concentrations indicated are suggestions: others may be more appropriate. For example, coat and conjugate dilutions of 1:100, 1:200, 1:400 often work well. Sensitivity varies more with conjugate dilution than with coat dilution.]



For this scheme the outside rows of wells are not used, as these sometimes give rise to spurious results, particularly at the corners.

(from M. F. Clark and A. N. Adams)

2. Give the rational behind virus diagnostic techniques used in your particular lab (e.g. - accuracy not required for home garden inquires).

Among the 21 responding labs which were university-affiliated diagnostic labs or clinics, more than half (12 labs or 57%) reported that most virus diagnoses were accomplished at the level of symptomatology. These labs justified the use of symptom diagnoses for the following reasons: (1) many virus diseases can be diagnosed on the basis of symptoms, (2) most virus problems were sent from homeowners who generally did not require a high level of accuracy for effective control recommendations (i.e., rouging out infected plant material, planting only virus-free plants), and (3) most efficient use of equipment, time, and expertise was achieved by referral of those few commercial virus problems which required accurate virus identification (serology, EM, indicator plants, ELISA, etc) to a virologist who was equipped for such work.

Four clinics stated that there was not enough time, people +/or facilities to pursue viral diagnosis further than the symptom-level. One clinic (Florida) reported that most of their samples were commercial and as such there was a justified need for accurate (beyond symptomatology) virus identification. Several labs mentioned that their labs do not receive many virus problems and therefore it is practical to refer these few samples to virology experts.

The clinic in Maryland and at Purdue use the EM leaf dip technique frequently on virus suspected samples due to the simplicity of the technique and the availability of equipment. Gail Ruhl reports this technique is a quick way to rule out growth regulator injury on tomato if TMV particles are found. Gail also uses this technique to differentiate between wheat streak mosaic, wheat spindle streak and wheat

soil-borne viruses on the basis of rod shape and size. Ethyl Dutky refers most potential virus samples to a research virology technician who does the EM work.

For Barley Yellow Dwarf diagnoses which are difficult to diagnose on the basis of symptoms, Cheryl Kaiser "borrows" materials once or twice a year to run the ELISA technique for BYDV identification. At Purdue, ELISA was also used to identify BYDV only here the samples were referred to a virology graduate student (who recently graduated!) who did the actual analysis.

Juliet Carroll made the following comments on the rational for the types of virology testing made at the Cornell (Ithaca) lab or by Cornell virologists: "Visual--yes, accuracy not essential for home garden. ELISA - I use this technique only if the research lab that performs this test is currently working on their samples. For CMV mainly. Electron microscopy & leaf dips - I use this technique to substantiate visual diagnoses on commercial crop plants. Local Lesion Plants - These are occasionally used in special cases. But it is difficult/impossible for me to maintain the assay plants. Plant Virus Inclusion Bodies - This technique is used in difficult cases where EM work has revealed evidence of virus particles, but no listing of viruses on the host exist. Or in cases where symptoms are distinct, but EM reveals no virus particles."

The California and Florida state department of agriculture labs rely more on specific virology identification techniques than on symptomatology. Their comments on the rational behind the techniques used are included below.

California Dept. of Agriculture (Mary Sorrell) - "Certain techniques are most suitable to certain situations or viruses. EM dips and/or serology are used whenever possible as these are rapid and accurate screening techniques for large volumes of samples."

Florida Dept. of Agriculture (Gail Wisler) - "With some knowledge of what to expect to find, an inclusion staining or leaf dip will often confirm our suspicions. With some that are totally unknown, we will use other techniques to try and make an accurate diagnosis. There are some cases where all our tests are consistently negative, but we still suspect a virus. In this case, we state this to the grower and caution him/her not to propagate from symptomatic plants."

Thomas Carroll, a virologist at Montana State University, commented that "Ideally, techniques should be simple, rapid, accurate, and inexpensive." I'm sure all those involved with diagnosis would be willing to stand up and applaud that statement!

3. List antisera which you use or have prepared. Also include the source of antisera.

Among the 32 respondents to our questionnaire, 24 respondents (75%) indicated that they did not use serology techniques at their facility and, therefore, could not contribute any information on this topic. One diagnostic lab referred the questionnaire to a virologist associate who answered this question. Other labs gave the name of a virologist in their area who did use antisera. Despite the fact that many labs involved with diagnosis (university, state department of agriculture, private and some research facilities) do not use serology in their work, several responding laboratories (8 or 25%) do use these techniques. I have listed below the antiserium used, its source and the respondent who provided information on the antiserum. In some instances the source of antiserum is not complete with respect to address. In most cases I could only include what information was sent to me. Where addresses are incomplete, I suggest that interested pathologists and diagnosticians contact the person who responded to the questionnaire for further details.

Antiserum	Source	Respondent
Curly Top Virus	Dave Mumford USDA Logan, Utah	S.V. Thomson Plant Disease Diagnostic Clinic Utah State Univ. Logan, UT.
Squash Mosaic Virus Cucumber Mosaic Virus AMV	Dennis Mayhew California Dept. of Food & Agriculture 1220 N. Street Sacramento, CA 95814	Mary Sorrell CDFA Sacramento, CA
A Variety of Antisera Obtained from a Variety of Sources.	Dennis Mayhew CDFA	Mary Sorrell
Poinsettia Mosaic Virus	Robert Fulton University of Wisconsin (retired)	-Jan Hall -Paul Ecke Research Labor. -Paul Ecke Poinsettias P. O. Box 488 Encinitas, CA 92024

Antiserum	Source	Respondent
Antisera Used at University of Florida	Dan Purcifull Plant Pathology Dept. University of Florida Gainesville, FL 32611	Tom Kucharek Plant Pathology Dept. Florida Plant Disease Clinic University of Florida Gainesville, FL
Antisera Used at Montana State University		Thomas W. Carroll Plant Virology Laboratory Montana State University Bozeman, Montana 59717-0002
BSMV	MSU	
WSMV	Ball	
BYDV	Rochow	
BCMV	Lundsgaard	
BYMV		
AMV	Herbert	
ALV		
PVX		
PVY	Shepard	
PVM		
TMV	Ours	
AgMV	ATCC-Slykhuis	
CYMV	ATCC-Melsh	
WCMV	ATCC-Barnett	
CMV	Shepard	
SBMV		
TEV	Ours	
BMV	ATCC-Brakke	

Antiserum	Source	Respondent
Maize Dwarf Mosiac A & B Wheat Streak Mosaic Wheat Soil Borne Mosaic Wheat Spindle Streak Mosaic Tobacco Mosaic Cucumber Mosaic	Kansas Virology Laboratory	Jane Houfek Plant Disease Diagnostic Lab Kansas State University Throckmorton Hall Manhattan, KS 66506
Barley Yellow Dwarf Virus	Ben Doupnik	Cheryl Kaiser Plant Disease Diagnostic Lab Univ. of Kentucky Lexington, KY 40546
Chrysanthemum Virus B Aspermy Virus Carnation Mottle Virus Etched Ring Virus	ATCC	Boligala Raju Yoder Bros. Inc. Box-68, Alva FL 33920
Hibiscus Chlorotic Ring Spot Virus	Howard Waterworth	Boligala Raju Yoder Bros. Inc. Box-68, Alva FL 33920
Barley Yellow Dwarf Virus	Graduate Students In Virology	Gail Ruhl Purdue Plant Diagnostic Clinic
Variety of Antisera	Agriculture Canada's Research Station in Vancouver, B.C.	-R. J. Howard -Regional Crop Lab -Alberta, Hort. Res. Center Brooks, Alberta
Cymbidium Mosaic	G. C. Wisler	-Gail Wisler -Div. of Plant Industry -Fla. Dept. of Ag & Consumer Services -Doyle Conner Bldg. -P. O. Box 1269 Gainesville 32601

Antiserum	Source	Respondent
Odontoglossum Ringspot V	G. C. Wisler	"
Peanut Stripe	D. E. Purcifull	"
Peanut Mottle	D. E. Purcifull	"
Cowpea Mosaic	D. E. Purcifull	"
Cucumber Mosaic	D. E. Purcifull	"
Lettuce Mosaic	B. W. Falk	"
Citrus Tristeza	S. M. Garnsey	"
Citrus Variegation V	S. M. Garnsey	"
Citrus Leaf Rugose V	S. M. Garnsey	"

4. List important virus diseases which must be accurately diagnosed in your region. List other virus diseases in your region.

	Important Virus Diseases
Alabama	Barley Yellow Dwarf Virus - Small grains.
	Maize Dwarf Mosaic Virus - Corn & sorghum.
	Soybean Mosaic Virus - Soybean.
	Peach Rosette Virus - Peach.
	Black Eye Cowpea Mosaic Virus - Southern pea.
	Peanut Stripe Virus - Peanut (not found yet but situation being closely monitored).
	Tobacco Mosaic Virus on tomato & peppers.
California	Too numerous to list - See Index of Plant Virus Diseases in California by Dennis Mayhew. (Refer to Question 6).
Delaware	Barley Yellow Dwarf
	Wheat Spindle Streak Mosaic
Georgia	St. Augustine Decline Virus
	Dogwood Canker Virus
	Tobacco Mosaic Virus (Tobacco)
	Soybean Mosaic Virus
	Pecan Bunch
	Pecan Rosette
	Tomato Ringspot Virus (peach)
	Peach Yellows
	Peach Rosette
	Peanut Mottle Virus
	Barley Yellow Dwarf
	Wheat Spindle Streak
	Maize Dwarf Mosaic Virus

Georgia	Maize Chlorotic Dwarf Virus
	Pepper: TMV
	Cucumber Mosaic
	Tobacco Etch Virus
	Potato Virus Y
	Tomato: TMV
	Cucumber Mosaic
	Cucumber: Watermelon Mosaic
	So. Pea: Cucumber Mosaic
	Cowpea Mottle Virus
	Cowpea Chlorotic Mottle
Florida	Important Viruses
	Citrus tristeza
	Citrus variegation
	Citrus leaf rugose
	Tatterleaf-citrange stunt
	Exocortis viroid*
	Psorosis*
	Xyloporosis*
	Lettuce mosaic
	Peanut stripe
	St. Augustine decline*
	Other Viruses:
	Peanut mottle
	Pokeweed mosaic
	PVX
	PVY
	Tobacco etch

Florida	Pepper mottle
	TMV
	Rose mosaic*
	Rough bark*
	Cucumber mosaic
	Nandina mosaic
	Nandina stem pitting
	Geminiviruses
	CyMV
	ORSV
	Papaya mosaic, distortion ringspot
	Bean yellow mosaic
	Cactus virus X
	Bidens mottle
	Hippeastrum mosaic
	Iris mosaic
	Lily fleck
	Hibiscus ringspot
	Carnation etched ringspot
	Carnation necrotic fleck
	Zucchini yellow
	Southern celery
	Soybean mosaic
	Squash mosaic
	Watermelon mosaic I, II

*Inclusions not yet found for these viruses.

Indiana

Important Virus Diseases

Maize dwarf mosaic virus

Maize chlorotic dwarf virus

Soybean mosaic virus

Tobacco ringspot virus

Tomato ringspot virus

Cucumber mosaic virus

Barley yellow dwarf virus

Wheat spindle streak virus

Soil borne wheat mosaic virus

Wheat streak mosaic virus

Potato viruses - PVX, PVY, PVS, etc.

Bean pod mottle virus

Alfalfa mosaic virus

Cowpea mosaic virus

Bean yellow mosaic virus

Brome mosaic virus

Squash mosaic virus

Watermelon mosaic virus

Apple chlorotic leaf spot virus

Apple stem grooving virus

Raspberry mosaic

Raspberry crumbly berry

Peach stem pitting

Apple union necrosis and decline

Tobacco mosaic virus - on tomato

Illinois	Important Virus Diseases
	Barley Yellow Dwarf
	Wheat Streak Mosaic
	Soil-borne Mosaic
	Maize Dwarf Mosaic
	Soybean Mosaic
	Bud Blight - soybean

Kansas	Most Important
	Wheat Streak Mosaic
	Wheat Spindle Streak Mosaic
	Wheat Soil Borne Mosaic
	Maize Dwarf Mosaic
	Maize Chlorotic Mottle
	Barley Yellow Dwarf
	Other
	Tobacco Mosaic
	Cucumber Mosaic
	Brome Mosaic
	Panicum Mosaic

Kentucky

Important Viruses Requiring Accurate Diagnosis

Barley Yellow Dwarf

Wheat Spindle Streak

Soil-borne Mosaic

Other Virus Problems

Rose Mosaic

Sterility Virus

Bean Yellow Mosaic

Tobacco Mosaic

Cucumber Mosaic

Tobacco Etch

Tobacco Ringspot

Tobacco Vein Mottling

Alfalfa Mosaic

Soybean Mosaic

Leaf Curl Virus - Brambles

Pea Mosaic

Potato Virus Y

Cymbidium Mosaic

*See "Burley Tobacco Virus Complex" Extension Bulletin, p. 15.

Maryland

Important Virus Diseases Known to Occur in Maryland
(Indicator Plant Testing)

Tomato Ring Spot (fruit trees; not strawberries)

Tobacco Ring Spot

Tobacco Streak

Raspberry Bushy Dwarf

Prunus Necrotic Ring Spot

Maryland

Prune Dwarf

Strawberry Mottle

Pallodosis

Strawberry Pallodosis

Apple Chlorotic Leaf Spot

Apple Stem Pitting

Apple Stem Grooving

Pear Vein Yellows

Other Viruses in Area or Suspected in Area but not Confirmed by Testing

Brambles - Raspberry Yellow Net

Black Raspberry Necrosis

Strawberries - Strawberry Crinkle

Apples - Latent Apple

Apple Ringspot

Dapple Apple
Rubbery Wood
Flat Limb
} probably Mycoplasmas

Pears - Chlorotic Leaf spot

Stoney Pitt

Prunus - Cherry Mottle Leaf*

Sour Cherry*

Green Ring Mottle*

Little Cherry*

Cherry Twisted Leaf*

Tomato Ringspot*

*Not found yet but situations being monitored

Maryland	Prunus - Sour Cherry**
	Green Ring Mottle**
	Plum Line Pattern**

**Presumed present but not yet confirmed.

Above information on Maryland virus situation was obtained via phone from L. M. Goff, Maryland Dept. Ag., Anapolis, MD.

Montana	Important Virus Diseases
	BSMV
	WSMV
	ByDV
	PVX
	PVY
	BCMV
	BYMV
	AMV
	Other Diseases
	Raspberry Mosaic Viruses
	WS + MV
	ALV
	CMV
	TMV (greenhouse tomatoes)
	Caul MV
	Cherry Viruses

New York	Important Virus Diseases
	CMV - Vegetables
	Maize Dwarf Mosaic
	Maize White Line Mosaic
	Watermelon Mosaic Virus - cucurbits
	Tomato Aspermy on chrysanthemum
	Barley Yellow Dwarf
	Chrysanthemum Mosaic
	Chrysanthemum Stunt Viroid
Oklahoma	Important Virus Diseases
	Wheat: Soil-borne Mosaic
	Wheat Streak Mosaic
	Peanuts: Peanut Mottle
	Cucurbits: Watermelon Mosaic
	Rose: Rose Mosaic
Pennsylvania	Common Virus Diseases
	Sweet Corn: Maize Dwarf Mosaic
	Tomatoes: Tobacco Mosaic
	Cucumber Mosaic
	Cucurbits: Cucumber Mosaic
	Watermelon Mosaic 2
	Beans: Common Bean Mosaic (BV-1)
	Bean Yellow Mosaic (BV-2)
Nebraskas	Important
	Wheat Streak Mosaic
	Soil-borne Wheat Mosaic
	Soybean Mosaic Virus
	Corn Lethal Necrosis

Nebraska	Others
	Rose Mosaic
	Barley Yellow Dwarf
	Maize Dwarf Mosaic
	Alfalfa Mosaic
	Tobacco Ringspot
	Bean Pod Mottle
North Dakota	Important
	PVX
	PVY on potatoes
	Potato Leaf Roll
	PVS
	Oat Blue Dwarf
	Barley Stripe
	Wheat Striate
	Barley Yellow Dwarf
	Cucumber or Squash Mosaic
	TMV
Tennessee	No important virus diseases are accurately diagnosed.
	Other Virus Diseases
	Tobacco Ringspot
	Tobacco Etch
	Several Green Bean Virus
	Alfalfa Mosaic
	Tobacco Vein Mottling Mosaic
	Tobacco Mosaic
	Potato Virus Y
	Maize Dwarf Mosaic
	Maize Chlorotic Dwarf

Tennessee	Soybean Mosaic
	Peanut Stunt Virus
	Bean Yellows Mosaic
	Cucumber Mosaic
	Barley Yellow Dwarf
	Wheat Spindle Streak
Utah	Important Virus Diseases
	Fruit Tree Viruses
	Small Grain Viruses
	Barley Yellow Dwarf
Virginia	*See listing on page 12 .
Washington	Barley Yellow Dwarf
	Potato Leaf Roll
	Pea Seed Borne Mosaic
	Wheat Streak Mosaic
	Many viruses of pome, stone & small fruits
Alberta, Canada	
	PVS
	PVY
	PSTV
	PLRV
	Tobacco Rattle Virus
	Tobacco Mosaic Virus
	Cucumber Mosaic Virus
	Poinsettia Mosaic Virus
	Wheat Streak Mosaic Virus

Ontario, Canada	TMV
	Tomato Ringspot Virus
	Potato Virus X, Y, Leafroll, (also spindle tuber viroid)
	Cucumber Mosaic Virus
	Turnip Mosaic Virus
	Barley Yellow Dwarf Virus
	Wheat Spindle Streak (see p. 19)

VIRUSES THAT HAVE BEEN IDENTIFIED FROM CROPS IN VIRGINIA[a]

HOST	VIRUS NAME	VIRUS GROUP	INOCULUM SOURCE OR OVERWINTERING HOST	BIOLOGICAL VECTOR
CORN	Maize dwarf mosaic (MDMV)	Potyvirus	Johnsongrass	Aphids
	Maize chlorotic dwarf (MCDV)	MCDV group	Johnsongrass	Black-faced Leafhopper - Graminella nigrifrons
TOBACCO	*Tobacco mosaic* (TMV)	Tobamovirus	Crop residue in soil; tobacco products; horse-nettle	Man
	Tobacco ringspot (TRSV)	Nepovirus	Many perennial herbaceous and woody plants	Dagger Nematode - Xiphinema
	Potato virus Y (PVY)	Potyvirus	Ground cherry; transplants of pepper and tomato	Aphids
	Tobacco etch (TEV)	Potyvirus	Horsenettle and ground Cherry	Aphids
	Tobacco vein mottling (TVMV)	Potyvirus	Dock, horsenettle, and ground cherry	Aphids
	Cucumber mosaic (CMV)	Cucumovirus	Many wild hosts, including chickweed, pigweed	Aphids
	Peanut stunt (PSV)	Cucumovirus	Wild legumes, white and red clover, crownvetch	Aphids
PEANUTS	Peanut stunt (PSV)	Cucumovirus	Same + seed-borne in peanut	Aphids
	Peanut mottle (PMV)	Potyvirus	Seed-borne in peanut	Aphids
	Peanut stripe (PSpV)	Potyvirus	Seed-borne in peanut	Aphids

[a]/From the records of S. A. Tolin, through 1983.

HOST	VIRUS NAME	VIRUS GROUP	INOCULUM SOURCE OR OVERWINTERING HOST	BIOLOGICAL VECTOR
SOYBEANS	Alfalma mosaic (AMV)	Ilarvirus	Many weeds	Aphids
	Bean pod mottle (BPMV)	Comovirus	Red clover, beggartick	Beetles - Ceratoma sp: Diabrotica sp.
	Bean yellow mosaic (BYMV)	Potyvirus	Red clover, (??)	Aphids
	Peanut mottle (PMV)	Potyvirus	Seed-borne in peanut	Aphids
	Peanut stunt (PSV)	Cucumovirus	Seed-borne in peanut; red, white clover, crownvetch	Aphids
	Soybean mosaic (SMV)	Potyvirus	Seed-borne in soybean	Aphids
	Tobacco ringspot (TRSV)	Nepovirus	Many wild herbaceous and woody plants	Daggar Nematode - Xiphinema
	Tomato ringspot (TmRSV)	Nepovirus	Many wild herbaceous and woody plants	Dagger Nematode - Xiphinema
SMALL GRAINS WHEAT	Agropyron mosaic (AMV)	Potyvirus	Quackgrass	Mites
	Wheat streak mosaic (WSMV)	Potyvirus	Volunteer wheat in summer	Mites - Aceria tulipae Wheat curl mite
	Wheat soil-borne mosaic (WSBMV)	'Tobamovirus'	Soil	Fungus -Polymyxa graminis
	Wheat spindle streak mosaic (WSSMV)	Potyvirus	Soil	Fungus -Polymyxa graminis
OATS	Soil-borne oat mosaic (SBOMV)	'Tobamovirus'	Soil	Fungus (?)
BARLEY	Barley ywllow dwarf (BYDV) (Also causes oat red leaf)	Luteovirus	Wind-borne vectors	Aphids - Persistent Rhopalosiphum maidis Macrosiphum avenae M. granarium, R. padi

OST	VIRUS NAME	VIRUS GROUP	INOCULUM SOURCE OR OVERWINTERING HOST	BIOLOGICAL VECTOR
EGETABLES				
OMATO	TMV	Tobamovirus	Borne on seed surface; mechanical transm.	Man
	CMV	Cucumovirus	Wild weed hosts	Aphid
WEET CORN	MDMV	Potyvirus	Annual & perennial grasses, Johnsongrass	Aphid
UCURBITS (Cucumber, Squash, elon, Pumpkin)	CMV	Cucumovirus	Seed-borne; perennial weeds	Aphid
	Squash mosaic (SqMV)	Comovirus	Seed-borne	Beetles
	Watermelon mosaic (WMV)	Potyvirus	????	Aphid
	Zuccini yellow mosaic (ZYMV)	Potyvirus	????	Aphid
EANS (Bush, tring, Snap, unner, Wax, Lima)	Bean yellow mosaic (BYMV)	Potyvirus	Wild hosts, red clover	Aphid
	Clover yellow vein (CYVV)	Potyvirus	Wild hosts, clovers	Aphid
	Peanut stunt (PSV)	Cucumovirus	Wild hosts, clovers	Aphid
PEPPER	TEV,PVY	Potyvirus	Wild hosts, infected transplants	Aphid
FORAGE LEGUMES				
ALFALFA	AMV	AMV group	Perennial Crop	Aphid
CLOVER (Red, white, alsike)	BYMV, CYVV	Potyvirus	Perennial Crop	Aphid
	PSV	Cucumovirus	Perennial Crop	Aphid
	White clover mosaic (WCMV)	Potexvirus	Perennial Crop	Mechanical
CROWNVETCH	PSV	Cucumovirus	Perennial Crop	Aphid

BARLEY TOBACCO VIRUS COMPLEX

UNIVERSITY OF KENTUCKY, COLLEGE OF AGRICULTURE, COOPERATIVE EXTENSION SERVICE
AGRICULTURE, HOME ECONOMICS AND DEVELOPMENT

KEY TO BACCO IS COMPLE

Tobacco vein mottling virus (TVMV) and tobacco etch virus (TEV) are common in Kentucky's burley tobacco crop each year but they have caused heavy damage in recent years. These viruses frequently occur together and are usually referred to as the virus complex. This complex is favored by three interacting factors: 1) crops that are set late so plants are smaller when infected by the virus, 2) populations of solanaceous weeds in and near tobacco fields that serve as overwintering sources of virus and 3) aphid populations that occur early and at a very high level. Much of the damage is in the form of stunting and necrotic spotting (dead spots) in the leaf, especially along the veins. The number of dead spots increases as harvest approaches, and secondary invasion by the brown spot fungus and other pathogens adds to the loss. Many fields visited late in the season have shown a 90 percent incidence of virus infections. Tobacco streak virus (TSV), tobacco mosaic virus (TMV), tobacco ring spot virus (TRSV), cucumber mosaic virus (CMV) and peanut stunt virus (PSV) also have been found in the tobacco crop but the damage due to these viruses has been very minor as compared to that from TVMV and TEV.

Symptoms of virus infections vary greatly depending on the virus involved, time of infection and variety. Thus, identification of a specific virus should be left to the experts. Virus infected plants may show:

- mosaic
- vein clearing
- stunt
- chlorosis (not as green as a healthy plant)
- irregular dark green areas along the veins (especially on the ruffles of older leaves and on the younger foliage)
- etch (white dead spots especially on older leaves along the veins)
- extensive necrotic spotting (similar to the physiological spotting seen on L8 hybrids and/or weather fleck) (see cover photo)
- death of the veins and mid ribs.

The earlier the plants become infected with TVMV or TEV, the greater the amount of stunting, chlorosis and spotting. Plants infected early may show complete breakdown of the plant by harvest time. The loss from plants infected before they reach knee-high may exceed 50 percent in highly sensitive varieties like Burley 37 and Kentucky 17, while those infected after flowering may show little reduction in yield. All commercially available varieties are susceptible to TVMV and TEV but varieties vary greatly in their sensitivity to virus infection (Table 1). Generally, black shank resistant varieties show greater damage from infection by TEV and/or TVMV than do varieties not resistant to black shank.

Varieties	Black Shank Resistance	Relative Susceptibility[1]	No. of Years Evaluated
Burley 64	-	4.9	5
Burley 49	+	4.9	5
Burley 37	+	4.7	5
Ky 17	+	4.2	2
Va 509	-	3.9	5
Clay's 501	+	3.8	1
Burley 21	-	3.6	5
Ky 14	-	3.0	5
Ky 15	-	3.0	2
R 7-11	-	3.0	1
B 21 x Ky 10	-	3.0	5
Ky 16	-	2.2	5
Ky 10	-	2.2	5
Ky 12	-	2.1	5
Ky 41 A	-	2.0	5

[1]Evaluated as: 0 = no symptoms; 1 = very slight mottling; 2 = vein mottling (no necrosis); 3 = vein mottling plus mild necrosis; 4 = vein mottling plus intermediate necrosis; 5 = vein mottling plus severe necrosis with loss of leaves.

Figure 1.—Early symptoms of the virus complex; note etching and mosaic of new growth.

TEV and TVMV overwinter in a variety of perennial weeds common to Kentucky. Horsenettle, groundcherry and dock are common hosts for these viruses. These viruses are not seedborne and do not overwinter in dead tobacco tissue. Thus, the viruses must overwinter in association with a living host. These perennial weeds serve as a source of virus over the winter. The viruses then are transmitted in the spring to other plants like tobacco by aphid feeding.

These viruses are transmitted by several aphid species when they feed on infected weeds and then move to tobacco. The aphids acquire the viruses from infected plants in less than a minute and can transmit them to healthy plants in a matter of a few seconds after they start probing. Thus, it is not necessarily the aphids which regularly colonize tobacco that are responsible for initially moving or transmitting TEV and TVMV in the tobacco patch; instead, transient aphids are believed to play a major role in transmission from weeds into the patch. However, once the viruses are in the patch, tobacco colonizing aphids may be important in transmission if they move from infected to healthy plants. Since the aphids acquire and transmit TEV and TVMV in such a short time, they can inoculate plants with those viruses before they are killed by insecticides. Thus, spraying plants with aphicides is not recommended to prevent transmission, but such sprays are still needed to prevent colonizing aphids from causing significant damage from their feeding and from causing secondary spread of the viruses.

Information on controlling these viruses is incomplete at present; however, five general practices coupled together should reduce the extent of tobacco damage from TEV and TVMV: 1) use of tolerant varieties where possible, 2) elimination of overwintering hosts, 3) reduction of virus incidence, 4) timely planting, and 5) proper site selection.

Use of Tolerant Varieties—Table 1 gives data on the reduction of yield observed in tests in Kentucky and North Carolina when selected varieties were infected early with these viruses. Notice that varieties vary greatly in their extent of yield reduction and no variety is completely resistant to both viruses. Generally, however, the black shank resistant varieties show the greatest damage, so do not plant black shank resistant varieties except where they are needed for black shank control (Table 2).

Varieties	Black Shank Resistance	Percent Yield Reduction	
		TEV	TVMV
Ky 10	-	16	35
Ky 14	-	7	10
Burley 21	-	2	20
21 x 10	-	7	30
B 21 x L8	-	44	35
B 37 x L8	-	63	50
B 37	-	36	60
B 49	-	60	55
Va 509	-	16	45

Figure 2.—Vein mottling symptoms of the virus complex.

Elimination of Overwintering Hosts—Dock, groundcherry and horsenettle survive Kentucky's winters as live plants and thus are perennial. The viruses are carried over in the living parts of these plants so it is important to eliminate or reduce these weeds where possible. The weeds closest to the tobacco field are the most important sources of overwintering. The weeds in the immediate border can be controlled through proper cultivation and the use of herbicides before tobacco is set. It is very important to control weeds in the drive-through area of strips.

Controlling these weeds in pastures and fence rows is more difficult but is possible (see Extension publication AGR-6, "Chemical Control of Weeds in Kentucky Farm Crops," specifically the pasture section, for details). Caution must be exercised with herbicides used near tobacco and other crops.

Figure 3.—Vein clearing and death of mid ribs.

Reduction of Virus Incidence—TEV and TVMV infected plants are more prevalent in the outside rows than the middle rows of the fields. Thus, strip plantings and small patches have more total virus problems than larger patches because the border makes up a much greater portion of the actual tobacco present. This occurs because the virus-carrying aphids land and probe plants near the edges first. Planting tobacco in large patches will help reduce this edge effect. Virus incidence has been reduced by planting several rows of corn as a barrier around experimental tobacco fields and in other crops. Apparently the aphids lose the virus while probing on these plants and also become more dispersed prior to reaching the crop. The total effect is that fewer aphids actually carrying viruses reach the tobacco crop.

Timely Planting—The younger the tobacco plant at the time it becomes infected with the virus, the greater is the reduction in yield. Aphid populations build up as the season progresses and the weed populations get larger as well. Thus, avoid setting tobacco late except when absolutely necessary.

Proper Site Selection—There may be significant variation in virus incidence from field to field, even on the same farm. Care should be taken to select fields that have low potential for occurrence of the virus complex. Avoid sites that have a history of serious outbreaks of the virus complex. The virus is overwintering in weedy hosts near these sites, so replanting to the area just maintains the problem. Locating small tobacco patches in the middle of, or adjacent to, weedy sites (pastures, hay fields, etc.) often leads to a high incidence of the virus complex because the overwintering sources of the viruses are nearby. In contrast, small patches located adjacent to or surrounded by weed-free (corn, soybeans, small grain, etc.) areas usually experience a much lower incidence of the virus complex. Growers should continue to follow recommended tobacco rotation intervals to prevent the buildup of other tobacco pathogens.

COVER PHOTO—Extensive necrotic spotting common with black shank resistant varieties.

... Cooperative Extension Work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Charles E. Barnhart, Director of ... Service, University of Kentucky, College of Agriculture, Lexington, and Kentucky State University, Frankfort.

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Cereal Virus Diseases

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Figure 1. Yellow dwart, caused by an aphid transmitted virus on barley in an experimental planting. Note the yellowing of leaves from tips downward, and the severe stunting of some plants.

Ontario farmers have not experienced total devastation of large fields of grain by viruses, as has occurred in Alberta and other areas of North America. But certain viruses cause serious reductions in yield of oats, wheat, and barley and the effects of the viruses are often unrecognized or attributed to other causes. In addition, other viruses occur here which could become serious if conditions favoring them should arise.

