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NEW JERSEY AGRICULTURAL EXPERIMENT STATION

RUTGERS PLANT DIAGNOSTIC LABORATORY

AND

NEMATODE DETECTION SERVICE

1994 ANNUAL REPORT

THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

PLANT DIAGNOSTIC LABORATORY AND NEMATODE DETECTION SERVICE
1994 ANNUAL REPORT

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 3,091 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 1994, the laboratory's third full year of operation and the second 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 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 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 three years and has become an integral part of the daily activities of the laboratory in the summer. 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 1994 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 weed identification and diagnosis of herbicide injury, Dr. George Wulster of Plant Science for assistance with problems on horticultural crops, and Dr. Raul Cabrera for assistance with problems in nursery production. 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 pest treatments.

OPERATIONS

Diagnostics

During 1994, the RPDL-NDS examined 822 specimens submitted for diagnosis or identification (Table 1A) and assayed 219 soil samples for nematodes (Table 2). Compared to 1993 levels, this represents a 3.8% increase in plant samples and a 31.1% increase in nematode samples. As expected, the majority of samples were submitted during the summer months and diminished in the fall and winter.

Table 1A. RPDL-NDS plant sample submissions by month - Rutgers University - 1991 to 1994.

Month	1991	1992	1993	1994
January		11	17	11
February		8	21	14
March		23	22	31
April		52	47	56
May		78	77	70
June	6[1]	95	70	146
July	107	117	244	172
August	104	80	110	135
September	59	103	92	75
October	45	56	43	55
November	25	38	34	28
December	25	15	15	29
Total:	371	676	792	822

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

For comparison purposes, a listing of 1991 through 1994 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.

Table 1B. RPDL-NDS plant sample submissions by month - the University of Maryland - 1991 to 1994.

Month	1991	1992	1993	1994
January	19	19	20	19
February	33	32	14	27
March	56	63	46	50
April	75	71	74	67
May	140	109	78	71
June	156	136	134	112
July	147	94	134	101
August	132	147	121	143
September	113	125	89	84
October	85	59	53	46
November	36	32	27	49
December	13	13	15	16
Total:	1005	900	805	785

For the first year since the laboratories inception, the RPDL-NDS received 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. 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 1994. 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.

The Nematode Detection Service began accepting soil samples on July 1, 1992. Prior to that date, this service was rendered by Dr. Jack Springer at the Upper Deerfield Station. At this time, Dr. Springer continued to process samples submitted by county extension faculty free of charge. He did not continue this practice in 1993. In 1994, the Nematode Detection Service processed 219 soil samples for nematode assays.

Table 2. RPDL-NDS nematode sample submissions by month - 1992 to 1994.

Month	1992	1993	1994
January		0	0
February		5	0
March		0	14
April		22	41
May		1	3
June		16	9
July	26	18	55
August	2	24	25
September	40	18	11
October	42	8	14
November	3	10	40
December	0	45	7
Total:	113	167	219

Of the specimens submitted to the RPDL-NDS for diagnosis or identification in 1994, 68% were from commercial growers, 23% were from residential clientele, and 9% were submitted from research faculty at Rutgers University (Table 3). Of the samples submitted to the Nematode Detection Service, 99% were from commercial growers, 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. In 1993, 16% of the nematode

samples were submitted to the laboratory from Rutgers research programs. In 1994, there were no samples from that group.

Table 3. RPDL-NDS sample submissions by origin - 1994.

Sample Origin	Number of Plant Samples	Percent of Total	Number of Nematode Samples	Percent of Total
Commercial Growers	561	68%	217	99%
Residential	187	23%	2	1%
Research Programs (Rutgers University)	74	9%	0	0%
Total:	822	100%	219	100%

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 4. RPDL-NDS sample submissions by crop category - 1994.

Crop	Number of Plant Samples	Percent of Total	Number of Nematode Samples	Percent of Total
Turf	389	47%	105	48%
Ornamentals	318	39%	3	1%
Other Crops	65	8%	111	51%
Plant Identification	50	6%	0	0
Total:	822	100%	219	100%

The vast majority of samples submitted for diagnosis (78%) 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 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. Most of the soil samples submitted to the laboratory for nematode analysis were from fine turf. The remainder 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 5A. RPDL-NDS sample submissions by county - 1991 to 1994.

