RUTGERS
COOPERATIVE
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NEW JERSEY AGRICULTURAL EXPERIMENT STATION

RUTGERS PLANT DIAGNOSTIC LABORATORY

AND

NEMATODE DETECTION SERVICE

1993 ANNUAL REPORT

THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

PLANT DIAGNOSTIC LABORATORY AND NEMATODE DETECTION SERVICE
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Mr. Richard Buckley, Laboratory Coordinator
Dr. Ann B. Gould, Faculty Coordinator

INTRODUCTION

The mission of the Rutgers Plant Diagnostic Laboratory and Nematode Detection Service (RPDL-NDS), a service of the New Jersey Agricultural Experiment Station (NJAES), is to provide the citizens of New Jersey with accurate and timely diagnoses of plant problems. These goals are achieved in cooperation with Rutgers Cooperative Extension (RCE) and research faculty at Cook College/NJAES. Since its establishment in April of 1991, the Plant Diagnostic Laboratory has examined over 2,050 samples submitted for plant problem diagnosis or nematode analysis. The laboratory has become an integral part of Rutgers Cooperative Extension and Cook College/NJAES programs by providing diagnostic and educational services and by assisting with research. This report summarizes the activities of the RPDL-NDS during the calendar year 1993, the laboratory's second full year of operation and the first full-year of operation for the nematode service.

HISTORY

The Rutgers Plant Diagnostic Laboratory was established in 1991 with an internal loan and is projected to be self-supporting within five years of establishment. The laboratory was established by the dedicated efforts of RCE faculty members Dr. Ann B. Gould and Dr. Bruce B. Clarke, Specialists in Plant Pathology, Dr. Zane Helsel, Director of Extension, and Dr. Karen Giroux, past Assistant Director of NJAES. Without their vision and persistence, this program would not exist.

On April 1, 1991, a Laboratory Coordinator was hired on a consultant basis to renovate laboratory space and order equipment. The laboratory is currently located in Building 6020, Old Dudley Road, on the Cook College Campus. This space belongs to the Department of Plant Pathology, who paid for renovations to the facility. We acknowledge the Department's generosity and thank them for their monetary support. The completion of the new Plant Science Building (Foran Hall), projected for 1994, may necessitate the demolition of the current facility; therefore, at that time, the laboratory must be moved to a permanent location.

The Rutgers Plant Diagnostic Laboratory began accepting samples on June 26, 1991. At that time, the majority of equipment and supplies were in place. A

full-time diagnostician (program associate) was hired September 1, 1991, and the Laboratory Coordinator was hired on a permanent basis on November 1, 1991.

STAFF AND COOPERATORS

Richard J. Buckley is the coordinator of the RPDL-NDS. He was promoted to the position in October of 1993 after the departure of Dr. Karen Kackley-Dutt to private industry. Mr. Buckley received his M.S. in turfgrass pathology from Rutgers University in 1991. He has a B.S. in Entomology and Plant Pathology from the University of Delaware. Mr. Buckley has work experience in diagnostics, soil testing, and field research. He has also received special training in nematode detection and identification. Mr. Buckley is responsible for sample diagnosis, soil analysis for nematodes, and the day-to-day operation of the laboratory. Mr. Buckley's former position of Program Associate remains unfilled.

The laboratory is also staffed, part time, by an undergraduate work-study student. Mr. Greg Balog has worked for the laboratory for two years. In the summer, he divides his time between the laboratory and Dr. Bruce Clarke's research group. During the growing season, other part-time labor and two volunteers have been utilized as needed.

The laboratory benefits from the assistance of faculty in the Departments of Entomology, Plant Pathology, and Plant Science. In the Department of Plant Pathology, Dr. Ann B. Gould (Laboratory Faculty Coordinator) and Dr. Bruce B. Clarke have devoted hundreds of hours to laboratory business from the inception of the diagnostic laboratory concept through its eventual set-up and operation. Additional faculty and staff in this department who have provided substantial assistance during 1993 include: Dr. Donald Kobayashi, phytobacteriology; Dr. Steve Johnston, vegetable pathology; Dr. Brad Hillman, virology; Dr. T. A. Chen Plant Pathology, Chair, for administrative assistance; and Glenn Tappen, Mark Peacos, and Pradip Majumdar for general assistance.

We would also like to thank Dr. John Meade of Plant Science for assistance in herbicide injury and weed identification, and Dr. George Wulster of Plant Science for assistance with problems on horticultural crops. Special thanks are extended to Dr. Louis Vasvary of the Entomology Department for all of his help and encouragement. His assistance with the insect diagnoses has been invaluable. Our sincere gratitude goes to Ms. Ethel M. Dutky of the University of Maryland Plant Diagnostic Laboratory. Her advice and assistance has been instrumental in the set-up and operation of the RPDL-NDS.

