Rutgers Cooperative Extension

New Jersey Agricultural Experiment Station

RUTGERS PLANT DIAGNOSTIC LABORATORY

AND

NEMATODE DETECTION SERVICE

1995 ANNUAL REPORT

THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

PLANT DIAGNOSTIC LABORATORY AND NEMATODE DETECTION SERVICE
1995 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) faculty and research faculty at Cook College/NJAES. Since its inception in April of 1991, the Plant Diagnostic Laboratory has examined over 4,288 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 1995, the laboratory's forth full year of operation and the third 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. 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 several undergraduate students. Mr. Greg Balog has worked for the laboratory for four years and has become an integral part of the daily activities of the laboratory in the summer. Unfortunately, graduation has forced Mr. Balog to move on. Ms. Sophie Penkrat, a sophomore plant science major, was hired as an hourly employee for the summer and has continued to remain on a part-time basis during the school year. This fall the laboratory also added Ms. Jessica Gere as a work-study student. 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 1995 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 Pradip Majumdar, and Marshal Bergen 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, Dr. Raul Cabrera for assistance with problems in nursery production, and Dr. Jennifer Johnson-Cicalese 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 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 1995, the RPDL-NDS examined 1068 specimens submitted for diagnosis or identification (Table 1A) and assayed 129 soil samples for nematodes (Table 2). Compared to 1994 levels, this represents a 30% increase in plant samples and a 41% decrease 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 - 1991 to 1995.

Month	1991	1992	1993	1994	1995
January		11	17	11	22
February		8	21	14	22
March		23	22	31	51
April		52	47	56	59
May		78	77	70	137
June	6[1]	95	70	146	161
July	107	117	244	172	147
August	104	80	110	135	246
September	59	103	92	75	106
October	45	56	43	55	61
November	25	38	34	28	49
December	25	15	15	29	7
Total:	371	676	792	822	1068

[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 1995 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. University of Maryland plant sample submissions by month - 1991 to 1995.

Month	1991	1992	1993	1994	1995
January	19	19	20	19	27
February	33	32	14	27	31
March	56	63	46	50	82
April	75	71	74	67	115
May	140	109	78	71	117
June	156	136	134	112	157
July	147	94	134	101	141
August	132	147	121	143	177
September	113	125	89	84	96
October	85	59	53	46	71
November	36	32	27	49	16
December	13	13	15	16	9
Total:	1005	900	805	785	1039

For the second year, the RPDL-NDS received more samples than the University of Maryland laboratory; however, a significant increase in submissions to the Maryland laboratory reduced the gap between the two laboratories. 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 continue to increase as we continue to advertise the laboratory and as more growers become aware of our services. It should be noted that a trend in declining sample submissions to the University of Maryland was reversed in 1995. This is a trend that the University of

Maryland laboratory has noted over a period of five years. This reversal may be in part due to the severe environmental conditions that most landscape plants have endured over the last several seasons.

The Nematode Detection Service began accepting soil samples on July 1, 1992. In 1995, the Nematode Detection Service processed 129 soil samples for nematode assays. The decline in nematode samples may be due in part to the success with nematode detection on golf courses. Many of the clients have identified trouble areas through widespread sampling of their golf greens and have subsequently begun to only sample these "hot spots." 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.

Table 2. RPDL-NDS nematode sample submissions by month - 1992 to 1995.

Month	1992	1993	1994	1995
January		0	0	6
February		5	0	0
March		0	14	1
April		22	41	24
May		1	3	6
June		16	9	14
July	26	18	55	18
August	2	24	25	19
September	40	18	11	11
October	42	8	14	10
November	3	10	40	13
December	0	45	7	7
Total:	113	167	219	129

Of the specimens submitted to the RPDL-NDS for diagnosis or identification in 1995, 67% were from commercial growers, 27% were from residential clientele, and 6% were submitted from research faculty at Rutgers University (Table 3). Of the samples submitted to the Nematode Detection Service, 100% were from commercial growers. 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.

Table 3. RPDL-NDS sample submissions by origin - 1995.

Sample Origin	Number of Plant Samples	Percent of Total	Number of Nematode Samples	Percent of Total
Commercial Growers	713	67%	129	100%
Residential	288	27%	0	0%
Research Programs (Rutgers University)	67	6%	0	0%
Total:	1068	100%	129	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 - 1995.