Effects

The virus diseases generally cause yellowing, usually in the form of mottling or streaking of the leaves. Such effects are most apparent when the plants are in stages of most rapid vegetative growth. The infected plants may be stunted to varying degrees and may die prematurely. Even plants that do not show severe discoloration may produce fewer tillers, fewer heads, and fewer and smaller seeds in each head.

Nature and Transmission of the Viruses

The viruses are so small they can be observed only with an electron microscope. They are nucleoproteins that multiply in the plant cells. Each appears to consist of specific particles which may be spherical, rodlike or threadlike. Also, each depends on some other specific agent to transmit it from plant to plant. The transmitting agents include insects, mites, organisms in the soil, seed and pollen.

Figure 2. Red leaf of oats caused by the barley yellow dwarf virus.

APHID-TRANSMITTED VIRUS

Red Leaf of Oats
Yellow Dwarf of Barley
Yellow Dwarf of Wheat

These diseases are caused by the barley yellow dwarf virus, but there are several quite distinctive strains of the virus. The virus consists of spherical particles which few people have seen, even with an electron microscope, but it is carried by aphids or plant lice that anyone can see in our grain fields. This is the most widespread type of cereal virus in the world. It occurs in Ontario every year.

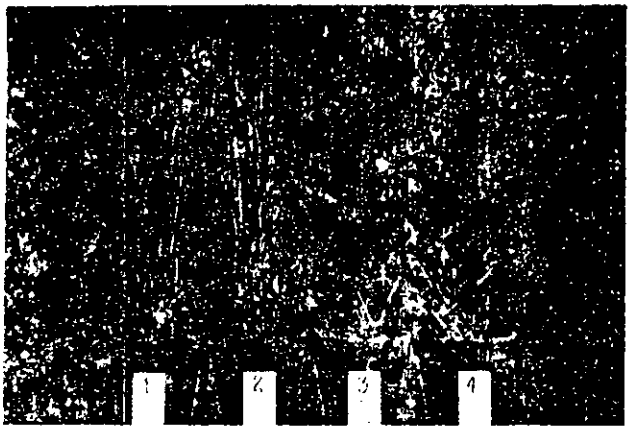

Figure 3. The different effects of two strains of barley yellow dwarf virus on Clintland 60 oats. 1. Control plants without aphids. 2. Plants exposed to virus free aphids when in the two leaf stage. 3 and 4. Plants exposed to aphids carrying different strains of the virus.

Effects:

The infection usually shows first in the rapidly growing grain crops in late May or in June. At first a few scattered plants develop a yellowing, or in oats it may be a reddening. Later the plants in patches or large areas of the field may develop the discoloration. On each plant the disease appears first as a yellowing starting near the leaf tips and progressing downward on the leaf. There may also be blotches or stripes of yellowing progressing until entire leaves become yellow to white, or red on some varieties of oats. Plants infected when very young may become severely stunted and die without heading. Others may be stunted to varying degrees and produce smaller than normal heads, some of which may be entirely or partially sterile.

Depends on aphids:

The virus is spread by several kinds of grass-feeding aphids, none of which live through the winter. Aphids from overwintered eggs must feed on diseased perennial grasses or other overwintered diseased plants before they can carry the virus. It appears that the earliest infections in spring are from aphids blown up from more advanced crops to the south. The aphids usually become most abundant in early summer or in the fall. The virus therefore usually spreads more rapidly in early summer and early fall. Therefore late seeded spring grains, particularly oats, usually become severely diseased in the summer. Winter barley and wheat are more subject to infection when sown very early, thereby becoming exposed to aphids present in September.

How serious:

The extent of the disease varies with the abundance of virus-carrying aphids at times when the crops are most susceptible. Severity varies with the strains of viruses present and the susceptibility of the crop. Each year some yield losses occur in oats, barley and wheat. The most severe losses usually occur in late-sown oats. Accurate figures on yield losses are not available, but this appears to be one of the most important diseases of cereals in Ontario.

Figure 4. Wheat spindle streak mosaic caused by a soil-borne virus that affects winter wheat in Ontario. Note the short spindle-shaped streaks on the second, third, and fourth leaves from the left and the severe yellow mosaic and partial death of the leaves toward the right.

ately tolerant to this disease, but oats are highly susceptible. There has been little success in attempts to breed varieties of oats with resistance. The best control practices are to avoid very late seeding of spring grains including oats, and very early seeding of fall grains.

SOIL-BORNE VIRUS

Wheat Spindle Streak Mosaic:

This disease is caused by a threadlike virus that is harbored in the soil. The disease was first recognized in Ontario but also occurs in Michigan, New York, Pennsylvania and Kentucky in the U.S.A. There is evidence that it also occurs in southern France.

Effects:

In some years all plants in some fields of winter wheat appear brownish-yellow during early May. Sometimes the yellowing occurs in patches. Several factors can cause such discoloration [illegible] spindle streak

Figure 5. Genesee wheat in a field in southwestern Ontario early May showing yellow and brown discoloration of leaves caused by the soil-borne wheat spindle streak mosaic virus.

On close examination this disease is first evident in April or early May as light green to yellow spindle shaped streaks in the leaves. As the discoloration progresses, spots and patches of tan tissue die. Normally, as temperatures become higher in late May, the symptoms become milder, and new leaves remain green with only light green dashes, but at cool temperatures longer than usual into June, all leaves may continue to become striped yellow and may die prematurely, resulting in fewer tillers with heads, and fewer seeds per head.

Effects on winter wheat

Wheat spindle streak mosaic is known only on wheat. It can develop anywhere in southern Ontario on any land on which wheat has been grown three or more times in 10 years. Infection occurs in the fall by means of a root-infecting fungus. Symptoms do not develop unless there are at least 60 days, principally in the spring, with mean temperatures between 5° and 15° C.

Estimates of yield losses in individual fields in which most plants were infected have varied from less than 5% to about 25%. In 1967 and 1968, when about 50% of all winter wheat survived in Ontario was diseased, total wheat yield in Essex and Kent Counties was reduced by about 5%.

Control

Wheat spindle streak mosaic can be controlled experimentally by disinfecting the soil with certain chemicals or heat, or by incorporating large quantities of nitrogen in the soil, but such procedures cannot at present be used economically.

It is hoped that high degrees of resistance found in some Ukrainian lines of wheat can be incorporated into new varieties of wheat for Ontario.

The most promising control at present is to avoid growing winter wheat more often than once in 4 or 5 years on the same field. Liberal use of poultry or livestock manure may also have a beneficial effect in reducing the buildup of the virus in the soil.

MITE-TRANSMITTED VIRUS

Two diseases that cause light green to yellow mottling and streaking in the leaves of wheat are caused by viruses with threadlike particles carried by microscopic, wormlike mites that live on the leaves of grasses. Neither of these diseases has been known to cause serious losses, but either disease could become serious under suitable conditions.

Figure 6. Wheat streak mosaic on leaves of winter wheat (Healthy leaf on left.) Agropyron mosaic also causes this type of mosaic on wheat, but the effects are milder. Both viruses are carried by allied microscopic mites.

Wheat Streak Mosaic

This disease can be most serious on wheat. It has caused total loss of yield some years in many wheat fields in the great plains states and in southern Alberta. In Ontario it was first detected on a few wheat plants in Middlesex County in 1964. It has since been found on wheat and corn in Essex and Kent counties and on scattered wheat plants in Dundas and Elgin counties. It is more common and serious in our neighboring states, Michigan and Ohio.

Effects.

Wheat that becomes infected early in the fall may show the yellow mosaic before winter but usually not until spring. The virus and the mites that carry it survive the winter on the wheat, then multiply rapidly during the warm weather of spring and early summer, when the yellow mosaic on the leaves and the stunting of plants become most evident. During the summer, especially as the wheat begins to mature, the mites carrying the virus are spread most rapidly, principally by wind. Neither the mites nor the virus survive long on the ripened crop. Susceptible corn or barley crops that become infected from the wheat may carry

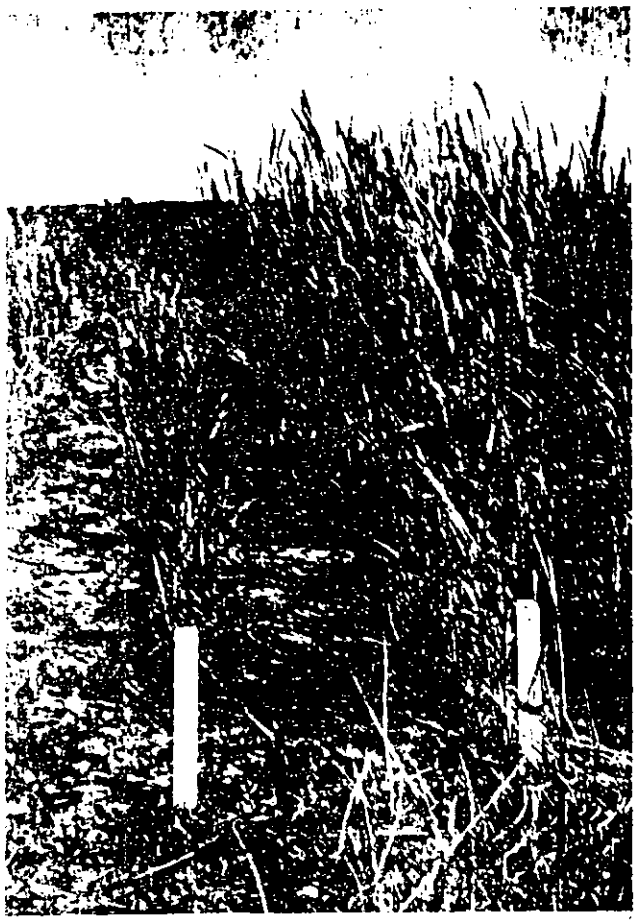

Figure 7. Plots of wheat sown at different dates adjacent to oversummered wheat carrying wheat streak mosaic virus. Note the severe stunting and early death of the plants in the rows on the left that were sown before the disease source was eliminated in contrast to the escape from disease of the wheat on the right sown later.

the disease until they mature. Corn is probably the most common source of infection for wheat.

Control:

Wheat should not be sown too early in the fall beside corn that could be carrying the virus. All immature wheat that could have become infected during the summer should be destroyed before the next crop is sown nearby.

Agropyron Mosaic

Agropyron mosaic is the other disease of wheat in Ontario caused by a mite-transmitted virus. It has been found on couch grass and wheat in many areas. In years when the fall weather is very warm after the new winter wheat crops emerge, the mites that carry the virus may be blown from couch grass into wheat at the edges of the fields. However, the most common strains of this virus are so mild and the rate of spread into wheat is so slow that this disease is not likely to cause significant losses in wheat grown under normal conditions.

Figure 8. Leaves of barley with varied mottling and striping symptoms caused by the only seed-borne virus disease in cereals, barley stripe mosaic. This disease is avoided by using disease-free seed.

SEED-BORNE VIRUS

Barley Stripe Mosaic

This is the only disease of cereals caused by a seed-borne virus. It can also be spread by pollen when the plants are in flower, or by the rubbing of the leaves of diseased plants against healthy wheat or barley. Particles of this virus appear under the electron microscope as short rods or unsharpened lead pencils.

The disease has been found in many countries. Several years ago it was common in some varieties of barley that were grown widely in the northern plains states and to a lesser extent in the prairie provinces. In Ontario it has been found only in certain varieties grown in experimental plots.

Under control:

Cereal specialists who recognize barley stripe mosaic can prevent its distribution with seed. This disease should therefore not occur in farmers' fields unless infected barley seed obtained elsewhere is unwittingly sown.

5. What are the most important references you consult when working on a virus diagnosis?

From the information obtained from the respondents, I have compiled a list of virology diagnostic references. The most commonly cited references are listed first with #1-8 cited frequently.

Virology Diagnosis References

1. Commonwealth Mycological Institute Descriptions of Plant Viruses. 1970-1984. Sets 1-20 Commonwealth Mycological Institute and Association of Applied Biologists. Commonwealth Mycological Institute, Jerry Lane, Kew, Surrey, England.

2. APS Compendia - several cited Wheat Compendia specifically.

3. Smith, K. M. 1972. A Textbook of Plant Virus Diseases. Academic Press. N.Y. 3rd ed.

4. Index of Plant Diseases in the United States. 1960. Agricultural Handbook No. 165. Crops Research Division Agricultural Research Service, USDA, U.S. Government Printing Office, Washington, D.C.

5. Virus Diseases and Noninfectious Disorders of Stone fruits in North America. 1976 Agriculture Handbook No. 437. Agricultural Research Service, USDA. U.S. Government Printing Office, Washington, D.C.

6. Christie, R. C. & J. R. Edwardson. 1977. Light and Electron Microscopy of Plant Virus Inclusions. Monograph No. 9. IFAS, University of Florida.

7. Index of Plant Virus diseases. 1966. Agriculture Handbook No. 307. Agricultural Research Service, USDA. U.S. Government Printing Office, Washington D.C.

8. Mayhew, Dennis E. 1978. Index of Plant Virus Diseases in California. State of California, Dept. of Food and Agriculture, Division of Plant Industry.

9. Converse, Richard H. 1977. Rubus Virus Diseases Important in the United States. Hort. Science, 12:9-14.

10. Proceedings of the Workshop Blackberries: Today and Tomorrow. 1984. Hort. Science 19:182-197.

11. Zillinsky, F. J. 1983. Common Diseases of Small Grain Cereals: A Guide to Identification. CIMMYT.

12. Matthews, R. E. F. 1981. Plant Virology. Academic Press. N.Y.

13. Indexing Procedures for 15 Virus Diseases of Citrus Trees. 1968. Agriculture Handbook No. 333. USDA.

14. Forsberg, J. L. 1963. Diseases of Ornamental Plants. University of Illinois, College of Agriculture, Special Publication No. 3.

15. Pirone, P. P. 1978. Diseases and Pests of Ornamental Plants. 5th Ed. John Wiley & Sons.

16. Lucas, G. 1975. Diseases of Tobacco. 3rd Ed. Biological Consulting Associates, Raleigh, North Carolina.

17. Dixon, G. R. 1981. Vegetable Crop Diseases. The AVI Publishing Co.

18. Westcott, C. 1960. Plant Disease Handbook. 2nd Ed. D. Van Nostrand Co.

19. Anderson, H. W. 1956. Diseases of Fruit Crops. McGraw-Hill Book Co.

20. Nyvall, R. F. 1979. Field Crop Diseases Handbook. The AVI Publishing Co.

21. Kurstak, E. Ed. 1981. Handbook of Plant Virus Infections-Comparative Diagnosis. Elsevier/North Holland Biomedical Press.

22. Chupp, C. and A. Sherf. 1960. Vegetable Diseases and Their Control. The Ronald Press Co., N.Y.

23. McNab, A., A. Sherf and J. Springer. 1983. Identifying Diseases of Vegetables. The Pennsylvania State University, College of Agriculture, University Park, PA.

24. Various Extension leaflets such as - "Geraniums III", Penn. State University.

6. Have you heard of the use of inclusion bodies for I.D. of certain viruses? Have you ever tried this technique; and if so, what were the results? What virus diseases do you identify with this technique? Where did you learn this technique?

Among the 32 respondents, 7 (22%) had never heard of the technique. A much larger number (12 or 38%) had heard of the technique but they had never tried it. Several of the diagnosticians and pathologists in this category commented that they would like to attend another workshop conducted by R. C. Christie. Several labs (5 or 16%) reported that they had seen the technique demonstrated in a class room situation or at a workshop conducted by R. C. Christie, but they do not use the technique. Four diagnostic facilities use the technique but report that they have had problems with some results. An equal number of labs (4 or 13%) reported that they do use the technique and feel that it is a reliable diagnostic aid in some virus diagnostic work.

At the California Dept. of Agriculture lab, the inclusion body technique is not used routinely. They prefer to rely more on EM dips and serology techniques which they believe are more accurate and less time consuming.

At the Lexington, Kentucky lab, the inclusion body technique is at present used mostly for identification of TMV. Some problems with the technique developed recently when tissue that tested negative for inclusions also tested positive on indicator plants.

At the Cornell lab, Juliet Carroll made the following comments:

"Results can be difficult to see and interpret without a very powerful light microscope. However, once one knows what to look for it becomes easier. Also, I think it is best to try both staining techniques on the same sample.

I identify or gain supporting evidence for a variety of different viruses. So far: Tobamoviruses, Potexviruses & Potyviruses.

A graduate student, Ms. Diane Florini, showed me the basics. The rest was self-taught using the reference, Christie & Edwardson, 1977."

At the Florida Department of Agriculture & Consumer Services, Gail Wisler reports: "Inclusion body staining is the most useful technique we have available. Without this we would not be able to verify about 60-70% of our samples. We get a large number of unknowns because of all the ornamentals we receive, and much less work has been done on them compared to agronomic crops. Luckily, R. C. Christie is 1 mile away at the U. of Florida, and we have worked with him over the past 5-6 years in addition to attending one of his workshops. From the previous list (quest. #4) of viruses, those we have not been able to find inclusions for are marked with an asterisk*. This doesn't mean they aren't there, we just haven't found them yet. Woody plants are a little more tricky to work with."

7. If you do not conduct serological or electron microscopy testing, do you have any arrangement(s) with virologists who do perform this tests? What are the arrangements and where are the virologists (or other specialists) located?

Of the 32 responding pathologists, 87% reported that they did have arrangements with (1) a virologist located at the same institution or location (56%) or (2) a virologist located elsewhere (31%) for serology and EM work. Most of the respondents commented that only "important" or very unusual samples were referred for virology testing. In some instances the samples were referred only at specific times when the virologist was conducting serology work on a particular virus. In some cases EM referrals and serology referrals were sent to different specialists at the same institution. In one diagnostic clinic (Gail Ruhl of Purdue's Plant Diagnostic Clinic) serology work is referred to a virology graduate student while Gail does the EM work herself. Of the respondents, who refer their samples to virologists, four reported that a charge was involved (Wisconsin, Michigan, Kansas and Oregon virologists) for their virology analyses. Three respondents (J. Peplinski of Pennsylvania Plant Disease Clinic, H. E. Smith of Smith's Plant Health, and Paul Kauffman of the Ohio Dept. of Agriculture) commented that they wanted to increase their contacts with cooperating virologists.

I have compiled the information received on cooperating virologists into a listing below. These virology specialists are currently assisting the indicated clinics, diagnostic labs or pathologists (to varying degrees) with virus identification. While these specialists are probably not looking for more diagnostic referral virus identifications, some of them may be willing to "help out" with those occasional samples which warrent or require the additional time and expertise.

Virologists Cooperating with Diagnostic Problems

Respondent	Cooperating Virologist
Jackie Mullen Plant Diagnostic Lab Auburn University	Bob Gudauskas Auburn University
Bob Mulrooney University of Delaware	Michigan State University Virologist-Blueberry Stunt Virus (analysis charged)
	Bill Rochow, Cornell University- Barley Yellow Dwarf Virus
Marianne Waindle Plant Disease Clinic University of Georgia	Cedric W. Kuhn University of Georgia
Juliet Carroll Insect & Plant Disease Diagnostic Lab Cornell University	Herb Israel, Cornell U. EM testing for commercial diagnoses only
	Thomas A. Zitter, Cornell U. CMV ELISA
	Rosario Provvidenti Geneva Exp. Sta. Geneva, N.Y. Vegetable Viruses
Margery Daughtrey Long Island Horticulture Research Lab	Herb Israel, Cornell U. EM testing for commercial diagnoses only
Jane Houfek Plant Disease Diagnostic Lab Kansas State University	Steve Lommel, K.S.U. Serology Tests
	Avelina Paulsen, K.S.U. EM work (analysis charged)
Paul Bachi Plant Disease Diagnostic Lab Princeton, KY	Cheryl Kaiser Plant Disease Diagnostic Lab University of Kentucky Barley Yellow Dwarf Virus only (see question #1)

Respondent	Cooperating Virologist
Cheryl Kaiser Plant Disease Diagnostic Lab University of Kentucky	Said Ghabriel Soybean viruses
Elizabeth Long Nancy Taylor University of Tennessee	Brad Reddick Univeristy of Tenn.
S. V. Thomson Plant Disease Diagnostic Clinic Utah State University	Gaylord Mink Prosser, WA ELISA testing of fruit & small grain viruses
Jan Hall Paul Ecke Research Lab.	Dennis Mayhew Calif. Dept. of Ag.
	Tom Allen Oregon State University Hydrangea, Potato, Lily Viruses (analyses charged)
Tom Kucharek Florida Plant Disease Clinic University of Florida	Dan Purcifull University of FL

Most respondents involved with diagnostic clinics commented that they did not have the time or equipment needed for virus identification via serology, EM, or indicator plant host range studies. Many of these diagnostic clinic workers commented that virus problems constituted a small proportion of their diagnoses and only a small percentage of the virus problems required positive virus identification using exact techniques. In this situation, it would not be practical for these diagnostic facilities to conduct virology analyses. Most respondents felt that their arrangements with cooperating virologists were adequate.

CLASSROOM EXPERIMENTS IN PLANT DISEASE

Luellen Pierce

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Introduction

The following are three experiments in plant pathology designed for young students from 6th through 8th grade. Younger students will require close supervision while older students will be able to do the experiments quite independently. We will study three diseases, one from each major group of plant pathogens, fungi, bacteria and viruses. We will study how the infections take place and what environmental conditions are necessary.

These experiments are designed to be done in the classroom with a minimum of laboratory equipment. The teacher need not be a plant pathologist. Only an interest in science is necessary. Generally only ordinary household or classroom items are needed. The most difficult item to obtain is the inoculum (disease causing microorganisms). Ask the nearest University with a plant pathology department for assistance. In California, the necessary inoculum is available at Extension Plant Pathology, 147 Hilgard Hall, University of California, Berkeley 94720, (415) 642-7153.

Snapdragon Rust

Snapdragon rust is caused by the fungus Puccinia antirrhini. Pustules of dark brown powdery spores develop on the stems and leaves, particularly on the underside of leaves. Rapid water loss from severely infected leaves causes them to dry up. The spores survive on snapdragon plants and on seeds. The fungus does not survive in the soil. The spores are windborne from plant to plant. The disease is favored by abundant dew, cool nights (50-55 F) and warm days (70 to 75 F).

The purpose of this experiment is to show that the spores of the rust fungus cause the disease provided environmental conditions are favorable for infection. It also demonstrates that rust from another kind of plant will not cause rust of snapdragon.

Materials and Equipment Required

1. **Snapdragon plants.** It is easiest to use small bedding plants obtainable from nurseries. Larger plants may be used if space is available. The plants should be potted individually. You should have at least 5 plants per treatment. Several plants per treatment are needed to be sure the results are not a "one of a kind" unusual occurrence.

2. **Snapdragon Rust Inoculum.** Plants with snapdragon rust are common. Look around gardens for some "rusted" plants. If you can't find any, contact the closest university with a plant pathology department. Collect rusted

leaves. Place them in water and rub with your fingers to remove the spores. You will need about 250 ml (2-3 cups) of water. The water should become very rusty colored with the spores.

3. **Plastic Bags.** You need one bag per plant. The bags should be large enough to cover the entire plant.

4. **3 Atomizers.** A small perfume type atomizer is best. Any small sprayer will work. Use a separate sprayer for each treatment.

5. **Mock Strawberry Rust Inoculum.** Make a spore suspension as described above in step 1 with rust spores from mock-strawberry. You may use rust from any plant other than snapdragon for this step.

6. **Pot labels.**

The experiment

Use at least 5 plants per treatment.

Treatment 1. Optimum disease. Spray the undersides of the snapdragon leaves with snapdragon rust. Cover the plant with a plastic bag overnight.

Rust spores infect leaves via the stomates. There are more stomates on the undersides of leaves.

Treatment 2. Humidity requirement. Spray the undersides of the leaves with snapdragon rust. Do not cover the plants with a plastic bag.

Rust requires moisture for germination. Without the plastic bag dew may not form on the leaves.

Treatment 3. Host specificty. Spray the undersides of the snapdragon leaves with rust from mock-strawberry. Cover with a plastic bag overnight.

Rust diseases are host specific. They will only infect one kind of plant. You will not get infection of snapdragon from Mock strawberry rust.

Treatment 4. Control. Spray the undersides of the leaves with water. Cover with a plastic bag overnight.

A control tests whether something in the procedure other than the pathogen (disease causing organism) is causing the symptoms.

All plants in the experiment should be placed outdoors overnight so that moisture will be present for spore germination. If the temperature does not drop enough at night no dew will form and infection will not take place. Protect the plants from frost.

After the first night remove the plastic bags. The plants may be placed in the classroom in a well lighted area but not in direct sun. Water soil as needed.

Evaluation

Rust pustules should appear in 4-5 weeks.

For each treatment count the number of leaves with rust spots on each plant. Add the values for each plant and divide by the number of plants per treatment to get an average disease rating.

The students should be able to answer the following questions:

1. What conditions result in the most severe disease?
2. Is dew on the leaves necessary for disease?
3. Will rust spores from mock strawberry infect snapdragon?
4. Why are control plants included in the experiment?
5. Why is it important to have replications (more than one plant per treatment)?

Tomato Crown Gall

Crown gall is caused by the bacterium, Agrobacterium tumefaciens. Irregular galls form on stems and sometimes leaves. A wound is necessary for infection with crown gall. The bacteria survive in galls and in the soil. The disease is often spread by hands or cutting tools when the plants are injured or pruned. The galls are favored by moist conditions. Unlike rusts, crown gall will attack a large number of different plants, from small herbaceous plants to shrubs and trees.

The purpose of this experiment is to demonstrate that the bacterium causes the disease. It also provides an illustration of biological control.

Materials and Equipment Required

1. **Tomato plants.** At least 20 tomato plants. Small plants are easiest to use but any size will do.
2. **Garden clippers.**
3. **Cotton swabs.** Use a separate swab for each treatment.
4. **Inoculum.** A culture of crown gall (Agrobacterium tumefaciens) and the bacterial antagonist Agrobacterium radiobacter 'K84' less than a week old. Pour some water into the culture tube and rub the surface of the culture with a swab to suspend the bacteria in the water. Pour the contents of the tube into about 100 ml (1/2 cup) of water. Stir well. The suspension of bacteria should look slightly cloudy. Do this separately for both the crown gall and 'K84' culture.
5. **Pot labels.**
6. **Plastic bags.** Plastic bags large enough to cover plant.

The experiment

Use at least 5 plants per treatment.

Treatment 1. Optimum Disease. Cut off the growing tips. Dip a cotton swab in the bacterial suspension. Swab the cut stem with crown gall bacteria. Cover plant with a plastic bag overnight, then remove it.

This treatment should have the largest galls because of the injury and the high humidity.

Treatment 2. Injury Requirement. Do not cut off growing tips. Gently swab foliage with crown gall bacteria. Cover with a plastic bag overnight. Then remove it.

Crown gall requires an injury for infection. Thus we would not expect galls in this treatment unless the plants are injured in handling.

Treatment 3. Biological Disease Control. Cut off growing tip. Swab cut stem with crown gall bacteria. Then swab cut stem with 'K84' bacterial antagonist. Cover with plastic bag overnight, then remove.

'K84' is a bacterium that is closely related to crown gall. When it is present it prevents crown gall infections. This is an example of biological disease control.

Treatment 4. Control. Cut off growing tip. Swab cut stem with water. Cover with plastic bag overnight, then remove.

We are testing the effect of cutting the stem when no disease bacteria are present.

Evaluation

Galls should become visible in 4 to 5 weeks.

For each treatment rate the gall on each plants as follows:

No gall - 0
Small gall - 1
Medium gall - 2
Large gall - 3

Add the rating numbers together and divide by 5 to get an average for each treatment.

The students should be able to answer the following questions:

1. Which treatment had the most severe disease?
2. Is an injury necessary for disease?
3. What is biological control? Did it work in this experiment?

Tobacco Mosaic Virus

Tobacco Mosaic Virus (TMV) is a common virus that infects many kinds of plants. It can cause a severe disease of tobacco and tomato. The virus is spread by contaminated equipment such as pruning shears and on the hands of people who have handled infected plants.

Two types of symptoms are seen on tobacco. Some varieties of tobacco show systemic infection in which the entire plant becomes infected. The leaves are puckered and show light and dark green areas. The other type of symptom seen on other tobacco varieties is the "local lesion" where small necrotic (dead) spots appear on inoculated leaves. Only inoculated leaves are

infected and the virus does not spread to the entire plant. We will be seeing the local lesion symptom.

The purpose of the experiment is to show how TMV can be spread. It also demonstrates the effect of diluting the virus preparation.

Materials and Equipment Needed

1. **TMV infected tobacco plant.**
2. **Healthy tobacco plant.** At least 4 healthy tobacco plants of the 'Glurk' cultivar, 6-8 weeks old.
3. **Mortar & pestle.** A mortar and pestle for grinding leaf tissue. Any method of grinding the tissue is acceptable.
4. **Beakers.** Two 100 ml (1/2 cup) beakers or small glass jars.
5. **Swabs.** A package of cotton tip swabs.
6. **Diatomaceous earth suspension.** Place 10 g (5 teaspoons) of Diatomaceous earth in about 1 quart of tap water. Stir before using. Swimming pool supply companies often have diatomaceous earth.
7. **Teaspoon.**

The experiment

Spots should become visible in 4-5 days.

Use at least 4 plants. Use 5 leaves per plant as the replications of the treatment. We are testing the effect of decreasing concentration of virus.

1. Grind a leaf of an infected tobacco plant in a mortar with about 50 ml (1/4 cup) of diatomaceous earth suspension. Dip a cotton swab into the suspension and wipe across the 5 tobacco leaves.

2. Put 50 ml of diatomaceous earth suspension in a beaker (or glass jar) and add 1 teaspoon (5 ml) of ground leaf preparation from step 1. Continue as in step 1.

3. Put 50 ml of diatomaceous earth suspension in a beaker. Add 1 teaspoon of liquid from step 2. Continue as in step 1.

4. Put 50 ml of diatomaceous earth suspension in a beaker. Do not add leaf tissue. Dip cotton swab in suspension and rub leaf. This is the control. We are testing the effect of rubbing the diatomaceous earth suspension on the leaf.

Evaluation

Count the number of spots on each inoculated leaf. Divide by 5 to get an average value per treatment (plant).

1. What is the effect of diluting the virus preparation (decreasing concentration of the virus)?
2. How does TMV spread from plant to plant?

FACULTY POSITION - ASSISTANT OR ASSOCIATE PROFESSOR OF PLANT PATHOLOGY

CLINIC DIRECTOR AND EXTENSION SPECIALIST

JOB DESCRIPTION: This is an 11-month tenure-track position comprised of 65% Extension activity, 10% teaching, and 25% research. The incumbent will be expected to develop an integrated teaching, research, and service program as Director of the Plant Disease Clinic. In addition to leadership in clinical services, a strong Extension program is expected in urban plant health, involving radio and television, computer technologies, and more traditional writings and workshoping. Teaching efforts will be coordinated with other faculty to include development of field and laboratory diagnostic courses. Research involving development of diagnostic biotechnologies is desired

QUALIFICATIONS: A Ph. D. in plant pathology is required with emphasis on diagnosis and control of plant diseases. Candidates with experience in clinical plant pathology and urban plant health problem solving are preferred.

SALARY: Competitive and commensurate with training and experience.

APPLICATION CLOSING DATE: June 1, 1985 or until a suitable candidate is found.

APPLICATION PROCEDURE: Submit a statement of career interests, curriculum vita, transcripts and other academic records, list of publications, and names of three references to:

Dr. Charles C. Powell
Search Committee Chairperson
Department of Plant Pathology
The Ohio State University
201 Kottman Hall
2021 Coffey Road
Columbus, OH 43210

THE OHIO COOPERATIVE EXTENSION SERVICE IS AN EQUAL OPPORTUNITY EMPLOYER AND APPLICATIONS WILL BE ACCEPTED WITHOUT REGARD TO AGE, RACE, SEX, RELIGION OR NATIONAL ORIGIN.