LABORATORY POLICY

The RPDL-NDS receives samples from a varied clientele. According to laboratory policy, samples for diagnosis from residential clients may be submitted only after they have been screened by appropriate county faculty or staff. If a sample requires more than a cursory diagnosis, it may be submitted, along with the appropriate payment, to the laboratory for evaluation. The county office provides the appropriate form, including instructions for proper sample selection and submission. Samples from professional clientele may be handled as above or may be submitted directly to the laboratory.

Detailed records are kept on all samples. A written response including the sample diagnosis, management and control recommendations, and other pertinent information is mailed or sent by FAX to the client. Additionally, the client is billed if payment does not accompany the sample. Copies are forwarded to appropriate county faculty and extension specialists for their records. Commercial growers are contacted by telephone or FAX to help them avoid delay in the treatment of pest problems.

OPERATIONS

Diagnostics

During 1993, the RPDL-NDS examined 792 specimens submitted for diagnosis or identification (Table 1) and assayed 167 soil samples for nematodes (Table 2). Compared to 1992 levels, this represents an 8% increase in plant samples and a 19% increase in nematode samples. As expected, the majority of samples were submitted during the summer months and diminished in the fall and winter.

For comparison purposes, a listing of 1991, 1992, and 1993 sample submissions from the University of Maryland Plant Diagnostic Laboratory is included in Table 1. From an agricultural perspective, New Jersey and Maryland are quite similar. Both states have similar demographics (a mix of major urban centers with surrounding suburban and rural areas), geographies, and agricultural crops. The University of Maryland Plant Diagnostic Laboratory has been in operation since 1979 and should serve as a predictive model for future sample submission to the RPDL-NDS. The University of Maryland Plant Diagnostic Laboratory does not assay soils for nematodes because the University has a separate Nematology Laboratory; therefore, data from the Rutgers Nematode Detection Service are presented in a separate table (Table 2).

Table 1. RPDL-NDS plant sample submissions by month - Rutgers University vs. the University of Maryland, 1991, 1992, and 1993.

	1991		1992		1993	
Month	**RU**	**UMD**	**RU**	**UMD**	**RU**	**UMD**
January		19	11	19	17	20
February		33	8	32	21	14
March		56	23	63	22	46
April		75	52	71	47	74
May		140	78	109	77	78
June	6[1]	156	95	136	70	134
July	107	147	117	94	244	134
August	104	132	80	147	110	121
September	59	113	103	125	92	89
October	45	85	56	59	43	53
November	25	36	38	32	34	27
December	25	13	15	13	15	15
Total:	371	1005	676	900	792	805

[1]Note that there were only three working days in June, hence the small number of samples.

Although plant samples were submitted to the Rutgers Diagnostic Laboratory in a seasonal pattern similar to that of the University of Maryland (Table 1), fewer samples were submitted to the Rutgers laboratory. This may have been due to: 1) the Maryland laboratory is established and well-known to the growers of the State, whereas the Rutgers laboratory is relatively new; and 2) the Maryland laboratory does not charge for samples submitted through a county agent, whereas the Rutgers laboratory charges to process these samples. We expect that the number of samples submitted to Rutgers will increase significantly as we continue to advertise the laboratory and as more growers become aware of our services. It should be noted that the number of samples submitted to the University of Maryland declined from 1991 to 1993. This is a trend that the University of Maryland laboratory has noted over a period of five years. The

Laboratory Coordinator at Maryland attributes this decline to a reduction in Cooperative Extension field faculty.

During its first six months of operation, the Nematode Detection Service at the Rutgers laboratory processed 113 soil samples for nematode assays. Prior to July 1, 1992, this service was rendered by Dr. Jack Springer at the Upper Deerfield Station. After July 1, 1992, Dr. Springer continued to process samples submitted by county extension faculty free of charge. He did not continue this practice in 1993. In 1993, the Nematode Detection Service processed 167 soil samples for nematode assays.

Table 2. RPDL-NDS nematode sample submissions by month - 1992 and 1993.

Month	1992 Samples	1993 Samples
January		0
February		5
March		0
April		22
May		1
June		16
July	26	18
August	2	24
September	40	18
October	42	8
November	3	10
December	0	45
Total:	113	167

Of the specimens submitted to the RPDL-NDS for diagnosis or identification, 70% were from commercial growers, 23% were from residential clientele, and 7% were submitted from research faculty at Rutgers University (Table 3). Of the samples submitted to the Nematode Detection Service, 83% were from commercial

growers, 16% were from research faculty at Rutgers University, and 1% were received from residential clientele. We expect that the number of nematode samples submitted from residential clients will remain low since much of this clientele is not familiar with nematode pests. Whereas samples from research programs represent a relatively small percentage of the total number of plant and soil samples received, they are an extremely important component. Research samples allow the diagnosticians to cooperate with University faculty on problems often of great importance to the State of New Jersey. The problems associated with these samples are challenging and occasionally lead to the diagnosis of a new disease.