Crop	Number of Plant Samples	Percent of Total	Number of Nematode Samples	Percent of Total
Turf	406	38%	74	57%
Ornamentals	434	41%	0	0%
Other Crops	93	9%	55	43%
Identification	135	12%	0	0
Total:	1068	100%	129	100%

Since turfgrass and ornamentals represent the largest agricultural commodities in New Jersey, it follows that the vast majority of samples submitted for diagnosis (79%) 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. 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 1995.

	Number of Plant Samples				
In-State	**1991**	**1992**	**1993**	**1994**	**1995**
Atlantic	9	20	8	20	40
Bergen	34	70	59	60	62
Burlington	16	38	51	31	54
Camden	8	14	28	25	37
Cape May	7	8	16	10	9
Cumberland	0	9	6	14	7
Essex	3	14	20	30	22
Gloucester	7	38	22	26	61
Hudson	0	9	5	0	6
Hunterdon	11	14	19	37	31
Mercer	26	32	36	65	47
Middlesex	50	75	66	85	119
Monmouth	24	65	79	59	77
Morris	16	24	22	34	53
Ocean	18	41	22	17	56
Passaic	3	21	34	19	44
Salem	1	2	0	9	11
Somerset	27	37	52	51	52
Sussex	7	15	18	6	13
Union	11	16	45	20	56
Warren	14	14	24	33	29
Rutgers Research	10	46	51	74	67
In-State Total:	302	622	683	725	953
Out-of-State:	69	54	109	97	115
Total:	371	676	792	822	1068

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 1995.

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

Approximately 12% 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, 43% were associated with biotic disease-causing agents (Table 6). Injury to 10% of the samples was caused by insects and related arthropods, and 36% of samples were associated with abiotic injuries and stresses (e.g., environmental extremes, nutrient deficiencies, poor cultural practices, poor soil conditions, etc.). Another 11% included insect, plant, and substance identification. The increase in this category over the 1994 total is primarily due to the large increase in insect identifications. After the retirement of Dr. Louis Vasvary, Extension Entomologist, many insect specimens have been forwarded to the laboratory for identification. The overall breakdown in sample submissions is typical of that reported by other diagnostic laboratories in the United States.

Table 6. RPDL-NDS plant sample submissions by diagnosis - 1995.

Diagnosis	Number of Samples	Percent of Total
Disease (biotic)	457	43%
Insect	104	10%
Identification	117	11%
Other	390	36%
Total:	1068	100%

In 1995, the mean response time for samples diagnosed in less than 21 days was 2.2 days. This is an improvement of more than one day over the 1994 mean response time of 3.3 days. This improvement is attributed largely to the presence of Mr. Greg Balog and Ms. Sophie Penkrat, competent helpers 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 94% 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 - 1995.		
Response time	**Number of samples**	**Percent of total**
0 to 3 days	842	79%
4 to 6 days	162	15%
7 to 10 days	38	4%
11 to 21 days	21	2%
>21 days	5	0%
Total:	1068	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 1995, 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 1995 included the Professional Turfgrass and Landscape Management Short Course, the Greenhouse Crop Production Short Course, the Home Gardeners School, and Landscape Integrated Pest Management: A Less Toxic Approach. The income generated by these activities with the Office of Continuing Education was $8550.

Mr. Buckley also served as the course coordinator for the Pest Management in Landscape Turf Short Course. This was the second year for this one-day program. He also served as the coordinator for the Advanced Turf Management Symposium. A two-day program dedicated to current problems in fine turf. The income generated by these programs with the Office of Continuing Education was $10,000.

Mr. Buckley was an invited speaker in several Rutgers Cooperative Extension programs, including the North Jersey Ornamental Horticulture Conference, the Central Jersey Turf and Ornamentals Workshop, the Integrated Crop Management Workshop, the Union County Golf Course Pesticide Recertification Program, the New Jersey Landscaping IPM Symposium, and the

Mercer County Master Gardener Program. The Laboratory received compensation for these efforts of $400.

Mr. Buckley also earned income for the RPDL-NDS as an invited speaker for the Lawn Doctor National Conference, the Lebanon Turf Products Turf Care Seminar, Pro-Lawn's Golf Course Seminar, and the Certified Tree Experts Educational Program. The income from these talks was $700.

