

RUTGERS COOPERATIVE EXTENSION

NEW JERSEY AGRICULTURAL EXPERIMENT STATION

**Rutgers Plant Diagnostic Laboratory
and
Nematode Detection Service**



1996 Annual Report

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*Mr. Richard Buckley
Laboratory 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 5,736 samples submitted for plant problem diagnosis, nematode analysis, or identification. 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 1996, the laboratory's fifth full year of operation and the fourth 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 become self-supporting. 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 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 this position from program associate in October of 1993. 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 student, Ms. Sophie Penkrat. Ms. Penkrat has worked for the laboratory for three years and has become an integral part of the daily activities

of the laboratory. The laboratory also is fortunate to receive the help of a work-study student during the school year. Ms. Jessica Gere filled the position in the spring semester and Mr. Richard Wang in the fall. During the growing season, other part-time labor and 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 1996 include: Dr. Donald Kobayashi, phyto bacteriology; Dr. Steve Johnston, vegetable pathology; Dr. Brad Hillman, virology; Dr. T. A. Chen, Plant Pathology, Chair, for administrative assistance; and Pradip Majumdar, and Marshal Bergen for general assistance.

We would also like to thank Dr. John Meade, Dr. Richard Innicki, and Dr. Jeffrey Derr of Plant Science for assistance in weed identification and diagnosis of herbicide injury, Dr. George Wulster of Plant Science for assistance with problems on horticultural crops, Dr. Raul Cabrera for assistance with problems in nursery production, and Dr. Paula Shrewsbury of entomology for consultation on insect identifications. 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 appropri-

ate 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 for their records. Commercial growers are contacted by telephone or fax to help them avoid delay in pest treatments.

Operations

Diagnostics

During 1996, the RPDL-NDS examined 1206 specimens submitted for diagnosis or identification (Table 1A) and assayed 242 soil samples for nematodes (Table 2). Compared to 1995 levels, this represents a 11% increase in plant samples and a 47% 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 1992 through 1996 sample submissions from the University of Maryland Plant Diagnostic Laboratory is included in Table 1B. 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, these data are not presented.

For the third year, the RPDL-NDS received

Table 1A. RPD-L-NDS plant sample submissions by month - Rutgers University, 1992 to 1996.

Month	1992	1993	1994	1995	1996
January	11	17	11	22	27
February	8	21	14	22	21
March	23	22	31	51	50
April	52	47	56	59	60
May	78	77	70	137	84
June	95	70	146	161	206
July	117	244	172	147	271
August	80	110	135	246	192
September	103	92	75	106	155
October	56	43	55	61	82
November	38	34	28	49	36
December	15	15	29	7	22
Totals	676	792	822	1068	1206

Table 1B. RPD-L-NDS plant sample submissions by month - the University of Maryland, 1992 to 1996.

Month	1992	1993	1994	1995	1996
January	19	20	19	27	14
February	32	14	27	31	32
March	63	46	50	82	29
April	71	74	67	115	48
May	109	78	71	117	114
June	136	134	112	157	148
July	94	134	101	141	101
August	147	121	143	177	133
September	125	89	84	96	115
October	59	53	46	71	66
November	32	27	49	16	40
December	13	15	16	9	9
Totals	900	805	785	1039	849

more samples than the University of Maryland laboratory. Although more plant samples were submitted to the Rutgers Diagnostic Laboratory, they were submitted in a seasonal pattern similar to that of the University of Maryland. The large increase in the sample load at the Rutgers laboratory in the summer reflects the large number of golf turf samples sent to the laboratory at that time. Maryland does not process turf samples in their laboratory. We expect that the number of samples submitted to Rutgers will continue to increase as we continue to advertise the laboratory and as more growers become aware of our services.