Table 3. RPDL-NDS sample submissions by origin - 1993.

Sample Origin	Number of Plant Samples	Percent of Total	Number of Nematode Samples	Percent of Total
Commercial Growers	556	70%	138	83%
Residential	185	23%	2	1%
Research Programs (Rutgers University)	51	7%	27	16%
Total:	792	100%	167	100%

The vast majority of samples submitted for diagnosis (79%) were either turfgrass or ornamental plants (Table 4). This may have been due to the fact that turfgrass and ornamentals represent the largest agricultural commodities in New Jersey. The wide variety of turf and ornamental species grown under diverse environmental conditions results in a large number of problems not readily identifiable by growers or county faculty. In addition, pest diagnosis and identification for commercial growers of other crops are still handled by Extension Specialists and County Agents in other parts of the State at no charge. Most of the soil samples submitted to the laboratory for nematode analysis were from production agriculture. The majority of these samples were from several growers in southern New Jersey who specialize in small grains, potatoes, and carrots. Special thanks to the IPM agents in vegetable and field crops for their support. It is hoped that, in the future, other state IPM programs will submit samples to the RPDL-NDS.

Table 4. RPDL-NDS sample submissions by crop category - 1993.				
Crop	Number of Plant Samples	Percent of Total	Number of Nematode Samples	Percent of Total
Turf	354	45%	48	29%
Ornamentals	361	46%	1	1%
Other Crops	32	4%	118	70%
Identification	45	5%		
Total:	792	100%	167	100%

Samples were submitted to the RPDL-NDS from all of the counties in New Jersey (Table 5). The majority of samples were submitted from the counties in closest proximity to the laboratory. Many citizens in central New Jersey contact Rutgers University directly for help with their plant-related problems and are referred to the laboratory. This distribution may also be influenced by the agricultural nature of the individual counties. Most of the counties with a high number of submissions are densely populated. The major commodities in these counties are frequently turf and ornamentals in residential landscapes or fine turf from golf courses. Problems on these crops are difficult to diagnose and are subsequently submitted to the laboratory. This county profile also identifies the county faculty who are familiar with the RPDL-NDS and utilize its services.

Approximately 13% of the samples submitted for diagnosis to the laboratory were from out-of-state (Table 5). Nearly all of these samples were turf. Because of his national reputation, many golf course superintendents around the country submit samples to Dr. Bruce Clarke, who always forwards these samples to the Diagnostic Laboratory. Because there are very few laboratories in the country that diagnose turfgrass diseases, these superintendents have continued to submit samples to the RPDL-NDS. The charge for out-of-state samples is substantially higher to help defray the cost of in-state samples.

Of the plant specimens submitted to the RPDL-NDS for diagnosis or identification, 51% were associated with biotic disease-causing agents (Table 6). Injury to 11% of the samples was caused by insects and related arthropods, and 33% were associated with abiotic injuries and stresses (e.g., nutrient deficiencies, poor cultural practices, poor soil conditions, etc.). Another 5% included plant and substance identification. This breakdown of samples is typical of that reported by other diagnostic laboratories in the United States.

Table 5. RPDL-NDS sample submissions by county - 1991 to 1993.

In-State	Number of Plant Samples 1991	Number of Plant Samples 1992	Number of Plant Samples 1993	Number of Nematode Samples 1992	Number of Nematode Samples 1993
Atlantic	9	20	8	0	3
Bergen	34	70	59	0	4
Burlington	16	38	51	0	31
Camden	8	14	28	0	1
Cape May	7	8	16	5	2
Cumberland	0	9	6	0	8
Essex	3	14	20	22	3
Gloucester	7	38	22	27	24
Hudson	0	9	5	0	0
Hunterdon	11	14	19	1	1
Mercer	26	32	36	1	17
Middlesex	50	75	66	0	6
Monmouth	24	65	79	1	4
Morris	16	24	22	0	4
Ocean	18	41	22	1	0
Passaic	3	21	34	1	0
Salem	1	2	0	0	14
Somerset	27	37	52	0	1
Sussex	7	15	18	1	0
Union	11	16	45	0	0
Warren	14	14	24	0	0
Rutgers Research	10	46	51	27	27
In-State Total:	302	622	683	873	150
Out-of-State	69	54	109	26	17
Total:	371	676	792	113	167

Table 6. RPDL-NDS plant sample submissions by diagnosis - 1993.		
Diagnosis	**Number of Samples**	**Percent of Total**
Disease (biotic)	399	51%
Insect	86	11%
Identification	45	5%
Other	260	33%
Total:	792	100%

In 1993, the mean response time for samples diagnosed in less than 21 days was 4.4 days. A response was prepared in less than three days for over half (55%) of the samples submitted (Table 7), and 78% of our clients received a response in less than a week. A number of the samples took longer than 10 days to diagnose. In these cases, special consultation was required for an accurate diagnosis, and the clients were advised of progress throughout the period. Since nematode samples deteriorate rapidly in storage, virtually all nematode processing was finished in less than three days.