Other educational services provided by the staff of the RPDL-NDS, for which the laboratory received no compensation, included lectures in two graduate level plant pathology courses and a lecture at Turf Field Day. 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 1995, Mr. Buckley cooperated with Dr. Ann Gould as a co-author of the Rutgers Cooperative Extension Fact Sheet FS809, entitled *Pine Wilt Disease*. Mr. William Tietjen, Mr. Buckley, and Dr. Gould co-authored Rutgers Cooperative Extension Fact Sheet FS808: *An Integrated Approach to the Control of Canker Diseases in Woody Ornamentals. I. Cytospora Canker of Spruce.* Dr. Karen Plumley, Mr. Buckley, and Mr. William Hlubik cooperated on Rutgers Cooperative Extension Fact Sheet FS814: *Managing Diseases of Landscape Turf*. Mr. Hlubik and Mr. Buckley co-authored Rutgers Cooperative Extension Fact Sheet FS798: *An Integrated Approach to Red Thread and Pink Patch Disease Control in Landscape Turf.* 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 1995, the RPDL-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 published bi-weekly from March to September and monthly from September to December by Rutgers Cooperative Extension and the New Jersey Agricultural Experiment Station. The laboratory staff also contributed monthly Plant Diagnostic Laboratory predictions to The Landscape IPM Newsletter, which is distributed monthly by the Landscape IPM program and Rutgers Cooperative Extension of Ocean County.

- **Service.** Mr. Buckley serves as a member of the Rutgers Cooperative Extension Home Horticulture Working Group. 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.

In 1995, 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 1995 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 12,000 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. This display was also set up at the Bergen County Landscape Contractors Association trade show. 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 plant pathogenic Coelomycetes.

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 current fee schedule for in-state and out-of-state samples is listed in Table 8.

Over $38,050 was generated from diagnostic services and nematode assays during 1995, representing a 16% increase in income over 1994. 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.

Table 8. Fee schedule for diagnostic services and nematode assays - 1995.

Client	Fee per sample
In-state residential	$20.00
In-state commercial growers: Fine turf All others	 $50.00 $20.00
All out-of-state samples	$75.00

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 158 of these "no charge" samples in 1995 (Table 9). These samples accounted for 13% of the samples processed. The value of these no charge requests was $3160.

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

Client Category	Number of Samples
RCE County Faculty/Program Associates	63
RCE Specialists	32
Rutgers Research Programs (not RCE)	13
Rutgers Non-Research Faculty/Staff	12
Direct Mail/Walk-ins	34
Other Government Agencies/University	2
Payment Returned - Sample Inadequate for Diagnosis	0
Resubmissions for Further Diagnosis	2
Total:	158

Income generated from all laboratory activities covered 100% of the non-salary expenses incurred in 1995, plus 74% of salaries, or 90% of the laboratory's total expenditures (including salaries and one-time costs for equipment). Salaries and benefits for laboratory employees accounted for 86% of laboratory expenses. For more detailed budget information see Appendix I.

FUTURE DIRECTIONS

As in the past, a top priority for 1996 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 1996 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

Diseases caused by living organisms are greatly influenced by the environment. The 1995 growing season was affected by a year-long drought that began in the fall of 1994 and ended abruptly in October of 1995 with heavy rains. Drought stress is one of the most damaging environmental stresses that plants can endure. Last year's drought caused many plantings to fail across the state, and we can expect to see the lingering effects of this stress for several years to come. Diseases favored by drought stress were especially prevalent.

Ornamentals

The majority of ornamental plants submitted to the laboratory were affected by environmental (or abiotic) stresses. Planting problems and poor site conditions were a primary cause of many planting failures. In some cases, well established trees died suddenly in mid-summer. In others, leaf scorch, premature defoliation, branch dieback, early or late fall color, and/or an overall decline in plant vigor were evident. Symptoms of heat and drought stress were also more severe on plants that were poorly maintained.

Of the diseases that were caused by biotic (or living) agents, several leaf spots, anthracnose, needlecasts, and rusts were diagnosed. Diseases enhanced by drought stress, particularly cankers (caused by the fungi *Botryosphaeria* and *Cytospora*), oak leaf scorch, pine wilt, and Dutch elm disease, were also prevalent. 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 were also affected by the activity of bark beetles or borers. Injury due to cooley spruce gall adelgid was especially common on Douglas-fir, and elongate hemlock scale and hemlock woolly adelgid continued to decimate strands of hemlock.

The most common diseases of greenhouse plants included root rots caused by *Pythium* and *Rhizoctonia.* In addition, a variety of plants were submitted to the Laboratory that tested positive for impatiens necrotic spot virus or tomato spotted wilt virus. Nutrient and salt problems were also common.