	Number of Plant Samples			
In-State	**1991**	**1992**	**1993**	**1994**
Atlantic	9	20	8	20
Bergen	34	70	59	60
Burlington	16	38	51	31
Camden	8	14	28	25
Cape May	7	8	16	10
Cumberland	0	9	6	14
Essex	3	14	20	30
Gloucester	7	38	22	26
Hudson	0	9	5	0
Hunterdon	11	14	19	37
Mercer	26	32	36	65
Middlesex	50	75	66	85
Monmouth	24	65	79	59
Morris	16	24	22	34
Ocean	18	41	22	17
Passaic	3	21	34	19
Salem	1	2	0	9
Somerset	27	37	52	51
Sussex	7	15	18	6
Union	11	16	45	20
Warren	14	14	24	33
Rutgers Research	10	46	51	74
In-State Total:	302	622	683	725
Out-of-State:	69	54	109	97
Total:	371	676	792	822

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. Many areas in these counties are densely populated and have disease problems associated with turf and ornamentals in residential landscapes or on golf courses. Disease problems on these commodities are difficult 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.

Table 5B. RPDL-NDS nematode submissions by county - 1991 to 1994.

	Number of nematode samples		
In-State	**1992**	**1993**	**1994**
Atlantic	0	3	1
Bergen	0	4	13
Burlington	0	31	58
Camden	0	1	9
Cape May	5	2	1
Cumberland	0	8	23
Essex	22	3	4
Gloucester	27	24	7
Hudson	0	0	0
Hunterdon	1	1	1
Mercer	1	17	15
Middlesex	0	6	4
Monmouth	1	4	7
Morris	0	4	7
Ocean	1	0	0
Passaic	1	0	3
Salem	0	14	23
Somerset	0	1	3
Sussex	1	0	1
Union	0	0	0
Warren	0	0	0
Rutgers Research	27	27	0
In-State Total:	873	150	180
Out-of-State:	26	17	39
Total:	113	167	219

Approximately 13% 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, 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, 57% were associated with biotic disease-causing agents (Table 6). Injury to 8% of the samples was caused by insects and related arthropods, and 29% were associated with abiotic injuries and stresses (e.g., nutrient deficiencies, poor cultural practices, poor soil conditions, etc.). Another 6% included plant and substance identification. This breakdown of samples is typical of that reported by other diagnostic laboratories in the United States.

Table 6. RPDL-NDS plant sample submissions by diagnosis - 1994.

Diagnosis	Number of Samples	Percent of Total
Disease (biotic)	466	57%
Insect	67	8%
Identification	50	6%
Other	239	29%
Total:	822	100%

In 1994, the mean response time for samples diagnosed in less than 21 days was 3.3 days. This is an improvement of more than one day over the 1993 mean response time of 4.4 days. This improvement is attributed largely to the presence of Mr. Greg Balog, a trained, competent helper who worked tirelessly in the laboratory during the summer months.

A laboratory response was prepared in less than three days for over half (67%) of the samples submitted (Table 7), and 89% 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 - 1994.		
Response time	**Number of samples**	**Percent of total**
0 to 3 days	542	67%
4 to 6 days	183	22%
7 to 10 days	40	4%
11 to 21 days	37	4%
>21 days	20	2%
Total:	822	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 1994, 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 teaches two courses, Diseases of Turf and Diseases of Ornamental Plants, in both the spring and fall sessions. This teaching commitment consists of one two-hour lecture in each class per week for ten weeks. Other short courses in which Mr. Buckley participated in 1994 included the Professional Turfgrass and Landscape Management Short Course, the Greenhouse Crop Production Short Course, the Home Gardeners School, and the Pesticide Safety for Landscape Contractors Short Course. Mr. Buckley also served as the course coordinator for the Pest Management in Landscape Turf Short Course. This course was new this year. The income generated by activities with the Office of Continuing Education was $11,640.