Table 7. Sample response times - 1993.		
Response time	**Number of samples**	**Percent of total**
0-3 days	431	55%
4-6 days	182	23%
7-10 days	84	11%
11-21 days	75	9%
>21 days	20	2%
Total:	792	100

Other Laboratory Activities

Teaching

In addition to providing diagnostic services, the staff of the RPDL-NDS provide educational services to Cook College/NJAES, Rutgers Cooperative

Extension, and other agencies (Appendix II). Many of these educational activities generated additional income for the laboratory.

In 1993, Mr. Buckley participated in a number of short courses offered by the Office of Continuing Professional Education. During the spring session, Mr. Buckley taught the Turf Diseases section of the Rutgers Professional Golf Turf Management School. This teaching commitment consisted of one two-hour lecture per week for ten weeks. In the fall semester, Mr. Buckley also assumed the responsibility of teaching the Diseases of Ornamental Plants section, increasing Mr. Buckley's commitment to 4 hours of lecture per week. Mr. Buckley plans to continue teaching both sections of this course during the coming years. Other short courses in which Mr. Buckley participated included the Professional Turfgrass and Landscape Management Short Course and the Greenhouse Crop Production Short Course. The income generated by the speaking engagements for the Office of Continuing Education was $6,150.

Mr. Buckley also earned income for the RPDL-NDS as an invited speaker for the Mercer County Master Gardeners and in a Greenhouse Production course at Manasquan High School. The income from these talks was $300.

Other educational services provided by the staff of the RPDL-NDS, for which the laboratory received no compensation, included lectures presented at the Central Jersey Turf and Ornamentals Institute in Middlesex, Monmouth, and Somerset Counties; at Brookdale Community College; and in several graduate level plant pathology courses. Short presentations describing how to utilize RPDL-NDS services were given to several groups, which included horticultural students at Brookdale Community College; master gardeners in Union and Middlesex counties; turfgrass managers at the Rutgers Turf Field Day; and to several Office of Continuing Education short courses. Mr. Buckley also presented a lecture on plant disease highlights for the Department of Plant Pathology seminar series.

Contract Labor

On several occasions during 1993, the staff of the RPDL-NDS generated extra income for the laboratory by contracting labor to help with various research projects within Cook College. This arrangement earned an additional $140 in income.

Extension Publications

In 1993, Mr. Buckley cooperated with Mr. William Tietjen and Dr. Ann Gould as a co-author of the Rutgers Cooperative Extension Fact Sheet 631, entitled *Sphaeropsis (Diplodia) Shoot Blight and Canker of Pines*. Several more extension publications were co-authored late in the year and are currently under review. These documents will be included in next year's report.

During 1993, the RPDL-NDS staff contributed regularly to the Insect-Disease-Weed Newsletter. The laboratory staff wrote a brief article for each issue of the newsletter, which is published weekly from March to September by Dr. Louis Vasvary, Extension Specialist in Entomology.

Service

Mr. Buckley serves as a member of the Rutgers Cooperative Extension Home Horticulture Working Group. In March, he volunteered his time at the New Jersey Flower and Garden Show at the Garden State Convention and Exhibit Center. Mr. Buckley conducted tours of the laboratory to regional high school students in March, and to Master Gardeners during their field day in October. At Ag Field Day, he organized and staffed a well-attended "Plant Problem Question and Answer Booth." Mr. Buckley provides service to the Department of Plant Pathology by helping to organize departmental picnics and by playing Santa Claus at the Christmas party.

During the fall of 1993, the staff of the RPDL-NDS sponsored a CIPED student from South Brunswick High School. This student was taught basic laboratory procedures and is currently utilizing these techniques to do an experiment on plant disease control.

This fall Mr. Buckley and Dr. Ann Gould became the Northeast region editors for Plant Diagnosticians Quarterly, a national publication devoted to plant disease diagnostics. The Northeast region editors report on plant problems of interest to plant pathologists in the region.

MARKETING

The RPDL-NDS developed a 15 minute slide presentation to help advertise laboratory services to various grower groups. Copies of this presentation are available on loan to anyone who wishes to advertise the laboratory's services. Numerous presentations of this program were made throughout 1993 by the staff of the Plant Diagnostic Laboratory, Extension Specialists, and County Faculty.

An advertising brochure was developed in 1992 for general distribution at county offices, grower meetings, and other activities. This brochure briefly describes the services of the RPDL-NDS and how to access them. To date, over 8,000 copies of this brochure have been distributed.