Turf

Fine turf in New Jersey and the mid-Atlantic region was especially hard hit by the drought. In some cases, large areas of turf were killed, and diseases associated with stress conditions were prevalent. Although summer patch was diagnosed with the most frequency last year, reports of anthracnose basal crown rot continued to increase in the state. As usual, brown patch and diseases caused by *Pythium* were frequently encountered. *Microdochium nivale*, the cause of pink snow mold, remained very active into late-spring. The disease was easily spread by mowing equipment and caused large, irregular streaks of infected turf to appear.

A rather unusual disease of perennial ryegrass appeared last fall in epidemic proportions. Gray leaf spot, caused by the fungus *Pyricularia grisea*, was diagnosed on several golf courses with ryegrass fairways. The disease resulted in extensive turf loss in the mid-Atlantic region; up to 70% of some ryegrass fairways were reported killed by the disease in the Baltimore-Washington area. Gray leaf spot is a disease of stressed turf and may have been associated with last season's drought.

In landscape turf, red thread was the most commonly diagnosed disease. Red thread is most common on turf that is not properly maintained or is affected by drought or inadequate nitrogen fertilization. Dollar spot, leaf spot and melting out, summer patch, and necrotic ringspot were other diseases of note. High population of chinch bugs also caused problems for many residential clients.

Vegetables

Root knot nematode in carrot and lesion nematode in potato were primary pest problems in 1995. Phytophthora fruit rot was very prevalent in late-season squash and in pumpkin; whole blocks of pumpkin declined rapidly from the disease late in the season.

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

Table 10. RPDL-NDS expenditures in 1995.	
Salaries & Benefits:	$ 69,120.62
Supplies and Services: (includes) Diagnostic supplies Printing/advertising References/publications Equipment maintenance Office supplies Photographic services	7464.43
Communications: Telephone/FAX Postage	 1060.15 763.89
Travel: (includes) Travel to give paid talks Travel to professional meetings Travel for training	1769.69
Total Expenditures:	$ 80,178.78

Table 11. RPDL-NDS income in 1995.	
Sample fees:	$ 36,445.00
Unpaid sample fees:	1645.00
Donations:[1]	1300.00
Lecture fees: Office of Continuing Professional Education Other	 18,550.00 1100.00
Value of no-charge samples	<$ 3,160.00>
	$ 62,200.00
Actual Total Income:	$ 59,040.00

[1] Donations kindly received included $500 from Pine Valley Golf Course, $400 for an electrical conductivity meter from Mr. Ned Lipman, director of the Office of Continuing Professional Education, and $400 in books from Dr. Robin Brumfield.

Table 12. RPDL-NDS estimated expenditures for 1996.	
Salaries and benefits:	$ 61,400
Seasonal labor:	8,000
General operating:	7,500
One-time equipment cost:	3,000
Educational development and travel:	2,000
New facility renovation?	?
Total Estimated Expenditures:	$ 81,900

Table 13. RPDL-NDS estimated income for 1996[1].	
Estimated TURF Sample Income: 45% @ $50	$ 33,750
Estimated OUT-OF-STATE Sample Income: 15% @ $75	16,875
Estimated ALL OTHER Sample Income: 40% @ $20	12,000
Estimated LECTURE FEE Income:	15,000
TOTAL ESTIMATED INCOME 1996:	$ 77,625

[1] Based on projected 1500 samples submitted in 1996.

APPENDIX II. Plant Diagnostic Laboratory charges in neighboring states.

Table 14. 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 1995.

Date	Title of Presentation	Audience	Location	Number of handouts	Type of participants[1]
1-3/95	Diseases of Turfgrass (10 Lectures)	Professional Golf Turf Management School	Cook College	20	T
1-3/95	Diseases of Ornamentals	Professional Golf Turf Management School	Cook College	20	T
1/5/95	Effective Use of the Plant Diagnostic Laboratory	Pest Management in Landscape Turf Short Course	Cook College	2	T,L
1/6/95	Diseases of Ornamental Plants	Professional Turfgrass and Landscape Management Short Course	Cook College	1	A,L,T
1/9/95	Diseases of Turfgrass	Professional Turfgrass and Landscape Management Short Course	Cook College	1	A,L,T
1/10/95	Tree Disease Update	Lawn Doctor National Conference	Atlantic Co.	1	A,I,L,T
1/18/95	Diagnosing Common Plant Problems	Master Gardeners	Mercer Co.	1	H