The Nematode Detection Service began accepting soil samples on July 1, 1992 after the retirement of Dr. Jack Springer. In 1996, the Nematode Detection Service processed 242 soil samples for nematode assays. The increase in nematode samples may be due in part to the success with nematode detection on golf courses. Many of the golf turf clients have identified nematodes as potential problems on golf greens and have begun to sample greens for nema-

todes as they develop integrated management programs. This active management by golf course superintendents, using laboratory services as part of their integrated pest management programs, has resulted in a reduction in nematicide use on fine turf within the state.

Of the specimens submitted to the RPD-L-NDS for diagnosis or identification in 1996, 66% were from commercial growers, 27% 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, 93% were from commercial growers and 7% were from Rutgers research projects. We expect that the number of nematode samples submitted from residential clients will be low or non-existent 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

Table 2. RPD-L-NDS nematode sample submissions by month, 1992 to 1996.

Month	1992	1993	1994	1995	1996
January		0	0	6	0
February		5	0	0	0
March		0	14	1	35
April		22	41	24	16
May		1	3	6	17
June		16	9	14	37
July	26	18	55	18	80
August	2	24	25	19	21
September	40	18	11	11	4
October	42	8	14	10	9
November	3	10	40	13	11
December	0	45	7	7	12
Totals	113	167	219	129	242

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.

Since turfgrass and ornamentals represent the largest agricultural commodities in New Jersey, it follows that the vast majority of samples submitted for diagnosis (87%) were either turfgrass or ornamental plants (Table 4). 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 plant 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. Soil

samples submitted to the laboratory for nematode analysis were roughly split between golf turf and from production agriculture. The majority of the samples from production agriculture were from several growers in southern New Jersey who specialize in small grains, potatoes, peaches, 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.

Samples were submitted to the RPDL-NDS from all of the counties in New Jersey (Tables 5A and 5B). The majority of samples, however, were submitted from counties in close proximity to the laboratory or from counties with dense populations that have disease problems associated with turf and ornamentals in residential landscapes or on golf courses. Disease problems on these commodities are difficult

Table 3. RPDL-NDS sample submissions by origin, 1996.

Sample Origin	Number of Plant Samples	Percent of Total	Number of Nematode Samples	Percent of Total
Commercial Growers	799	66%	224	93%
Residential	326	27%	0	0%
Research Programs (Rutgers University)	81	7%	18	7%
Totals	1206	100%	242	100%

Table 4. RPDL-NDS sample submissions by crop category, 1996.

Crop	Number of Plant Samples	Percent of Total	Number of Nematode Samples	Percent of Total
Turf	546	45%	124	51%
Ornamentals	389	32%	0	0%
Other Crops	101	8%	118	49%
Identification	170	14%	0	0
Totals	1206	100%	242	100%

to diagnose and are subsequently submitted to the laboratory. In addition, many citizens in central New Jersey contact Rutgers University directly for help with plant-related problems and are referred to the laboratory. This county profile also identifies the county faculty who are familiar with the RPDL-NDS and utilize its services.

Approximately 20% of the samples submitted for diagnosis to the laboratory were from out-of-state (Table 5A and 5B). Nearly all of these samples were turf. Because of his national reputation and his

strong support for the laboratory, Dr. Bruce Clarke has helped the Rutgers laboratory develop into one of the premier golf turf diagnostic facilities in the country. Many golf course superintendents send samples to Dr. Clarke, who always forwards them to the laboratory for diagnosis. Samples of golf turf were received by the laboratory from 18 states, from as far away as Hawaii and California. Because there are very few laboratories in the country that diagnose turfgrass diseases, these superintendents have continued to submit samples to the RPDL-NDS. Furthermore, many golf turf professionals at other uni-

Table 5A. RPDL-NDS sample submissions by county, 1992 to 1996.