REVISION OF U.S.D.A. HANDBOOK 165

James L. Reveal

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In a cooperative program between the U.S. Department of Agriculture and the University of Maryland, U.S.D.A. Handbook 165, "Index of Plant Diseases in the United States" is being revised and updated.

With the use of an Alpha-Micro L1072 computer and STAR software, the University has created a database of the information contained in the original version of HB 165 published in 1960. These data are being revised and updated by Ms. Muriel O'Brien at the Agricultural Research Center, Beltsville, Maryland. STAR allows for complex searches of the data, rapid revision, and will provide camera-ready copy for a new printed edition of the "Index." The data will ultimately be transferred to the U.S.D.A. PRIM computer where it will become an on-line database service and will be continually updated.

Host taxonomy, distribution data and information are being compiled for each entity at the University of Maryland in cooperation with the Plant Taxonomy Laboratory, ARS, Beltsville. The taxonomy of the pathogens is being compiled by the Mycology Laboratory, also at Beltsville. In this way, it is hoped proper nomenclature will be used throughout. O'Brien will determine what entries are to be included in the final publication.

A request was made early in 1983 for information from State Experiment Stations which was received by O'Brien. The decision has been made to attempt to carry all records through 1984, including that found in the literature published through 1984.

Plant Clinic reports would be exceedingly useful in updating and expanding the state by state host/pathogen records. Accordingly, any new data obtained since information was sent initially to O'Brien -- or if none was sent prior -- any available data that would be useful to compiling data on the plant diseases of the United States, may be sent to Muriel O'Brien, Germplasm Resources Laboratory, Rm 4C, Building 009, BARC-W, ARS, USDA, Beltsville, MD 20705.

It is hoped that all data will be computerized by the end of June 1987, with publication before the end of the year.

BLACK ROOT ROT OF HOLLY

Disease of the Quarter
-Southern Division-

Coordinators: C.A. Kaiser and P.R. Bachi

INTRODUCTION

Black root rot was first identified on Japanese hollies (Ilex crenata) in Virginia in 1976. This disease has since been diagnosed on Japanese hollies in nurseries and landscapes in several other southern states, including North Carolina, Florida and Kentucky. Black root rot has also been identified on declining blue (Ilex X merservea) hollies (Ilex aquifolium X I. rugosa) and inkberry (Ilex glabra) growing in Kentucky.

SYMPTOMS

The first indications of root dysfunction include yellowing and marginal scorch of the foliage. Later, twigs may dieback and eventually the entire plant may die. The root system of the declining plant is stunted and decayed. Black lesions on the infected roots contrast sharply with the adjacent healthy white portions. Lesions may appear on the tips of feeder roots or elsewhere along the root.

LIFE CYCLE and ETIOLOGY

Black root rot is caused by the fungus, Thielaviopsis basicola (Berk & Br.)Fr. Conidia are 80-170u in length and 3-6u wide, hyaline, with slightly rounded ends. Mature conidia are pushed out the end of the tapered tip of endoconidiophores as new spores are formed within. A second, very distinctive spore type, the chlamydospore (25-65u by 10-12u) is also produced (Fig. 51). Chlamydospores are hyaline at first, later darkening to brown or black with age.

T. basicola can persist indefinitely in the soil as endoconidia and chlyamydospores or as a saprophyte. The hyphae of germinating conidia or chlamydospores infect susceptible roots by direct penetration of the epidermis.

SUSCEPTIBLE HOSTS

As stated previously, black root rot has been identified on Japanese holly, blue holly and inkberry. Susceptible blue holly cultivars include: Blue Angel, Blue Maid, Blue Prince, Blue Princess, Blue Stallion, China Boy, China Girl and Dragon Lady. English and Chinese hollies are reportedly resistant, while American and Yaupon hollies are considered moderately resistant.

Black root rot may also infect the following hosts: alfalfa, begonia,

citrus, cotton, cowpea, cyclamen, eggplant, geranium, gloxinia, oxalis, peanut, phlox, poinsettia, snap bean, soybean, sweet pea, tobacco, tomato, verbena, and viola. In greenhouse inoculation studies, English boxwood was also found to be susceptible.

DIAGNOSIS

Root samples can be collected using a core borer or a trowel, making it unnecessary to disturb the entire root system. Remove the small feeder roots and carefully wash them free of soil. Select root samples with easily distinguished blackened lesions and mount them on a slide. Examine the root tissue microscopically for the presence of characteristic chlamydospores. Frequently the chlamydospores are restricted to only the darkest portion of the root lesion, thus clearing the tissue before hand is helpful. This can be accomplished by heating the roots in lactophenol prior to examination. Endoconidia may also be present but they are not only less common, but also more difficult to locate.

Since chlamydospores are so readily evident in infected roots, culturing the roots is generally unnecessary. However, if obtaining an isolate is desirable, the following technique can be used:

1. Wash roots thorougly and cut into 2-3 mm pieces.

2. Wash and surface sterilize blemish-free carrots for 15-20 minutes in 10% household bleach. Slice the carrot into pieces approximately 0.5- 1 cm thick. Place the carrot discs into a sterile petri dish lined with moist filter paper. The prepared discs may be refrigerated until used.

3. Aseptically place the holly roots on the center portion of each of several carrot discs. Be sure to leave some carrots as "non-inoculated" checks since carrots can be naturally infested with Chalaropsis thielavioides, a fungus remarkably similar to T. basicola.

4. Incubate the carrot discs 4-10 days at room temperature and then examine for the presence of chlamydospores. The isolate can then be transferred to PDA or other suitable agar medium.

CONTROL

1. Plant only disease-free hollies in the landscape. In Kentucky, we have observed that some container-grown blue hollies shipped from out-of-state sources were already infected with the black root rot fungus. The root systems, therefore, should be examined prior to planting in the landscape. If blackened roots are evident, the presence of T. basicola can be confirmed through microscopic examination or laboratory assay.

2. Avoid planting susceptible hollies in soils known to be infested with the fungus. While the fungus is widespread, it may be present in higher levels in soils where black root rot was previously a problem on other crops, such as tobacco. When these old agricultural lands are developed for housing, homeowners may find they have also purchased a black root rot problem. In many cases, however, it is not possible to have this type of

knowledge beforehand.

3. In the landscape, badly infected plants should be removed and the site replanted with a non-susceptible host. An attempt can be made to remove the infested soil at the site and to replace it with "clean" Thielaviopsis-free soil. While not necessarily an easy task, it could permit replanting with a susceptible holly.

4. There are no effective fungicide drenches available for controlling black root rot of holly. Steam pasteurization or fumigation with methyl bromide will eradicate the fungus from propagating and growing media in nurseries.

5. The observations of some nursery workers and researchers indicate that good cultural practices may enable some plants to continue to grow in spite of the disease. Plants in the early stages of infection should be well fertilized and watered.

REFERENCES

Bachi, P.R., J.R. Hartman and R.E. McNiel. 1984. The association of Thielaviopsis basicola with decline of blue holly in Kentucky. (Abstr.) Phytopathology 74:822.

Lucas, G.B. 1975. Black root rot in Diseases of Tobacco. Biological Consulting Associates, Raleigh, NC. Third ed. 621 pp.

Wick, R.L. and L.D. Moore. 1983. Histopathology of root disease cited by Thielaviopsis basicola in Ilex crenata. Phytopathology 73:561-564.

Yarwood, C.E. 1946. Isolation of Thielaviopsis basicola from soil by means of carrot disks. Mycologia 38:346-348.

Black Root Rot

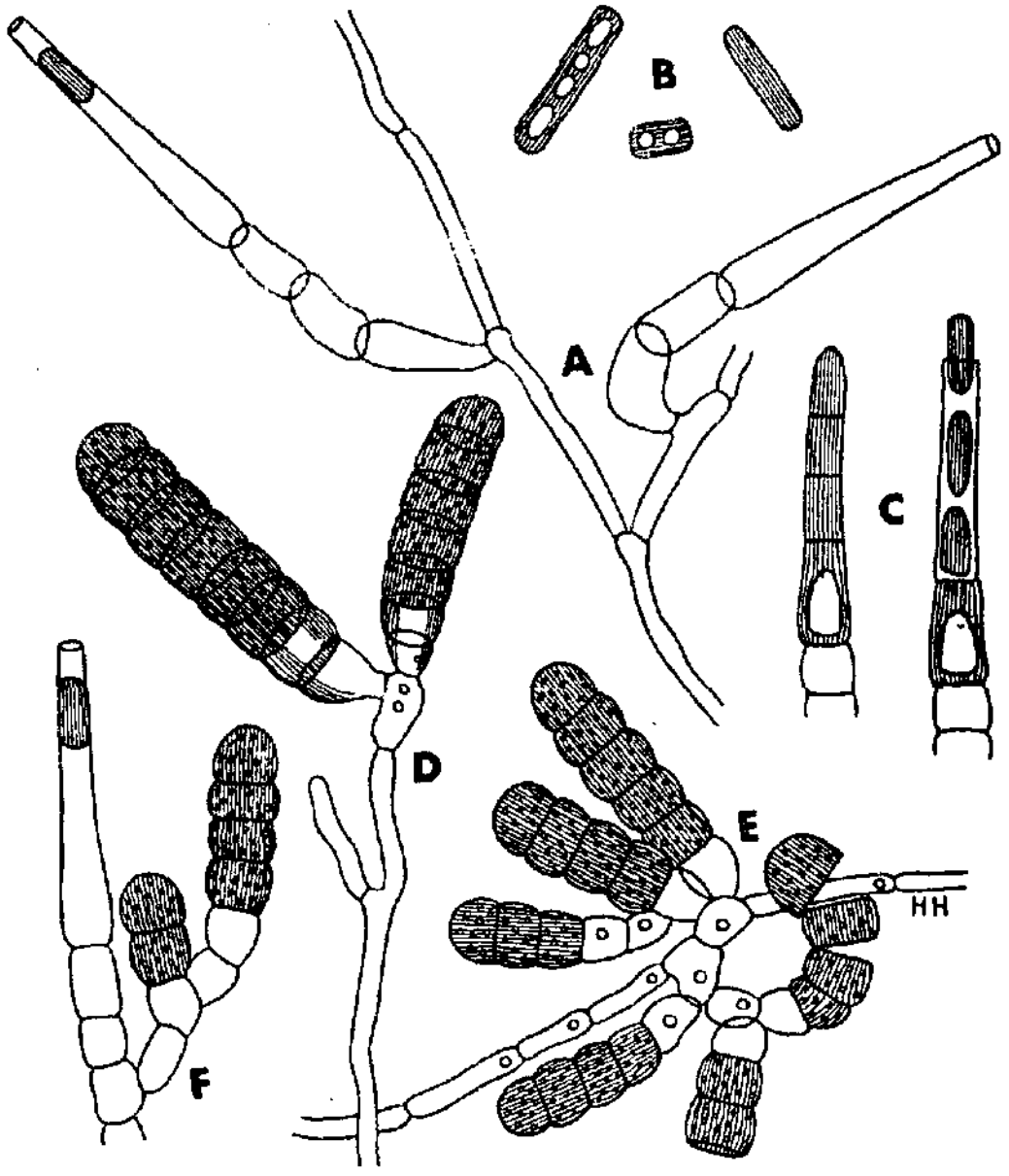

FIG. 51. *Thielaviopsis basicola* (Berk. and Br.) Ferraris. A—hypha with 2 endoconidiophores; B—conidia; C—endoconidiophores forming conidia; D,E—hyphae producing chlamydospores; F—hypha with endoconodiophore and chlamydospores. (Drawing by H. Hirschmann after Zopf)

Plant Pathology Circular No. 204
September 1979

Fla. Dept. Agric. & Consumer Serv.
Division of Plant Industry

BLACK ROOT ROT OF JAPANESE HOLLY

R. C. Lambe[1] and W. H. Ridings

Japanese holly (Ilex crenata Thunb.) is an important evergreen shrub grown in nurseries in Florida. Many of the shrubs are grown for shipment to northern states. Recently a disease new to Florida, black root rot, was detected in containers of Japanese holly (3). This disease, incited by the fungus Thielaviopsis basicola (Berk. & Br.) Ferraris, was first reported in 1976 on Japanese holly in Virginia (4).

SYMPTOMS. Black lesions commonly occur on the tips of infected roots but may occur elsewhere on the roots (fig. 1). The foliage of infected container-grown Japanese holly exhibits chlorosis, and the roots are stunted (fig. 2). Stems and leaves have not been observed to be colonized by T. basicola. Roots of Japanese holly colonized by T. basicola bear conidia and chlamydospores on the surface and in the root tissues. Other fungi such as Rhizoctonia solani Kuhn and Pythium spp. may be associated with roots colonized by T. basicola. Although black root rot has not been detected in landscape plantings in Florida, T. basicola has been cultured from the roots of declining landscape holly in Virginia (1).

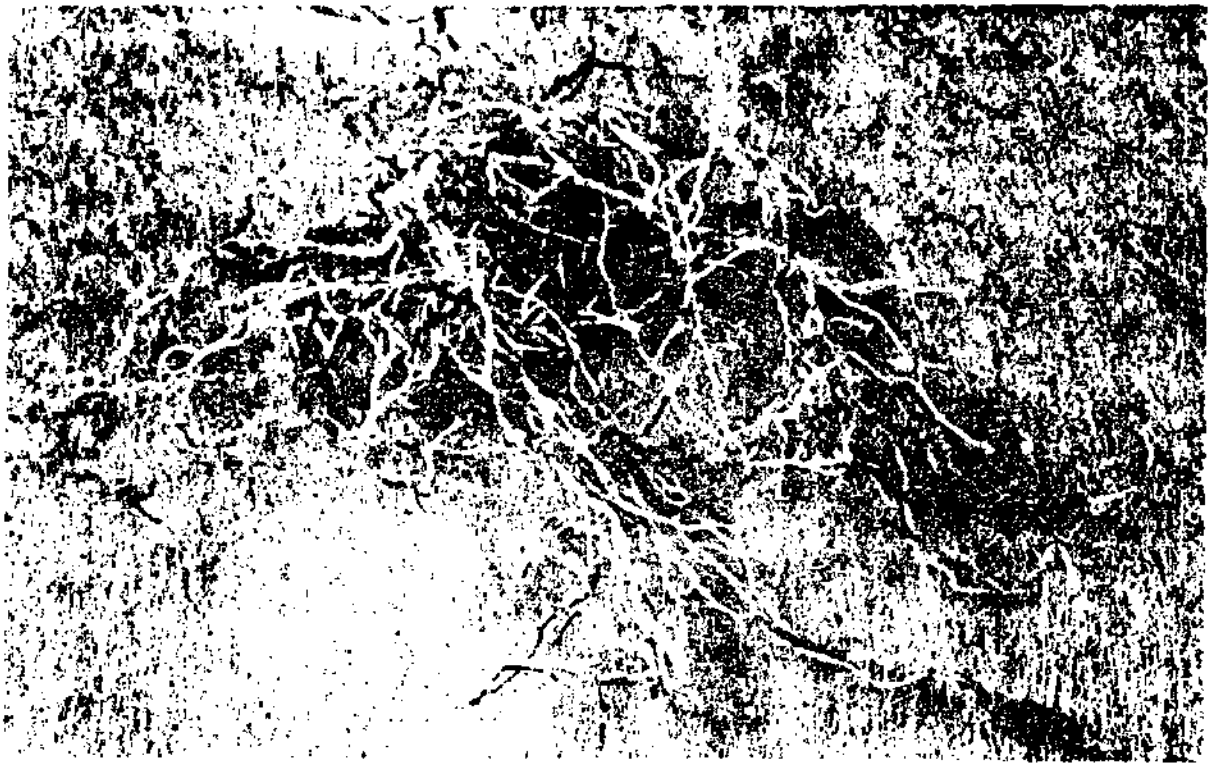

Fig. 1. Black lesions caused by Thielaviopsis basicola on root tip of Ilex crenata.

Contribution No. 471, Bureau of Plant Pathology, P. O. Box 1269, Gainesville, FL 32602.

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Fig. 2. Thielaviopsis basicola on Ilex crenata. Diseased and discolored roots on plant on left, healthy plant in center, and severe loss of roots caused by numerous root infections on plant on right.

HOST RANGE. Black root rot has been listed on numerous herbaceous ornamentals by Pirone (6). Thielaviopsis basicola has caused the failure of scion-rootstock grafts in several woody ornamentals (2). Six cultivars of Japanese holly are reported to be highly susceptible while I. vomitoria Ait. and I. opaca Ait. are moderately resistant and I. aquifolium L. and I. cornuta Lindl. are highly resistant (5).

When various ornamental and non-ornamental plants were inoculated in the greenhouse with T. basicola from Japanese holly, it was found that pansy (Viola tricolor L.) and English boxwood (Buxus sempervirens var. suffruticosa L.) were susceptible (7). Vegetables susceptible to infection included tomato (Lycopersicon esculentum Mill.), eggplant (Solanum melongena L.), bean (Phaseolus vulgaris L.), and cowpea (Vigna sinensis (Torner) Savi.). Field crops found to be susceptible include soybean (Glycine max L.), peanut (Arachis hypogaea L.), alfalfa (Medicago falcata L.), and tobacco (Nicotiana tabacum L.).

CONTROL. Only cuttings from healthy plants should be rooted on raised benches so as to avoid pathogen contamination from the soil. Rooting and growing media that contain soil, flats or containers, and benches should be free of the fungus. Pasteurization with aerated steam or fumigation with a chemical such as methyl bromide will eradicate conidia and chlamydospores in the growing medium.

REFERENCES.

1. Anonymous. 1978. Virginia Plant Disease Clinic Report. Dept. Plant Pathol. and Physiol., VPI & SU, Blacksburg, VA 24061. (unpublished)
2. Baker, K. F., L. H. Davis, and H. E. Thomas. 1953. Grafting failure of ornamentals induced by Thielaviopsis basicola. Plant Dis. Reptr. 37:526.
3. Bureau of Plant Pathology. 1979. Plant Disease Records, Division of Plant Industry, Fla. Dept. Agric. and Consumer Serv., Gainesville. (unpublished)
4. Lambe, R. C., and W. H. Wills. 1976. Thielaviopsis root-rot of Japanese holly. (Abstr.) Proc. Amer. Phytopathol. Soc. 3:264.
5. _____, _____, and L. A. Bower. 1979. Susceptibility of some Ilex species to Thielaviopsis basicola. SNA Nursery Research Journal 6(2).
6. Pirone, P. O. 1970. Disease and pests of ornamental plants. 4th ed. The Ronald Press. 546p.
7. Wills, W. H., and R. C. Lambe. 1976. Pathogenicity of Thielaviopsis basicola from Japanese holly (Ilex crenata) to some other host plants. Plant Dis. Reptr. 62:1102-1106.

The 1984 Annual Report of the

Plant Disease Clinic

A service of the Department of Plant Pathology, Seed and Weed Sciences

In cooperation with the Cooperative Extension Service,

Iowa State University, Ames, Iowa

Laura E. Sweets and Christopher J. Luley
Extension Plant Pathologist and Graduate Research Assistant

The Plant Disease Clinic (PDC) continued to offer a free plant disease diagnostic service to all Iowa residents and agricultural businesses in 1984. The primary purpose of this service is to diagnose plant diseases and to supply information on their development, control and prevention. As in the past, the PDC also served several other functions in addtion to the primary diagnostic service. These additional functions include the following:

(1) Providing a backup service for extension and IPM field staff on plant disease ID and control and other matters such as mushroom ID, pesticide recommendations and diagnosis of chemical injury to plants.

(2) The PDC provides the opportunity for students in plant pathology and other agricultural disciplines to gain first-hand in diagnosing plant problems.

a. Clinical Plant Pathology Course (PPSW 691)- A plant disease diagnosis course is taught in conjunction with the PDC every other summer. The PDC cooperated in teaching and providing samples for this course in 1984.

b. Graduate Student Assistant- A graduate student is employed year round on a three quarter time graduate assistantship. The student works full time during the growing season handling many of the mail samples, phone calls, and walks-ins. During the rest of the year the student participates in extension activities and meetings and handles incidental phone calls and samples.

(3) The PDC provides information on plant disease epidemics and new or unusual disease problems by contributing weekly articles to the Insect, Weed and Disease Newsletter and disease updates via the IPM EXNET computer system.

(4) The PDC cooperates with the IPM program in problem identification and scout training.

(5) The PDC cooperated in collecting samples, developing the format and teaching a workshop on the field and laboratory identification of tree diseases for the 1984 Shade Tree Short Course. This workshop wil be taught again in 1985.

(6) Cooperating with other extension and Plant Pathology Seed and Weed Science personnel to provide more indepth diagnosis or testing on certain problems. Specifically, nematode analysis of field crop soils was available through Dr. Norton and race testing of Phytophthora infected soybeans was conducted by Dr. Nyvall in 1984.

Activities of the PDC are directed by Drs. Robert Nyvall and Laura Sweets. Christopher Luley was the graduate student assistant for 1984. Assitance was also given by Dr. Epstein, Dr. Fawcett, Dr. Foley, Dr. Hill, Dr. Norton, Dr. Owen and other members of the Plant Pathology, Seed and Weed Science faculty. Mr. R. G. Hartzler handled the majority of the herbicide injury questions and samples. Calls and samples which were not disease problems, herbicide injury or weed identification were referred to Agronomy, Entomology, Forestry or Horticulture Extensions.

Samples Received During 1984

1. The PDC received a minimum of 1,903 samples (see Table 1) through the mail during 1984. Approximately 10 percent of these entries contained multiple samples (sometimes as many as five). Therefore, the number of samples actually received is significantly higher than 1,903. Starting in 1983, all samples recieved through the mail were entered on a computerized filing

system. Modifications of this system should eliminate the entry of multiple samples on one form and should make searching files easier. As in the past, all samples were answered with a letter containing the diagnosis, control recommendations and related printed matter.

TABLE 1. Breakdown by host of mail samples received during 1984.

Host	Number of Samples	Percent of Total Number of Samples
Trees	857	44.9%
conifers	(301)	(35.1%)
deciduous	(556)	(64.8%)
Field Crops	316	16.5%
soybeans	(166)	(52.3%)
corn	(76)	(24.0%)
forage	(49)	(15.5%)
small grains	(25)	(7.9%)
Herbicide Injury	190	9.9%
Fruits	159	8.3%
Flowering Annuals and Perennials	91	4.7%
Shrubs	73	3.8%
Vegetables	68	3.6%
Turf	58	3.4%
Miscellaneous	34	1.8%
Houseplants	32	1.7%
Mushroom ID	23	1.2%
Greenhouse crops	2	0.1%
TOTAL	1903	

2. Phone Calls

Although no record is kept of the number of phone calls received, the PDC answers between two and three thousand calls a year. The phone calls start as

soon as the temperatures begin warming up in the spring and they continue until the first killing frost in the fall. The Horticluture department initiated a hotline number in 1983 to answer horticulture related question. Although this may have alleviated some of the phone calls to the PDC, the number of phone calls still averages 30 to 50 a day. The phone calls are usually either requests for specific information or calls invovling a description of a problem for diagnosis and control recommendation. Most of the phone calls were answered during the course of the phone conversation or by sending the caller appropriate printed matter.

3. Walk-ins

Walk-ins include all contacts by individuals who come into the clinic in person with questions or samples. Samples brought in were usually in better condition than those recieved in the mail, and the individual was there to supply the information essential for accurate diagnosis. Walk-ins tend to require more time than mail or phone calls because individuals tend to ask numerous questions about their sample and the diagnosis and control recommendation. The majority of walk-ins were answered at the time of their visit. Some were referred to other departments. Some samples brought in required culturing or additional work and in these cases, a written response was sent to the individual.

Highlights of the 1984 Season

Non Field Crops: In the spring of 1984, the PDC cooperated with Dr. L. Tiffany and Dr. G. Knaphus on collecting samples of morels and false morels. All samples of these fungi were forwarded for species determination and charting distribution in the state.

The majority of early season samples were of winter injury to conifer and fruit trees. Other marginally hardy species such as privet were also damaged or killed by the severe winter. Symptoms of winter injury continued to develop throughout the first part of the growing season because of damage to cambial and bark tissues.

Diplodia tip blight of conifers and anthracnose of hardwoods were severe again in 1984 due to one of the wettest springs in 112 years. This is at least the third straight year of high levels of these diseases. The wet springs have significantly impacted conifers, many of which are now showing extensive dieback due to Diplodia and other foliar diseases. Naemacyclus needlecast was identified through the clinic as one of the important foliar diseases of conifers in many parts of the state. To date, hardwoods affected by successive years of anthracnose are not showing significant dieback due to this disease.

The wet spring also resulted in severe apple scab and cedar apple rust. Fire blight, peach leaf curl and plum pockets were other fruit tree diseases that reach noticable and damaging levels in 1984. Many samples of strawberries and raspberries were sent in that exhibited symptoms of winter injury along with black root rot and cane blights, respectively. The wet spring was equally favorable for Helminthosporium diseases of turf grass which appeared widespread throughout the state.

The driest August in 112 years produced many drought related disorders in trees, fruits and vegetables. Dry weather conditions in 1983 believed to be responsible for a large number of oak wilt samples diagnosed in 1984. The disease may continue to impact oaks because of drought conditions in 1984.

Vegetable diseases comprised only 3.6 percent of the total samples recieved. However, bacterial canker of tomato was identified in tomato plantings in the Muscatine area. The disease is believed to have been brought

in on diseased transplants grown outside the state. A study has been initiated to determine if the pathogen can overwinter under Iowa conditions. The potential of a continuing problem due to this disease may exist if it can successfully overwinter in the area. Identification of this disease and initiation of this study resuted directly because of the samples received in the PDC.

Field Crops: Soybean samples made up 52.3% of the total 316 field crop samples submitted. The majority of soybean samples and early season corn samples were of damping off or related later season root rot. Many farmers replanted a number of times due to seed decay or seedling blight which occurred because of the cool, wet spring. The unfavorable spring growing conditions also resulted in many samples of apparent herbicide injury to crop plants. These samples along with non-field crop herbicide related cases made up nearly 10% of the clinic samples in 1984. Although this is a definite increase from previuous years, these samples were efficently and astutely handled by R. G. Hartzler, Dr. Mike Owen and Dr. Richard Fawcett.

The wet spring also again resulted in high levels of wheat scab and foliar diseases of wheat. Many samples of Phytophthora root rot of alfalfa were diagnosed, possibly because of wet soil conditions early in the season.

Late season dry weather slowed the spread of foliar diseases of corn and soybeans. Grey leaf spot appeared again in southeast Iowa, although it caused minimal damage because of dry weather conditions. However, charcol rot of soybeans which often appears in hot, dry years, was identified from the southern portion of the state.

Soybean cyst nematode has now been found in ten counties, mainly in the northern part of Iowa. The latest find of the nematode in Wright county moves the pathogen significantly closer to the central region of the state.

THE UNIVERSITY OF MARYLAND
Cooperative Extension Service
College Park - Eastern Shore

ANNUAL REPORT
PLANT DIAGNOSTIC CLINIC
1984

Department of Botany
University of Maryland
College Park, MD 20742

ANNUAL REPORT - PLANT DIAGNOSTIC CLINIC
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I. INTRODUCTION

The primary function of the Plant Diagnostic Clinic is to provide Maryland Cooperative Extension Service agents and specialists with the laboratory backup needed for accurate diagnosis of plant diseases on all crops.

Since its establishment in 1979 by the Department of Botany and the Maryland Cooperative Extension Service (MCES) the Clinic has examined over 7,000 plant samples. The Clinic cooperates with University extension, research and teaching faculty, with researchers at the USDA-SEA Beltsville Agricultural Research Center, and with the Maryland Department of Agriculture. The Clinic is an integral part of the Department of Botany, providing opportunities for practical experience in the diagnosis of plant diseases. Clinic staff and facilities are used for workshops to train MCES agents, Master Gardener volunteers and IPM scouts.

II. OPERATIONS - 1984

From January 1, 1984 through December 31, 1984 the Clinic examined 1354 samples, of which 52% were submitted by MCES faculty (Table 1). Detailed records are kept of all samples. A written response is sent for all samples, with control options explained when appropriate. Clinic staff also answered about 1,000 telephone inquiries from MCES faculty, growers, agriculture consultants, IPM scouts, businesses and the public.

Table 1. Affiliation of persons submitting samples to the Clinic.

	Number of Samples	Percent of Total
MCES faculty	708	52
General public (not via MCES faculty)	283	21
Urban IPM MCES project	87	7
Commercial consultants - (Parks, nurseries, lawn services, ect.)	207	15
Not in Maryland, miscellaneous	69	5
Total	1354	

First priority is assigned to samples submitted via MCES personnel and to samples which represent high value agricultural, nursery or greenhouse crops. Samples submitted direct to the Clinic by home gardeners are processed as time permits but the diagnosis is sent to the county agent who then contacts the client. This policy is intended to encourage the public to become acquainted with their local county extension service.

No fees are charged for Clinic services; however, grants-in-aid and contributions to the Department of Botany are accepted from commercial clients using the Clinic.

Table 2. Number of samples submitted - by month.

	1979 - 1983 average	1984
January	25	31
February	30	40
March	55	54
April	100	90
May	183	156
June	299	279
July	237	229
August	157	156
September	123	141
October	85	103
November	40	51
December	19	24
Total	1353	1354

Most samples are submitted during the period May through September (Table 2). Part-time labor is hired for this period. Most diagnoses are based upon microscopic examinations and identification of causal agents by symptoms and signs. More elaborate and time consuming procedures are required for most diseases caused by bacteria, viruses and some fungi. Culturing of causal agents or other elaborate procedures were performed on 310 samples in 1984.

The Clinic staff always endeavors to respond promptly. Most samples are diagnosed in three days or less. The Clinic has consistently maintained a short turnaround time averaging 1.7 days in 1984 (Table 3).

Table 3 Response Time

Days	Number of samples (%) total 1979-83	Number of samples (%) 1984
0-3	4518 (69)	933 (69)
4-6	893 (14)	231 (17)
7-10	541 (8)	148 (11)
Over 11	616 (9)	41 (3)
Mean days to reply	3.0	1.7

As in previous years, the percentage of samples from ornamentals remains high at 62%. This category endompasses the largest number of plants growing under the most diverse conditions. Samples from production agriculture represent a relatively small number of samples, but often present very interesting and challenging cases which may requi a visit to the site by Clinic staff or MCES specialists. MCES agents are generally familiar with diseases, pests and other problems on crops, and usually submit good samples for unusual crop problems (Table 4).

Table 4. Sample totals by major crop categories.

	Number of samples	Percent of total
Woody Ornamentals - landscape, nursery, tree fruit and turf	648	48
Herbaceous Ornamentals - flowers, indoor plants, and greenhouse crops	182	14
Vegetables	81	6
Agronomic and Forage Crops	76	6
Small Fruit	47	4
Total*	1034	

*Note: This total is less than the yearly total because some samples did not fit into these categories

Most plant diseases are caused by fungi, and samples diagnosed by the Clinic reflect this fact (Table 5 - see following page). A substantially smaller number of "bad samples", that is those in poor condition and/or with inadequate information on symptoms, cultural practices, etc. were submitted in 1984 as compared with previous years From 1979 through 1983, "bad samples" comprised about 17% of the total. In 1984 only 66 "bad samples" comprising only 5% of the total were sent to the Clinic. This is a big improvement which reflects the increased care that MCES agents are taking when submitting samples to the Clinic.

Table 5. Distribution of samples by major diagnostic categories.