Mr. Buckley was an invited speaker in several Rutgers Cooperative Extension programs, including the North Jersey Ornamental Horticulture Conference, the Integrated Crop Management Workshop, the Regional Grounds Maintenance Conference, the Landscape IPM Pest Clinic, and the South Jersey Nursery Meeting. The Laboratory received compensation from the Integrated Crop Management Workshop and the Landscape IPM Pest Clinic of $160.

Mr. Buckley also earned income for the RPDL-NDS as an invited speaker for the Golf Course Superintendents Association of New Jersey, the Landscape Contractors Association of Maryland, DC, and Virginia, the Lebanon Turf Products Turf Care Seminar, the Opti-Gro Principles of Turf and Grounds Maintenance Seminar, the

International Society of Arborist Plant Health Care Workshop, the Association of Specialty Cut Flowers, the Delaware Turfgrass Conference, the Professional Lawn Care Association of America Annual Conference, the New Jersey Turfgrass Expo, and Pro-Lawn's Delmarva Golf Course Seminar. The income from these talks was $1713.08.

Other educational services provided by the staff of the RPDL-NDS, for which the laboratory received no compensation, included lectures in graduate level plant pathology courses. Short presentations describing how to utilize RPDL-NDS services were given to several groups and to several Office of Continuing Education short courses.

Extension Publications. In 1994, Mr. Buckley cooperated with Dr. Ann Gould as a co-author of the Rutgers Cooperative Extension Fact Sheet FS757, entitled *Proper Sampling of Soil and Plant Tissue for Detection of Plant Parasitic Nematodes.* 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. Also during 1994, the RPDL-NDS staff contributed regularly to the Insect-Disease-Weed Newsletter. The laboratory staff wrote a brief article on laboratory activities for each issue of the newsletter, which was 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 volunteered to speak 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.

During the fall of 1994, 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.

In 1994 Mr. Buckley and Dr. Ann Gould acted as 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 1994 by the staff of the Plant Diagnostic Laboratory. Special thanks goes to the Department of Continuing Professional Education, who allowed the RPDL-NDS staff to make this presentation in each of their plant oriented short courses.

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 10,000 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 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.

PROFESSIONAL IMPROVEMENT

Mr. Buckley attended the national meeting of the American Phytopathological Society (APS) in August. At the meeting, Mr. Buckley received work-related training on root-infecting *Pythium* in turfgrass and the use of Rapid Tests in Plant Disease Diagnostics.

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 1994 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 $31,285 was generated from diagnostic services and nematode assays during 1994, representing a 13.4% increase in income over 1993.

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 162 of these "no charge" samples in 1994 (Table 8). These samples accounted for 16% of the samples processed. The value of these no charge requests was $3,240.

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

Client Category	Number of Samples
RCE County Faculty/Program Associates	45
RCE Specialists	44
Rutgers Research Programs (not RCE)	22
Rutgers Non-Research Faculty/Staff	18
Direct Mail/Walk-ins	24
Other Government Agencies/University	5
Payment Returned - Sample Inadequate for Diagnosis	0
Resubmissions for Further Diagnosis	4
Total:	162

Income generated from all laboratory activities covered 100% of the non-salary expenses incurred in 1994, plus 70% of salaries, or 74% of the laboratory's total expenditures (including salaries and one-time costs for equipment). Salaries and benefits for laboratory employees accounted for 89% 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, 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 1994 growing season was greatly affected by an unusually harsh winter followed by hot and dry weather in early-June. Diseases favored or enhanced by these conditions were especially prevalent.

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 shallow rooted species that had significant root dysfunction caused by the winter freeze. In some cases, trees died suddenly in the early-June heat wave. In the spring, numerous samples were submitted to the lab with symptoms of winter injury and injury by de-icing salt.