In-State	1992	1993	1994	1995	1996
Atlantic	20	8	20	40	42
Bergen	70	59	60	62	71
Burlington	38	51	31	54	67
Camden	14	28	25	37	42
Cape May	8	16	10	9	16
Cumberland	9	6	14	7	8
Essex	14	20	30	22	20
Gloucester	38	22	26	61	19
Hudson	9	5	0	6	1
Hunterdon	14	19	37	31	22
Mercer	32	36	65	47	44
Middlesex	75	66	85	119	129
Monmouth	65	79	59	77	58
Morris	24	22	34	53	90
Ocean	41	22	17	56	63
Passaic	21	34	19	44	69
Salem	2	0	9	11	12
Somerset	37	52	51	52	54
Sussex	15	18	6	13	15
Union	16	45	20	56	27
Warren	14	24	33	29	30
Rutgers Research	46	51	74	67	81
In-State Totals	622	683	725	953	981
Out-of-State	54	109	97	115	225
Totals	676	792	822	1068	1206

versities often refer their clients to Rutgers for second opinions. The charge for out-of-state samples is substantially higher to help defray the cost of in-state samples. This area of sample submissions is the fastest growing area in the laboratory.

Of the plant specimens submitted to the RPDNDS for diagnosis or identification, 48% were associated with biotic disease-causing agents (Table 6). Injury to 8% of the samples was caused by insects and related arthropods, and 30% were associated

with abiotic injuries and stresses (e.g., environmental extremes, nutrient deficiencies, poor cultural practices, poor soil conditions, etc.). Another 14% included insect, plant, and substance identification. The regular increases in this category since 1994 are primarily due to the large increase in insect identifications. After the retirement of Dr. Louis Vasvary most insect identifications have been forwarded to the laboratory for identification. The increase in insect identifications is the second largest growth area, after out-of-state golf turf, for the laboratory.

Table 5B. RPDNDS nematode submissions by county, 1992 to 1996.

In-State	Number of nematode samples				
	1992	1993	1994	1995	1996
Atlantic	0	3	1	2	16
Bergen	0	4	13	3	2
Burlington	0	31	58	38	40
Camden	0	1	9	15	37
Cape May	5	2	1	0	2
Cumberland	0	8	23	10	2
Essex	22	3	4	4	1
Gloucester	27	24	7	10	22
Hudson	0	0	0	0	0
Hunterdon	1	1	1	2	1
Mercer	1	17	15	0	21
Middlesex	0	6	4	7	5
Monmouth	1	4	7	1	0
Morris	0	4	7	5	3
Ocean	1	0	0	0	0
Passaic	1	0	3	0	3
Salem	0	14	23	3	9
Somerset	0	1	3	0	0
Sussex	1	0	1	0	2
Union	0	0	0	0	0
Warren	0	0	0	0	0
Rutgers Research	27	27	0	0	18
In-State Totals	873	150	180	100	184
Out-of-State	26	17	39	29	58
Totals	113	167	219	129	242

The overall breakdown in sample submissions is typical of that reported by other diagnostic laboratories in the United States.

In 1996, the mean response time for samples diagnosed in less than 21 days was 2.25 days. This is a slight decrease in response time from the 1995 mean response time of 2.2 days. The rapid response time is attributed largely to the presence of Ms. Sophie Penkrat, an exceptionally competent helper who worked tirelessly in the laboratory during the summer months. Ms. Penkrat has developed into an assistant who can easily fulfill most of the responsibilities of a program associate or horticultural consultant. Adequately trained staff is essential to the efficient operation of the laboratory. The University of Maryland laboratory's response time increased by approximately one full day when a summer position went unfilled.

A laboratory response was prepared in less than three days for most (79%) of the samples submitted (Table 7), and 92% 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.

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 1996, Mr. Buckley participated in a number of short courses offered by the Office of Continuing Professional Education. Mr. Buckley is an instructor in the Rutgers Professional Golf Turf Management School. He traditionally taught two courses, Diseases of Turf and Diseases of Ornamental Plants, in both the spring and fall sessions. This teaching commitment consisted of one two-hour lecture in each class per week for ten weeks. In 1996, Mr. Buckley added a third course, Insect Pest of Turf, to his commitment to the turf school. This course consists of an additional set of 10 weekly lectures in both the spring and fall sessions. Mr. Buckley's efforts in the Professional Golf Turf Management School generated \$11,000 in income for the laboratory in 1996.