		Number of Samples	% of Total***
Plant diseases - biotic agents		466	34%
fungal	395		
bacterial	51		
*nematode	6		
viral	14		
Plant diseases - abiotic agents		389	29%
herbicide	107		
drought, heat, cold	58		
other, mechanical, animals, nutrient, cultural	224		
Insect and mite damage		170	13%
Identifications		144	11%
higher plants	107		
fungi, algae, lichens, etc.	11		
insects, other invertebrates	26		
Unsuitable or insufficient sample		66	5%
Miscellaneous inquiries		202	15%
	Total	1437**	

* Most suspected nematode problems are directed to the department of Botany's Nematode Assay lab which performs all assays of soil samples for nematodes. The Plant Clinic does not analyze soil for nematodes.

** The total number of diagnoses is greater than the number of samples since some samples had more than one problem

*** This is the percentage of samples diagnosed as having a problem in each group listed; these will be greater than 100% since some samples had more than one problem.

For a detailed listing of 1984 Clinic diagnoses see Appendices at the end of this report.

Samples are being submitted from all regions in the state. As in previous years, most walk-in samples are from counties located near the College Park campus (Table 6).

Table 6. Regional Distribution of Samples from Maryland

	Extension Samples*	Public Samples**
Western Maryland (Garrett, Allegany, Washington, Frederick)	42	9
Central Maryland (Carroll, Baltimore, Harford, Cecil, Kent, Queen Anne)	146	23
Washington, D.C. - Baltimore Metropolitan Area (Howard, Montgomery, Baltimore City, Prince Georges)	269	134
Southern Maryland (Anne Arundel, Calvert, Charles, St. Mary's)	100	17
Eastern Shore (Talbot, Caroline, Dorchester, Wicomico, Somerset, Worchester)	151	11

*Extension samples include all those submitted or referred by MCES agents, specialist or extension programs including samples from IPM programs.

**Public samples are those submitted direct to the plant clinic without prior consultation with MCES field faculty.

III. STAFF AND CONSULTANTS

Ethel Dutky, Faculty Extension Assistant in the Department of Botany, is the Clinic diagnostician who examines all samples, trains and supervises other Clinic workers and students and is responsible for the day-to-day operation of the laboratory. Erica Barditch and Alan Brooks (undergraduate students majoring in Botany) worked as Clinic technicians. Karen Kackley (M.S.-Horticulture) and Penny Wolkow (M.S.-Plant Pathology) worked as Clinic summer assistants. Both Karen and Penny have worked for several seasons in the Clinic and are able to manage all Clinic operations when Ms. Dutky is out of town.

The Clinic cooperates with and benefits from assistance from faculty and staff in the Departments of Agronomy, Botany, Horticulture and Entomology. I am especially grateful to the following Botany faculty, staff and students who assisted the Clinic on a regular basis: Dr. Jerome Motta for identification of fungi; Dr. Steven Hill, Ms. Hollie Bedell and Mr. Conley McMullen for plant identifications; Dr. Lorin Krusberg and Ms. Sandra Sardanelli,

Nematology Diagnostic Laboratory for nematode identifications and all assay of soil when nematode damage was suspected; Dr. Kenneth Corbett and graduate students Mark Fox and Ed Podleckis for identification of viruses; Dr. Paul Steiner for consultation on fruit problems; Dr. Arvydas Grybauskas for consultation on field crops, small grains and computer hardware and software; Dr. James Kantzes for aid with vegetables and field crops and for his support, advice and encouragement.

IV. 1984 PLANT DISEASE HIGHLIGHTS

Weather is a major factor determining the severity and incidence of plant diseases. In 1984 a moderate winter with several very cold periods, a cool, wet spring with cold periods into early summer, a moderate summer with adequate rainfall which extended into a mild fall and early winter provided conditions for specific plant disease problems.

The very cold periods in the 1983-84 winter started with an abrupt drop to sub-freezing temperatures on Christmas Eve, 1983 and caused severe cold injury to many ornamentals in most of Maryland. Many large deodar cedars were killed throughout most of Maryland except for parts of Southern Maryland and the southern part of the Eastern Shore.

One benefit of the cold winter was seen on small grains. The severity of various leaf diseases (e.g. rusts and powdery mildew) on winter cereals is largely dependent on the carry over of inoculum on leaf tissue infected in the fall. In 1984 both mildew and rust were delayed, largely due to the removal of most of this leaf tissue during the severe winter.

The wet spring was favorable for wheat spindle streak mosaic virus (WSSMV) which is vectored by a soil water mold, Polymyxa graminis. WSSMV, confirmed by electron microscopy, was widespread in Maryland. Warm spring weather probably prevented yield reductions.

The cold, wet spring was ideal for a new disease on the flowering dogwood, Cornus florida, caused by the fungus Discula sp. Symptoms include leaf spots, anthracnose, twig and branch blight, cankers and death of entire trees. This disease has been causing serious losses to woodland and landscape dogwoods in the Northeast for over six years. It was first found in Maryland in 1983. In 1984 Discula anthracnose was associated with death of large numbers of woodland dogwoods in several counties in Western and Central Maryland.

The cold weather which continued into early summer caused losses to watermelon transplants which respond to chilling with sudden wilt, collapse and death.

The summer had plentiful rainfall which was good both for many diseases and crop growth. Maryland saw record corn crop yields in 1984. Many foliage diseases were plentiful on corn. Dr. Arvydas Gryhauskas, graduate student Kent Smith (Botany) and Dr. Peter Thomison (Agronomy) conducted a survey for gray leaf spot (Cercospora zeae-maydis) detecting the disease in corn areas throughout the state.

The plentiful rainfall was favorable for the spread of several bacterial blights on vegetables and ornamentals. Bacterial blight was very common on peppers. A bacterial leaf spot and blight was very common on zinnia. Bacterial soft rot was prevalent in canteloupes and melons, causing much post harvest loss and complaints from consumers of poor flavor and texture.

A detailed listing of diseases diagnosed in 1984 is provided in Appendix I.

V. COOPERATIVE PROJECTS

The Clinic continues to be an essential part of Urban and Field Crops Integrated Pest Management (IPM) programs initiated by faculty in the Department of Entomology. Clinic staff trained IPM scouts, diagnosed plant problems and contributed disease control information for IPM programs and newsletters.

The Department of Horticulture is conducting a long-term variety trial at the Sharpsburg Research and Education Center to evaluate pest and disease resistant apple cultivars for Maryland. Ms. Dutky is the plant pathologist for this project. The clinic diagnoses diseases which occur in other variety trials and research plots on fruit, vegetables, and ornamentals, especially in cases where the causal agent must be isolated in culture to confirm the field symptom diagnosis.

The Clinic continues to work with researchers at the USDA-SEA Agricultural Research Center at Beltsville and the Plant Protection staff of the Maryland Department of Agriculture to exchange information on plant diseases in Maryland.

The Clinic is participating in the National APHIS Pest and Disease Detection program. Funding is provided by this program to aid the Clinic in computerized data storage and retrieval so that Clinic data can be contributed to the national system.

VI. EDUCATIONAL ACTIVITIES

A - Training sessions, workshops and meetings.

Ms. Dutky taught the plant disease diagnosis and control portion of the first Ornamental Plants, Pest and Diseases Short Course, which met once a week for eight weeks. Dr. John Davidson (Entomology) organized the short course to train Maryland Arborists in the use of IPM to control pests and diseases in the landscape.

Ms. Dutky, Dr. Peter Dernoeden (Agronomy) and Dr. Lee Hellman (Entomology) presented a one-day workshop on diagnosis of turf problems for Master Gardener volunteers and MCES agents.

During the spring and summer growing season MCES field faculty organize six regional Plant Clinics which meet biweekly to discuss the current situation in production agriculture. Clinic staff attended and spoke at these clinics as often as possible and were invited speakers at three clinics.

Ms. Dutky presented talks on plant disease diagnosis and control including the following: Baltimore County Commercial Vegetable Growers, Davidsonville Commercial Vegetable Growers, Allegany County Commercial Fruit and Vegetable Growers, Vine Crops Meeting - Upper Eastern Shore, Rockawalkin Commercial Vegetable Growers, New Jersey Delmar Va. Plant Pathologists Regional Conference, Maryland Nurseryman's Day, Talbot County Nurseryman's Day, Maryland Christmas Tree Growers Summer Field Day, Western Maryland Research and Education Center Field Day, Maryland Arborists Association, Metropolitan Shade Tree Conference, Triennial Extension Conference - Southern Region.

Ms. Dutky visited Senegal and Guinea-Bissau to consult with several AID plant protection projects in establishment of a national plant diagnostic clinic for the plant protection service in each country.

Ms. Dutky presented guest lectures on plant diseases for several courses in Entomology and Horticulture. Ms. Dutky served as a committee member for two Horticulture M.S. students and three Entomology M.S. students

B - Printed materials.

The Clinic staff produces a newsletter, Plant Clinic Notes, which provides a brief review of current plant problems seen by the Clinic. The newsletter is sent to MCES faculty and cooperators. Ms. Dutky wrote features for the Maryland Greenhouse Growers News, Maryland Nurserymen's News, and a column for the Maryland Arborist's Newsletter, "Shady Notes".

Ms. Dutky revised Bulletin 294, Control of Plant Diseases in Maryland Landscapes, and PPM #26, Diplodia Tip Blight of Pines." She wrote the disease diagnosis and control portion of Bulletin #165, Growing Azaleas, and two new plant pathology mimeos, PPM #11 Cytospora Canker of Spruce and PPM #54 Juniper Blights, Phomopsis and Kabatina.

VII. FUNDING

The Maryland Cooperative Extension Service funds salaries, wages, equipment and instate travel. Space, administrative and secretarial support are provided by the Department of Botany. Out-of-state travel for Ms. Dutky and some equipment and supplies are supported by gifts

and grants-in-aid to the Department of Botany for the Clinic. The Department of Entomology supported the Clinic through administration of the APHIS pest and disease detection project and by sharing equipment.

VIII. FUTURE PROGRAM AREAS

Sample number remains at a stable level and I do not anticipate a large increase in 1985. Computer hardware and software was delivered in fall, 1984. We will continue to work with the computer to improve data storage and retrieval. The appendices and tables for this report were done on the Clinic computer.

I shall continue to work with other MCES specialists to improve pest and disease identification, to promote the use of Integrated Pest Management practices to reduce losses, and to improve safety in use of pesticides. I will contribute to workshops, training sessions, mass media presentations and printed material oriented to specific commodity groups and specific population sectors.

The largest budget item for Clinic operations is salaries and wages. I continue to look for ways to provide additional funding to the Clinic, for summer labor and additional equipment.

I look forward to a busy and productive year in 1985.

Respectfully submitted,

Ethel M. Dutky
Faculty Extension Assistant
Department of Botany

EMD/kms

Appendix I DISEASES and PESTS

A. Woody Ornamentals, Tree Fruit, and Vines

Abies, Fir (4)
- Wilt - Pine Wood Nematode, Bursaphelenchus xylophilus
- Needle Browning - Spider Mite
- Needle Browning and Drop - Dog Urine Injury
- Needle Bronzing - Herbicide
- Weak Growth - Transplant Shock

Acer, Maple (30)
- Brown Leaf Blotches - Anthracnose, Gloeosporium sp.
- Leaf Spot, Phyllosticta minima
- Wilt - Verticillium albo-atrum
- Dieback - Ostershell scale, Lepidosaphes ulmi
- Leaf Curl - Spider Mite, Tetranychidae
- Gall - Eriophyid Mite, Vasates quadripedes
- Bark splitting - cultural, failed to wrap young tree
- Decline - stress complex
- Leaf Scorch - Root disturbance
- Decline - Soil compaction
- Wet wood - due to bark injury
- Leaf Tattering - Wind Injury

Aesculus hippocastanum, Horse-Chestnut (1)
- Leaf Blotch - Guignardia aesculi

Albizia julibrissin, Silk Tree (1)
- Branch Dieback - Mimosa Wilt, Fusarium oxysporum f. perniciosum

Amelanchier, Juneberry (1)
- Dieback - Ostershell scale, Lepidosaphes ulmi

Aucuba japonica, Japanese Laurel (2)
- Blight - Phomopsis sp.
- Necrotic Leaf Spots - Chemical Injury

Betula, Birch (4)
- Black Spots on Leaves - Sooty mold, Cladosporium sp.
- Brown Areas on Leaves - Leaf Miner - Fenusa pusilla
- Dieback - Bronze birch borer, Agrilus anxius
- Distorted Growth - Herbicide injury - phenoxy type

Buxus, Boxwood (25)
- Dieback - Blight and Canker, Volutella buxi
- Dieback - Root rot, Rhizoctonia sp.
- Leaf spot, Macrophoma sp.
- Dieback - Nematodes, Rotylenchus sp. and Trichodorus sp.
- Leafminer, Monarthropalpus buxi
- Leaf Curl Psyllid, Psylla negundinis
- Stunting and Marginal Chlorosis - Herbicide injury
- Dieback - Mechanical damage
- Dieback - Winter injury

Calluna vulgaris, Heather (1)
- Decline - Cultural

Camellia (1)
- Leaf Spots - Spray injury

Carpinus, Hornbeam (1)
- Necrotic Leaf Spots - Site problem

Carya illinoensis, Pecan (1)
- Nuts Fail to fill - cultural

Castanea, Chestnut (3)
- Dieback - Blight, Endothia parasitica
- Canker - due to injury
- Dieback - Herbicide injury - phenoxy type

Cedrus deodara, Deodar Cedar (15)
- Blackening of Needles - Chemical injury
- Decline and Death - Winter injury
- Flagging of New Growth - Salt injury

Celtis occidentalis, Common Hackberry (1)
- Nipple Gall, Eriophyid mite, Pachypsylla celtidismamma

Cercis, Redbud (1)
- Necrotic Leaf Spots - Herbicide injury

Cladrastis lutea, Kentucky Yellow-Wood (1)
- Bleaching of foliage - Chemical injury

Cornus florida, Dogwood (24)
- Blight - Anthracnose, Discula sp.
- Fruit spot, Septoria cornicola
- Leaf spot, Ascochyta cornicola
- Leaf spot, Septoria sp.
- Leaf spot, Phyllosticta sp.
- Flossy substance - Flatid Plant Hopper, Anormenis septentrionalis
- Wilting - Borer, Oberea tripunctata
- White Mass - Scale, Pulvinaria innumerabilis
- Decline - trunk injury
- Leaf Scorch - Transplant shock
- Herbicide injury - growth regulator type
- Stunting and Bronzing of Leaves - triazine injury
- Scorch - due to root injury

Crataegus, Hawthorn (4)
- Galls - Rust, Gymnosporangium clavipes
- Leaf Stippling - Lace Bug, Corythucha cydoniae

Cryptomeria (5)
- Needle Browning, Decline - Maskell scale, Lepidosaphes pallida
- Needle Browning, Decline - Spider mites, Tetranychidae
- Needle Browning - Chemical Injury
- Dieback - Winter injury

Cunninghamia lanceolata, China fir (1)
- Browning - Normal Fall Browning

Deutzia (1)
- Leaf Stippling - Tarnished Plant Bug, Lygus lineolaris
- White Mass - Flatid plant hopper, Anormenis septentrionalis

Diospyros kaki, Japanese Persimmon (1)
- Dieback - Canker, Botryosphaeria ribes

Elaeagnus (1)
- Honeydew - Aphids, Capitophorus elaeagni

Euonymus (10)
- Necrotic Leaves and stems - Anthracnose, Colletotrichum sp.
- Black Leaf Spot, Cladosporium sp.
- Dieback - Euonymus scale, Unaspis euonymi
- Leaf Notching - weevil
- Leaf Browning and Drop - Chemical injury
- Reddish Leaf Mottle - Drought injury
- Dieback - Winter injury

Fagus, Beech (5)
- Leaf Spots - Anthracnose, Gloeosporium sp.
- White Mass - Aphid, Phyllaphis fagi
- Yellow Leaf Patches - Eriophyid mite, Aculitus fagerinea
- Sooty mold - Secondary to Insects

Ficus carica; Fig (2)
Fruit Rot - Fruit Flies

Forsythia (2)
Dieback - Canker, Botryosphaeria sp.

Fraxinus; Ash (3)
Leaf Spot - Anthracnose; Gloeosporium aridum

Ginko biloba; Maidenhair-Tree (1)
Leaf Scorch - Drought

Gleditsia; Honey Locust (2)
Distorted Leaves - Leaf Hopper; Macropsis fumipennis
Distorted Leaves - Plant Bug; Diaphnocoris chlorionis

Gordonia altamaha; Franklinia (1)
Chlorosis - Scale; Pulvinaria floccifera

Gymnocladus; Kentucky Coffee-Tree (1)
Leaf Stippling - Spider Mite; Tetranychus urticae

Hedera helix; English Ivy (6)
Dieback - Anthracnose; Amerosporium trichellum
Leaf Spot; Xanthomonas hederae
Dieback - Spider Mite; Tetranychus urticae

Hibiscus syriacus; Rose of Sharon (1)
White Egg Masses - Scale; Pulvinaria sp.

Hydrangea quercifolia; Oak Leaf Hydrangea (1)
Leaf Spot - Chemical Injury

Ilex; Holly (14)
Leaf Spot; Phyllosticta sp.
Defoliation - Root Rot; Thielaviopsis basicola
White Masses - Scale; Pulvinaria floccifera
Death - Chemical Injury
Decline - Winter Injury
Leaf Spot - Boron Deficiency

Juglans regia; English Walnut (3)
Dieback - Botryosphaeria sp.
Chewed Fruits - Squirrel Injury

Juniperus; Juniper (61)
Twig Blight; Phomopsis juniperovora
Twig Blight; Kabatinar juniperi
Root Rot; Phytophthora sp.
Dieback - Scale; Carulaspis juniperi
Dieback - Tip Midge; Oligotrophus betheli
Dieback - Spider Mites; Tetranychidae
Dieback - Chemical Injury
Twig Dieback - poor drainage
Dieback - Soil compaction

Kalmia latifolia; Mountain Laurel (1)
Leaf Blight; Phomopsis kalmiae

Koelreuteria paniculata; Panicled Golden Rain Tree (2)
Curling Leaves - Chemical Injury
Dieback - Winter Injury

Lagerstroemia indica; Crape myrtle (1)
Leaf Scorch - Chemical Injury

Leucothoe fontanesiana (1)
Red Leaves - Transplant Shock

Ligustrum; Privet (2)
Leaf Notching - Weevil
Dieback - Winter Injury

Liriodendron tulipifera; Tulip Tree (1)
Cupping & Twisting of Leaves - Herbicide Injury

Platanus; Plane Tree (3)
Anthracnose; Gnomonia sp.
Dieback - Scale; Coccoidea
Canker - Mechanical Injury

Populus; Popular (4)
Leaf Spot; Marssonia sp.
Rust; Melampsora sp.

Prunus; Peach; Cherry; Plums;
Nectarines; and Apricots (37)
Gall - Black Knot; Dibotyron morbosum
Blight; Phomopsis sp.
Fruit Rot; Botrytis sp.
Leaf Blister; Taphrina cersai
Leaf Spot; Cylindrosporium sp.
Canker; Fusicoccum sp.
Leaf Curl; Taphrina deformans
Wood rot; Fomes sp.
Canker - Borer; Synantheodon pictipes
Dieback - Scale; Quadraspidiotus perniciosus
Dieback - Scale; Pulvinaria sp.
Leaf spot - Captan Spray Injury
Distorted Leaves - Phenoxy Herbicide Injury
Leaf Spot - Magnesium and Calcium Deficency
Leaf Scorch - Root Injury
Dieback - Winter Injury

Pseudotsuga menziesii; Douglas Fir (4)
Distorted foliage - Aphid; Adelges cooleyi
Root Rot - Poor Drainage
Wilting - Transplant Shock

Pyracntha (2)
Dieback - Sawwores; Thyridopteryx ephemeraeformis
Leaf Notching - Weevil; Callirhopalus bilaciatus
Dieback - Winter Injury

Pyrus; Pear (3)
Canker; Nectria cinnabarina
Marginal Necrosis - Chemical Injury
Necrotic Leaves - Poor Site

Quercus; Oak (31)
Canker; Nectria sp.
Leaf Spot; Actinopelte dryina
Oak Anthracnose; Gnomonia quercina
Leaf Blister; Taphrina caerulescens
Powdery Mildew; Phyllactinia corylea
Root rot; Ganoderma sp.
Twig Gall; Callirhytis punctata
Midge Gall; Macrodiplosis erubescens
Oak Skeletonizer; Bucculatrix ainsliella
Dieback - Scale; Melanaspis obscura
Decline - Borer; Cerambycidae
Canker - Borer; Agrilus bilineatus
Decline - Soil Compaction
Cupped Leaves - Herbicide Injury
Winter Injury

Rhododendron; Azalea (26)
Leaf Gall; Exobasidium vaccinii
Leaf Drop - Cylindrocladium sp.
Dieback - Phytophthora cinnamomi
Leaf Spot; Mycosphaerella sp.
Leaf Spot; Phyllosticta sp.
Dieback - Botrysosphaeria ribes
Petal Blight; Ovulinia azalea
Leaf Blotch - Leaf Miner;
Gracillaria azallela
Yellowed Leaves - Lacebug;
Stephanitis pyrioides
Leaf Notching - Weevil

Plantanus, Plane Tree (3)
- Anthracnose, Gnomonia sp.
- Dieback - Scale, Coccoidea
- Canker - Mechanical Injury

Populus, Popular (4)
- Leaf Spot, Marssonia sp.
- Rust, Melampsora sp.

Prunus, Peach, Cherry, Plums, Nectarines, and Apricots (37)
- Gall - Black Knot, Dibotyron morbosum
- Blight, Phomopsis sp.
- Fruit Rot, Botrytis sp.
- Leaf Blister, Taphrina cersai
- Leaf Spot, Cylindrosporium sp.
- Canker, Fusicoccum sp.
- Leaf Curl, Taphrina deformans
- Wood rot, Fomes sp.
- Canker - Borer, Synantheodon pictipes
- Dieback - Scale, Quadrasspidiotus perniciosus
- Dieback - Scale, Pulvinaria sp.
- Leaf spot - Captan Spray Injury
- Distorted Leaves - Phenoxy Herbicide Injury
- Leaf Spot - Magnesium and Calcium Deficency
- Leaf Scorch - Root Injury
- Dieback - Winter Injury

Pseudotsuga menziesii, Douglas Fir (4)
- Ditorted foliage - Aphid, Adelges cooleyi
- Root Rot - Poor Drainage
- Wilting - Transplant Shock

Pyracntha (2)
- Dieback - Bagworms, Thyridopteryx ephemeraeformis
- Leaf Notching - Weevil, Callirhopalus bifaciatus
- Dieback - Winter Injury

Pyrus, Pear (3)
- Canker, Nectria cinnabarina
- Marginal Necrosis - Chemical Injury
- Necrotic Leaves - Poor Site

Quercus, Oak (31)
- Canker, Nectria sp.
- Leaf Spot, Actinopelte dryina
- Oak Anthracnose, Gnomonia quercina
- Leaf Blister, Taphrina caerulescens
- Powdery Mildew, Phyllactinia corylea
- Root rot, Ganoderma sp.
- Twig Gall, Callirhytis punctata
- Midge Gall, Macrodiplosis erubescens
- Oak Skeletonizer, Bucculatrix ainsliella
- Dieback - Scale, Melanaspis obscura
- Decline - Borer, Cerambycidae
- Canker - Borer, Agrilus bilineatus
- Decline - Soil Compaction
- Cupped Leaves - Herbicide Injury
- Winter Injury

Rhododendron, Azalea (26)
- Leaf Gall, Exobasidium vaccinii
- Leaf Drop - Cylindrocladium sp.
- Dieback - Phytophthora cinnamomi
- Leaf Spot, Mycosphaerella sp.
- Leaf Spot, Phyllosticta sp.
- Dieback - Botrysosphaeria ribes
- Petal Blight, Ovulinia azalea
- Leaf Blotch - Leaf Miner, Gracillaria azaliela
- Yellowed Leaves - Lacebug, Stephanitis pyrioides
- Leaf Notching - Weevil

Rhododendron, Azalea (Continued)
- Dieback - Drought
- Death - Cold Injury
- Chlorosis - Iron Deficiency
- Dieback - Fertilizer Burn
- Death - Deep Planting
- Tattered Leaves - Wind Damage

Rhododendron, Rhododendron (32)
- Dieback - Root Rot, Phytophthora cinnamomi
- Dieback - Botrysosphaeria ribes
- Yellowed Leaves - Lacebug, Stephanitis pyrioides
- Dieback - Deep Planting
- Flower Bud Death - Cold Injury

Robinia pseudoacacia, Black Locust (2)
- Root rot, Fomes rimosus
- Leafminer, Xenochalepus dorsalis

Rosa, Rose (7)
- Blight, Botrytis cinerea
- Bud Blast, Botrytis cinerea
- Crown Gall, Agrobacterium tumifaciens
- Root rot, Pythium sp.
- Deformed Growth - Herbicide Injury

Salix, Willow (2)
- Bacterial Wetwood, Erwinia sp.
- Dieback - Mechanical Injury

Sambucus canadensis, American elder (1)
- Rust, Puccinia balleyana

Sophora japonica, Japanese Pagoda Tree (1)
- Twig Canker, Fusicoccum sp.

Sequoiadendron giganteus, Giant Sequoia (1)
- Canker, Pestalotia funerea
- Canker, Phomopsis juniperovora

Styrax japonica, Snowbell (1)
- Bark Splitting & Peeling - Borers

Syringa vulgaris, Common Lilac (3)
- New Growth Deformed - Chemical Injury
- Interveinal Chlorosis - Nutrient Deficiency

Taxus, Yew (14)
- Dieback - Scale, Aspidiotus cryptomeriae
- Dieback - Scale, Lecanium fletcheri
- Death - Chemical Injury
- Blighted Tips - Herbicide Injury
- Dieback - Salt Injury
- Root Rot - poor drainage
- Needle Yellowing - Transplant Shock

Thuja, Arborvitae (6)
- Needle Browning - Mite, Tetranychus urticae
- Dieback - Root Injury

Tilia, Linden (4)
- Leaf Stippling - Leafhopper, Cicadellidae
- Dieback - Soil Compaction

Tsuga, Hemlock (8)
- Chlorosis - Wooly Adelgid, Adelges tsugae
- Needle Browning - Scale, Fiorinia externa
- Dieback - Drought Injury (from prior year)

Toxicodendron radicans, Poison Ivy (1)
- Leaf Gall - An Eriophyid Mite, Aculops toxicophagus
- Twisted Leaves - Herbicide Injury (2,4-D)

Ulmus, Elm (18)
Flagging - Dutch Elm Disease; Ceratocystis ulmi
Wetwood - Erwinia sp.

Viburnum plicatum tomentosum;
Doublefile Viburnum (1)
Dieback - Dog Urine Injury
Cankers - Borers

Vinca, Myrtle (5)
Dieback - Blight, Phomopsis sp.
Dieback - Canker, Phoma sp.
Blight, Sclerotium rolfsii

Wisteria (3)
Curling Leaves - 2,4-D Injury

Zelkova (1)
Leaf Bronzing & Drop - Air Pollution Injury

Vegetables

Arachis hypogaea, Peanuts (1)
Leaf Spot, Cercospora personata
Pepper Spot, Leptosphaerulina crassiasca

Armoracia, Horseradish (3)
Leaf Spot, Alternaria sp.
Leaf Spot, Xanthomonas sp.

Asparagus officinales, Asparagus (4)
Crown Rot, Fusarium moniliforme
Distorted Spears - Late Frost Injury

Basella, Malabar Spinach (1)
Leaf Spot - Insect Feeding Injury

Brassica, Cruciters (Cabbage, Cauliflower, ect.) (8)
Yellows, Fusarium oxysporum
Wirestem, Rhizoctonia solani
Marginal Chlorosis - Magnesium Deficiency
Stem Cavities - hot weather

Capsicum, Pepper (13)
Bacterial Spot, Xanthomonas vesicatoria
Blight, Fruit Rot, Alternaria sp.
Wilt, Fusarium sp.
Leaf Distortions - Chemical Injury

Citrullus vulgaris, Watermelon (1)
Collapse of Young Plants - Cold Injury

Cucumis melo, Cantaloupe and Musk-Melon (14)
Anthracnose, Colletotrichum lagenarium
Downy Mildew, Pseudoperonospora cubensis
Wilt, Fusarium oxysporum f. melonis
Leaf Spot, Alternaria sp.
Fruit Rot, Erwinia carotovora

Cucumis sativus, Cucumber (2)
Anthracnose, Colletotrichum sp.
Leaf Mottling, Cucumber Mosaic Virus

Cucurbita, Squash (1)
Leaf Death - Sunburn and Cold Injury

Ipomoea batatas, Sweet Potato (3)
Scurf, Monilochaetes infuscans
Stem Rot, Fusarium sp.

Lycopersicon esculentum, Tomato (16)
Bacterial Spot, Xanthomonas vesicatoria
Leaf Spot, Septoria lycopersici
Two-spotted Spider Mite, Tetranychus urticae
Deformed Foliage - 2,4-D Injury (a herbicide)
Walnut Wilt - a toxin from walnut roots

Phaseolus, Garden Beans (LimaGreen) (4)
Root Rot, Fusarium solani
Pod Distortion - Stink Bug Feeding Injury

Pisum sativum (4)
Bacterial Leaf Spot, Pseudomonas syringae
Root and Stem Rot, Rhizoctonia solani
Root Rot, Fusarium solani f. pisi

Rheum rhaponticum, Rhubarb (1)
Leaf Spot - Curculio, Lixus concavus

Solanum tuberosum, Potato (4)
Deformed Tuber - Root-Knot Nematode, Meloidogyne sp.
Purple Leaves - Nutrient Imbalance

Vigna sinensis, Black-eyed Beans (1)
Root Rot, Rhizoctonia solani

C. Fruit

Fragaria, Strawberry (11)
Black Root Rot - fungal complex and poor drainage
Fruit Rot, Botrytis sp.
Leaf Blight, Dendrophoma sp.
Powdery Mildew, Sphaerotheca macularis
Slime Mold, Diachea leucopodia (saprophytic)
Death - Cold Injury
Deformed Leaves - Herbicide Injury

Ribes, Currants (2)
San Jose Scale, Quadraspidiotus perniciosus
Leaf Bleaching - Chemical Injury

Rubus, Raspberry (17)
Crown Canker, Fusarium sp.
Fruit Rot, Botrytis sp.
Leaf Spot, Septoria sp.
Spur Blight, Didymella applanata & Phoma sp.
Wilt, Verticillium albo-atrum
Cane Blight - Fungal
Leaf Stippling - Spider Mite, Tetranychidae
Cane Swelling - Borer, Agrilus ruficollis
Bud Death - Winter Injury

Vaccinum, Blueberry (4)
Root Rot, Phytophthora cinnamomi

Vitis, Grape (13)
Black Rot, Guignardia bidwelli
Downy Mildew, Plasmopara viticola
Leaf Spot, Cristulariella pyramidalis
Grape Cane Girdler, Ampeloglypter ater
Leaf Curling - Herbicide Injury
Fruit Spots - Spray Injury
Stem Splitting - Winter Injury

D. Agronomic and Forage Crops

Avena sativa, Oats (3)
Browning Root Rot, Pythium spp.
Leaf Spot, Ascochyta graminicola
Yellow Leaf Striping - Nutrient Deficiency

Glycine max, Soybean (25)
Root Rot, Phytophthora megasperma
Root Rot & Wilt, Fusarium sp.
Blight, Phomopsis sp.
Blight Sclerotium rolfsii
Bacterial pustule, Xanthomonas campestris
Bud Blight - Tobacco Ring Spot Virus
Wilting & Stunting - flexous rod virus
Stunting - Herbicide Injury
Leaf Spot - Potassium Deficiency

Hordeum vulgare, Barley (3)
Net Blotch, Pyrenophora teres
Root Rot and Browning, Pythium spp.
Corkscrew Stems - cold injury

Medicago sativa, Alfalfa (10)
Blight, Sclerotinia sp.
Leaf Spot, Leptosphaerulina briosiana
Wilt, Fusarium oxysporum
Root Rot, Phytophthora megasperma
Spring Black Stem, Phoma medicaginis

Nicotiana tabacum, Tobacco (10)
Brown Spot, Alternaria alternata
Stem Rot, Erwinia carotovora
Leaf Spot - spherical virus
Mosaic Leaves - flexuous rod virus

Secale cereale, Rye (1)
Leaf Rust, Puccinia recondita f.sp. recondita

Triticum, Wheat (14)
Glume Blotch, Septoria nodorum
Scab, Fusarium spp.
Powdery Mildew, Erysiphae graminis
Leaf Spot, Septoria sp.
Leaf Rust, Puccinia recondita f. sp. tritica
Take All, Gaeumannomyces graminis var. tritici
Light Heads - Herbicide Injury

Zea mays, Corn (10)
Ear, Root, and Stalk Rot, Diplodia sp.
Ear, Root, and Stalk Rot, Fusarium moniliforme
Leaf Blight, Helminthosporium maydis
Leaf Spot, Alternaria sp.
Leaf Spot, Cercospora zeae-maydis
Leaf Spot, Phyllosticta sp.
Curled Roots - Herbicide Injury
Chlorotic Streaks & Stunting - Zinc Deficiency

C. Herbaceous Ornamentals

Achillea millefolium, Perennial Yarrow (1)
Root Rot, Rhizoctonia sp.