To help advertise laboratory services at grower meetings or other activities, a mobile display unit was developed and utilized. This display unit briefly describes the services of the RPDL-NDS and how to access them, and is available on loan to anyone who wishes to advertise the laboratory services. The events

at which the display was utilized included Ag Field Day, the Rutgers Gardens Open House, and Turf Field Day. Funding for the display unit was provided by Dr. G. David Lewis of the Department of Plant Pathology. We wish to acknowledge his generosity and support.

In cooperation with the Home Horticulture Working Group and the County Agents of Bergen, Middlesex, Somerset, and Union Counties, approximately 400 RPDL-NDS brochures and sample submission forms were placed on literature racks in selected garden centers. The forms were marked so that the laboratory staff could track submissions generated by this effort. To date, only one sample accompanied by a marked submission form has been sent to the laboratory.

PROFESSIONAL IMPROVEMENT

Mr. Buckley attended the Nematode Identification Course for Professional Consultants held at Clemson University, 12/28/92 to 1/7/93. This training greatly refined Mr. Buckley's skills in nematode detection and identification. Funding for this training was provided by Dr. Steve Johnston of the Rutgers Research and Development Center in Upper Deerfield, NJ. We wish to acknowledge his generosity and support.

Mr. Buckley attended the national meeting of the American Phytopathological Society (APS) in November. At the meeting, Mr. Buckley received work-related training at two workshops on *Pythium* Identification and the use of Rapid Tests in Plant Disease Diagnostics. Funding for this training was generously provided by Dr. Steve Johnston. We thank him once again for his generosity and support.

FUNDING

The Plant Diagnostic Laboratory is expected to be self-supporting within five years of its establishment. Funding for the laboratory is generated by charging clientele for diagnostic services and educational activities.

The 1993 fee schedule for diagnostic services and nematode assays was:

Residential Clients	$20.00/sample
Commercial Growers	
Fine turf	$50.00/sample
All others	$20.00/sample
Out-of-State Growers	$75.00/sample

Over $27,600 was generated from diagnostic services and nematode assays during 1993, representing a 14% increase in income over 1992.

A sample submission form and the appropriate payment accompanied the majority of samples received from residential clientele. Most commercial samples were accompanied by a submission form; however, the majority of these submissions did not include payment. In most cases, commercial growers preferred to be sent a bill. Over 99% of the clients billed have remitted payment. Many samples diagnosed for research programs at Rutgers University were paid for by transfer of funds.

Laboratory policy allows Rutgers employees, government agencies, County faculty, Extension Specialists, and selected government agencies to submit a small number of samples "free of charge." These samples are to be used for educational development and government service. The Diagnostic Laboratory processed 153 of these "no charge" samples in 1993 (Table 8). These samples accounted for 16% of the samples processed. The value of these no charge requests was $3,060.

Table 8. Plant Diagnostic Laboratory sample submissions - no charge requests.

Client Category	Number of Samples
RCE County Faculty/Program Associates	44
RCE Specialists	24
Rutgers Research Programs (not RCE)	10
Rutgers Non-Research Faculty/Staff	11
Direct Mail/Walk-ins	48
Other Government Agencies/University	2
Payment Returned - Sample Inadequate for Diagnosis	0
Resubmissions for Further Diagnosis	14
Total:	153

Income generated from all laboratory activities covered 100% of the non-salary expenses incurred in 1993, plus 53% of salaries, or 58% of the laboratory's total expenditures (including salaries and one-time costs for equipment). Salaries and benefits for laboratory employees accounted for 90% of laboratory expenses. For more detailed budget information see Appendix I.

FUTURE DIRECTIONS

As in the past, the top priority for 1994 will be to generate more income. To accomplish this, we will continue to advertise laboratory services to increase sample number. Continued cooperation with the Office of Continuing Professional Education and other educational activities are expected to generate additional funds.

Other priorities in 1994 include: developing additional educational materials in the form of bulletins and fact sheets in cooperation with extension faculty; focusing on ways to add and train labor for the laboratory during its busiest periods; finding and moving into suitable permanent facilities as soon as possible; and professional improvement (which includes participation in professional societies).

We are constantly evaluating the immediate and future needs of the State for additional services. Possibilities for additional services include assays for determining pest tolerance (apple scab, brown rot, and European red mite) for the Fruit IPM program, and expanded nematode, insect, and weed identification services. In order to offer additional services, however, it will be necessary to increase staffing. It is hoped that the additional services will decrease the net costs per sample.

PLANT DISEASE HIGHLIGHTS

The occurrence and severity of plant diseases are strongly influenced by environmental conditions. The 1993 growing season was unusually hot and dry; therefore, diseases favored or enhanced by these conditions were especially prevalent. In addition, many plant dysfunctions were directly associated with these environmental extremes.