Other short courses in which Mr. Buckley participated in 1996 included the Professional Grounds Maintenance Short Course, the Greenhouse Crop Production Short Course, the Home Gardeners School, Introduction to Golf Turf Management, Landscape Integrated Pest Management: A Less Toxic Approach, Pest Management in Ornamental Landscape Plants Short Course, and the Home Depot Garden Center Management Workshop. The income generated by these activities with the Office of Continuing Education was \$1,325.

Mr. Buckley also served as the course coordinator for the Pest Management in Landscape Turf Short Course. This was the third year for this one-day

Table 6. RPDL-NDS plant sample submissions by diagnosis, 1996.

Diagnosis	Number of Samples	Percent of Total
Disease (biotic)	579	48%
Insect	91	8%
Identification	170	14%
Other	366	30%
Totals	1206	100%

Table 7. Sample response times, 1996.

Response time	Number of samples	Percent of total
0 to 3 days	957	79%
4 to 6 days	146	12%
7 to 10 days	43	4%
11 to 21 days	41	3%
>21 days	19	2%
Totals	1068	100

program. It was offered twice in 1996. He also served as the coordinator for the Advanced Turf Management Symposium. A two-day program dedicated to current problems in fine turf also under his direction for the third year. The income generated by these programs with the Office of Continuing Education was \$10,625.

Mr. Buckley was an invited speaker in several Rutgers Cooperative Extension programs, including the North Jersey Ornamental Horticulture Conference, the Field Crop and Vegetable Integrated Crop Management Workshop, the Union County Golf Course Pesticide Recertification Program, Landscape IPM: Ornamental of Turf Pest Control Basics, and the Mercer, Middlesex, and Ocean County Master Gardener Programs. The Laboratory received compensation for these efforts of \$310.

Mr. Buckley also earned income for the RPD-L-NDS as an invited speaker for the Eastern Pennsylvania Turf Conference, the Delaware Turf Conference, the New Jersey Turf Expo, the Landscape Contractors Association of MD, VA, and DC Winter Workshop, the Golf Course Superintendents Association of New Jersey Winter Meeting, the Ocean City (Maryland) Parks Department Pesticide Recertification Program, the Lebanon Turf Products Lawn Care Clinic, the W.L. Cleary's Turf Product Sales Training Program, the Rutgers Turfgrass Alumni Association monthly meeting, the New Jersey Chapter of the International Society of Arboriculture Annual Conference, the New Jersey Shade Tree Federation Shade Tree Expo, the Certified Tree

Experts Educational Program, and in a gardening class at Jackson Vocational School. The income from these talks was \$1,450.

Other educational services provided by the staff of the RPD-L-NDS, for which the laboratory received no compensation, included lectures in several undergraduate courses including Principles of Applied Nematology, Greenhouse Environmental Control, and Urban Forestry. Short presentations describing how to utilize RPD-L-NDS services were given to several groups and to several Office of Continuing Education short courses.

Extension Publications. During 1996, the RPD-L-NDS staff contributed regularly to the Plant & Pest Advisory. The laboratory staff wrote a brief article on laboratory activities for each issue of the newsletter, which was bi-weekly from March to September and monthly from September to December by Rutgers Cooperative Extension and the New Jersey Agricultural Experiment Station. Several extension factsheets were co-authored with various extension personnel during the year and are currently under review. These documents will be included in next year's report.

Service. Mr. Buckley served as a member of the Rutgers Cooperative Extension Home Horticulture Working Group and the Resource Center Planning Committee. At Ag Field Day, he organized and staffed a well-attended "Plant Problem Question and Answer Booth."

In 1996 Mr. Buckley acted as the Northeast region editor 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.

During the summer of 1996, Mr. Buckley sponsored a South Brunswick High School student in the schools CIPED program. The CIPED program is designed to help students relate classroom learning to real world experiences. Ms. Prajacta Nadkarian, a South Brunswick High School junior, worked in the lab once a week for several weeks in the summer.