Ageratum houstonianum, Floss Flower (1)
Root Rot - overwatering

Aglaonema simplex, Chinese evergreen (2)
Leaf Blight - Low Temperature Injury

Antirrhinum majus, Snapdragon (1)
Root and Stem Rot - poor drainage

Asplenium nidus, Bird's Nest Fern (1)
Leaf Scorch - Fertilizer Burn

Auraucaria excelsa, Norfolk Island Pine (1)
Leaf Stippling - Insect Injury

Begonia (6)
Leaf Rot, Botrytis sp.
Root Knot Nematode, Meloidogyne incognita

Brassaia actinophylla, Umbrella Tree (3)
Edema - physiological water relations
Leaf Cupping - Spider Mites, Tetranychidae

Celosia, Cockscomb (4)
Leaf Distortions - Chemical Injury
Root Rot - irregular watering

Cereus, Spiney Cactus (1)
Stem Rot, Rhizoctonia sp.

Chrysalidocarpus, Areca Palm (3)
Leaf Stippling - Spider Mite, Tetranychidae
Leaf Stippling - Thrips, Thysanoptera

Chrysanthemum, Daisy and Mum (12)
Leaf Spot, Pseudomonas cichorii
Root Rot and Wilt, Fusarium sp.
Root Rot, Pythium sp.
Southern Blight, Sclerotium rolfsii
Stem Rot, Rhizoctonia solani
Tarnished Plant Bug, Lygus lineolaris

Codiaeum variegatum, Croton (1)
Leaf Drop - Spider Mite, Tetranychidae

Crassula argentea, Jade Plant (1)
Blackened Leaves - Powdery Mildew, Erysiphaceae

Crossandra infundibuliformis (1)
Leaf Spots - Cold Water Damage

Cyclamen (3)
Soft Rot, Erwinia carotovora
Wilt and Corm Rot, Fusarium sp.

Cyphomandra betacea, Tree Tomato (1)
Mosaic Leaves - Flexuous Rod Virus

Dahlia (2)
Leaf Spot, Alternaria sp.
Spider Mite, Tetranychus urticae

Dianthus caryophyllus, Carnation (1)
Leaf Spot and Blight, Alternaria dianthi

Dracaena (5)
Spider Mite, Tetranychidae
Death - Cold Injury
Root Rot - Overwatering

Epidendium, An Orchid (2)
Root Rot, Pythium sp.
Root Rot, Thielaviopsis sp.

Euphorbia pulcherrima, Poinsettia (12)
Blight, Erwinia chrysanthemi
Stem Canker, Corynebacterium poinsettiae
Stem Rot, Erwinia carotovora
Root Rot, Pythium sp.
Root Rot - Over Fertilized

Ficus, Rubber Plant and Weeping Fig (5)
Chlorosis - Soft Scale, Coccus hesperidum
Leaf Drop, Decline, Root rot
Leaf Yellowing, Decline - salt injury - overfertilization
Gerbera jamesoni, Gerbera Daisy (1)
Wilt and Root Rot, Fusarium sp.

Gardenia jasminoides (1)
Root Rot - cultural

Haemaria discolor, An Orchid (1)
Root and Cutting Rot, Fusarium sp.

Hibiscus (2)
Root Rot, Pythium sp.

Hippeastrum, Amaryllis (2)
Leaf Spot, Stagnospora sp.

Iberis sempervirens, Candytuft (2)
Leaf necrosis - Chemical Injury

Impatiens (7)
Leaf Spot, Alternaria sp.
Root Rot, Pythium sp.
Leaf Spot - Chemical Injury

Iris (2)
Leaf Spot, Didymellina macrospora
Leaf Malformations - Chemical Injury

Lobularia maritima, Alyssum (1)
Root Rot, Pythium sp.

Lobelia compacta (1)
Root Rot, Pythium sp.

Nymphaea, Waterlily (7)
Bud Rot, Pythium sp.
Leaf Spot, Alternaria sp.
Petiole Rot, Pythium sp.
Decline + Tuber Rot - Phosphate Deficiency

Paeonia, Peony (4)
Anthracnose, Gloeosporium sp.
Leaf + Stem Blotch, Cladosporium paeoniae

Passiflora, Passion Flower (1)
Thrips, Thysanoptera

Pelargonium, Geranium (22)
Leaf Spot, Xanthomonas pelargoni
Leaf Spot, Pseudomonas cichorii
Wilt, Pseudomonas solanacearum
Stem Rot, Botrytis sp.
Leaf Spot, Botrytis sp.
Root Rot, Pythium
Purple Leaves - Nutrient Deficiency
Marginal Chlorosis - Salt Injury

Pellaea rotundifolia, Cliff Brake Fern (1)
Root Rot, Pythium sp.

Peperomia, Wax Plant (1)
Fungus Gnat, Sciara sp.

Persea americana, Avacado (1)
Leaf Scorch and Drop - cultural

Petunia (1)
Fungus Gnat, Sciara sp.
Root Rot - overwatering

Phalaenopsis, An Orchid
Leaf Spots - flexuous rod virus
(Probably Cymbidium mosaic virus)

Rhodeckia, Gloriosa Daisey (1)
Blight, Sclerotium rolfsii

Sanguinaria canadensis, Bloodroot (1)
Root Rot, Phytophthora cinnamomi

Saintpaulia ionantha, African Violet (4)
Leaf Curling - Mite, Steneotarsonemus pallidus
Leaf Spots - Cold Injury
Leaf Spots - Spray Injury

Sedum (1)
Root and Stem Rot, Phytophthora sp.

Sinningia, Gloxinia (1)
Leaf Spot - Cold Water Injury

Tagetes, Marigold (1)
Death - Salt Injury

Tulipa, Tulip (2)
Blight, Botrytis tulipae

Vinca rosea, Madagascar Periwinkle (2)
Root Rot, Rhizoctonia sp.

Yucca (4)
Leaf Spot, Coniothyrium concentricum
Leaf Spot, Diplodia circinans
Leaf Spot, Phyllosticta sp.
Chlorosis - Nitrogen Deficiency

Zinnia (25)
Canker, Botrytis sp.
Leaf Spot, Xanthomonas nigromaculans
Leaf Spot, Alternaria sp.
Dwarfing - Cucumber Mosaic Virus

Zygocactus truncatus, Christmas Cactus (2)
Basal Stem Rot, Fusarium oxysporum

E. TURF

Agrostis palustris, Bentgrass (1)
Leaf Spot, Curvularia sp.
Root Rot, Pythium sp.

Cynodon dactylon, Bermudagrass (1)
Leaf Spot, Curvularia sp.

Festuca, Fescue (2)
Brown Patch, Rhizoctonia solani

Lolium prenne, Perennial Ryegrass (1)
Browned Out - Normal

Poa pratensis, Bluegrass (6)
Dollar Spot, Sclerotinia homoeocarpa
Leaf Spot, Helminthosporium sp.

Zoysia japonica, Zoysia (4)
Dead Spots - Dog Urine Injury
Spring Dead Spot, Gaeumannomyces sp.

APPENDIX II IDENTIFICATIONS

A. Higher Plants (107)

Acalypha virginia L. (Virginian) - a spurge (SH)
Agrostis sp. L. - bent grass (ED)
Agropyron sp. Gaertn - quack grass (ED)
Alopecurus myosuroides Huds. - black grass (2) (SH,BM)
Amaranthus sp. L. - amaranth (3) (HB)
Amaranthus spinosus L. - spiny amaranth (RR)
Anthoxanthum odoratum L. - sweet vernal grass (SH)
Arabidopsis Thaliana L. Heynh. - mouse-ear cress (SH)
Arctium tomentosus Mill. - burdock (HB)
Arisaema triphyllum (L.) Shott - jack in the pulpit (HB)
Artemisia ludoviciana Nutt. - wormwood (HB)
Ascyrum Hypericoides - St. Andrew's cross (SH)
Baccharis halimifolia L. - ground bush (ED/CM)
Berberis julianae - wintergreen barberry (ED)
Berberis sp. L. - barberry (ED)
Calycanthus floridus L. - strawberry shrub (ED,KK)
Chenopodium sp. L. - a pigweed (SH)
Cirsium arvense (L.) Scop. - Canada thistle (2) (HB)
Clethra alnifolia L. - summersweet (KK)
Convolvulus arvensis L. - bindweed (ED)
Convolvulus sepium L. - bindweed (HB)
Cornus Mas. - cornelian cherry (SS,JM)
Cotoneaster apiculatus - cranberry cotoneaster (KK)
Crataegus mollis - red hawthorn (ED)
Cynanchum laeve - honey vine (CM)
Cynodon sp. Richard - bermudagrass (KK)
Cyperus cuspidatus L. - a cyperus (HB)
Dactylis glomerata L. - orchard grass (RR)
Desmodium canescens (L.) DC. - trefoil (HB)
Deutzia gracilis Sieb. & Zucc. - deutzia (ED)
Diodia teres Walt. (SH)
Diospyros Batatas Dcne. - air potato (SH)
Diospyros virginiana L. - persimmon (ED)
Echinochloa Walteri (Pursh) Nash - a barnyardgrass (HB)
Echium vulgare L. - Blue weed (HB)
Elaeagnus pungens - thorny elaeagnus (ED)
Equisetum arvense L. - field horsetail (ED)
Equisetum variegatum - horsetail (ED)
Euonymus fortunei - wintercreeper euonymus (2) (ED,KK/AB)
Euonymus sp. L. - euonymus (KK)
Euphorbia hirta - a spurge (HB)
Euphorbia nutans - a spurge (SH)
Euphorbia sp. L. - a spurge (2) (HB)
Festuca elatior L. - tall or meadow fescue (SH)
Fraxinus pennsylvanica Marsh. - green ash (HB,ED)
Funcus effusus (HB)
Galinsoga ciliata (Raf.) Blake - galinsoga (SH)
Hedeoma pulegioides (L.) Pers. - american pennyroyal (SH)
Hedra Helix L. - english ivy (HB)
Hibiscus trionum L. - flower-of-an-hour (HB)
Hypericum spentionoides - a St. John's-wort (SH)
Hypochoeris radicata L. - cats-ear (SH)
Ilex verticillata (L.) Gray - common winterberry (KK)
Ipomoea purpurea (L.) Roth - red morning glory (HB)
Koelreuteria paniculata - golden rain tree (ED)
Lespedeza cuneata (Dumont) G. Don - a bush clover (CM)
Lespedeza stipulacea Maxim. - korean clover (HB)
Lindera Benzoin (L.) Blume - spicebush (ED)
Lithospermum arvense L. - stoneseed (SH)
Lonicera sp. L. - honeysuckle (2) (ED)
Lysimachia punctata L. - loosestrife (SH)
Marchantia sp. - a liverwort (ED)
Nepeta cataria L. - catnip or catmint (ED)
Oxalis stricta L. - common woodsorrel (ED)
Panicum dichotomiflorum Michx. - fall panicum (ED)
Panicum miliaceum L. - broom corn millet (HB)
Parthenocissus quinquefolia - Virginia creeper (AB)
Paspalum laeve LeConte - a paspalumgrass (ED)
Poa trivialis L. - rough bluegrass (SH)
Poa bulbosa L. (ED)
Poa pratensis - kentucky bluegrass (SH)
Potamogeton sp. L. - pondweed (ED)
Polygonum perfoliatum L. - tearthumb (ED)
Polygonum scandens - false buckwheat (HB)
Polygonum sp. - a knotweed (BM)
Prunus sp. L. (SH)
Prunus tomentosa (Thumb.) - nanking cherry (SH)
Pyrus sp. L. - pear (SH)
Quercus marilandica - blackjack oak (SH)
Quercus prinoides Willd. - scrub oak (HB)
Quercus sp. L. - an oak (ED)
Quercus stellata Wang. - post oak (HB)
Rhizophora mangle L. - red mangrove (KK)
Rorippa sp. Scop. - yellow cress (SH)
Sassafras albidum (Nutt.) Nees - sassafras (KK)
Scleranthus annus L. - knawel (2) (SH)
Solidago sp. L. - goldenrod (SH)
Solanum Dulcamara L. - bittersweet (ED)
Spergularia sp. J.& C. Presl - sand-spurrey (SH)
Styrax japonicus - japanese snowbell (KK)
Taxus cupsidata 'Expansa' - a japanese yew (KK)
Taxus x media 'Hicksii' - anglojap yew (KK)
Tsuga canadensis (L.) Carr. - canadian hemelock (ED)
Veronica arvensis L. - veronica (SH)
Viburnum prunifolium L. - black haw (HB)
Vitis sp. L. - grape (SH)

B. Fungal (11)

Diachea leucopodia - plasmodium	ED
Ganoderma lucidum - basidiocarp	JM
Ganoderma sp. - basidiocarp	JM
Hohenbuehelia sp. (Pleurotus) - basidiocarp - Heart rot	JM
Irpex sp. - basidiocarp	ED
Morchella angusticeps - apothecia	JM
Psilocybe cubensis - basidiocarp	JM
Sphaerobolus sp. - gleba	ED
Trichoderma sp. - chlamydospores	ED
Order Tremellales - basidiocarp - jelly fungus	JM

C. Miscellaneous Arthropods, etc. (in addition to Appendix I)

Class Insecta - Insects	
Order Coleoptera - Beetles	
Click Beetle - family Elateridae	KK
Eastern Hercules Beetle - adult female - family Scarabaeidae Dynastes tityus (L.)	KK
Elm Leaf Beetle - family Chrysomelidae - Pyrrhalta luteola (Muller)	JD
Pine Bark Beetle - family Scolytidae - Dendroctonus sp.	ED
Powder-Post Beetle - family Lyctidae	MR
Order Diptera	
Blow Fly - larvae - family Calliphoridae - Lucilia illustris	ED
Order Hemiptera	
Stink Bugs - hatched eggs - family Pentatomidae	ED
True Bugs	DS
Order Homoptera	
Juniper Scale - family Diaspididae - Carulaspis juniperi	KK
Oystershell scale - family Diaspididae - Lepidosaphes ulmi (L.)	JD
Dog Day Cicada - cast skins - family Cicadidae - Tibicen pruinosa	ED
Order Hymenoptera	
Carpenter ant - family Formicidae - Camponotus pennsylvanicus (2)	GW/ED
Yellow-jackets - family Vespidae - Vespula sp.	JD
Order Isoptera	
Termite	ED
Order Lepidoptera	
Butterfly - aborted pupa - family Nymphalidae	ED
Corn earworm - family Noctuidae - Heliothis zea (Boddie)	KK/DS
Greenstriped Maplesworm - family Citheroniinae - Anisota rubicunda	KK
Orange-striped oakworm - family Citheroniinae - Anisota senatoria	KK/ED
Sphinx moth - larvae - family Sphingidae	ED
Walnut Caterpillar - family Notodontidae - Datana integerrima	JD
Order Orthoptera	
Katydid - eggs - family Pseudophyllinae	KK
Praying Mantis - egg mass - family Mantidae	ED
Order Thysanoptera	
Greenhouse Thrips - family Thripidae - Heliothrips haemorrhoidalis	ED
Class Arachnida - Arachnids	
Order Araeida	
Wolf spider - family Lycosidae	JD/MR
Crab spider - family Thomisidae	JD/MR

CREDITS:

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AGRICULTURAL EXTENSION SERVICE

UNIVERSITY OF MINNESOTA DIAL U
Insect and Plant Information
155 Alderman Hall
1970 Folwell Avenue
St. Paul, Minnesota 55108

1985 SUMMARY REPORT OF PLANT PATHOLOGY CONTACTS

Jill D. Pokorny
Sandra L. Gould

In January 1983 the Plant Disease Clinic became part of an integrated extension clinic called Dial U. Plant pathology, horticulture and entomology are each represented. The following information deals specifically with plant pathology contacts.

Contact Information

Contact Type	Number	Percentage
Phone	2133	64.5
Mail	564	17.0
Walk-in	417	12.5
Other	190	6.0
Total	3304	100.0

Contact Sources

Contact Source	Number	Percentage
Commercial	299	9.0
Non-Commercial	3005	91.0
Total	3304	100.0
County Agents*	595	18.0

* County agent contacts include both commercial and non-commercial contacts.

Fee System

$2.00 for phone calls and samples not requiring culture work.
$5.00 for samples requiring culture work or taxonomic identification.
No charge for samples submitted through county agents.

Summary of Contacts in Major Host Categories

Host Category	Number	Percentage
Deciduous Trees	1104	33
Conifers	207	6
Shrubs and Vines	171	5
Annual Flowers	54	2
Perennial Flowers	59	2
Florist Crops and Houseplants	80	2
Vegetables	181	6
Fruits	349	11
Turf	582	18
Field Crops	172	5
Other	345	10
	3304	100

Disease Breakdown of Major Host Categories

Host: Deciduous Trees

Diagnosis	Number
Fungal vascular wilt	419
Fungal leafspot	136
Fungal canker	47
Other misc. questions (fungicide, etc.)	45
Bacterial	36
Fungal root & stem rot	11
Rust	7
Healthy	7
Wood decay	6
Referrals	6
Insufficient sample	174
Total	1104

Host: Annual Flowers

Diagnosis	Number
Mold	14
Fungal leafspot	13
Fungal root and stem rot	5
Bacterial	4
Other questions	2
Virus	1
Insufficient samples	15
Total	54

Host: Conifers

Diagnosis	Number
Needlecast	40
Fungal canker	32
Rust	20
Healthy	11
Fungal root and stem rot	3
Fungal leafspot	2
Referral	2
Other questions	1
Insufficient samples	96
Total	207

Host: Perennial Flowers

Diagnosis	Number
Fungal root and stem rot	19
Fungal leafspot	15
Bacterial	4
Rust	3
Virus	1
Other	1
Insufficient samples	16
Total	59

Host: Shrubs and Vines

Diagnosis	Number
Fungal leafspot	72
Fungal canker	8
Fungal root and stem rot	6
Rust	6
Fungal gall	4
Fungal vascular wilt	2
Bacterial leafspot	1
Virus	1
Other questions	1
Insufficient sample	70

Host: Florist Crops and Houseplants

Diagnosis	Number
Fungal root and stem rot	15
Fungal leafspot	13
Healthy	4
Soil molds	3
Bacteria	2
Virus	2
Insufficient samples	41
Total	80

Host: Vegetables

Diagnosis	Number
Fungal leafspot	57
Bacterial	18
Fungal root and stem rot	15
Bulb, fruit or tuber rot	5
Fungal vascular wilt	3
Fungal gall	3
Scab	3
Virus	3
Mushroom ID	2
Rust	1
Smut	1
Referral	1
Insufficient samples	69
Total	181

Host: Fruits

Diagnosis	Number
Bacterial canker	77
Fungal leafspot	55
Rust	31
Fungal canker	22
Fungal gall	19
Fruit rot	16
Fungal root and stem rot	13
Virus	8
Other questions	4
Healthy	2
Snow mold	2
Slime mold	1
Referral	1
Insufficient samples	98
Total	349

Host: Turf

Diagnosis	Number
Fungal root and stem rot	298
Mushrooms	45
Fungal leafspot	41
Snow mold	19
Slime mold	11
Fairy ring	8
Rust	3
Healthy	2
Other	1
Insufficient samples	154
Total	582

Host: Field Crops

Diagnosis	Number
Fungal root and stem rot	56
Fungal leafspot	19
Referral	16
Fungal canker	13
Storage molds	8
Other questions	7
Healthy	5
Bacterial	3
Smut	3
Scab	1
Fungal vascular	1
Virus	1
Rust	1
Snow mold	1
Insufficient sample	37
Total	172

SUMMARY OF THE TOP 5 DECIDUOUS TREE HOSTS

	Number	Percentage
Elm	430	39
Oak	302	27
Maple	124	11
Ash	79	7
Mountain ash	42	4

DISEASE BREAKDOWN OF TOP 5 DECIDUOUS TREE HOSTS:

Host: Elm

Diagnosis	Number
DED	349
Fungicide info	31
Wetwood	9
Fungal leafspot	8
Other questions	4
Referral	1
Insufficient samples	28
Total	430

Host: Oak

Diagnosis	Number
Oak wilt	228
Fungal leafspot	23
Fungal root and stem rot	3
Wood decay	3
Referral	3
Other questions	3
Fungal canker	1
Insufficient samples	38
Total	302

Host: Maple

Diagnosis	Number
Fungal vascular wilt	40
Fungal leafspot	29
Fungal canker	6
Other	6
Wood decay	1
Insufficient samples	42
Total	124

Host: Ash

Diagnosis	Number
Fungal leafspot	53
Other	1
Fungal canker	1
Insufficient samples	24
Total	79

Host: Mountain ash

Diagnosis	Number
Bacterial canker	20
Fungal leafspot	4
Fungal root and stem rot	1
Fungal canker	1
Insufficient samples	16
Total	42

Insect and Plant Disease Diagnostic Laboratory

Annual Report

1984

COOPERATIVE EXTENSION
CORNELL UNIVERSITY

New York State College of Agriculture and Life Sciences
Insect and Plant Disease Diagnostic Laboratory
Caldwell Hall
Ithaca, New York 14853

CONTENTS

The Insect and Plant Disease Diagnostic Laboratory was initiated at Cornell University to help serve the growing need for service to noncommercial agricultural constituents in New York State in November of 1971. The laboratory is a joint effort of the Departments of Entomology and Plant Pathology at Cornell University and is supported by the Cooperative Extension Service and the College of Agriculture and Life Sciences. The Laboratory aids field staff in diagnosing more difficult or unusual problems in the counties, rather than serving as a diagnostic service for each individual residing in New York State. As of May 1, 1983, a fee system was established to help cover the increasing cost of operating the lab.

The staff consists of two employees, Carolyn Klass (Entomology) and Juliet E. Carroll (Plant Pathology). James K. Liebherr, Assistant Professor of Entomology, is the current project coordinator, and has overall responsibility for the Diagnostic Laboratory. Secretarial assistance is provided by Linda Harrington, Entomology and Roxanna Barnum, Plant Pathology. Technical aide and consultation are provided by faculty and staff in Entomology, Plant Pathology and related fields.

In addition to the diagnosis of specimen material, the Diagnostic Lab staff prepare a series of informational leaflets on insect and plant disease topics. These leaflets are used by the laboratory staff to respond to pest problems. In addition they are distributed to all counties in New York to provide field staff with the information. The field staff may, in turn, use this information where appropriate to help answer pest problems. These publications are designed to highlight some of the common pest problems encountered and to serve as an educational tool for both the field staff and their constituents.

At various times during the year, the staff prepare press releases on current or potential insect and disease problems. These serve to alert the field staff and to inform the public about problems which will hopefully lessen the load of inquiries on these subjects for both the county and lab staff.

The lab staff try to provide complete information when responding to an inquiry, rather than just identifying the pest problem. This includes, where appropriate, information about the life history of the organism as well as suggestions for control. We feel this has been helpful, since most of the inquiries we have received from the field staff have not been repetitive. New York residents, through their Cooperative Extension Office have a single direct source of contact with the informational resources of Cornell University concerning insects and plant diseases occurring in and around the home.

NEW INFORMATIONAL LEAFLETS PUBLISHED IN 1984

1. Cultural Practices for Managing Vegetable Diseases
2. Boxelder Bug
3. Currant Borer
4. Magnolia Scale

REVISED LEAFLETS - 1984

1. Apple Scab
2. European Chafer
3. Fusarium Blight Syndrome
4. Guidelines for Packaging and Sending Plant Material into the Diagnostic Laboratory
5. Oak Leaf Blister
6. Orange Rust of Blackberry and Raspberry
7. Spraying the Home Orchard

A summary of the activities of the lab follows. During 1984 a total of 2598 inquiries were received, an increase of 76 from the previous year.

SUMMARY OF THE ACTIVITIES OF THE INSECT AND PLANT DISEASE DIAGNOSTIC LAB

1984

Month	# inquiries	Agent	Public
January	76	31	45
February	74	30	44
March	89	34	55
April	164	80	84
May	246	120	126
June	369	217	152
July	438	298	140
August	409	270	139
September	286	161	125
October	231	134	97
November	174	94	80
December	42	26	16
TOTALS	2598	1495	1103

* Inquiries included problems on many commodities as follows:

Plant Disease Problems	1419
Plant Specimens for Identification	29
Insects (Not including household pests)	643
Household Insects (including structural pests)	506
Others	206

*Some samples contain more than one problem

The following is a list of specimen material and inquiries on pest problems received by the Diagnostic Laboratory in 1984. Species names are listed in some instances where we feel they are important; or when numerous specimens of the same pest have been received.

We have divided this section into two major parts: (1) Insect pests and (2) Plant disease pests. These major parts are further divided into commodity groups and then, in the case of the plant diseases, by host plant.

INSECTS

A. Structural Pests	# inquiries
1. Carpenter ants	
a. Camponotus noveboracensis	4
b. Camponotus nearticus	3
c. Camponotus pennsylvanicus	35
2. Carpenter bee	
a. Xylocopa virginica	7
1. general	1
3. Powder post beetles	13
a. Antlered powder post beetle (Ptilinus ruficornis)	3
b. Lyctus sp.	1
c. Trogoxylon parallelopipedum	1
4. Termites	
a. Eastern subterranean (Reticulitermes flavipes)	19
5. Old house borer (Hylotrupes bajulus)	2
6. Cerambycid borers/log cabins	5
7. Other	1
SUBTOTAL	95

B. Stored Food Products Pests	
1. Beetles	
a. Bean Weevil (Acanthoscelides obtectus)	3
b. Cigarette beetle (Lasioderma serricorne)	4
c. Confused flour beetle (Tribolium confusum)	1
d. Cowpea weevil (Callosobruchus maculatus)	1
e. Drugstore beetles (Stegobium paniceum)	6
f. Granary weevil (Sitophilus granarius)	2
g. Mealworms (Tenebrio sp.)	13
h. Red flour beetle (Tribolium castaneum)	4
i. Rice or black weevil (Sitophilus oryzae)	1
j. Saw-toothed grain beetle (Oryzaephilus surinamensis)	2
k. Others	1
2. Mites	
a. Grain mites	1
1. Tyrophagus sp. (in horse feed)	1

B. Stored Food Products Pests (Cont'd)	# inquiries
3. Moths	
a. Indian meal moth (Plodia interpunctella)	32
b. Meal moth (Pyralis farinalis)	1
c. Mediterranean flour moth (Anagasta kuehniella)	1
d. Others	1
4. General information on food pests	2
SUBTOTAL	77

C. Ornamental, Shade Tree and Forest Pests	# inquiries
1. Aphids, general	14
a. Giant willow aphid (Lachnus salignus)	1
2. Arborvitae leafminer (Argyresthia thuiella)	8
3. Bagworms, general	1
a. Apterona crenulla f. helix	1
b. Fumaria casta	5
4. Balsam wooly aphid (Adelges piceae)	1
5. Bark beetles (Scolytidae)	13
a. Elm bark beetles	1
6. Barklice (Psocids)	2
7. Birch	
a. Aphids on	1
b. Birch catkin bug (Kleidocerys resedae)	1
c. Hardened sap, not scale	1
8. Birch leafminer (Fenusa pusilla)	8
9. Black turpentine beetle (Dendroctonus terebrans) info.	1
10. Black vine weevil (Taxus weevil)(Otiorhynchus sulcatus)	14
11. Borers	
a. Bronze birch borer (Agrilus anxius)	3
b. Carpenterworms (oaks)	1
c. Parandra brunnea	2
d. Pine sawyers (Monochamus scutellatus)	1
e. Red headed ash borer (Neoclytus acuminatus)	2
f. Roundheaded apple tree borer (Saperda candida)	5
g. Root borers	2
h. Two-lined chestnut borer (Agrilus bilineatus)	1
i. Others	10

C. Ornamental, Shade Tree and Forest Pests (Cont'd)	# Inquiries
13. Boxelder bug (Leptocoris trivattatus) - See Section J	
14. Boxwood psyllid	1
15. Cankerworms	
a. Fall cankerworm (Alsophila pometaria)	5
16. Cicada, general	1
a. Periodical cicada(Brood VII)	7
17. Elm leaf beetle (Pyrrhalta luteola) (See Section J)	1
18. Fall webworm (Hyphantria cunea)	2
19. Gypsy moth (Porthetria dispar)	5
a. Parasites	
1. Egg parasite (Oencyrtus kuvanae)	1
20. Honey locust plant bug (Orthotylus althaeae)	2
21. Honeysuckle brooming-aphid (Hyadaphis tartaricae)	4
22. Japanese beetle (Popillia japonica)	3
23. Leafminers - mockorange	1
24. Leafrollers, miscellaneous	2
25. Maple - cultural problems	2
26. Maple gall mites	
a. Maple spindle galls (Vasates aceris-crumeno)	2
b. Crimson erineum galls (Aceria sp.)	2
27. Oak skeletonizer (Bucculatrix ainsliella)	5
28. Pine - sap bleeding	1
29. Pine weevils	
a. White pine weevil (Pissodes strobi)	11
30. Pitch mass borer (Vespamima pini)	1
31. Plant galls	
a. Ash - eriophyid mite galls	3
b. Hackberry nipple gall	2
c. Hickory gall aphid (Phylloxera caryaecaulis)	3
d. Oak apple gall	1
e. Oak bullet galls (Dischlcaspis sp.)	1
f. Oak - gouty oak gall	1
g. Oak - horned oak gall	2
h. Rose - stem gall (Diplolepsis sp.)	2