Ornamentals

The majority of ornamental plants submitted to the laboratory were affected by abiotic agents. Planting problems and poor site conditions were a primary cause of many plant failures. Heat and drought stress were particularly

troublesome to species poorly adapted to growth in New Jersey. In the spring, numerous samples were submitted to the lab with symptoms of winter injury caused by the March blizzard.

Of the diseases that were caused by biotic agents, several leaf spots, anthracnose, needlecasts, and rusts were diagnosed. Diseases enhanced by heat and drought stress, including Dutch elm disease, Verticillium wilt, Cytospora canker, and oak leaf scorch, were particularly prevalent. Root-infecting pathogens frequently detected this year on a variety of ornamental plants included *Phytophthora*, *Pythium*, *Fusarium*, and *Rhizoctonia*.

Insect problems most commonly diagnosed were caused by spruce mites and various scales; however, many samples also had evidence of bark beetle or borer activity. Pine wilt disease, caused by the pine wood nematode, was diagnosed in several samples from northern New Jersey.

Greenhouse diseases of note included black leg and cutting rot of geranium; downy mildew on snapdragon; tomato spotted wilt on New Guinea impatiens; Fusarium wilt of cyclamen; and Pythium and Rhizoctonia root rots on a wide variety of plants.

During the spring of 1992, new and unusual disease problems caused by bacteria were detected in a New Jersey nursery. *Pseudomonas syringae* and *Xanthomonas campestris* were associated with a dieback and foliar blight of *Euonymus fortunei*. In 1993, several samples from the same nursery were diagnosed with a foliar blight caused by the same bacteria.

Turf

The unusually hot weather was very conducive for cool-season diseases of turf. On fine turf, *Pythium* diseases, including Pythium blight and Pythium crown and root rot, were particularly troublesome. It is hoped that this high incidence of crown and root rot *Pythiums* in fine turf can be investigated further in 1994. Other hot weather diseases frequently diagnosed on golf turf were summer patch and brown patch. Anthracnose was common on *Poa annua* that had been stressed by poor root development and environmental extremes. Turf loss due to nematode activity was also very common in 1993. It has been said that this was the worst season for golf turf since 1988.

In landscape turf, leaf spot and melting-out was the most commonly diagnosed disease problem. This disease is troublesome in Kentucky bluegrass turf that is not properly maintained. Dollar spot, red thread, and summer patch are other diseases of note. High populations of chinch bugs were also a problem for many residential clients.

Vegetables

Diseases of note in 1993 included bacterial canker of tomato, caused by *Clavibacter michiganensis* subs. *michiganensis*, root knot nematode in carrot, and lesion nematode in potato.

APPENDIX I. RPDL-NDS BUDGET

Table 9. RPDL-NDS expenditures in 1993.	
Salaries & Benefits:[1]	$ 61,492.60
Supplies and Services:[2] (includes) Diagnostic supplies Printing/advertising References/publications Equipment maintenance Office supplies Photographic services	3,865.35
Communications:[2] Telephone/FAX Postage	 601.20 535.51
Travel:[2] (includes) Travel to give paid talks Travel to professional meetings Travel for training	1,691.92
Total Expenditures:	$ 68,186.58

[1]From Account #89676 and #89232.
[2]From Account #89232.

Table 10. RPDL-NDS income in 1993.	
Sample fees:	$ 27,463.56
Unpaid sample fees:	155.00
Contract labor:	140.00
Lecture fees: Office of Continuing Professional Education Other	 6,150.00 300.00
Faculty gifts for education of RPDL-NDS staff:	1,962.32
Value of no-charge samples	<$ 3,060.00>
	$ 39,230.88
Actual Total Income:	$ 36,170.88

Table 11. RPDL-NDS estimated expenditures for 1994.	
Salaries and benefits:	$ 52,659.09
Seasonal labor:	4,000.00
General operating:	7,500.00
One-time equipment cost:	3,000.00
Educational development and travel:	2,000.00
New facility renovation?	?
Total Estimated Expenditures:	$ 69,159.00

Table 12. RPDL-NDS estimated income for 1994[1].	
Estimated TURF Sample Income: 42% @ $50	$ 31,500
Estimated OUT-OF-STATE Sample Income: 13% @ $75	14,625
Estimated ALL OTHER Sample Income: 45% @ $20	13,500
Estimated LECTURE FEE Income:	10,000
TOTAL ESTIMATED INCOME 1994:	$ 69,625

[1] based on 1500 samples submitted in 1994 with 1993 distribution.