Marketing

The RPDN-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 1996 by the staff of the Plant Diagnostic Laboratory.

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 RPDN-NDS and how to access them. To date, over 15,000 copies of this brochure have been distributed. Once again, special thanks goes to the Department of Professional Continuing Professional Education, who placed a copy of the advertising brochure in each short course educational packet that was 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 RPDN-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, the Salem County Fair, 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.

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 (Table 8).

Over \$51,520 was generated from diagnostic services and nematode assays during 1996, representing a 26% increase in income over 1995.

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 95% of the clients billed have remitted payment. Almost all 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 154 of these "no charge" samples in 1996 (Table 9). These samples accounted for 11% of the samples processed. The value of these no charge requests was \$3080.

Income generated from all laboratory activities covered 100% of the non-salary expenses incurred in 1996, plus 88% of salaries, or 99% of the laboratory's total expenditures (including salaries and one-time costs for equipment). Salaries and benefits for laboratory employees accounted for 88% of laboratory expenses. For more detailed budget information see Appendix I.

Future Directions

As in the past, the top priority for 1997 will be to generate more income. To accomplish this, we will continue to advertise laboratory services to increase

Table 8. Fee schedule for diagnostic services and nematode assays, 1996.

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

sample number. Continued cooperation with the Office of Continuing Professional Education and other educational activities are expected to generate additional funds.

Other priorities in 1997 include: developing additional educational materials in the form of bulletins, fact sheets, and slide sets 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 1996 growing season was greatly affected by a year of regular rains and overcast weather. Diseases favored or enhanced by these conditions were especially prevalent.

Ornamentals

As usual, a vast majority of ornamental plants submitted to the laboratory were affected by abiotic agents. The symptoms of these problems appeared as leaf scorch, premature defoliations, branch die-back, or early and late fall color, and an overall decline in plant vigor. Planting problems and poor site conditions were a primary cause of many plant failures. The cumulative effects of several seasons of erratic and extreme weather also strongly contributed to many plant failures.

Table 9. Plant Diagnostic Laboratory sample submissions, no charge requests.

Client Category	Number of Samples
RCE County Faculty/Program Associates	90
RCE Specialists	9
Rutgers Research Programs (not RCE)	24
Rutgers Non-Research Faculty/Staff	17
Direct Mail/Walk-ins	10
Other Government Agencies/University	2
Payment Returned - Sample Inadequate for Diagnosis	0
Resubmissions for Further Diagnosis	2
Total	154

Of the diseases that were caused by biotic agents, several leaf spots, anthracnose, needlecasts, and rusts were diagnosed. These leaf diseases are enhanced by frequent spring rains. Cankers caused by the fungi *Botryosphaeria* and *Cytospora*, were prevalent in trees and shrubs injured during the drought of 1995. Root-infecting pathogens 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. Cooly spruce gall adelgid injury was especially common on Douglas fir and elongate hemlock scale and hemlock wooly adelgid continue to decimate the local stands of hemlock.

In the greenhouse, *Pythium* and *Rhizoctonia* root rots continue to be the most common problem. Nutrient and salt problems are also prevalent. Several growers submitted samples to the laboratory of a variety of plants that tested positive for the tospoviruses, impatiens necrotic spot or tomato spotted wilt. Arabis mosaic virus, a relatively rare virus, was detected in a poinsettia crop late in the year.

Turf

Fine turf in New Jersey and the mid-Atlantic region was also hurt by the overcast weather and excess soil moisture. The turfgrass never really took off; therefore, diseases associated with stress conditions and slow growing grass increased. Brown patch was diagnosed with the most frequency this year. Anthracnose continues to increase in the state and may be the most prevalent golf turf disease. As usual, red thread and *Pythium* diseases were also very prevalent. This spring, due to the extra long winter and massive snow accumulations, snow molds were everywhere.