Of the diseases that were caused by biotic agents, several leaf spots, anthracnose, needlecasts, and rusts were diagnosed. Diseases enhanced by winter stress, particularly cankers caused by the fungi *Botryosphaeria* and *Cytospora*, were prevalent. Root-infecting pathogens detected this year on a variety of ornamental plants included *Phytophthora*, *Pythium*, *Fusarium*, and *Rhizoctonia*. Oak leaf scorch, caused by the bacterium *Xylella fastidiosa*, is becoming more common in red and pin oak. This disease was detected in Somerset and Monmouth counties for the first

time this season. Rhododendron necrotic ringspot virus was detected in mountain laurel from Mercer county.

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.

Greenhouse diseases of note included black leg and cutting rot of geranium; downy mildew on snapdragon and *Alyssum*; impatiens necrotic spot of snapdragon and impatiens; and Pythium, Rhizoctonia, and Fusarium root or bulb rots on a wide variety of plants.

Turf

Fine turf in New Jersey and the mid-Atlantic region was especially hard hit by the extended freeze this winter. In some cases, large turf areas were killed. These areas, reseeded in April, were subsequently attacked by Rhizoctonia and Pythium seedling blights or were killed outright by the 90 degree heat wave in mid-June. Turf that survived the winter slowly declined as the summer went on. Gray snow mold was troublesome in New Jersey for the first time in years.

The hot, humid, and rainy weather of late-summer 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. With night temperatures exceeding 70°F regularly, brown patch was frequently diagnosed. Summer patch continues to be problem in the state, and 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 1994. Populations of nematodes were 4 to 5 times higher than normal in most samples.

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. Stripe smut is beginning to re-emerge as a problem of Kentucky bluegrass and was diagnosed by the laboratory several times this spring. 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

In vegetables, root knot nematode in carrot and lesion nematode in potato continue to be primary problems. Downy mildew was very prevalent in pumpkin and late-season squash this year. Whole blocks of pumpkin declined rapidly from the disease after week-long periods of rain in August. Hot, humid weather at other times stimulated severe outbreaks of powdery mildew in squash. Cucumber mosaic virus and alfalfa mosaic were detected in samples of tomato and pepper.

RUTGERS COOPERATIVE EXTENSION

NEW JERSEY AGRICULTURAL EXPERIMENT STATION

Plant Disease Control

PROPER SAMPLING OF SOIL AND PLANT TISSUE FOR DETECTION OF PLANT PARASITIC NEMATODES

RUTGERS PLANT DIAGNOSTIC LABORATORY AND NEMATODE DETECTION SERVICE

Richard J. Buckley, Coordinator
Rutgers Plant Diagnostic Laboratory

Ann B. Gould, Ph.D.
Extension Specialist in Plant Pathology

Nematodes are microscopic worms that are associated with plants and soil. Most nematodes feed on debris and other microorganisms. A few species, however, can cause substantial damage to plants by feeding on living roots or foliage. Although all soils contain nematodes, not all nematodes cause plant disease. Moreover, plant parasitic nematodes usually occur in populations that are too small to result in plant injury.

To determine whether populations of nematodes are high enough to cause noticeable plant injury in commercial or residential plantings, send soil or plant samples to a nematode detection laboratory for analysis. For best results, representative soil and root samples must be collected and sent to the laboratory using the following procedures:

SOIL SAMPLES

I. To submit soil samples from *row and field crops, fallow fields, and home gardens*:

- For each field, take samples from areas with a common crop history. Areas that are different in slope, drainage, and soil type should be sampled and tested separately.
- Sampling areas should not exceed four acres. Larger fields should be divided into subsections and sampled separately.
- Sample root zones of affected plants at least 6 to 8 inches below the soil surface. Take a uniform core or thin slice of soil with a spade or soil probe. Follow a systematic pattern (Fig. 1), and sample at least 20 different locations within the sample area. Deposit the soil in a clean bucket, mix well, and submit a 1 qt. subsample in a plastic bag to the Rutgers Nematode Detection Service for analysis.