C. Ornamental, Shade Tree and Forest Pests (Cont'd)	# inquiries
32. Rhododendron - bark splitting	1
33. Rose midge (Dasineura rhodophaga)	1
34. Sawflies	
a. Dogwood sawfly	2
b. Elm sawfly (Cimex americana)	1
c. European pine sawfly (Neodiprion sertifer)	1
d. Mountain-ash sawfly (Pristiphora geniculata)	1
35. Scale insects	
a. Cottony maple scale (Pulvinaria sp.)	1
b. Euonymus scale (Unaspis euonymi)	4
c. Fiorinia scale (on hemlock)(Fiorinia externa)	1
d. Juniper scale (Carulaspis juniperi)	1
e. Magnolia scale (Neolecanium cornuparvum)	3
f. Pine needle scale (Chionaspis pinifoliae)	2
g. Pine tortoise scale (Toumeyella parvicornis)	1
h. White peach scale (Pseudaulacaspis pentagona)	2
i. Wax scale (Ceroplastes ceriferus)	1
36. Scallop shell geometrid (cherry)(Hydria prunivorata)	1
37. Sooty mold	1
38. Spider mites	9
39. Spruce - coneworm damage	2
40. Spruce gall adelgids	
a. Eastern spruce gall adelgid (Adelges abietis)	2
b. Cooley spruce gall adelgid (Adelges cooleyi)	9
c. Miscellaneous (not identified to species or information on control only)	6
41. Treehopper oviposition injury	2
42. White pine aphid (Cinara strobi)	2
43. Woolly aphids	2
44. Miscellaneous	8
45. Spray injury	4
46. Oil injury	1
47. Fertilizer burn	2
SUBTOTAL	246

D. Fruits and nuts	# inquiries
1. Apple maggot (Rhagoletis pomonella)	3
2. Appletree borer information	1
3. Blackberry knot gall	1
4. Cherry maggot	1
5. Codling moth (Laspeyresia pomonella)	2
6. Currant borer (Synanthedon tipuliformis)	1
7. Elderberry borer	1
8. European fruit lecanium (Lecanium corni)	2
9. Fig - ants in fruit	1
10. Grape cane girdler	1
11. Grape pelidnota (Pelidnota punctata)	4
12. Grape phylloxeran galls (Dantulosphaira vitifoliae)	1
13. Japanese beetle injury (Popillia japonica)	2
14. Peach tree borers	2
15. Pear leaf blister mite (Phytoptus pyri)	5
16. Pear midge (Contarinia pyrivora)	1
17. Pear psylla (Psylla pyricola)	2
18. Pear plant bug (Lygocoris communis)	1
19. Pear russet mite	1
20. Plum curculio (Conotrachelus nenuphar)	3
21. Raspberry cane borer (Oberea bimaculata)	1
22. Raspberry cane maggot (Pegomya rubivora)	1
23. Raspberry root borer	1
24. Raspberry fruitworm	1
25. Strawberry	
a. Millipedes	1
b. Root weevil (Otiorhynchus ovatus)	1
c. Whiteflies on leaves	1
26. Tarnished plant bug injury (Lygus lineolaris)	2

D. Fruits and nuts	# inquiries
27. Nuts - General information/pests	1
a. Butternut curculio	1
b. Chestnut weevils	1
c. Walnut husk maggot	4
d. Walnut - a curculio	2
28. Other	6
SUBTOTAL	60

E. Vegetables	# inquiries
1. Asparagus beetles	2
2. Calasoma (ground beetle) larva	2
3. Carrot weevil (Listronotus oregonensis)	
4. Colorado potato beetle (Leptinotarsa decemlineata)	1
5. Cutworms	1
6. European corn borer	
a. Rhubarb	1
b. Potato stems	1
c. General	1
7. Flea beetles	3
8. Imported cabbageworm (Pieris rapae)	1
8. Japanese beetle (on corn)	1
9. Leafminer (? sp.)	1
10. Onion maggot (Hylemya antiqua)	1
11. Onion - thrips (in stored onions)	2
12. Potato insects information	1
13. Seedcorn maggot (Hylema platura)	1
14. Slugs and snails	6
15. Spider mites	2
16. Spittlebugs (rhubarb)	1
17. Squash vine borer (Melittia satyriniformis)	2
19. Stalk borer (Papaipema nebris)	1
20. Striped cucumber beetle (Acalymma vittata)	1
20. Tarnished plant bug (Lygus lineolaris)	1
22. Tomato hornworm (Manduca quinquemaculata)	2

E. Vegetables (Cont'd)	# inquiries
23. Miscellaneous	7
24. Bleach poured on garden	1
SUBTOTAL	44

F. Turf	# inquiries
1. Bluegrass billbug (Sphenophorus parvulus)	1
2. Chinch bugs (Blissus leucopterus hirtus)	2
3. European chafer (Rhizotrogus majalis)	6
4. Grubs, general	8
5. Japanese beetle (Popillia japonica)	1
6. March flies - larvae in turf	5
7. Thrips	1
8. Miscellaneous	3
SUBTOTAL	27

G. Flower, Garden and/or Greenhouse Pests/Houseplants	# inquiries
1. Aphids	1
2. Borer	1
3. Broad mite (Polyphagotarsonemus latus) - Begonia	1
4. Cutworms - houseplants	1
5. Cyclamen mites (Steneotarsonemus pallidus)	
a. African violet	1
b. Clematis	1
c. Gloxinia	1
d. Miscellaneous	1
6. Fourlined plant bug (Poecilocapsus lineatus)	2
7. Fungus gnats	5
8. Gladiolus thrips (Thrips simplex)	1
9. Grubs - rose garden	1
10. Iris borer (Macronoctua onusta)	3
11. Leafminers, general	1
12. Mealybugs	6
13. Scales on houseplants	8

G. Flower, Garden and/or Greenhouse Pests/Houseplants	# inquiries
14. Shore fly	2
15. Slugs	1
16. Spilosoma virginica caterpillars - greenhouse mums	1
17. Spider mites	6
18. Thrips	2
19. Whiteflies	5
20. Miscellaneous	3
21. Chemical injury	1
22. Cultural problems	2
SUBTOTAL	58

H. Livestock/Animals	# inquiries
1. Hippoboscid flies	
a. Lipoptena sp. from deer hides	3
SUBTOTAL	3

I. Field and Forage Crops	# inquiries
1. General information	2
2. Alfalfa	
a. Spittlebugs	1
b. Potato leafhopper injury	1
3. Grasshoppers	2
4. Wheat - hession fly info	1
SUBTOTAL	7

J. Pests In and Around the Home	# inquiries
1. Aquatic (associated with aquatic sites)	
a. Crane fly (larva)	1
b. Backswimmers (in pool)	1
c. Cladocera sp.	1
d. Dobsonflies	1
e. Dragonflies	2
f. Giant water bug	2
g. Leeches	1
h. Mayflies	1
i. Midges	6
j. Stoneflies	3
k. Waterboatmen (in pool)	1
l. Others	1

J. Pests In and Around the Home	# inquiries
2. Ants, general	20
a. Acanthomyops interjectus	3
b. Alleghany mound builder (Formica exsectoides)	2
c. Formica integra	1
d. Crematogaster cerasi	4
e. Formica rufa group	1
g. Lasius sp.	6
h. Pavement ant (Tetramorium caespitum)	8
i. Pharoh ant (Monomorium pharaonis)	1
3. Assassin bugs	
a. Reduvius personatus	7
4. Bees, general	
a. Halictidae - mining bees	8
5. Bees, honey	5
6. Black vine weevil (Otiorhynchus sulcatus) in houses	2
7. Booklice (psocids)	7
8. Boxelder bugs (Leptocoris trivittatus) - in houses	1
9. Carpet beetles	
a. Black carpet beetles (Attagenus megatoma)	5
b. Varied carpet beetles (Anthrenus verbasci)	10
c. Odd beetle - Thylodrias contractus	1
d. Trogoderma versicolor	7
10. Clothes moths and related pests	
a. Casemaking clothes moth (Tinea pellionella)	2
b. Webbing clothes moth (Tineola bisselliella)	2
c. Miscellaneous information on and other species	12
11. Cluster flies (Pollenia rudis)	15
12. Cockroaches	
a. American (Periplaneta americana)	1
b. German (Blattella germanica)	1
c. Wood (Parcoblatta spp.)	2
d. Miscellaneous control information	11
13. Crickets	6
14. Drain flies or moth flies (Psychoda sp.)	12
15. Drosophila flies (fruit, vinegar or pomace flies) Drosophila sp.	8
16. Earwigs, European (Forficula auricularia)	3
17. Elm leaf beetles (Pyrrhalta luteola)	12
18. European chafer (swarming around house/chimney)	5

J. Pests in and Around the Home (Cont'd)	# inquiries
19. Firewood insects	
a. Bark beetles	4
b. Bellamia scalaris	1
c. Cerambycids (not identified to species)	2
d. Checkered beetles (Cleridae)	3
e. Cyrtophorus verrucosus	1
f. Neoclytus acuminatus	2
g. A flat bark beetle, Cucujidae: Cucujus clavipes	1
h. Phymatodes amoenus	1
i. Phymatodes testaceous	4
j. Saperda tridentata	1
20. Flies, general (other than cluster)	4
a. Blowflies	7
b. Leptocera sp.	3
c. Phoridae	2
21. Larder beetles (Dermestes lardarius)	8
22. Millipedes and related pests	
a. House centipede (Scutigera coleoptrata)	2
b. Millipedes	2
23. Minute brown scavenger beetles & Hairy fungus beetles	3
24. Pseudoscorpions	3
25. Silverfish (Lepisma saccharina)	2
26. Sowbugs	5
27. Spiders	17
a. Black widow (from Arizona in lettuce shipment)	1
28. Springtails	9
a. Snow fleas	3
29. Wasps, yellowjackets	
a. Chalcidae	4
b. Cicada killer (Sphecius speciosus)	1
c. European hornet (Vespa crabro)	6
d. Ichneumonids	5
e. Mud dauber	1
f. Paper wasps	2
g. Sphecids	4
h. Wood wasps	1
i. Yellowjackets	10
j. Others	2
30. Wharf borer (Nacerdes melanura)	5
SUBTOTAL	334

K. Biting Insects and Related Arthropods	# inquiries
1. Bedbugs	0
2. Bird mites	13
a. Tropical rat mite (gerbil) Ornithonyssus bacoti	1
3. Blackflies	2
4. Clover mites (Bryobia praetiosa)	1
5. Fleas	19
6. Horseflies and deerflies	2
8. Lice	
a. Crab louse (Pthirus pubis)	0
b. Head louse (Pediculus humanus capitis)	8
8. Mosquitoes	3
9. Ticks	
a. Ixodes cookei	1
b. Ixodes dammini	6
c. General information	1
10. General information	2
11. Stable fly	1
12. Scabies information given	2
SUBTOTAL	62

L. Miscellaneous (including non-pests)	# inquiries
1. Beetles	
a. Click beetles	6
b. Darkling beetles	1
c. Foreign grain beetle	1
d. Ground beetles (Carabidae)	2
e. Ladybugs	2
f. Phyllophaga (grubs in house)	1
g. Rove beetles (Staphilinidae)	1
h. Silphidae (Nacerdes surinamensis) (in house)	1
i. Tortoise beetles	1
j. Weevils	1
1. Larvae brought in nuts	1
2. Acorn weevil	1
k. Miscellaneous	2
1. Info on Megasoma mars, a hercules beetle	1
2. Beneficial insects information	2
3. Decaying trees and compost	2
4. Earthworm information	8
5. Flies - March flies (Bibionidae - Bibio sp.)	2
6. Flies, other	3
7. Grubs	2
8. Horsehair worms (Gordiids)	2
9. Lucanidae: Cerochus piceus	1
10. Osmoderma eremicola	1

L. Miscellaneous (including non-pests) Cont'd	# inquiries
12. Lepidoptera	
a. Baltimore larva	1
b. Black swallowtail (Papilio polyxenes asterius)	2
c. Cecropia moth (Hyalophora cecropia)	5
d. Monarch chrysalis	1
e. Noctuid moths	1
f. Silkworm information	1
g. Sphinx moths	1
1. Others	3
h. Wax moth (information on)	1
i. Information - caterpillar hairs stinging	1
j. Miscellaneous	5
13. Mites associated with molds	1
14. Oligochaete worms	2
15. Phymata fasciata georgiensis - an ambush bug	2
16. Redback salamander	1
17. Roundworm - fish parasite	1
18. Sap beetles	3
19. Scorpion - from South Carolina (in a table)	1
20. Small milkweed bug (Lygaeus kalmii)	1
21. Stinkbugs (Pentatomidae)	2
22. Crushed or no insect found in sample	11
23. Information on organic/mechanical methods for pest control	2
a. Electronic/Ultrasonic devices for control	3
b. Information on Integrated Pest Management	1
24. Information on insecticides	11
25. Information on insects, general (equipment, books, slides, supplies, etc.)	20
26. Insect for fish bait	2
Miscellaneous insects	3
SUBTOTAL	136
TOTAL	1149

PLANT DISEASES

A. Field Crops and Forage	# inquiries
1. Avena sativa, 'Astro', Oats	
a. Blast	1
2. Medicago sativa, Alfalfa	
a. Anthracnose, Colletotrichum sp.	2
b. Bacterial soft rot, Pseudomonas sp. & Erwinia sp.	1
c. Fusarium root rot, Fusarium sp.	1
d. Fusarium wilt, Fusarium sp.	1
e. Insufficient sample	1
f. Sclerotinia crown and stem rot, Sclerotinia sp.	1
g. Spring black stem, Phoma medicaginis	5
h. Verticillium wilt, Verticillium albo-atrum	5
3. Zea mays, Field Corn	
a. Nutritional deficiency	1
SUBTOTAL	19

B. Flowers	# inquiries
1. Aconitum sp., Monkshood	
a. Heat Stress	1
b. Secondary stem rot, Pythium sp.	1
2. Actaea pachypoda, Doll's-eyes	
a. Leaf spot, Ascochyta sp.	1
3. Alstroemeria sp., Peruvian lily	
a. Botrytis blight, Botrytis sp.	1
b. Tobacco mosaic virus	1
4. Amaryllis sp., Amaryllis	
a. Nutrient deficiency	1
5. Antirrhinum majus, Snapdragon	
a. Herbicide injury	1
6. Aster sp., Aster	
a. Botrytis stem rot, Botrytis sp.	1
b. Insufficient sample	1
c. No diseases	1
7. Begonia sp., Begonia	
a. Bacterial leaf spot, Xanthomonas begoniae	1
b. Powdery mildew, Oidium sp.	2
8. Canna sp., Canna	
a. Bud rot, Xanthomonas sp.	1
9. Chrysanthemum x morifolium, Florist's Chrysanthemum	
a. Flower blight, Botrytis sp.	1
b. Frost injury	1
c. Fusarium wilt, Fusarium sp.	1
d. Insufficient sample	1

B. Flowers (Cont'd)	# inquiries
9. Chrysanthemum (Cont'd)	
e. Leaf and stem blight, Botrytis cinerea	1
f. Leaf spot, Pseudomonas sp.	1
g. Root and stem rot, Fusarium sp.	1
h. Root rot, Pythium sp. & Fusarium sp.	1
i. Soluble salts injury	2
10. Cyclamen sp., Cyclamen	
a. Fusarium wilt, Fusarium sp.	1
b. Gray mold, Botrytis sp.	1
11. Dahlia sp., Dahlia	
a. Insufficient sample	2
b. Leaf spot, Alternaria sp.	1
c. Scab, Streptomyces scabies	1
12. Digitalis sp., Fox-glove	
a. Leaf and stem blight, Alternaria sp.	1
13. Euphorbia pulcherrima, Poinsettia	
a. Abiotic injury	1
b. Cultural problem	1
c. Environmental injury	1
d. Root and stem rot, Pythium sp.	3
e. Root and stem rot, Rhizoctonia sp.	2
f. Secondary stem rot, Fusarium sp.	1
g. Secondary vascular infection, Xanthomonas sp.	1
14. Exacum affine, Persian violet	
a. Canker blight, Botrytis sp.	1
15. Fuchsia sp., Fuchsia	
a. Abiotic injury	1
b. Gray mold blight, Botrytis sp.	1
16. Gerbera jamesonii, Transvaal Daisy	
a. Anthracnose, Colletotrichum sp.	1
b. Cultural Problem	1
c. Secondary leaf spot, Alternaria sp.	1
17. Gladiolus x hortulanus, Gladiolus	
a. Blue mold, Penicillium sp.	1
b. Flower spot, Botrytis sp.	1
c. Fusarium dry rot, Fusarium sp.	1
d. Scab, Pseudomonas marginalis	1
18. Hemerocallis fulva, Daylily	
a. Leaf blight, Aureobasidium sp.	1
19. Hibiscis sp., Rose-of-Sharon	
a. Oedema	1
b. Sooty mold	1
20. Hyacinthus orientalis, Hyacinth	
a. Leaf and flower rot, Penicillium sp. and Erwinia sp.	1

B. Flowers (Cont'd)	# Inquiries
21. Iberis sempervirens, Edging Candytuft	
a. Secondary root rot, Fusarium sp.	1
b. Root rot, Armillaria mellea	1
22. Impatiens sp., Impatiens	
a. Anthracnose, Colletotrichum sp.	1
b. Heat and sun scorch	1
c. High soluble salts injury	1
d. Pythium root rot, Pythium sp.	1
23. Iris sp., Iris	
a. Colletotrichum sp. on dead leaves	1
b. Leaf spot, Heterosporium state of Didymellina macrospora	1
c. Root rot, Basidiomycete	1
24. Lilium longiflorum, Easter lily	
a. Root rot, Pythium sp.	1
25. Lilium sp., Lily	
a. Botrytis blight, Botrytis sp.	1
b. Slug injury	1
26. Lilium candidum, Madonna lily	
a. Botrytis blight, Botrytis sp.	1
27. Limonium sp., Statice	
a. Environmental Problem	1
28. Lupinus sp., Lupine	
a. Transplant shock	1
29. Narcissus sp., Daffodil	
a. Blue mold, Penicillium sp.	1
30. Orchids	
Cymbidium hybrids	
a. Cymbidium mosaic virus	1
b. Leaf spot, Phyllosticta sp.	1
c. Negative for virus	1
Cattleya sp.	
a. Cymbidium mosaic virus	1
Ansellia nilotica gigantea	
a. Cymbidium mosaic virus	1
Dendrobium sp.	
a. Insufficient sample	1
Oncidium leucochilum	
a. Cymbidium mosaic virus	1

B. Flowers (Cont'd)	# inquiries
30. Orchids (Cont'd)	
Phalaenopsis sp.	
a. Bacterial leaf spot	1
b. Crown rot, Fusarium sp.	1
c. Cymbidium mosaic virus	1
d. Soft rot, Erwinia carotovora	1
31. Paeonia lactiflora, Peony	
a. Botrytis blight, Botrytis sp.	3
b. Crown rot complex, Fusarium sp., Rhizoctonia sp.	1
c. Herbicide injury	1
d. Leaf curl virus	1
e. Red spot, Cladosporium paeoniae	4
f. Root and crown rot, Phytophthora sp.	1
g. Root rot, Armillaria mellea	1
h. Verticillium wilt, Verticillium sp.	1
32. Paeonia suffruticosa, Tree peony	
a. Botrytis blight, Botrytis sp.	1
b. No virus found	1
c. Red spot, Cladosporium paeoniae	1
33. Papaver orientalis, Oriental poppy	
a. Bacterial blight, Xanthomonas papavericola	1
34. Pelargonium x hortorum, Geranium	
a. Bacterial blight, Xanthomonas pelargonii	1
b. Bacterial leaf spot	1
c. Black leg, Pythium sp.	1
d. Bud blast, Botrytis sp.	1
e. Canker, Botrytis sp.	1
f. Chemical injury	5
g. Cutting rot, overwatering	1
h. Fasciation, Corynebacterium fasciens	1
i. Leaf spot, Botrytis sp.	3
j. Negative for virus	1
k. Secondary root rot, Fusarium sp.	2
l. Tobacco mosaic virus	3
35. Pelargonium peltatum, Ivy geranium	
a. Leaf spot, Botrytis sp.	1
b. Oedema	1
c. Root rot, Pythium sp.	1
36. Phlox sp., Phlox	
a. Canker, Colletotrichum sp.	1
b. Physiological leaf blight	1
37. Platycodon grandiflorus, Balloon flower	
a. Stem anthracnose, Colletotrichum sp.	1

B. Flowers (Cont'd)	# inquiries
38. Rhododendron sp., Potted Azalea	
a. Dieback, Botrytis sp.	1
b. Frost injury	1
c. Leaf spot, Phyllosticta sp.	1
39. Rosa sp., Rose	
a. Abiotic injury	1
b. Black spot, Marssonina state of Diplocarpon rosae	4
c. Insufficient sample	1
d. Leaf scorch	1
e. Nutrient or virus problem	1
f. Physiological problem	1
g. Rose mosaic virus	1
40. Salvia sp., Salvia	
a. Cultural problem, Alternaria sp. secondary	1
41. Senecio x hybridus, Cineraria, 'Palette'	
a. Tomato spotted wilt virus	2
42. Stephanotis floribunda, Wax flower	
a. Root rot, Pythium sp.	1
43. Syringa sp., Lilac	
a. Chemical injury	1
b. Phytophthora blight	1
44. Tagetes sp., Marigold	
a. Abiotic problem	1
b. Alternaria blight, Alternaria zinniae	2
c. Chemical injury	1
d. Insufficient sample	3
e. Stem blight, Botrytis sp.	1
45. Tulipa sp., Tulip	
a. Cultural problem	1
b. Environmental injury	1
c. Tulip fire, Botrytis tulipae	2
46. Viola sp., Pansy	
a. Botrytis blight, Botrytis sp.	1
47. Zinnia sp., Zinnia	
a. Alternaria blight, Alternaria zinniae	3
b. Powdery mildew, Oidium sp.	1
48. Miscellaneous Perennials	
a. Root and stem rot, Fusarium sp.	1
b. Root rot complex, Rhizoctonia sp. and Pythium sp.	1
SUBTOTAL	164

C. Fruit	# inquiries
1. Fragaria sp., Strawberry	
a. Black root rot	2
b. Common leaf spot, Ramularia state of Mycosphaerella fragariae	2
c. June yellows	1
d. Leaf blight, Dendrophoma obscurans	2
e. Poor establishment	1
f. Verticillium wilt, Verticillium sp.	1
g. Winter injury	2
2. Castanea sp., Chestnut	
a. Nut rot, Penicillium sp.	1
3. Corylus sp., Filbert	
a. Nut anthracnose, Colletotrichum sp.	1
4. Malus sp., Apple	
a. Apple scab, Spilocea state of Venturia inaequalis	4
b. Chemical injury	2
c. Frog-eye leaf spot, Sphaeropsis sp.	2
d. Fruit spot, Undetermined	1
e. Nutrient deficiency	1
f. Powdery mildew, Oidium sp.	1
g. Premature fruit drop, cause undetermined	1
h. Winter injury	1
5. Prunus armeniaca, Apricot	
a. Canker rot fungus	1
b. Leaf scorch	1
6. Prunus persica, Peach	
a. Bacterial spot, Xanthomonas pruni	1
b. Peach leaf curl, Taphrina deformans	1
c. Transplant stress	1
d. X-disease	1
7. Prunus sp., Plum	
a. Black knot, Apiosporina morbosa	4
b. Brown rot, Monilinia fructicola	1
c. Chemical injury	1
8. Prunus sp., Nectarine	
a. Bacterial spot, Xanthomonas pruni	1
b. Peach leaf curl, Taphrina deformans	1
c. Winter injury	1
9. Prunus sp., Cherry	
a. Bacterial canker, Pseudomonas syringae	1
b. Canker, undetermined	2
c. Chemical injury	2
d. Fireblight, Erwinia amylovora	1
e. Leaf scorch	1
f. Leaf spot, Coccomyces hiemalis	3
g. Nutrient deficiency	2
h. Shot hole	1
i. Valsa canker	1

C. Fruit (Cont'd)	# inquiries
10. Pyrus sp., Pear	
a. Dieback, Sphaeropsis sp.	1
b. Fire blight, Erwinia amylovora	1
c. Hail injury	1
d. Marginal necrosis	1
e. Scab, Fusicladium state of Venturia pyrina	1
f. Secondary leaf spot, Phyllosticta sp.	1
g. Sooty mold	2
h. Transplant stress	1
i. Twig canker, Venturia pyrina	1
j. Winter injury	1
11. Rubus sp., Blackberry	
a. Anthracnose, Elsinoe veneta	1
b. Canker, Mycosphaerella sp.	1
c. Leptostroma sp. on canes	1
d. Winter injury	1
12. Rubus sp., Raspberry	
a. Cane blight, Coniothyrium state of Leptosphaeria coniothyrium	3
b. Crumbly berry	4
c. Fruit rot	1
d. Fusarium sp. on crown	1
e. Insufficient sample	4
f. Leaf spot, Phlyctaena vagabunda	1
g. Nutrient deficiency	1
h. Orange rust, Gymnoconia sp.	1
i. Root rot, Basidiomycete	1
j. Root rot, Fusarium sp.	1
k. Site problem	2
l. Spur blight, Phoma state of Didymella applanata	4
m. Transplant stress	1
n. Winter injury	3
13. Vaccinium sp., Blueberry	
a. Canker, Phomopsis sp.	1
b. Leaf spot, Ramularia sp.	1
c. Transplant shock and failure	1
d. Winter injury	1
14. Vitis sp., Grape	
a. Black rot, Phyllosticta state of Guignardia bidwellii	1
b. Callous cell proliferation (Tissue Culture)	1
c. Downy mildew, Plasmopara viticola	1
d. Winter injury	1
SUBTOTAL	106

D. Houseplants	# inquiries
1. Aeschynanthus pulcher, Lipstick plant	
a. Heat scorch	1
2. Aglaonema sp., Chinese evergreen	
a. Leaf spot, Phyllosticta sp.	1
3. Araucaria heterophylla, Norfolk Island Pine	
a. Cultural Problem	2
b. Dieback, Guignardia sp.	1

D. Houseplants (Cont'd)	# inquiries
4. Bactris sp., Palm	
a. Surface mold, Cladosporium sp.	1
5. Brassaia actinophylla, Schefflera	
a. Anthracnose, Colletotrichum gloeosporoides	2
b. Leaf spot, abiotic	2
c. Oedema	1
6. Cactaceae, Cacti	
General	
a. Bacterial blight, undetermined	1
b. Fusarium root and stem rot	1
c. Sun scorch and heat stress	1
Opuntia ramosissima, Pencil cactus	
a. Cladode rot, Phyllosticta sp.	1
7. Chamaedorea elegans, Parlor palm	
a. Anthracnose, Colletotrichum gloeosporoides	1
b. Cultural problem	1
8. Chlorophytum comosum, Spider plant	
a. Cultural problem	1
9. Chrysalidocarpus lutescens, Areca palm	
a. Leaf spot, Dothiorella sp.	1
10. Cissus sp., Grape ivy	
a. Oedema	1
b. Root and stem rot, Rhizoctonia sp. and Nectria solani	1
11. Citrus limon, Lemon	
a. Anthracnose, Colletotrichum sp.	1
b. Cultural injury	1
12. Citrus sp., Orange	
a. Frost injury	1
b. Nutrient deficiency	1
13. Cordyline indivisa, Blue dracaena	
a. Physiological problem	1
14. Crassula argentea, Jade plant	
a. Insufficient sample	1
b. Oedema	1
15. Dieffenbachia sp., Dieffenbachia	
a. Anthracnose, Colletotrichum sp.	1
16. Dracaena marginata 'Spike', Dracaena	
a. Leaf spot, Undetermined	1
b. Cultural problem	1
c. Mechanical injury	1
d. Undetermined	1
17. Epipremnum aureum, Pothos	
a. Leaf spot, Botryosphaeria sp.	1
b. Secondary bacterial leaf spot, non-fluorescent, Pseudomonas sp.	1

D. **Houseplant** (Cont'd)	**# inquiries**
18. *Ficus benjamina*, Weeping fig	
a. Cultural problem	1
b. Dieback, undetermined	1
c. Insufficient sample	1
19. *Ficus elastica*, Rubber tree	
a. Chemical injury	1
b. Anthracnose, *Colletotrichum* state of *Glomerella cingulata*	1
20. *Howea forsterana*, Kentia Palm	
a. Anthracnose, *Colletotrichum* sp.	1
b. Cultural problem	1
21. *Hoya carnosa*, Wax plant	
a. Cultural problem	1
b. Nutrient deficiency	1
22. Palmaceae, Palm	
a. No diseases	1
23. *Peperomia* sp., Peperomia	
a. Cultural problem	1
b. High soluble salts injury	1
24. *Persea americana*, Avocado	
a. Oedema	1
b. Mechanical injury	1
c. Scorch	1
25. *Saintpaulia ionantha* hybrids, African violet	
a. Cultural problem	3
26. *Setcreasea purpurea*, Purple heart	
a. Frost injury	1
27. *Soleirolia soleirolii*, Baby's tears	
a. Leaf and stem blight, *Rhizoctonia* sp.	1
28. *Spathiphyllum* sp., Peace lily	
a. Leaf spot, *Guignardia* sp.	1
b. Secondary bacterial leaf spot, non-fluorescent, *Pseudomonas* sp.	1
29. *Tradescantia* sp., Wandering Jew	
a. Leaf necrosis, cause unknown	1
30. *Yucca* sp., Yucca	
a. Floride toxicity	2
SUBTOTAL	60

E. ORNAMENTALS	# inquiries
1. Abies concolor, White fir	
a. Damping off, Rhizoctonia sp.	1
b. Site problem	1
c. Tree death, cause unknown	1
2. Abies fraseri, Fraser fir	
a. Abiotic injury	1
b. Basal canker, Cylindrocladium sp.	1
c. Herbicide injury	1
d. Insufficient sample	1
e. Normal Phenomenon	2
f. Nutrient deficiency	1
g. Site disturbance	1
3. Albizia julibrissin, Mimosa	
a. Genetic mutation	1
4. Acer negundo, Box elder	
a. Anthracnose, Kabatiella apocrypta	1
b. Bull's eye spot, Cristulariella sp.	1
c. Canker, Cytospora sp.	1
d. Decline	1
e. Decay fungus, Polyporus sp.	1
f. Dieback, Colletotrichum state of Glomerella cingulata	1
g. Physiological problem	1
5. Acer japonicum, Japanese maple	
a. Abiotic injury	1
b. Dieback, Phomopsis sp.	1
c. Leaf scorch	1
6. Acer palmatum, Japanese red maple	
a. Bull's eye spot, Cristulariella sp.	1
b. Leaf scorch	1
c. Verticillium wilt	1
7. Acer platanoides, Norway maple	
a. Anthracnose, Kabatiella apocrypta	1
b. Bacterial leaf spot, Pseudomonas sp.	1
c. Canker, Cytospora sp.	2
d. Canker, Fusarium state of Nectria	1
e. Canker, Steganosporium ovatum	1
f. Canker, Tubercularia state of Nectria cinnabarina	1
g. Canker rot, Daedalea unicolor	1
h. Girdling roots	2
i. Insufficient sample	1
j. Leaf spot, Didymosporina aceris	2
k. Leaf spot, Septoria aceris	1
l. Maple decline	2
m. Negative for Verticillium wilt	1
n. Purple eye leaf spot, Phyllosticta minima	2
o. Verticillium wilt, Verticillium dahliae	2