Vegetables

In vegetables, root knot nematode in carrot and lesion nematode in potato continue to be primary problems. *Phytophthora* fruit rot was very prevalent in pumpkin and late-season squash this year. Whole blocks of pumpkin declined rapidly from the disease late in the season. Powdery mildew was diagnosed in greenhouse and field tomato for the first time in New Jersey in 1996. The disease, first diagnosed by the laboratory, was subsequently reported in *Plant Disease* by Dr. Steve Johnston and Dr. James White of the Department of Plant Pathology. The tomato crop also was hard hit by bacterial leaf spot problems early in the season.

APPENDIX I. Rutgers Plant Diagnostic Laboratory and Nematode Detection Service Budget.

Table 10. RPDL-NDS expenditures in 1996.

Salaries & Benefits:	\$ 70,932.42
Supplies and Services: (includes)	7457.33
Diagnostic supplies	
Printing/advertising	
References/publications	
Equipment maintenance	
Office supplies	
Photographic services	
Communications:	
Telephone/Fax	991.35
Postage	757.75
Travel: (includes)	118.00
Travel to give paid talks	
Travel to professional meetings	
Travel for training	
Total Expenditures:	\$ 80,256.85

Table 11. RPDL-NDS income in 1996.

Sample fees:	\$ 48,040.00
Unpaid sample fees:	3480.00
Lecture fees:	
Professional Golf Turf School	11,000.00
O.C.P.E. Short Course Coordinator	10,626.00
O.C.P.E. Short Course Instructor	1325.00
Other	1760.00
Value of no-charge samples:	<3080.00>
Potential Total Income	<\$ 79,310.00>
Actual Total Income:	\$ 76,230.00

Table 12. RPDL-NDS estimated expenditures for 1997.

Salaries and benefits:	\$ 64,200
Seasonal labor:	10,000
General operating:	7,500
One-time equipment cost:	3,000
Educational development and travel:	2,000
New facility renovation?	?
Total Estimated Expenditures:	\$ 86,500

Table 13. RPDL-NDS estimated income for 1997¹.

Estimated Turf Sample Income:	
40% @ \$50	\$ 30,000
Estimated Out-of-State Sample Income:	
20% @ \$75	22,500
Estimated All Other Sample Income:	
40% @ \$20	12,000
Estimated Lecture Fee Income:	20,000
Total Estimated Income 1997:	\$ 84,500

¹ Based on 1500 samples submitted in 1997.

Appendix II. Complete listing of lectures presented during 1996, Richard J. Buckley, Laboratory Coordinator, Plant Diagnostic Laboratory.