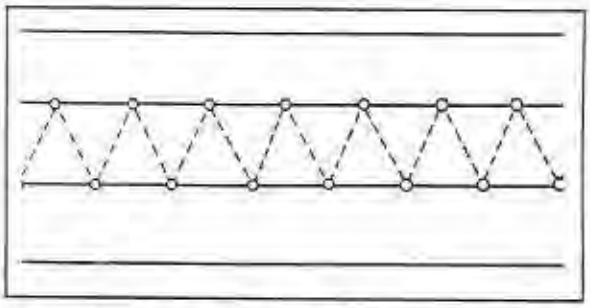

Figure 1. Sampling pattern for row and field crops, home gardens, fallow fields, turf, vineyards, or fruit and nursery blocks.

II. To submit soil samples from *established plantings (i.e., trees, shrubs, fruit crops, and turfgrasses)*: sample each plant species separately. Collect soil from the root zone of declining plants. Do not sample from dead plants.

Fruits and nursery crops: Remove at least three soil cores per plant, 12 to 15 inches deep, from the fibrous root zone under the canopy of declining plants. Soil samples should be collected from blocks containing plants of a similar species, variety, cultivar, and age. Follow a systematic

sampling pattern in the block (Fig. 1), and submit a 1 qt. subsample.

Turfgrass: Collect samples around the margin of the affected patch. Systematic sampling (Fig. 1) from the transition zone ensures optimum results. Soil cores should be collected from the root zone at a depth of 3 to 5 inches. Submit a 1 qt. subsample.

Individual trees and shrubs: Following a zig-zag pattern around the dripline of each plant, collect soil from the fibrous root zone in several locations (Fig. 2). Sample at a depth of 12 to 15 inches. Take 10 cores for large specimens and 15 cores for row plantings. Submit a 1 qt. subsample to the Rutgers Nematode Detection Service.

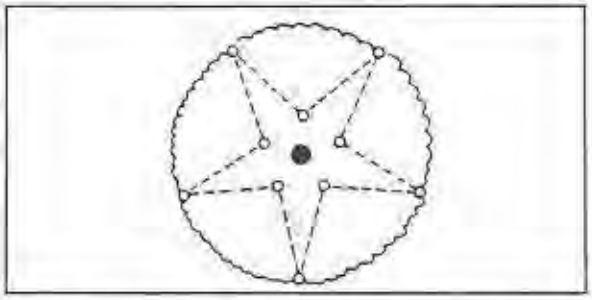

Figure 2. Sampling pattern for trees and shrubs.

PLANT SAMPLES

Include root tissue, or whenever possible, whole plants with soil samples. For diagnostic purposes, one ounce of fibrous root tissue is sufficient. This is especially important for plants susceptible to root infecting nematodes such as lesion, lance, root knot, and cyst nematodes.

To diagnose the nematode disease known as Pine Wilt, nematodes must be extracted from woody plant material. Although samples may be collected at any time during the year, sampling is most effective when done in the summer. Collect branch samples that appear unthrifty but that still have needles attached. Look for branches that are at least one inch in diameter, lack resin when cut, and have obvious insect exit holes (insects transport nematodes from tree to tree).

To confirm the diagnosis of foliar, stem, and bulb nematodes, whole plants must be submitted to the laboratory for analysis.

TIMING OF SOIL SAMPLING

For nematode detection, soil samples may be taken at any time when the soil temperature exceeds 40°F. The best time to obtain samples, however, is in the fall when nematode populations are generally the highest. Samples should be taken when the soil or sand is moist, but not excessively wet or dry.

HANDLING THE SAMPLE

Place a 1 qt. subsample of soil in a plastic bag and seal tightly to prevent drying. Place plant tissue in loosely sealed plastic bags to avoid over heating and to slow the decomposition process. Securely attach the following information to the sample *in its own plastic bag*:

- Plant name from which the sample was taken and, for annual crops, the names of the plants that will be planted in the future.
- Sample identification specifying the field number, location, or some other owner designation. This is very important if more than one sample is submitted to the laboratory.
- Name, address, telephone number, county of grower, and the person to whom the response should be sent.

Information regarding cultural conditions, pesticide use, site conditions, crop history, and plant symptoms should also be included with the samples. Since sunlight or freezing will kill nematodes, samples must be protected from temperature extremes. For best results, maintain collected samples between 40 and 70°F.