[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]
1/24/95	Managing Diseases of Landscape Turf	Lebanon Turf Care Seminar	Middlesex Co.	3	I,L,T
1/25/95	Diagnosing Common Plant Problems	Landscape Integrated Pest Management: A Less Toxic Approach	Middlesex Co.	3	A,L,T
2/7/95	Diagnosing Turf Problems	North Jersey Ornamental Horticulture Conference	Morris Co.	3	A,L,T
2/8/95	Diagnosing Turf Problems	North Jersey Ornamental Horticulture Conference	Morris Co.	3	A,L,T
2/9/95	Should Fungicides be Used For Tree Diseases?	North Jersey Ornamental Horticulture Conference	Morris Co.	3	A,L,T
2/15/95	Turf Disease Update	Pro-Lawn Annual Turf Seminar	Langhorne, PA	3	I,T
2/21/95	Diagnosing Common Greenhouse Disorders	Greenhouse Crop Production Workshop	Cook College	3	G,N
2/24/95	Field Crop Disease Update	Field Crop ICM Workshop	Hunterton Co.	2	P
3/3/95	Field Crop Disease Update	Field Crop ICM Workshop	Mercer Co.	2	P
3/7/95	Tree Diseases: To Spray or Not to Spray?	Central Jersey Turf and Ornamental Institute	Monmouth Co.	2	A,L,T
3/8/95	Tree Diseases: To Spray or Not to Spray?	Central Jersey Turf and Ornamental Institute	Mercer Co.	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]
3/9/95	Tree Diseases: To Spray or Not to Spray?	Central Jersey Turf and Ornamental Institute	Somerset Co.	2	A,L,T
3/18/95	Diagnosing Common Plant Problems in the Landscape	Home Gardeners School	Cook College	3	H
3/18/95	What's Wrong With My Plant?	Home Gardeners School	Cook College	3	H
3/28/95	Turf Disease Update	Union County Golf Course Pesticide Recertification Program	Union Co.	2	T
3/28/95	Effective Use of the Plant Diagnostic Laboratory	Master Gardeners	Middlesex Co.	2	H
5/4/95	Common Tree Diseases and Their Management	Certified Tree Experts Educational Program	Monmouth Co.	3	A,L
6/1/95	Identification and Control of Common Turf Diseases	Rutgers Turf Field Day	Monmouth Co.	2	L,T
6/1/95	Effective use of the Plant Diagnostic Laboratory	Twilight Fruit Meeting and Strawberry Breeding Showcase	Monmouth Co.	2	P
7/18/95	Identification and Control of Common Diseases in Ornamental Plants	Plant Disease Clinic 16:770:536	Cook College	1	C

[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]
10/25/95	Introduction to Nematology	Introduction to Plant Pathology 16:770:501	Cook College	10	C
11/16/95	$ Spot, Red Thread, and the Cultural Control of Turf Diseases	New Jersey Landscaping IPM Symposium: Landscaping for the 90's	Ocean Co.	4	A,L,T
10-12/95	Diseases of Turfgrass (10 Lectures)	Professional Golf Turf Management School	Cook College	20	T
10-12/95	Diseases of Ornamentals (10 Lectures)	Professional Golf Turf Management School	Cook College	20	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.

FS808

RUTGERS COOPERATIVE EXTENSION

NEW JERSEY AGRICULTURAL EXPERIMENT STATION

Plant Disease Control

AN INTEGRATED APPROACH TO THE CONTROL OF CANKER DISEASES IN WOODY ORNAMENTALS

I. CYTOSPORA CANKER OF SPRUCE

William Tietjen
County Agricultural Agent

Richard J. Buckley, Coordinator
Rutgers Plant Diagnostic Laboratory

Ann B. Gould, Ph. D.
Specialist in Ornamental Plants

Cytospora canker, caused by the fungus *Leucocytospora kunzei* (syn. *Cytospora kunzei*), is the most destructive disease of Colorado blue and Norway spruce in New Jersey. This disease commonly occurs on spruce in both landscape and Christmas tree settings and affects a variety of other conifers as well (Table 1).