E. Ornamentals (Cont'd)	# inquiries
8. Acer rubrum, Red maple	
a. Abiotic injury	2
b. Anthracnose, Kabatiella apocrypta	2
c. Canker, Cytospora sp.	1
d. Canker, undetermined	2
e. Insufficient sample	1
f. Leaf blister, Taphrina sp.	3
g. Leaf scorch	1
h. Maple decline	1
i. Poor healing branch stubs	1
9. Acer saccharinum, Silver maple	
a. Abiotic injury	1
b. Canker, Cytospora sp.	1
c. Canker, Undetermined	1
d. Dieback, Tubercularia state of Nectria cinnabarina	1
e. Speckled tar spot, Rhytisma punctatum	1
f. Root rot	1
10. Acer saccharum, Sugar maple	
a. Anthracnose, Kabatiella apocrypta	3
b. Anthracnose, Gloeosporium sp.	1
c. Canker and Dieback, Cytospora sp.	3
d. Canker, Botryosphaeria sp.	1
e. Canker, Steganosporium ovatum	3
f. Construction injury	1
g. Insufficient sample	2
h. Leaf scorch	1
i. Maple decline	7
j. Normal midsummer leaf drop	1
k. Nutrient deficiency	1
l. Root and butt rot	1
m. Root rot, Armillaria mellea	1
n. Transplant Stress	1
o. Verticillium wilt, Verticillium dahliae	4
p. Wilt, cause undetermined	2
11. Acer sp., Maple	
a. Abiotic injury	4
b. Anthracnose, Discula sp.	1
c. Anthracnose, Gloeosporium sp.	1
d. Anthracnose, Kabatiella apocrypta	4
e. Bull's eye spot, Cristulariella sp.	1
f. Canker, Cytospora sp.	3
g. Canker, undetermined	1
h. Girdling roots	2
i. Insufficient sample	2
j. Leaf blister, Taphrina sp.	1
k. Leaf scorch	2
l. Leaf spot, Phyllosticta sp.	1
m. Maple decline	4
n. Purple eye leaf spot, Phyllosticta minima	1
o. Shot hole	1
p. Tar spot, Rhytisma acerinum	1
q. Verticillium wilt, Verticillium dahliae	3
r. Winter injury	1

E. Ornamentals (Cont'd)	# inquiries
12. Actidinia arguta, Actidinia	
a. Basal canker	1
13. Aegopodium podagraria "Variegatum' Goutweed	
a. Leaf spot, Septoria sp.	1
14. Aesculus hippocastanum, Horse Chestnut	
a. Leaf blotch, Phyllosticta state of Guignardia aesculi	1
15. Ajuga sp., Ajuga	
a. Leaf spot, Ramularia sp.	1
16. Asclepias currasavica, Bloodflower	
a. Virus, possibly a protexvirus	1
17. Asclepias tuberosa, Butterfly weed	
a.Virus, possibly a protexvirus	1
18. Berberis sp., Barberry	
a. Overwatering injury	1
19. Betula sp., Birch	
a. Canker, Dothiorella sp.	1
b. Chemical injury	1
c. Secondary canker, Selenophoma sp.	1
d. Systemic chemical injury	2
20. Buxus, sp., Boxwood	
a. Dieback, Volutella state of Pseudonectria rouselliana	1
21. Castanea mollissima, Chinese chestnut	
a. Chemical injury	1
22. Catalpa sp., Catalpa	
a. Abiotic injury	1
b. Canker, undetermined	1
c. Herbicide injury	1
d. Leaf spot, Phyllosticta catalpae	1
e. Verticillium wilt	1
23. Cedrus atlantica, Atlas cedar	
a. Transplant shock	1
24. Cedrus libani, 'Stenacoma', Cedar-of-Lebanon	
a. Shoot blight, Kabatina sp.	1
25. Cercidiphyllum japonicum, Katsura tree	
a. Winter injury	1
26. Clematis sp., Clematis	
a. Winter injury	1
27. Cornus florida, Flowering dogwood	
a. Nutrient deficiency	1
b. Transplant stress	1
28. Cornus sericea, Redtwig dogwood	
a. Canker, Dothiorella state of Botryosphaeria ribis	2
b. Possible defoliant injury	1

E. Ornamentals (Cont'd)	# inquiries
29. Cornus sp., Dogwood	
a. Canker, Botryosphaeria sp.	1
b. Dieback related to borer injury	1
c. Herbicide injury	1
d. Lack of flowers	1
e. Leaf spot, Phyllosticta sp.	2
f. Leaf spot, undetermined	1
g. Normal callous	1
h. Normal fall color	1
i. Sooty mold	1
30. Corylus convoluta	
a. Canker, Botryosphaeria sp.	1
31. Cotinus sp., Smokebush	
a. Flower and twig blight, Colletotrichum sp.	1
32. Cotoneaster sp., Cotoneaster	
a. Canker and dieback, Fusarium sp.	1
33. Craetagus sp., Hawthorn	
a. Leaf blight, Entomosporium state of Diplocarpon maculata	3
b. Insufficient sample	1
c. Leaf spot, Phyllosticta sp.	1
d. Powdery mildew, Podosphaera oxyacanthae	1
34. Dictamnus albus, Dittany	
a. Leaf spot, Ascochyta sp.	1
35. Elaeagnus angustifolia, Russian olive	
a. Canker, Dothiorella sp.	1
b. Canker, Phomopsis sp.	7
c. Canker, undetermined	1
d. Granulodiplodia sp. on dead branch	1
e. Overwatering injury	1
36. Eryngium sp., Eryngium	
a. Stem lesions, Botrytis sp. and Alternaria sp.	1
37. Euonymous japonica, Euonymous	
a. Dieback, undetermined	1
b. Powdery mildew, Oidium sp.	1
38. Euonymus alatus, Burning bush	
a. Dieback, undetermined	1
b. Insufficient sample	1
39. Euonymus sp., Euonymus	
a. Canker, Phomopsis sp.	2
b. Creosote injury	1
c. Nutrient deficiency	1
40. Fagus sp., Beech	
a. Canker, Phomopsis sp.	1

E. **Ornamentals** (Cont'd)	# inquiries
41. Fagus sylvatica, European beech	
a. Canker, Tubercularia state of Nectria cinnabarina	1
b. Leaf scorch	1
c. Normal Phenomenon	1
42. Filipendula palmata, Meadowsweet	
a. Leaf spot, Phyllosticta sp.	1
43. Forsythia sp., Forsythia	
a. Chemical injury	1
b. Herbicide injury	1
44. Fraxinus sp., Ash	
a. Anthracnose, Discula state of Gnomonia errabunda	10
b. Canker, Cytospora sp.	1
c. Environmental injury	1
d. Late spring dieback, winter injury	1
e. Normal midsummer leaf drop	2
45. Hedera sp., English ivy	
a. Anthracnose, Colletotrichum trichellum	1
b. Normal phenomenon	1
c. Spot anthracnose, Sphaceloma hederae	1
d. Stem canker	1
46. Hosta sp., Plantain lily	
a. Anthracnose, Colletotrichum sp.	3
b. Anthracnose, Kabatiella sp.	1
47. Hydrangea sp., Hydrangea	
a. No virus found	1
48. Ilex crenata, Japanese holly	
a. Leaf spot, Phyllosticta sp.	1
49. Ilex sp., Holly	
a. Colletotrichum sp. and Phyllosticta sp. on leafminer injury	1
b. Leaf spot, Guignardia sp.	1
c. Nutrient deficiency	1
d. Overfertilization injury	1
e. Powdery mildew, Phyllactinia sp.	1
f. Spine spot on the leaves	1
g. Winter injury	1
50. Juglans nigra, Black walnut	
a. Anthracnose, Discula state of Gnomonia leptostyla	1
b. Construction injury	1
51. Juglans regia, Carpathian walnut	
a. Anthracnose, Colletotrichum sp.	1
b. Canker Cytospora sp. and Phomopsis sp.	1
c. Canker, Nectria cinnabarina	1

E. Ornamentals (Cont'd)	# inquiries
52. Juniperus sp., Juniper	
a. Abiotic injury	2
b. Bacteria, Amoeba, Protozoa in Tissue Culture	1
c. Dieback, Pestalotia sp.	1
d. Dieback, Sphaeropsis sapinea	1
e. Dieback, undetermined	1
f. Establishment problem	1
g. Gall rust, Gymnosporangium sp.	2
h. Hot air vent injury	1
i. Secondary root and stem infections, Fusarium sp.	1
j. Site problem	3
k. Winter injury	1
l. Tip blight, Phomopsis juniperovora	3
m. Tip blight, Sclerophoma pythiophila	2
n. Tip blight, Kabatina juniperi	11
53. Jupidanthus sp., Jupidanthus	
a. Anthracnose, Glomerella cingulata	1
54. Laburnum anagyroides, Golden-chain tree	
a. Chemical injury	1
55. Lavandula sp., Lavendar	
a. Root rot, Armillaria mellea	1
56. Leucothoe sp., Leucothoe	
a. Canker, undetermined	1
57. Ligustrum sp., Privet	
a. Dieback, Dothiorella	1
b. Environmental injury	2
c. Insufficient sample	1
d. Root rot, undetermined	2
58. Liriodendron tulipifera, Tulip tree	
a. Herbicide injury	1
59. Lonicera sp., Honeysuckle	
a. Insufficient sample	2
b. Leaf scorch	1
60. Magnolia sp., Magnolia	
a. Canker, Tubercularia state of Nectria cinnabarina	1
b. Leaf spot, Phyllosticta sp.	1
c. Winter injury	1
61. Malus sp., Crabapple	
a. Abiotic injury	1
b. Apple scab, Spilocea state of Venturia inaequalis	17
c. Burr knots	1
d. Callus cell proliferation (Tissue culture)	1
e. Canker, Dothiorella state of Botryosphaeria sp.	1
f. Canker, Fusicoccum sp.	1
g. Nutrient deficiency	1
h. Fireblight, Erwinia amylovora	1
i. Winter injury	1

E. Ornamentals (Cont'd)	# inquiries
62. Morus sp., Mulberry	
a. Canker, Tubercularia state of Nectria cinnabarina	1
63. Pachysandra sp., Pachysandra	
a. Leaf scorch	1
b. Transplant stress	1
c. Volutella blight, Volutella pachysandrae	2
64. Philadelphus sp., Mock Orange	
a. Normal Phenomenon	1
b. Stem canker, Fussicoccum sp.	1
65. Physocarpus opulifolius, Ninebark	
a. Powdery mildew, Sphaerotheca humuli	2
66. Picea abies, Norway spruce	
a. Normal autumn color	2
b. Red squirrel twig pruning	1
c. Transplant stress	1
d. Winter injury	4
67. Picea glauca, White spruce	
a. No injury found	1
b. Transplant stress	1
c. Winter injury	5
68. Piceaglauca var. albertiana, Alberta spruce	
a. Winter injury	1
69. Picea pungens, Blue spruce	
a. No injury found	1
b. Nutrient deficiency	1
c. Red squirrel twig pruning	1
d. Rhizosphaera needlecast, Rhizosphaera kalkhoffii	2
e. Secondary dieback, Fusarium sp. and Phomopsis sp.	1
f. Site problem	3
g. Spruce canker, Cytospora kunzei	4
h. Transplant stress	1
i. Winter injury	4
70. Picea sp., Spruce	
a. Abiotic injury	2
b. Animal injury to buds	1
c. Environmental injury	3
d. Insufficient sample	2
e. Normal male and female cones breaking bud	1
f. Normal needle senescence	3
g. Rhizosphaera needlecast, Rhizosphaera kalkhoffii	3
h. Sample healthy	1
i. Site problem	3
j. Spruce canker, Cytospora kunzei	6
k. Transplant shock	2
l. Winter injury	17
71. Pieris japonica, Pieris	
a. Canker, undetermined	1
b. Dieback, Botryosphaeria sp.	1

E. Ornamentals (Cont'd)	# inquiries
72. Pinus bungeana, Lace bark pine	
a. Cold temperature needle spotting	1
73. Pinus flexlis, Limber pine	
a. Needlecast, Lophodermium sp.	1
b. Secondary dieback, Phomopsis sp.	1
74. Pinus mugo, Mugo pine	
a. Normal needle senescence	1
b. Secondary needle blight, Dothichiza sp.	1
c. Winter injury	1
75. Pinus nigra, Austrian pine	
a. Abiotic Injury	2
b. Diplodia tip blight, Sphaeropsis sapinea	5
c. Normal phenomenon	1
d. Sapsucker injury	1
e. Secondary dieback, Phoma sp.	1
f. Transplant stress	1
76. Pinus resinosa, Red pine	
a. Bluestain, Verticicladiella sp.	1
b. Root rot or site problem	2
c. Normal needle senescence	1
d. Construction injury	1
77. Pinus strobus, White pine	
a. Abiotic injury	1
b. Canker, Phoma sp.	2
c. Decline	1
d. Environmental injury	1
e. Herbicide injury	1
f. Normal Phenomenon	3
g. Normal resin	1
h. Secondary canker, Pestalotia sp.	1
i. Site and root problem	3
j. Transplant stress	3
k. White pine blister rust, Cronartium ribicola	1
l. Winter injury	5
78. Pinus sylvestris, Scots pine	
a. Bluestain	1
b. Diplodia tip blight, Sphaeropsis sapinea	2
c. Needlecast, Naemacyclus sp.	1
d. Needlecast, undetermined	1
79. Pinus thunbergiana, Japanese black pine	
a. Air pollution injury	2
b. Canker, Cenangium ferruginosum	1
c. Cold temperature needle spotting	2
d. Insufficient sample	2
e. Needlecast, Lophodermium sp.	1
f. Root rot, Fusarium sp. and Cylindrocarpon sp.	1

E. **Ornamentals** (Cont'd)	# inquiries
80. *Pinus* sp., Pine	
a. Abiotic Injury	1
b. Chemical injury	2
c. Cold temperature spotting	1
d. Diplodia tip blight, *Sphaeropsis sapinea*	5
e. Negative for needlecast	1
f. Normal phenomenon	5
g. Site problem	1
h. Winter injury	2
81. *Platanus occidentalis*, Sycamore	
a. Anthracnose, *Discula* state of *Gnomonia platani*	1
b. Canker, *Gnomonia platani*	1
82. *Platanus acerifolia*, London plane	
a. Anthracnose, *Discula* state of *Gnomonia platani*	1
b. Canker, *Discula* state of *Gnomonia platani*	1
83. *Podocarpus macrophyllus*, Buddhist pine	
a. No disease found	1
b. Verticillium wilt, *Verticillium albo-atrum*	1
84. *Polygonum* sp., Spotted lungwort	
a. Leaf and stem blight, *Botrytis* sp.	1
85. *Populus deltoides*, Cottonwood	
a. Leaf spot, *Marssonina* sp.	1
86. *Populus nigra*, Lombardy poplar	
a. Canker, undetermined	1
87. *Potentilla* sp., Potentilla	
a. Herbicide injury	1
88. *Prunus serotina*, Black cherry	
a. Death of Cambium, cause unknown	1
b. Systemic chemical injury	1
89. *Prunus serrulata*, Japanese flowering cherry	
a. Spray injury	1
90. *Prunus triloba*, Flowering almond	
a. Bacterial canker, undetermined	1
91. *Prunus virginiana*, Chokecherry	
a. Chemical injury	1
92. *Pseudotsuga menziesii*, Douglas fir	
a. Abiotic injury	3
b. Canker, *Cytospora* sp.	1
c. Damping off, *Rhizoctonia* sp.	1
d. Flooding injury	1
e. Fungus in storage, Basidiomycete	1
f. Needlecast, *Rhabdocline* sp.	2
g. Normal autumn senescence	2
h. Physiological damping off	1
i. Winter injury	2

E. Ornamentals (Cont'd)	# inquiries
93. Pterophyta, Fern	
a. Abiotic injury	1
b. Rust, Uredinopsis sp.	1
94. Pyrus calleryana, Bradford pear	
a. Winter injury	1
95. Quercus alba, White oak	
a. Anthracnose, Discula state of Gnomonia quercina	3
b. Leaf spot, undetermined	1
96. Quercus palustris, Pin oak	
a. Abiotic injury	1
Secondary dieback, Macrophoma sp.	1
b. Dieback, Dothiorella sp.	1
c. Leaf spot, Actinopelte dryina	2
d. Micronutrient chlorosis	5
e. Oak leaf blister, Taphrina caerulescens	1
Secondary dieback, Phomopsis sp.	1
f. Physiological leaf spot	1
97. Quercus rubra, Red oak	
a. Abiotic injury	1
b. Leaf scorch	1
98. Quercus sp., Oak	
a. Botryodiplodia sp. on bark	1
b. Canker, Cytospora sp.	1
c. Decline	1
d. Herbicide Injury	1
e. Leaf blister, Taphrina caerulescens	1
f. Leaf spot, Actinopelte dryina	2
g. Winter injury	1
h. Wood decay, Polyporaceae	1
99. Rhamnus frangula, Rhamnus	
a. Canker, Undetermined	1
b. Winter injury	2
100. Rhododendron sp., Rhododendron	
a. Canker, Botryosphaeria sp.	3
b. Canker, Dothiorella state of Botryosphaeria sp.	2
c. Canker, Phoma sp.	1
d. Canker, undetermined	2
e. Chemical injury	1
f. Cutting rot	1
g. Dieback, Mycosphaerella sp.	1
h. Environmental injury	1
i. Gray blight, Pestalotia sp.	2
j. Insufficient sample	1
k. Leaf scorch, Septoria sp.	1
l. Leaf spot, bud blast and canker, Dothiorella sp.	1
m. Leaf spot, Guignardia sp.	1
n. Leaf spot, Phyllosticta sp.	3
o. Negative for Phytophthora	1

E. **Ornamentals** (Cont'd)	# inquiries
100. Rhododendron (Cont'd)	
p. No disease found	1
q. Normal phenomenon	1
r. Nutrient deficiency	2
s. Oedema	1
t. Phytophthora root rot and wilt, *Phytophthora* sp.	3
u. Transplant stress	7
v. Winter injury and sun scald	3
101. *Rhododendron* sp., Azalea	
a. Canker, *Dothiorella* sp.	1
b. Phytophthora wilt, *Phytophthora* sp.	1
c. Secondary leaf spot. *Pestalotia* sp.	1
102. *Rhus* sp., Sumac	
a. Canker, *Phomopsis* sp.	1
b. Root problem	1
103. *Robinia pseudoacacia*, Black locust	
a. Dieback, *Dothiorella* sp.	1
104. *Salix* sp., Willow	
a. Black canker, *Gloeosporium* state of *Glomerella miyabeana*	5
b. Canker, *Marssonina* sp.	1
c. Chemical injury	1
d. Leaf spot and twig blight, *Marssonina salicicola*	1
105. *Sambucus* sp., Elderberry	
a. Normal Phenomenon	1
b. Rust, *Puccinia bolleyana*	1
106. *Sassafras albidum*, Sassafras	
a. Site problem	1
107. *Sedum* sp., Sedum	
a. Root and stem rot, *Phytophthora* sp.	1
108. *Skimmia japonica*, Skimmia	
a. Canker, *Phomopsis* sp.	1
b. Root and collar rot, *Fusarium* sp.	1
c. Winter injury	1
109. *Sophora japonica*, Japanese Pagoda tree	
a. Herbicide injury	1
b. Transplant failure	1
c. Winter injury	1
110. *Sorbus aucuparia*, European mountain ash	
a. Canker, *Cytospora* sp.	1
111. *Sorbus* sp., Mountain ash	
a. Apple scab, *Spilocea* state of *Venturia inaequalis*	3
b. Canker, *Cytospora* sp. and *Phomopsis* sp.	1
c. Early fall coloration	1
d. Fire injury	1
e. Fireblight, *Erwinia amylovora*	3
f. Herbicide injury	1
g. Leaf spot, *Kabatiella* sp.	1
h. Leaf spot, *Sphaeropsis* sp.	1
i. Leaf spot, undetermined	1
j. Transplant stress	1

E. Ornamentals (Cont'd)	# inquiries
112. Spirea sp., Spirea	
a. Cuttings did not root	1
b. Insufficient sample	1
113. Symphoricarpos sp., Snowberry	
a. Canker, Phomopsis sp.	1
114. Syringa reticulata, Japanese tree lilac	
a. Ozone injury	1
115. Syringa sp., Lilac	
a. Alternaria sp. on leaves	1
b. Bacterial blight, Pseudomonas syringae	1
c. Chemical injury	1
d. Botrytis blight, Botrytis sp.	1
e. Frost injury	1
f. Herbicide injury	4
g. Insufficient sample	1
h. Leaf spot, Ascochyta sp.	1
i. Needs rejuvenation	1
j. Normal phenomenon	1
k. Phytophthora blight	1
l. Powdery mildew, Microsphaera alni	4
m. Secondary dieback, Diplodia sp. and Coniothyrium sp.	1
116. Taxus sp., Yew	
a. Abiotic injury	2
b. Chemical injury	2
c. Herbicide injury	4
d. Pestalotia sp. on weak shoots	1
e. Seconary root rot, Cylindrocarpon sp.	1
f. Site problem	4
g. Transplant stress	4
h. Unknown cause of death	1
i. Winter injury	2
117. Thuja occidentalis, Arborvitae	
a. Canker and dieback, Phomopsis sp.	2
b. Chemical injury	1
c. Dieback, undetermined	1
d. Drought injury	1
e. Environmental injury	4
f. Herbicide injury	3
g. No injury found	1
h. Normal phenomenon	3
i. Road salt injury	1
j. Site problem	3
k. Tip blight, Pestalotia sp.	1
l. Tip blight, Sclerophoma sp.	1
m. Transplant stress	5
n. Winter injury	4
118. Tilia americana, Basswood	
a. Secondary leaf spots, Alternaria sp. and Cladiosporium sp.	1

E. Ornamentals (Cont'd)	# inquiries
119. Tilia europaea, European linden	
a. Physiological leaf scorch	1
120. Tilia sp., Linden	
a. Cultural problem	1
121. Tsuga sp., Hemlock	
a. Chemical injury	3
b. Environmental injury	2
c. Healthy callus over hail or freeze injury	1
d. Herbicide injury	1
e. Insufficient sample	1
f. Lime sulfur injury	1
g. No disease found	1
h. Normal phenomenon	1
i. Nutrient deficiency	1
j. Physiological problem	1
k. Site problem	1
l. Secondary canker, Phomopsis sp.	1
122. Ulmus parvifolia, Chinese elm	
a. Canker, Botryodiplodia hypodermia	1
b. Wet wood	1
123. Ulmus, sp., American elm	
a. Canker, Cytospora sp.	1
b. Canker, Botryodiplodia hypodermia	1
c. Info on Dutch Elm Disease	1
124. Ulmus sp., Elm	
a. Black spot, Gnomonia ulmea	1
b. Canker, Botryodiplodia hypodermia	2
c. Canker, Tubercularia state of Nectria cinnabarina	1
d. Dutch Elm Disease, Ophiostoma ulmi	3
e. Herbicide injury	1
f. Late leafing out	1
g. Leaf spot, Phyllosticta sp.	1
h. Negative for Dutch Elm Disease	1
i. Winter injury	1
125. Viburnum sp., Viburnum	
a. Canker, undetermined	1
b. Chemical injury	1
c. Downy mildew, Plasmopara viburni	2
d. Environmental injury	1
e. Insufficient sample	1
f. Nutrient deficiency	1
g. Transplant stress	2
126. Vinca sp., Periwinkle	
a. Soluble salts injury	1
127. Genus/sp. unkown, Laurel	
a. Iron chlorosis	1
b. Leaf spot, Guignardia sp.	1
SUBTOTAL	742

F. Turf	# inquiries
1. Gramineae, Turf	
a. Anthracnose, Colletotrichum sp.	3
b. Brown patch, Rhizoctonia sp.	4
c. Dollar spot	1
d. Establishment problem, cause unknown	1
e. Fairy ring	3
f. Foliar blight, Fusarium sp.	3
g. Fusarium blight syndrome	1
h. Gas leak injury	1
i. Insufficient sample	8
j. Leaf spot, Ascochyta sp.	2
k. Leaf spot, Ascochyta sp., Septoria sp., and Dreshlera sp.	1
l. Leaf spot, Dreschlera sp. and Ascochyta sp.	2
m. Leaf spot, Dreschlera sp. and Septoria sp.	1
n. Leaf spot and melting out, Bipolaris sorokiniana	1
o. Leaf spot and melting out, Deschlera poae	3
p. Leaf spot and melting out, Dreschlera siccans	1
q. Leaf spot and melting out, Dreschlera sp.	6
r. Pythium blight, Pythium sp.	4
s. Pythium root rot, Pythium sp.	6
t. Slime mold	2
u. Thatch problem	1
2. Agrostis sp., Bentgrass	
a. Insufficient sample	1
b. Leaf spot, Curvularia sp.	1
c. Root rot, Pythium sp.	1
3. Festuca sp., Fescue	
a. Anthracnose, Colletotrichum sp.	1
b. Leaf spot and melting out, Bipolaris sp.	1
c. Leaf spot and melting out, Curvularia lunata	1
4. Lolium sp., Ryegrass	
a. Anthracnose, Colletotrichum sp.	1
b. Brown patch, Rhizoctonia sp.	1
c. Rust, Puccinia sp.	1
5. Poa annua, Annual bluegrass	
a. Root rot, Pythium sp., and Fusarium sp.	1
6. Poa pratensis, Kentucky bluegrass	
a. Leaf spot and melting out, Dreschlera poae	1
b. Powdery mildew, Oidium sp.	1
c. Root rot and leaf spot. Rhizoctonia sp.	1
7. Poa sp., Bluegrass	
a. Abiotic injury	1
b. Anthracnose, Colletotrichum sp.	2
c. Brown patch, Rhizoctonia sp.	2
d. Fusarium blight syndrome	1
e. Insufficient sample	1
f. Leaf spot, Ascochyta sp.	1
g. Leaf spot and melting out, Dreschlera sp.	1
h. Leaf spot and melting out, Dreschlera sp. and Curvularia sp.	1
i. Powdery mildew, Oidium sp.	1
j. Pythium blight, Pythium sp.	1
k. Stripe smut, Ustilago striiformis	1

F. Turf (Cont'd)	# inquiries
8. Zoysia sp., Zoysia grass	
a. Anthracnose, Colletotrichum sp.	1
b. Leaf spot, Curvularia sp., Dreschlera sp. and Ascochyta sp.	1
c. Normal browning after frost	1
d. Rust, Puccinia sp.	1
SUBTOTAL	85

G. Vegetables and Herbs	# inquiries
1. Allium sativum, Garlic	
a. Bulb rot, Fusarium sp.	1
b. Purple blotch, Alternaria porri	1
c. Wet soil injury	1
2. Allium sp., Onion	
a. Bacteria, Erwinia sp.	1
b. Bacterial rot	1
c. Bulb rot, Fusarium sp.	1
d. Downy mildew, Peronospora destructor	1
e. Neck and bulb rot, Pseudomonas sp.	1
f. Pink root, Pyrenochaeta sp.	1
g. Root rot, Pythium sp.	1
3. Armoracia rusticana, Horseradish	
a. Black leaf spot, Alternaria brassicae	1
4. Asparagus sp., Asparagus	
a. Crown rot, Fusarium sp.	3
5. Beta sp., Beet	
a. Environmental injury	1
6. Brassica napus, Rutabaga	
a. Crown gall, Agrobacterium tumefaciens	1
b. Hollow heart, boron deficiency	1
7. Brassica oleracea, Broccoli	
a. Environmental pollutant injury	1
b. White mold, Sclerotinia sclerotiorum	1
8. Brassica oleracea, Cabbage	
a. Black leaf spot, Alternaria brassicicola	3
b. Black rot, Xanthomonas camoestris	3
c. Chemical injury	1
d. Club root, Plasmodiophora brassicae	1
e. Crown gall, Agrobacterium tumefaciens	1
f. Root and stem rot, Fusarium sp.	3
g. Soft rot, Erwinia sp.	1
9. Brassica oleracea, Cauliflower	
a. Abiotic injury	1
b. Black rot, Xanthomonas campestris	1
c. Black leaf spot, Alternaria brassicicola	3
d. Club root, Plasmodiophora brassicae	1

6. Vegetables and Herbs	# inquiries
10. Brassica rapa, Turnip	
a. Hollow heart, boron deficiency	1
11. Capiscum annuum, Pepper	
a. Bacterial spot, Xanthomonas vesicatoria	1
b. Cucumber mosaic virus	1
c. Drought stress	1
d. Fusarium wilt, Fusarium sp.	1
e. Insufficient sample	1
f. Leaf spot, cause unknown	1
g. Leathery skin, cause unknown	1
h. Physiological or genetic problem	1
12. Citrullus lanatus, Watermelon	
a. Fusarium wilt, Fusarium sp.	1
b. Root rot, Fusarium sp.	1
13. Cucumis melo, Muskmelon	
a. Leaf spot, Septoria sp.	1
b. Mold on jiffy discs	1
14. Cucumis sativus, cucumber	
a. Alternaria leaf spot, Alternaria cucumerina	1
b. Bacterial soft rot	1
c. Bacterial wilt, Erwinia trachaophila	2
d. Belly rot, Rhizoctonia solani	1
e. Chilling injury	1
f. High soluble salts injury	1
15. Cucurbita spp., Pumpkin	
a. Insufficient sample	1
b. Peduncle rot, Alternaria sp. and Collectotrichum sp.	1
c. Scab, Cladosporium cucumerinum	1
16. Cucurbita spp., Squash	
a. Angular leaf spot, Pseudomonas lachrymans	1
b. Herbicide injury	1
c. Pythium cottony leak, Pythium sp.	1
17. Cucurbita spp., Zucchini	
a. Cultural problem	1
b. Root rot	1
18. Helianthus divaricata, Sunflower	
a. Alternaria blight, Alternaria zinniae	1
b. Powdery mildew, Oidium sp.	1
c. Root rot, Armillaria mellea	1
19. Lactuca sp., Lettuce	
a. Damping off, Rhizoctonia sp.	1
b. Heat stress	1
c. Powdery mildew, Oidium state of Erysiphe cichoracearum	1
20. Lycopersicon lycopersicum, tomato	
a. Bacterial wilt, Pseudomonas solanacearum	1
b. Cat-facing	1

6. Vegetables and Herbs	# inquiries
20. Lycopersicon lycopersicum, Tomato (Cont'd)	
d. Cucumber Mosaic Virus	2
e. Early blight, Alternaria solani	2
f. Environmental Injury	2
g. Fruit blemishes: Erwinia sp., Pseudomonas sp.	1
h. Fusarium wilt, Fusarium sp.	3
i. Growth cracks	1
j. Insufficient sample	3
k. Leaf mold, Fulvia fulva	1
l. Leaf spot, undetermined	1
m. Physiological fruit abscission	1
n. Root and stem rot, Fusarium sp. and Rhizoctonia sp.	1
o. Septoria blight, Septoria lycopersici	6
p. Sooty mold	1
q. Transplant stress	2
r. Virus or herbicide injury	1
s. Walnut wilt	1
t. White mold and timber rot, Sclerotinia sp.	2
u. Wilt, undetermined	4
21. Mentha sp., Mint	
a. Leaf spot, Phyllosticta sp.	1
22. Monarda didyma, Bee balm	
a. Powdery mildew, Oidium sp.	1
b. Rust, Puccinia menthae	1
23. Nicotiana tabacum, Tobacco	
a. Cultural Problem	2
b. No blue mold	1
24. Phaseolus limensis, Lima bean	
a. Halo blight, Pseudomonas sp.	1
b. Herbicide injury	1
25. Phaseolus vulgaris, Bean	
a. Bacterial spot	1
b. Common bacterial blight, Xanthomonas phaseoli	1
c. Deicing salt spill injury	1
d. Erwinia sp. in flecks	1
e. Fusarium dry root rot, Fusarium sp.	2
f. Fusarium wilt, Fusarium sp.	1
g. Insufficient sample	1
h. Leaf spot, Alternaria sp.	1
i. Negative for bacterial blight	1
j. Root rot, Pythium sp. and Fusarium sp.	1
k. Rust, Uromyces phaseoli	1
26. Pisum sativum, Pea	
a. Insufficient sample	1
b. Root rot, Fusarium sp.	1
c. Root rot, undetermined	2
27. Pisum sativum var. macrocarpon, Snow pea	
a. Ascochyta blight, Ascochyta pisi	1

6. Vegetables and Herbs	# inquiries
28. Rheum sp., Rhubarb	
a. Leaf spot, Ascochyta sp.	2
b. Nutrient deficiency	1
c. Transplant stress	1
29. Solanum melongena var. esculentum, Eggplant	
a. Insufficient sample	1
b. Leaf spot, Septoria lycopersici	1
c. Leathery skin, cause undetermined	1
30. Solanum tuberosum, Potato	
a. Common scab, Streptomyces scabies	4
b. Early blight, Alternaria solani	2
c. Fungi on seed pieces, Gliocladium sp., Gilmaniella sp. and Fusarium sp.	1
d. Gray mold, Botrytis sp.	2
e. Late blight, Phytophthora infestans	1
f. Leak, Pythium sp.	1
g. No disease found	1
h. Skinning injury	1
i. Soft rot, Erwinia carotovora	1
j. Stem rot, Rhizoctonia solani	1
k. Tuber lesions, Rhizoctonia solani	1
31. Spinacia oleracea, Spinach	
a. Broad bean wilt virus	1
b. Leaf spot, Alternaria sp.	1
32. Zea mays, Sweet corn	
a. Herbicide injury	1
b. Smut, Ustilago maydis	2
SUBTOTAL	163

H. Fungi	
1. Aspergillus sp., Penicillium sp. and Memnoniella sp. on Market packs	1
2. Bahusakala sp.	1
3. Basidiomycete associated with a lichen on tree bark	1
4. Bird's nest fungus, Nidulariales	1
5. Coprinus micaceous	1
6. Lenzites trabea f. trametes	1
7. Polyporaceae	1
8. Mildew on paint in home	1
9. Peziza domiciliana	1
10. Polyporaceae	1
11. Pyronema omphalodes	1
12. Sent information on growing truffles	1
13. Shiitake, Japanese mushrooms grown on logs	1
14. Slime mold	2
15. Sphaerobolus stellatus - spore capsule on plants	1
16. Stinkhorn, Mutinus caninus	2
17. Sulphur shelf, Polyporus sulphureus	1
18. Wood deay fungus, Daedalea unicolor	1
19. Wood decay in houses	2
SUBTOTAL	22

I. General	# inquiries
1. Requests for Information on Plant Diseases	33
2. Requests for Information on Plant Disease Management	19
3. Requests for Information on Fungicides, Bactericides and Nematicides	6
SUBTOTAL	58
TOTAL	1419

Other Inquiries	# inquiries
1. Plant Identifications Only (other than those referred to Bailey Hortorium)	11
2. Plant Identifications and Eradication Recommendations	18
3. Requests for Information on Plants	14
4. Requests for Information on Moss, Algae, Lichens	5
5. Requests for informaton on Small Animal control	
a. Bats	1
b. Moles	1
c. Rats	1
d. Squirrels	4
e. Woodpecker/sapsucker	1
f. Miscellaneous	2
6. Requests for Laboratory Publications	92
7. Miscellaneous	10
In addition, inquiries were referred to:	
a. Bailey Hortorium	22
b. Cooperative Extension Offices	1
c. Entomology	5
d. Floriculture and Ornamental Horticulture	6
e. Natural Resources	1
f. Plant Pathology	27
g. Pomology	4
h. Vegetable Crops	2
i. Other	7
SUBTOTAL	235

THE PLANT DISEASE AND INSECT CLINIC

N.C. State University at Raleigh

- A PARTIAL SUMMARY -

DISEASES OF MAJOR AND KEY CROPS

1984

Ronald K. Jones, Ext. Plant Pathology Spec.
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INTRODUCTION

In 1984, 5,124 disease specimens were received by the Plant Disease and Insect Clinic. Since many specimens had more than one disease and/or other damage, we estimate that 6,421 problems were diagnosed. David Stephan, Clinic entomologist, identified 2,070 insect specimens. This is a grand total of 8,491 diagnoses and identifications handled for the year.