For best results, samples should be promptly delivered to the *Rutgers Plant Diagnostic Laboratory and Nematode Detection Service* at either of the following addresses:

For U.S. Mail only, mail to:

P. O. Box 550, Milltown, NJ 08850-0550

For other delivery services:

Building 6020, Dudley Road
Cook College, New Brunswick, NJ 08903

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APPENDIX I. Rutgers Plant Diagnostic Laboratory and Nematode Dection Service - Budget

Table 9. RPDL-NDS expenditures in 1994.	
Salaries & Benefits:	$ 58,914.93
Supplies and Services: (includes) Diagnostic supplies Printing/advertising References/publications Equipment maintenance Office supplies Photographic services	4,624.45
Communications: Telephone/FAX Postage	 734.82 409.80
Travel: (includes) Travel to give paid talks Travel to professional meetings Travel for training	1427.11
Total Expenditures:	$ 66,111.17

Table 10. RPDL-NDS income in 1994.	
Sample fees:	$ 31,285.00
Unpaid sample fees:	770.00
Lecture fees: Office of Continuing Professional Education Other	 11,640.00 1713.08
Value of no-charge samples	<$ 3,240.00>
	$ 48,647.08
Actual Total Income:	$ 45,407.08

Table 11. RPDL-NDS estimated expenditures for 1994.	
Salaries and benefits:	$ 59,340
Seasonal labor:	5,000
General operating:	7,500
One-time equipment cost:	3,000
Educational development and travel:	2,000
New facility renovation?	?
Total Estimated Expenditures:	$ 76,840

Table 12. RPDL-NDS estimated income for 1994[1].	
Estimated TURF Sample Income: 47% @ $50	$ 35,250
Estimated OUT-OF-STATE Sample Income: 13% @ $75	14,625
Estimated ALL OTHER Sample Income: 40% @ $20	12,000
Estimated LECTURE FEE Income:	15,000
TOTAL ESTIMATED INCOME 1994:	$ 76,875

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

APPENDIX II. Plant Diagnostic Laboratory charges in neighboring states.

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 III. Complete listing of lectures presented during 1994.

Date	Title of Presentation	Audience	Location	Number of handouts	Type of participants[1]
1-3/94	Diseases of Turfgrass (10 Lectures)	Professional Golf Turf Management School	Cook College	20	T
1-3/94	Diseases of Ornamental Plants (10 Lectures)	Professional Golf Turf Management School	Cook College	30	T
1/6/94	Managing Diseases of Landscape Turf	Pest Management in Landscape Turf Short Course	Cook College	25	L,T
1/6/94	Using the Plant Diagnostic Laboratory	Pest Management in Landscape Turf Short Course	Cook College	1	L,T
1/10/94	Managing Diseases of Landscape Turf	Professional Turf and Landscape Management Short Course	Cook College	5	L,T
1/11/94	Turf Disease Update - Diseases Caused by the Fungus Pythium	Golf Course Superintendents Association of New Jersey	Bergen Co.	2	T
1/13/94	Using the Plant Diagnostic Laboratory	Pest Management in Ornamental Plants Short Course	Cook College	2	A,L,T

[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]
1/25/94	Using the Plant Diagnostic Laboratory	Park Management Short Course	Cook College	2	L,T
1/27/94	Using the Plant Diagnostic Laboratory	Integrated Pest Management Short Course	Middlesex Co.	2	A,L,T
1/28/94	Using the Plant Diagnostic Laboratory	Urban Forestry Short Course	Cook College	1	A,L
1/31/94	Using the Plant Diagnostic Laboratory	Small Business Survival Skills Short Course	Cook College	1	A,L,T
2/3/94	Using the Plant Diagnostic Laboratory	Landscape Restoration Short Course	Cook College	1	L,T
2/15/94	Turf Diseases You'll Never Forget	Landscape Contractors Association of MD, DC, VA	Rockville, MD	3	A,L,T
2/17/94	Tree Disease Update	North Jersey Ornamental Horticulture Conference	Morris Co.	5	A,L
2/18/94	Nematodes in Field Crops	Integrated Crop Management Workshop	Sussex Co.	3	F
2/22/94	How to Diagnose Greenhouse Crop Diseases	Greenhouse Crop Production Short Course	Cook College	2	G