Date	Title of Presentation	Audience	Location	Number of handouts	Type of participants ¹
1-3/96	Diseases of Turfgrass (10 Lectures)	Professional Golf Turf Management School	Cook College	20	T
1-3/96	Diseases of Ornamentals (10 Lectures)	Professional Golf Turf Management School	Cook College	20	T
1-3/96	Insects of Turfgrass (10 Lectures)	Professional Golf Turf Management School	Cook College	20	T
1/4/96	Managing Diseases in Landscape Turf	Pest Management in Landscape Turf Short Course	Cook College	2	T,L
1/10/96	Diseases of Ornamental Landscape Plants	Eastern Pennsylvania Turf Conference	Valley Forge, PA	2	T,L
1/11/96	Disease Management and Control in the Landscape	Pest Management in Ornamental Landscape Plants Short Course	Cook College	2	A,T,L
1/11/96	Using the Plant Diagnostic Laboratory	Introduction to Golf Turf Management Short Course	Cook College	2	T
1/18/96	Turf Diseases You'll Never Forget	Lebanon Turf Products Lawn Care Clinic	Middlesex Co.	3	L,L,T
1/19/96	Diseases of Turfgrass	Professional Grounds Maintenance Short Course	Cook College	3	L,T
1/23/96	Diagnosing Common Plant Disorders	Landscape Integrated Pest Management: A Less Toxic Approach	Cook College	3	A,L,T
2/6/96	Best Management Strategies for Turfgrass Diseases	Landscape Contractors Association of MD, VA, DC	Bethesda, MD	1	A,T,L
2/14/96	Drought Stress & Related Diseases of Ornamental Plants	North Jersey Ornamental Horticulture Symposium	Morris Co.	3	A,T,L
2/20/96	Diagnosing Greenhouse Crop Disorders	Greenhouse Crop Production Short Course	Cook College	3	G
3/1/96	Summer Patch/Anthracnose Update	W.L. Cleary Turf Product Sales Training	Middlesex Co.	2	I
3/8/96	Plant Diseases in the Home Landscape	Master Gardeners	Middlesex Co.	2	H
3/12/96	Turf Disease Update	Golf Course Superintendents Association of New Jersey	Bergen Co.	2	T
3/14/96	Plant Parasitic Nematodes	Field Crop and Vegetable Integrated Crop Management Workshop	Mercer Co.	2	P
3/15/96	Diagnosing Plant Disorders	Landscape IPM: Ornamental and Turf Pest Control Basics	Ocean Co.	4	A,L,T
3/22/96	Tree Disease Update	New Jersey Chapter, International Society of Arboriculture Annual Conference	Morris Co.	2	A,L
3/23/96	What's Eatn' My Flowers?	Home Gardeners School	Cook College	3	H
3/26/96	Diagnosing Plant Problems	Home Depot Garden Center Management Workshop	Middlesex Co.	4	I
3/28/96	IPM Tactics for Golf Courses	Union County Golf Course Pesticide Recertification Program	Union Co.	2	T
4/9/96	Diagnosing Plant Problems in the Greenhouse	Greenhouse Environmental Control 11:530:321	Cook College	1	C
4/16/96	Diagnosing Plant Problems	Urban Forestry 11:704:300	Cook College	1	C
4/18/96	Drought Stress & Other Disorders of Ornamental Plants	Ocean City Parks Department Tree Care Symposium	Ocean City, MD	1	A,L,T
4/23/96	Diagnosing Plant Problems	Master Gardeners	Ocean Co.	2	H
5/9/96	Tree Disease Update	Certified Tree Experts Arborist Prep Course	Monmouth Co.	2	A,L
5/17/96	Plant Diseases in the Home Landscape	Master Gardeners	Middlesex Co.	2	H
9/10/96	Effective use of the Plant Diagnostic Laboratory	Rutgers Turfgrass Alumni Association Meeting	Cook College	2	T
9/21/96	Should Fungicides be Used in the Home Landscape?	Home Gardeners School	Cook College	2	H
10/2/96	Plant Pest Diagnosis	Master Gardeners	Mercer Co.	2	H
10/24/96	Identification of Plant Parasitic Nematodes	Principles of Applied Nematology 11:770:416	Cook College	5	C
11/1/96	Tree Disease Update	New Jersey Shade Tree Federation Annual Meeting	Camden Co.	2	A,I,L
11/15/96	Plant Diseases in the Home Landscape	Master Gardeners	Middlesex Co.	2	H
11/20/96	Managing Turf Diseases	Delaware Turfgrass Conference	Hockessin, DE	2	L,T
12/4/96	Disease Problems in Ornamental Landscape Plants	Pest Management in Ornamental Plants Short Course	Cook College	2	A,L,T
12/5/96	Managing Diseases in Landscape Turf	Pest Management in Landscape Turf Short Course	Cook College	3	L,T
12/10/96	Field Diagnosis of Tree and Shrub Problems	New Jersey Turf Expo	Atlantic Co.	4	A,I,L,T
12/12/96	Plant Disease Diagnosis	Jackson Vocational School	Ocean Co.	3	I
10-12/96	Diseases of Turfgrass (10 Lectures)	Professional Golf Turf Management School	Cook College	20	T
10-12/96	Diseases of Ornamentals (10 Lectures)	Professional Golf Turf Management School	Cook College	20	T
10-12/96	Insects of Turfgrass (10 Lectures)	Professional Golf Turf Management School	Cook College	20	T

¹Audience 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.

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