We call your attention to the greater number of abiotic problems compared to infectious diseases (see Table 1). This has always been true, but few realize this fact. Abiotic problems are much more difficult to diagnose and report than are infectious diseases. Those viewing and reviewing Clinic operations, planning computer programs, etc. need to be aware that abiotic problems are a significant part of Clinic work.

Table 1. Total number of problems diagnosed on the crops summarized and the distribution by type of causal agent.

	Total Number	Percent
Specimens	3,045	
Problems diagnosed	3,818	
Infectious diseases	1,599	42%
Abiotic problems	2,219	58%

The Plant Disease and Insect Clinic at N. C. State University marked its 34th year of operation in 1984. This represents tens of thousands of specimens diagnosed and many times over that number of

hours put into carrying out the diagnostic work. The years of uninterrupted service the Clinic has provided the growers of North Carolina is a tribute to the many individuals who have contributed to this effort, sometimes against great odds.

As in 1983, tobacco was again plagued by weather fleck and virus diseases as the leading problems, with Granville wilt a humble third place.

For the first time in several years, the number of ornamental specimens dropped, while there were increases in numbers of field crop specimens and several other crop categories (see Table 2).

Table 2. Distribution of samples by crop category.

Crop category	No. specimens 1984	1983
Field crops	865	784
Forage crops	35	32
Fruits & Nuts	541	472
Misc. ID's	57	39
Ornamentals	1696	1864
Small grains	91	107
Trees	657	585
Turf	266	237
Vegetables	916	845

Weather again affected the kinds of problems we observed. Due to heavy rains into mid-summer, there was a high incidence of leaf spot disease as well as water damage to plant roots. Anthracnose of maple and drowned Japanese hollies are examples.

The most striking weather-related disease observed in the Clinic in 1984 was Rhizoctonia leaf spot of tobacco. A few cases were observed in 1983, but only on lower leaves. This year the perfect stage of Rhizoctonia solani (Thanatephorus cucumeris) formed on some of the samples, producing basidiospores which allowed the fungus to spread as high as 16 leaves up the stalk. Rhizoctonia leaf spot doubtfully will occur each year, but it will be something to watch for in the future, particularly in wet, cool summers.

Another interesting situation was the widespread ozone injury on new needles of white pine. It had been occasionally observed before but never to this extent. In 1984, numerous samples were received from all over the state. Most had the typical severe necrotic dieback of new needles with half or more of the needle affected.

We express gratitude to our summer assistant, Lynda Curlee, Plant Pathology faculty and students who participated in diagnostic work, and the Ext. Crop Science and Horticultural Science specialists who willingly came to our aid. Our regular staff (listed on the cover) deserves much credit for consistent, dedicated work.

Following is a list of diseases identified in the Clinic in 1984 that were not previously reported from North Carolina and a partial summary of diseases on major or representative crops. Due to the large number of specimens, a complete summary is not feasible, but anyone needing information on a crop not listed may arrange to see Clinic records.

New Disease Reports for North Carolina

Pathogen	Host
Agrobacterium tumefaciens	Blueberry (rabbit-eye)
Armillariella mellea	Sweet potato
Ascochyta violicola	Pansy
Belonolaimus spp.	Green bean
Botrytis cinerea	Lettuce
Botryosphaeria dothidea	Forsythia
Botryosphaeria dothidea	Pussywillow
Cercospora sp.	Dieffenbachia
Cercospora sp.	Hydrangea
Cercospora sp.	Spinach
Cercospora sp.	Sweet potato
Erwinia carotovora	Cyclamen
Fomes annosus	Azalea
Fusarium oxysporum f. *cyclaminis*	Cyclamen
Gloeosporium sp.	Red cedar
Meloidogyne spp.	Tuberose
Microsphaera penicillata	Rhododendron
Phomopsis sp. (sec.)	White pine
Phomopsis sp. (sec.)	Grape (var?)
Phytophthora cactorum	Ginseng
Phytophthora cinnamomi	Persian lilac
Phytophthora parasitica	Forsythia
Phytophthora parasitica	Pyracantha
Phytophthora parasitica	*Vinca major*
Rhizoctonia solani	Forsythia
Sclerotinia sclerotiorum	Swedish ivy

FIELD CROPS

CORN 118 specimens (105 in 1983)

22	Nematodes	
	- Stubby-root (11)	*Paratrichodorus minor*
	- Sting (2)	*Belonolaimus longicaudatus*
	- Misc. others (9)	
3	Root rot	Water damage suspected
2	Anthracnose	*Colletotrichum graminicola*
2	Southern corn leaf blight	*Helminthosporium maydis*
2	Southern rust	*Puccinia polysora*
1	Bacterial blight	*Erwinia stewartii*
1	Gray leaf spot	*Cercospora zeae-maydis*
1	Maize dwarf mosaic virus	
1	Root rot/seedlings	*Rhizoctonia solani*
1	Stalk rot	*Gibberella zeae*
65	Soil-related problem, primarily fertilizer injury & low pH	
8	Insects	
28	Chemical injury suspected	
8	Miscellaneous (inadequate specimens, etc.)	

145 Problems diagnosed 36 Infectious diseases

PEANUT 78 specimens (97 in 1983)

16	Root & stem rot	*Rhizoctonia*, *Pythium* & *Fusarium* spp.
11	Black rot	*Cylindrocladium crotalariae*
10	Pod rot	Several fungi
5	Southern stem rot	*Sclerotium rolfsii*
3	Crown rot	*Aspergillus niger*
2	Cercospora leaf spot	*Cercospora* spp.
2	Sclerotinia blight	*Sclerotinia minor*
1	Botrytis blight	*Botrytis cinerea*
1	Collar rot	*Botryodiplodia theobromae*
1	Foliar blight	*Rhizoctonia solani*
1	Nematodes	*Meloidogyne* spp.
1	Web blotch	*Phoma arachidicola*
5	Insects	
10	Chemical injury suspected	
8	Fertilizer injury (or suspected)	
13	Miscellaneous (soil-related problems, etc.)	

90 Problems diagnosed 54 Infectious diseases

SOYBEAN 141 specimens (151 in 1983)

37	Nematodes	
	- Cyst (23)	Heterodera glycines
	- Root-knot (5)	Meloidogyne spp.
	- Sting (3)	Belonolaimus longicaudatus
	- Misc. others (6)	
16	Root and stem rot, damping-off	Rhizoctonia, Fusarium and Pythium spp.
9	Pod and stem blight	Diaporthe sojae
9	Southern stem rot	Sclerotium rolfsii
8	Brown spot	Septoria glycines
6	Bacterial induced chlorosis	Rhizobium spp.
4	Leaf and stem spot	Cercospora spp.
3	Anthracnose	Colletotrichum dematium
3	Phytophthora root & stem rot	Phytophthora megasperma var. sojae
2	Downy mildew	Peronospora manshurica
2	Virus suspected	
1	Brown stem rot	Phialophora gregata
1	Charcoal rot	Macrophomina phaseolina
4	Insects	
30	Soil-related problem suspected	
10	Chemical injury suspected	
10	Fertilizer injury suspected	
10	Miscellaneous (inadequate specimens and unknown abiotic problems)	

165 Problems diagnosed 95 Infectious diseases

TOBACCO 481 specimens (420 in 1983)

76	Weatherfleck	Ozone
52	Virus	Tobacco mosaic (22)
		Vein mottling (15)
		Etch (5)
		Tobacco streak (5)
		Potato virus Y (4)
		Ringspot (1)
25	Granville wilt	Pseudomonas solanacearum
22	Nematodes	
	- Root-knot (20)	Meloidogyne incognita (8)
		" unknown sp. (9)
		" arenaria (2)
		" javanica (1)
	- Lesion (2)	Pratylenchus spp.
20	Soreshin	Rhizoctonia solani
11	Black shank	Phytophthora parasitica var. nicotianae
10	Damping-off	Rhizoctonia, Pythium & Fusarium spp.
9	Rhizoctonia leaf spot	Rhizoctonia solani

TOBACCO (contd)

7	Southern stem rot	Sclerotium rolfsii
6	Angular leaf spot	Pseudomonas angulata
5	Brown spot	Alternaria longipes
5	Frenching, or frenching-type symptoms	
5	Fusarium wilt	Fusarium oxysporum
5	Lightning injury	
4	Ragged leaf spot	Phoma exigua
1	Blue mold	Peronospora tabacina
80	Chemical injury suspected	
80	Soil problem suspected, primarily high pH	
48	Fertilizer injury (or suspected)	
25	Environmental damage suspected (cold, too wet, etc.)	
7	Insects	
42	Miscellaneous (unknown abiotic problems, inadequate specimens, etc.)	

545 Problems diagnosed 177 Infectious diseases

FORAGE CROPS

ALFALFA 32 specimens (26 in 1983)

9	Crown & stem rot	Sclerotinia trifoliorum
7	Leaf spot	Leptosphaerulina & Stemphylium spp.
6	Anthracnose	Colletotrichum spp.
6	Crown rot	Rhizoctonia & Fusarium spp.
1	Damping-off	Pythium spp.
7	Environmental/nutritional problem	
3	Insects	
2	Inadequate specimens	
1	Soil compaction	

42 Problems diagnosed 29 Infectious diseases

SMALL GRAINS

OATS 19 specimens (23 in 1983)

8	Barley yellow dwarf virus, or suspected	
6	Leaf spot	Helminthosporium avenae
2	Loose smut	Ustilago avenae

OATS (contd)

2	Soil-borne oat mosaic virus	
4	Nutritional problem suspected	
2	Insects	
2	Inadequate specimen	
1	Cold injury	

27 Problems diagnosed 18 Infectious diseases

WHEAT 53 specimens (58 in 1983)

11	Glume blotch, leaf spot	Septoria nodorum
7	Barley yellow dwarf virus, or suspected	
4	Take-all	Gaeumannomyces graminis var. tritici
1	Powdery mildew	Erysiphe graminis
26	Soil/nutritional problem, primarily high pH	
5	Cold injury or other environmental problem	
3	Insects	
2	Inadequate specimen	
1	Chemical injury suspected	

60 Problems diagnosed 23 Infectious diseases

VEGETABLES

BEAN (GREEN AND LIMA) 125 specimens (95 in 1983)

27	Root & stem rot, damping-off	Rhizoctonia, Pythium and Fusarium spp.
14	Virus suspected	
9	Southern blight	Sclerotium rolfsii
8	Nematodes	
	- Root-knot (7)	Meloidogyne incognita
	- Sting (1)	Belonolaimus longicaudatus
8	Air pollutant damage suspected	
4	Yeast seed pitting	Nematospora phaseoli
2	Anthracnose	Colletotrichum spp.
2	Rust	Uromyces phaseoli var. typica
1	Black root rot	Thielaviopsis basicola
1	Pod spot	Phoma exigua
1	Sunscald	
1	White mold	Sclerotinia sclerotiorum
21	Insects, spider mites	

BEAN (GREEN AND LIMA) (contd)

36	Fertilizer injury and other soil-related problems
7	Chemical injury suspected
12	Miscellaneous (unknown problems, inadequate specimens, etc.)

154 Problems diagnosed 69 Infectious diseases

PEPPER 81 specimens (78 in 1983)

12	Southern blight	Sclerotium rolfsii
6	Damping-off, root rot	Rhizoctonia solani
5	Bacterial leaf spot	Xanthomonas vesicatoria
4	Blossom-end rot	Physiological
4	Virus	Etch (2) Mosaic (1) PVY (1)
3	Nematodes	Meloidogyne spp.
2	Leaf spot	Alternaria spp.
1	Anthracnose fruit rot	Colletotrichum capsici
1	Bacterial soft rot	Erwinia carotovora
1	Botrytis blight	Botrytis cinerea
1	Frogeye leaf spot	Cercospora capsici
1	Leaf spot	Phoma exigua
1	Phytophthora blight	Phytophthora capsici
23	Fertilizer injury	
7	Chemical injury suspected	
2	Nutritional problem suspected	
2	Sunburn	
1	Insects	
7	Miscellaneous (unknown injuries and inadequate specimens)	

84 Problems diagnosed 38 Infectious diseases

SWEET POTATO 46 specimens (53 in 1983)

7	Circle spot	Sclerotium rolfsii
5	Soil pox	Streptomyces ipomoea
4	Bacterial soft rot	Erwinia spp.
4	Fusarium root rot, stem rot	Fusarium spp.
4	Nematodes	Meloidogyne spp.
2	Surface rot	Fusarium oxysporum
1	Leaf spot	Cercospora sp.
1	Scurf	Monilochaetes infuscans
1	Soft rot	Erwinia spp.
4	Insects	
4	Fertilizer injury	
12	Miscellaneous (nutritional, genetic, environmental, etc.)	

49 Problems diagnosed 29 Infectious diseases

TOMATO 215 specimens (260 in 1983)

27	Southern bacterial wilt	Pseudomonas solanacearum
19	Southern blight	Sclerotium rolfsii
18	Septoria leaf spot	Septoria lycopersici
10	Early blight	Alternaria solani
8	Leaf mold	Cladosporium fulvum
7	Virus	TMV-tomato strain (4) Tomato aspermy (2) PVY (1)
6	Hollow stem, soft rot	Erwinia carotovora
5	Nematodes	Meloidogyne spp.
5	Stem rot	Rhizoctonia & Pythium spp.
3	Bacterial leaf spot	Xanthomonas vesicatoria
3	Blossom-end rot	Physiological
3	Fusarium wilt	Fusarium oxysporum f. sp. lycopersici
3	Root rot	Pythium spp.
2	Anthracnose fruit rot	Colletotrichum phomoides
2	Botrytis blight	Botrytis cinerea
2	Edema	Physiological
2	Fruit rot	Rhizoctonia & Gloeosporium spp.
1	Buckeye rot	Phytophthora parasitica
1	Catfacing	Unknown
1	Phoma leaf spot	Phoma exigua
1	Sunscald	
1	Verticillium wilt	Verticillium albo-atrum
6	Insects	
22	Fertilizer injury (or suspected)	
21	Nutritional problem suspected	
13	Chemical injury suspected	
27	Miscellaneous (unknown injuries, inadequate specimens, etc.)	

219 Problems diagnosed 123 Infectious diseases

FRUITS

APPLE 99 specimens (92 in 1983)

36	Scab	Venturia inaequalis
15	Cedar-apple rust	Gymnosporangium juniperi-virginianae
12	Frogeye leaf spot	Physalospora obtusa
8	Fly speck	Mycrothyriella rubi
7	Sooty blotch	Gloeodes pomigena
5	Bitter rot	Glomerella cingulata
4	Collar rot suspected	Phytophthora cactorum
4	Cork spot	Calcium deficiency
2	Burr-knot	Various factors related
2	Necrotic leaf blotch of Golden Delicious	
2	White rot-fruit	Botryosphaeria dothidea

APPLE (contd)

1	Canker	Botryosphaeria dothidea
1	Crown gall	Agrobacterium tumefaciens
1	Fire blight	Erwinia amylovora
1	Powdery mildew	Podosphaera leucotricha
24	Insects, spider mites	
20	Problem suspected lower down in tree	
3	Cold injury	
2	Drowning suspected	
1	Russet	
11	Miscellaneous (inadequate specimens and various abiotic problems)	

162 Problems diagnosed 93 Infectious diseases

GRAPE 65 specimens (33 in 1983)

11	Black rot	Guignardia bidwellii
4	Bitter rot	Melanconium fuligineum
3	Anthracnose (bunch)	Elsinoë ampelina
3	Macrophoma rot	Botryosphaeria dothidea
2	Crown gall suspected	Agrobacterium tumefaciens
2	Ripe rot	Glomerella cingulata
1	Leaf roll virus suspected	
1	Pierce's disease	Rickettsia-like bacterium
1	Powdery mildew	Uncinula necator
1	Target spot	Cristulariella moricola
9	Insects	
5	Cold injury suspected	
4	Fertilizer injury (or suspected)	
22	Miscellaneous (nutritional, chemical, etc.)	

69 Problems diagnosed 29 Infectious diseases

PEACH 74 specimens (35 in 1983)

10	Leaf curl	Taphrina deformans
9	Scab	Cladosporium carpophilum
4	Brown rot	Monilinia fructicola
3	Bacterial spot	Xanthomonas pruni
3	Nematodes	Meloidogyne spp.
2	Crown gall	Agrobacterium tumefaciens
1	Blossom blight	Monilinia fructicola
1	Root rot	Armillariella mellea suspected
10	Insects	
8	Chemical injury suspected	
6	Fertilizer injury	
4	Root or soil problem suspected	
3	Cold injury	

PEACH (contd)

2	Drowning
14	Miscellaneous (fruit drop, inadequate specimens, etc.)

80 Problems diagnosed 33 Infectious diseases

STRAWBERRY 80 specimens (126 in 1983)

14	Nematodes	
	- Stunt (6)	Tylenchorhynchus claytoni
	- Root-knot (4)	Meloidogyne spp. (species not determined; probably not M. hapla)
	- Lesion (3)	Pratylenchus spp.
	- Sting (1)	Belonolaimus spp.
11	Black root rot	Nematodes, fungi, etc.
6	Crown rot; leaf & petiole blight	Rhizoctonia solani
6	Scorch	Diplocarpon earliana
5	Anthracnose	Colletotrichum spp.
5	Leaf spot	Mycosphaerella fragariae
5	Red stele	Phytophthora fragariae
4	Powdery mildew	Sphaerotheca macularis
1	Gray mold	Botrytis cinerea
1	Hard rot	Rhizoctonia solani
1	Leaf spot	Hainsia lythri
1	Virus suspected	
6	Insects, spider mites	
10	Fertilizer injury (or suspected)	
7	Cold injury suspected	
4	Chemical injury suspected	
3	Nutritional problem suspected	
13	Others (unknown injuries, inadequate specimens, etc.)	

103 Problems diagnosed 60 Infectious diseases

ORNAMENTALS

AZALEA 215 specimens (275 in 1983)

53	Nematodes (primarily stunt)	Tylenchorhynchus claytoni
38	Phytophthora root rot	Phytophthora cinnamomi
19	Twig blight, dieback	Phomopsis sp.
13	Leaf gall	Exobasidium vaccinii
6	Pythium root rot (greenhouse)	Pythium spp.
5	Leaf spot	Cercospora, Pestalotia and Macrophoma spp.
5	Powdery mildew	Microsphaera penicillata

AZALEA (contd)

4	Stem galls	Cause unknown
3	Cutting blight	Rhizoctonia solani
2	Botrytis blight	Botrytis cinerea
2	Isolated from roots & crown	Fomes annosus
2	Lichens	
1	Petal blight suspected	Ovulinia azaleae
1	Phytophthora dieback	Phytophthora parasitica
1	Root rot	Unknown
1	Rust	Pucciniastrum myrtilli
1	Secondary on stems	Gloeosporium sp.
1	Slime mold	
1	Sooty mold	
28	Insects, spider mites	
27	Cold injury	
50	Fertilizer injury (or suspected)	
19	Nutritional problem suspected	
36	Miscellaneous (deep planting, unknown injuries and inadequate specimens)	

319 Problems diagnosed 155 Infectious diseases

BOXWOOD 255 specimens (105 in 1983)

123	Nematodes (primarily lesion)	Pratylenchus spp.
27	Phytophthora root rot	Phytophthora parasitica & Phytophthora cinnamomi (2)
84	Insects, spider mites	
95	Fertilizer injury (or suspected)	
32	Inadequate specimens	
26	Secondary leaf spot	Macrophoma & Volutella spp.
4	Cold injury	
1	Chemical injury suspected	
17	Miscellaneous (nutritional or environmental)	

409 Problems diagnosed 176 Infectious diseases

HOLLY (MOSTLY JAPANESE) 179 specimens (271 in 1983)

46	Drowning	
43	Nematodes	
	- Ring (19)	Criconemella spp.
	- Dagger (12)	Xiphinema americanum
	- Root-knot (6)	Meloidogyne spp.
	- Miscellaneous (6)	
18	Black root rot	Thielaviopsis basicola
10	Secondary leaf spot	Pestalotia, Macrophoma spp., etc.
5	Sooty mold	
5	Twig dieback, flower blight	Botrytis & Gloeosporium spp.

HOLLY (MOSTLY JAPANESE) (contd)

3	Root rot	Armillariella mellea
2	Phytophthora root rot (on Fosteri holly)	Phytophthora cinnamomi
29	Insects, spider mites	
11	Cold injury suspected	
6	Root girdling/pot-bound	
58	Fertilizer injury (or suspected)	
51	Miscellaneous (nutritional, environmental and inadequate specimens)	

287 Problems diagnosed 81 Infectious diseases

JUNIPER 76 specimens (115 in 1983)

11	Phytophthora root rot	Phytophthora cinnamomi
1	Blight	Phomopsis juniperovora
1	Root rot	Pythium spp.
3	Cold injury	
2	Drowning suspected	
19	Insects, spider mites	
13	Fertilizer injury (or suspected)	
36	Miscellaneous (environmental, cultural, inadequate specimens)	

86 Problems diagnosed 13 Infectious diseases

RHODODENDRON 107 specimens (115 in 1983)

25	Dieback	Botryosphaeria dothidea
22	Phytophthora root rot	Phytophthora cinnamomi
5	Phytophthora dieback	Phytophthora cactorum
4	Leaf spot	Several fungi
3	Dieback	Phomopsis sp.
2	Damping-off	Rhizoctonia solani
2	Root rot	Pythium spp.
1	Powdery mildew	Microsphaera penicillata
1	Root rot	Armillariella mellea
10	Cold injury	
11	Insects	
26	Miscellaneous (unknown injuries, nutritional, environmental, inadequate specimens)	

112 Problems diagnosed 65 Infectious diseases

ROSE 43 specimens (47 in 1983)

6	Canker, dieback	Botrytis & Coniothyrium spp.
4	Nematodes	
	- Lesion (2)	Pratylenchus spp.
	- Root-knot (1)	Meloidogyne spp.
	- Stunt (1)	Tylenchorhynchus spp.
2	Mosaic virus	
2	Root rot	Pythium spp.
1	Black spot	Marssonina rosae
1	Crown gall	Agrobacterium tumefaciens
1	Isolated from roots	Rhizoctonia solani
1	Powdery mildew	Sphaerotheca macularis
8	Insects, spider mites	
6	Chemical injury suspected	
6	Cold injury	
3	Fertilizer injury	
14	Miscellaneous (cultural, environmental, nutritional)	

55 Problems diagnosed 18 Infectious diseases

GRASSES

CENTIPEDEGRASS 109 specimens (96 in 1983)

59	Nematodes	
	- Ring (45)	Criconemella spp.
	- Sting (6)	Belonolaimus spp.
	- Lesion (1)	Pratylenchus spp.
	- Stubby-root (1)	Paratrichodorus minor
	- Miscellaneous (6)	
37	Winter injury suspected	
5	Fairy ring suspected	
1	Brown patch	Rhizoctonia solani
1	Dollar spot suspected	Sclerotinia homoecarpa
1	Leaf spot	Curvularia sp.
8	Ground pearls and other insects	
26	High soil pH	
15	Fertilizer injury	
9	Miscellaneous (drought, thatch, etc.)	

162 Problems diagnosed 67 Infectious diseases

FESCUE 73 specimens (69 in 1983)

33	Brown patch	Rhizoctonia solani
7	Leaf spot	Helminthosporium spp.
2	Anthracnose	Colletotrichum graminicola
2	White patch	Mushroom fungus

FESCUE (contd)

1	Dollar spot	Sclerotinia homoeocarpa
1	Pink patch	Limonomyces roseipellis
1	Pythium blight	Pythium spp.
1	Rust	Puccinia sp.
7	Insects	
30	Fertilizer injury	
16	Miscellaneous (drought, site/soil problems, etc.)	

101 Problems diagnosed 48 Infectious diseases

TREES

DOGWOOD 65 specimens (60 in 1983)

10	Spot anthracnose	Elsinoë corni
3	Septoria leaf spot	Septoria cornicola
1	Dogwood canker	Unknown
1	Phytophthora root rot	Phytophthora cinnamomi
1	Powdery mildew	Phyllactinia guttata
4	Drowning	
4	Insects	
1	Cold injury	
9	Fertilizer injury (or suspected)	
37	Miscellaneous (problem lower down, stress, injuries, inadequate specimens, etc.)	

71 Problems diagnosed 15 Infectious diseases

FIR (MOSTLY FRASER) 105 specimens (115 in 1983)

31	Phytophthora root rot	Phytophthora cinnamomi & Phytophthora spp.
2	Shoot blight following injury	Botrytis cinerea
2	Frost damage	
4	Insects, spider mites	
33	Fertilizer injury (or suspected)	
2	Herbicide injury suspected	
31	Miscellaneous (environmental, cultural, inadequate specimens, etc.)	

105 Problems diagnosed 33 Infectious diseases

PINE 111 specimens (119 in 1983)

21	Ozone injury (white pine)	
11	Root rot	Undetermined

PINE (contd)

2	Needle rust	Coleosporium spp.
2	Phytophthora root rot	Phytophthora cinnamomi & Phytophthora spp.
2	Pitch canker (or suspected)	Fusarium moniliforme var. subglutinans
2	White pine blister rust (or suspected)	Cronartium ribicola
1	Needle cast	Several fungi
1	Pine wood nematode	Bursaphelenchus xylophilus
1	Rhizoctonia blight	Rhizoctonia solani
1	Sooty mold following aphid injury	
16	Insects, spider mites	
6	Cold injury	
7	Fertilizer injury (or suspected)	
44	Miscellaneous (environmental, cultural, inadequate specimens)	

117 Problems diagnosed 22 Infectious diseases

SOUTH DAKOTA STATE UNIVERSITY PLANT DISEASE CLINIC: 1984 SUMMARY

Submitted by: Dale J. Gallenberg, South Dakota State University

SPECIMEN CLASS	TOTAL
TREES, SHRUBS, ORNAMENTALS	169
FRUITS	72
VEGETABLES	22
TURF	26
FLOWERS, HOUSEPLANTS	44
TOTAL	333
ELM FOR D.E.D. TESTING	153
TOTAL HORTICULTURE/FORESTRY	486
FIELD CROPS	128
I.D. (FUNGI, PLANTS, ETC.)	8
TOTAL CLINIC SAMPLES	622

1984 SUMMARY FOR THE PLANT DIAGNOSTIC CLINIC[a]

MONTH	ELM SAMPLES TESTED FOR D.E.D.	YTD[b]	OTHER SAMPLES	YTD[b]	CLINIC TOTAL	YTD[b]
JANUARY	-	-	1	1	1	1
FEBRUARY	-	-	3	4	3	4
MARCH	-	-	9	13	9	13
APRIL	-	-	25	38	25	38
MAY	-	-	75	113	75	103
JUNE	2	2	103	216	105	218
JULY	103	105	117	333	220	438
AUGUST	37	142	78	411	115	553
SEPTEMBER	7	149	27	438	34	587
OCTOBER	4	153	22	460	26	613
NOVEMBER	-	153	5	465	5	618
DECEMBER	-	153	4	469	4	622

[a] Totals do not include samples submitted for smut testing; these are handled by Dr. Ferguson. (1984 total = approx. 70)
[b] YTD = yearly total through that month.

The months of May, June, July and August together totalled:
142 D.E.D. samples, or 93% of the total D.E.D. samples,
373 OTHER samples, or 80% of the total OTHER samples, and
515 total samples, or 83% of the TOTAL CLINIC samples.

The months of June and July totalled:
105 D.E.D. samples, or 69% of the total D.E.D. samples,
220 OTHER samples, or 47% of the OTHER samples, and
325 total samples, or 52% of the TOTAL CLINIC samples.

Note - Summary contains only plant disease samples and not those samples with insect or herbicide damage.