Table 1. Conifers commonly affected by **Cytospora canker.**

Spruce	Other conifers
black Colorado blue Engelmann Norway Oriental red white	Balsam fir Douglas-fir eastern hemlock eastern white pine Himalayan white pine larch red pine Western red cedar

Cytospora canker rarely affects young, vigorously growing trees. The disease is much more likely to occur on trees at least 10 to 15 years old or on trees weakened by environmental stress. Colorado blue spruce grown east of its natural Rocky Mountain range is more commonly affected. Although infection by *L. kunzei* is rarely fatal, the fungus produces cankers that kill branches and seriously disfigure trees.

SYMPTOMS

L. kunzei is an opportunistic pathogen that infects trees at the base of twigs or branches through wounds or breaks in the bark. Once inside, the fungus grows throughout the inner bark, resulting in the formation of a diamond-shaped lesion of dead tissue called a canker. As a canker enlarges, the affected branch slowly becomes girdled, and tissue beyond the canker is killed. Needles on dying branches turn brown, persist on the branch throughout the growing season, and drop during the winter.

Cytospora canker first appears on branches closest to the ground, but the disease eventually spreads to all but the uppermost limbs. Only in the most severe cases are branches at the top affected. The cankers that result from infection, although difficult to see at first, produce copious quantities of resin. The resin drips to lower branches, eventually hardens, and turns crusty and white.

DISEASE DEVELOPMENT

L. kunzei produces two types of fruiting bodies on the edges of cankers and in dead bark distal to the canker. These fruiting bodies, called pycnidia and ascostroma, resemble tiny, black spheres smaller than the head of a pin and are easily visible with a hand lens after the bark is carefully cut away. Throughout the spring, summer, and fall, yellow masses of spores, called conidia, ooze in curled tendrils from pycnidia during wet weather. Ascospores, which are the result of sexual reproduction, are released in abundance from ascostroma during wet weather in the spring and early summer.

Both conidia and ascospores are easily dispersed from branch to branch by running and splashing water or by wind-blown rain, insects, pruning tools, or clothing. Spores introduced to wounds or tiny breaks in branch tissue germinate and initiate new infections. The optimum temperature for the infection process is 80°F. Since conditions in spring and early summer can be ideal for spore release and germination, **Cytospora canker** is most likely to appear early in the growing season.

MANAGEMENT

An integrated approach for the control of **Cytospora canker** should begin with the selection of disease-free planting material. Be sure to choose healthy, disease-free material from a reputable dealer, and inspect trees before planting. Since healthy, vigorously growing trees are less susceptible to disease, proper tree maintenance reduces the severity of **Cytospora canker.** In spruce, there is no known genetic resistance to this disease.

When planting trees, select sites that are suitable for good plant growth. Since **Cytospora canker** is more severe in trees stressed by excessive drought, choose moist, well-drained soils for planting. Be sure to adequately space plants. In older, established plantings, maintain or improve plant vigor through proper irrigation, pruning, and fertilization. Decrease humidity around the base of trees with good weed control and by pruning competing limbs and branches on surrounding trees whenever possible.

Since *L. kunzei* is an opportunistic fungus that infects stressed and injured plant material, protect trees by carefully avoiding wounds on susceptible trees. Lawn mowers, pets, and traffic should also be kept away from plantings, and snow should not be allowed to accumulate on the lower branches. For best results, closely monitor and control other potential disease problems, insects, and mites.

Through careful monitoring and early detection, **Cytospora canker** can be eradicated before the aesthetic value of a tree is reduced. Branches with symptoms of **Cytospora canker** should be promptly pruned during dry weather at least 6 to 8 inches below affected tissue. If possible, remove the branch from the tree by properly cutting the limb flush to the branch collar, not flush to the trunk. To prevent the spread of this disease on pruning tools, surface-sterilize tools between cuts with denatured alcohol. Since *L. kunzei* is known to persist and sporulate in dead plant material for extended periods, do not leave diseased debris near healthy trees. Fungicides are ineffective against this disease and are, therefore, not recommended.

750-0895

RUTGERS COOPERATIVE EXTENSION
N.J. AGRICULTURAL EXPERIMENT STATION
RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY
NEW BRUNSWICK

Distributed in cooperation with U.S. Department of Agriculture in furtherance of the Acts of Congress of May 8 and June 30, 1914. Cooperative Extension work in agriculture, home economics, and 4-H. Zane R. Helsel, director of Extension. Rutgers Cooperative Extension provides information and educational services to all people without regard to sex, race, color, national origin, disability or handicap, or age. Rutgers Cooperative Extension is an Equal Opportunity Employer.