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Date	Title of Presentation	Audience	Location	Number of handouts	Type of participants[1]
2/24/94	Using the Plant Diagnostic Laboratory	Athletic Field Maintenance Short Course	Cook College	1	T
2/25/94	Using the Plant Diagnostic Laboratory	Cemetery Management Short Course	Cook College	1	L,T
2/28/94	Managing Diseases of Landscape Turf	Lebanon Turf Products Turf Care Seminar	Middlesex Co.	3	I,L,T
3/1/94	Tree Disease Update	Regional Grounds Maintenance Conference	Cape May Co.	2	A,L,T
3/2/94	Using the Plant Diagnostic Laboratory	Landscape Construction Short Course	Cook College	1	L,T
3/4/94	Nematodes in Field Crops	Integrated Crop Management Workshop	Burlington Co.	3	F
3/8/94	Using the Plant Diagnostic Laboratory	Pruning Landscape Ornamentals Short Course	Cook College	1	A,L
3/19/94	Diagnosing Common Plant Problems	Home Gardeners School	Cook College	3	R
3/21/94	Turf Diseases You'll Never Forget	Opti-Gro Principles of Turf and Grounds Maintenance Seminar	Essex Co.	3	T
3/25/94	Plant Pest Diagnosis	Plant Health Care Workshop	Morris Co.	3	A,L

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Date	Title of Presentation	Audience	Location	Number of handouts	Type of participants[1]
5/25/94	Landscape Disease Update	Landscape IPM Pest Clinic	Cook College	0	A,L,T
6/28/94	Landscape Disease Update	Landscape IPM Pest Clinic	Somerset Co.	0	A,L,T
8/6/94	Using the Plant Diagnostic Laboratory	Association of Specialty Cut Flower Growers Meeting	Monmouth Co.	2	G,N
9/10/94	Diagnosing Common Plant Problems	Home Gardeners School	Cook College	3	H
10-12/94	Diseases of Turfgrass (10 Lectures)	Professional Golf Turf Management School	Cook College	20	T
10-12/94	Diseases of Ornamental Plants (10 Lectures)	Professional Golf Turf Management School	Cook College	30	T
10/8/94	Diagnosing Common Plant Problems	Master Gardener Field Day	Cook College	2	H
10/11/94	Using the Plant Diagnostic Laboratory	Master Gardener Hotline Training	Cook College	1	H
10/19/94	Managing Diseases of Landscape Turf	Delaware Turfgrass Conference	Delaware	1	A,I,L,T
10/19/94	Diseases of Trees and Shrubs	Delaware Turfgrass Conference	Delaware	1	A,I,L,T

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Date	Title of Presentation	Audience	Location	Number of handouts	Type of participants[1]
10/25/94	Disease Identification and Control in the Nursery	South Jersey Nursery Meeting	Cumberland Co.	0	G,N
10/25/94	Using the Plant Diagnostic Laboratory	South Jersey Nursery Meeting	Cumberland Co.	2	G,N
11/16/94	Managing Diseases of Landscape Turf	Professional Lawn Care Association of America Annual Conference	St. Louis, MO.	1	A,I,L,T
11/29/94	Diagnosing Plant Problems	The New Jersey Turfgrass Expo	Atlantic Co.	2	A,I,L,T
12/7/94	Turf Disease Update	Pro-Lawn's Delmarva Golf Course Seminar	Ocean City, MD.	2	I,T
12/16/94	Diagnosing Common Problems in the Landscape	Pesticide Safety for Landscape Contractors Short Course	Cook College	1	A,L,T
12/16/94	Using the Plant Diagnostic Laboratory	Pesticide Safety for Landscape Contractors Short Course	Cook College	2	A,L,T

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