Table 13. Plant Diagnostic Laboratory Charges in Neighboring States.	
Connecticut (Ag. Expt. Sta.): All salaries and operating expenses are covered. Types of samples handled include diseases, insects, nematodes and soils.	No charge for any sample.
Maryland (UMD): All salaries and operating expenses are covered by Cooperative Extension. Discussing implementing a charge of $15 to $20 per sample.	No charge if submitted through county agent.
Massachusetts (UMass): There is no Plant Diagnostic Laboratory. All samples are handled by Specialists who charge growers.	$25.00 No charge to county agents.
New York (Cornell): All salaries and operating expenses are covered by Cooperative Extension. General diagnosis: Nematode or virus assay: These fees are charged by both the Diagnostic Lab and by Specialists. There are no free samples; even county agents pay for services. Some county offices charge to look at samples (usually only $2 to $3).	 $25.00 $40.00
Pennsylvania (Penn State): All salaries and operating expenses are covered by Cooperative Extension. Discussing implementing a charge for samples not submitted through county agent.	No charge if submitted through county agent.
Vermont (U of VT): All salaries and operating expenses are covered by Cooperative Extension.	$15.00

Richard J. Buckley
Laboratory Coordinator
Plant Diagnostic Laboratory

Appendix 2. Complete listing of lectures presented during 1993.

Date	Title of Presentation	Audience	Location	Number of handouts	Type of participants[1]
1-3/93	Diseases of Turfgrass (10 Lectures)	Professional Golf Turf Management School	Cook College	20	T
1/12/93	Managing Diseases of Landscape Turf	Professional Turfgrass and Landscape Management Short Course	Cook College	1	L,T
2/10/93	Diseases of Shade Trees	Professional Golf Turf Management School	Cook College	0	T
2/14/93	Diagnosing Greenhouse Crop Disorders	Greenhouse Crop Production Short Course	Cook College	1	G
3/2/93	Managing Diseases of Landscape Turf	Central Jersey Turf and Ornamentals Institute	Monmouth Co.	1	I,L,T
3/3/93	Managing Diseases of Landscape Turf	Central Jersey Turf and Ornamentals Institute	Mercer Co.	1	I,L,T
3/4/93	Managing Diseases of Landscape Turf	Central Jersey Turf and Ornamentals Institute	Somerset Co.	1	I,L,T
3/21/93	Diagnosing Greenhouse Crop Disorders	New Jersey State Florist Association	Bergen Co.	1	I,G

[1] Audience Addressed: A = Arborists; C = College (Academic); G = Greenhouse; H = Residential Clientele; I = Industry; L = Landscape Professionals; N = Nursery Growers; T = Turfgrass Managers; X = Christmas Tree Growers.

Date	Title of Presentation	Audience	Location	Number of handouts	Type of participants[1]
3/22/93	Using the Plant Diagnostic Laboratory - 1992 Disease Highlights	Department of Plant Pathology Seminar Series	Cook College	1	C
4/6/93	Using the Plant Diagnostic Laboratory/Soil Related Diseases	Introduction to Soil Science ORH-115	Brookdale Community College	2	C
4/20/93	Diagnosing Greenhouse Crop Diseases	Greenhouse Management	Manasquan High School	1	C
6/3/93	Using the Plant Diagnostic Laboratory	Turfgrass Field Day	Monmouth Co.	2	I,L,T
9/21/93	Using the Plant Diagnostic Laboratory	Master Gardeners	Middlesex Co.	2	H
10-12/93	Diseases of Turfgrass (10 Lectures)	Professional Golf Turf Management School	Cook College	20	T
10-12/93	Diseases of Ornamental Plants (10 Lectures)	Professional Golf Turf Management School	Cook College	30	T
10/2/93	Using the Plant Diagnostic Laboratory (w/lab tour)	Master Gardeners Field Day	Cook College	2	H
10/20/93	Introduction to Nematology	Introduction to Plant Pathology 16:770:501	Cook College	10	C

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Date	Title of Presentation	Audience	Location	Number of handouts	Type of participants[1]
10/29/93	Using the Plant Diagnostic Laboratory	Master Gardeners	Union Co.	2	H
12/1/93	Diagnosing Plant Diseases and Using the Plant Diagnostic Laboratory	Plant Diseases and Pests ORH-235	Brookdale Community College	3	C
12/8/93	Diagnosing Plant Diseases and Using the Plant Diagnostic Laboratory	Master Gardeners	Mercer Co.	1	H
12/16/93	Using the Plant Diagnostic Laboratory	Introduction to Interior Plantscaping Short Course	Cook College	2	G
12/17/93	Using the Plant Diagnostic Laboratory	Pesticide Safety for Landscape Contractors Short Course	Cook College	2	L,T

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FS631

RUTGERS COOPERATIVE EXTENSION

NEW JERSEY AGRICULTURAL EXPERIMENT STATION

Plant Disease Control

SPHAEROPSIS (DIPLODIA) SHOOT BLIGHT AND CANKER OF PINES

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INTRODUCTION

Sphaeropsis (Diplodia) shoot blight and canker, caused by the fungus *Sphaeropsis sapinea*, is a common disease of two- and three-needle pines. In the northeastern and mid-Atlantic states, this disease is most devastating on Austrian, mugo, red, and Scots pines. On susceptible trees, infection by *Sphaeropsis* results in tip blight, canker formation on main stems and branches, lower branch dieback, and death of cones. In severe cases, the fungus may cause the death of entire trees.

Sphaeropsis shoot blight and canker is most frequently seen on mature trees of cone-bearing age or on trees that have been stressed by environmental factors. It is rarely seen on young, vigorously growing pines unless they are in close proximity to severely infected ones. Pine trees in naturally forested areas are rarely affected.

SYMPTOMS

Infection by *Sphaeropsis* occurs in early spring during periods of cool, rainy weather. New buds, succulent stems, and two year old cones are most frequently infected by the fungus. The first symptoms of **Sphaeropsis shoot blight and canker** include minute drops of resin that ooze from tiny lesions (spots) on infected buds. These lesions enlarge rapidly, and succulent shoots are killed before they can fully elongate. This results in a stunted, straw-colored branch tip where the dead needles, which are much shorter than healthy ones, remain on the tree.

In vigorously growing trees, *Sphaeropsis* kills only the current season's growth. In trees that are stressed by adverse environmental conditions, however, infection may proceed into older tissue, where the wood beneath the bark becomes discolored, cankered, and resin-soaked. The dead shoots become hard and brittle as the resin crystallizes. The destruction of many shoots year after year results in branch death and tree decline. Symptoms are usually more extensive on lower branches, but infected tissue may be scattered throughout the entire crown.

DISEASE DEVELOPMENT

Plant tissue is most susceptible to infection by *Sphaeropsis* during a two to three week period in the springtime. During periods of cool, rainy weather, the fungus

produces spores in tiny, black fruiting bodies called pycnidia. These pycnidia can be seen with the aid of a hand lens at the base of dead needles and on cone scales. The spores are carried to susceptible new growth and cones by splashing rain, wind, or on pruning tools.

Sphaeropsis spores need at least 12 hours of leaf wetness to germinate and penetrate young needles. The fungus may also enter plant tissue through stomata and wounds. Although the fungus grows best at 82°F, spores can germinate at temperatures between 55 and 95°F. Following infection, symptoms start to appear in three to four days. Disease epidemics in landscape trees and in nurseries are promoted by extended periods of wet spring weather.

Although *Sphaeropsis* produces pycnidia on infected needles and shoots, the most abundant spore production occurs on infected cone scales. For this reason, mature trees of cone bearing age (older than 20 years) are more likely to be affected by this disease than are younger trees. However, closely spaced trees of any age (i.e., in nurseries or Christmas tree plantations) may become infected.

Sphaeropsis shoot blight and canker may be confused with damage caused by insects, other diseases, or by environmental stress. Insect injury may be recognized by the presence of larvae or tunnels within affected tissue. In trees affected by **Sphaeropsis shoot blight and canker,** infected needles are frequently retained on the tree for several months, whereas other diseases and environmental stress frequently result in needle loss. Diagnosis of this disease is often complicated because *Sphaeropsis* will also grow on pine tissue killed by other agents. This fungus can be found on virtually any dead pine branch at any time of the year, so careful observations are essential for proper diagnosis.

DISEASE MANAGEMENT

Removal of dead branches, cones, and fallen debris will improve the appearance of affected trees. To help prevent the spread of *Sphaeropsis* and its spores, prune only during dry weather and frequently surface sterilize tools with denatured alcohol. Do not leave diseased debris near healthy trees. Severely affected trees should be removed.

Since **Sphaeropsis shoot blight and canker** is more severe on stressed trees, proper site selection and good tree maintenance are important components of a disease management program. Pines are predisposed to this disease by moisture stress, soil compaction, root injury, and excessive shade. Cultural practices that reduce stress and promote tree vigor will also reduce the impact of this disease. Japanese black pine and five-needle pines, such as Eastern white pine and limber pine, are tolerant of *Sphaeropsis* and may offer an alternative where this disease has been a problem in the past.

Currently, the fungicide Cleary 3336 (thiophanate-methyl) is registered for control of **Sphaeropsis (Diplodia) shoot blight and canker**. In landscape settings, this fungicide is best applied by licensed professionals. Where this disease is a problem, apply the fungicide at budbreak to the entire tree (especially the lower branches). Repeat this procedure two or three times at 7- to 14-day intervals. It may be necessary to apply the fungicide more than one year for adequate control.

When applying fungicides, be certain that the plant you intend to treat is listed on the label. **Always apply fungicides according to label directions.** Since pesticide recommendations may change frequently, contact your local County Cooperative Extension Office for up-to-date fungicide information.

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