RUTGERS COOPERATIVE EXTENSION

NEW JERSEY AGRICULTURAL EXPERIMENT STATION

Plant Disease Control

PINE WILT DISEASE

Richard J. Buckley, Coordinator
Rutgers Plant Diagnostic Laboratory

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

INTRODUCTION

Since the early 1900s, the pine wood nematode, which causes pine wilt disease, has been responsible for the widespread loss of pines in Japan. This nematode, *Bursaphelenchus xylophilus*, was first reported in the United States in Missouri in 1979. It is now found in nearly all the states east of the Rocky Mountains and in California and southern Canada. The wide distribution of *B. xylophilus* in North America suggests that this nematode is a native species that had been previously overlooked as a pathogen.

HOST RANGE

The pine wood nematode has a wide host range that includes more than 28 species of pine. Highly susceptible species include Austrian, cluster, Japanese black, Japanese red, loblolly, mugo, Scots, and Virginia pines. The nematode has also been found in eastern-white, jack, longleaf, pitch, shortleaf, slash, and table-mountain pine. Although pine wilt disease has been reported in hosts such as atlas and deodar cedar, balsam fir, blue and white spruce, European larch, and hemlock, its occurrence is rare.

SYMPTOMS

Trees affected by the pine wood nematode appear wilted soon after infection. The needles rapidly turn yellow, then brown, and may remain attached to the tree. Death of highly susceptible trees may occur by the end of the growing season. Branches cut from infected trees appear "dry" with visibly reduced resin flow.

CAUSAL AGENT

B. xylophilus is eel-shaped, very small (0.8 mm long), and difficult to see without magnification. This nematode can utilize both fungi and living plant material as a food source. Within the tree, *B. xylophilus* feeds upon on the epithelial cells that line the resin canals in woody tissue. Each adult female nematode can lay about 80 eggs that develop into reproductive adults after four molts. These adults may disperse rapidly throughout the tree. Upon the fourth molt, the nematode may also develop into dauerlarvae, which are resistant to drying and are important in nematode dispersal.

VECTOR

The pine wood nematode is carried from tree to tree by long-horned beetles in the family Cerambycidae. Known cerambycid vectors of this nematode include *Monochamus titillator*, *M. scutellatus*, *M. carolinensis*, and *M. obtusus*. Other wood boring insects, however, may also be potential carriers of pine wilt disease.

THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

DISEASE CYCLE

The disease cycle begins in the spring when adult beetles emerge from dead wood carrying thousands of dauerlarvae within their tracheae and on their bodies. The beetles feed on the tender tissue of healthy pines, creating wounds through which the nematode larvae enter the tree. Beetles can transmit nematodes the entire growing season.

Once in the tree, the nematodes molt and migrate to the resin canals, where they feed upon and destroy the epithelial cells that line the canals. Throughout the growing season, the nematode reproduces and spreads quickly throughout the tree. The subsequent reduction in transpiration and water flow causes the tree to rapidly wilt and die. Heat and drought stress contribute to disease progression and to high levels of tree mortality.

Toward the end of the growing season, adult long-horned beetles are attracted to freshly cut, weakened, or dying pines for mating and egg laying. These trees are also attractive to bark beetles in the family Scolytidae. Scolytid beetles carry secondary fungal invaders called the "blue stain fungi" (*Ceratocystis* spp). Pine wood nematodes can utilize these fungi as a food source.

Beetle eggs are laid singly under the bark and hatch in a few days. The beetle larvae form feeding galleries in the woody tissue. Nematode juveniles collect in these galleries and molt into dauerlarvae. After the insect overwinters, pupates, and becomes an adult, the dauerlarvae invade the newly emerging beetles and are carried to a new host, thus completing the disease cycle.

B. xylophilus may also be present on woody tissue that has been killed by environmental factors, other diseases, or insects. Under these circumstances, the nematode can build to high populations and become an inoculum source for healthy trees.

DIAGNOSIS

Trees with pine wilt disease rapidly wilt and die, frequently within a single growing season. Needles on affected pines will turn brown and may hang on the tree. Other diagnostic characteristics of this disease include the presence of beetle exit holes, lack of resin production in fresh cuts, and the presence of a blue stain in the wood.

Positive confirmation of pine wilt disease, which consists of the extraction of nematodes from woody plant material, must be performed by a plant diagnostic laboratory or nematode detection service. To submit a sample to the Rutgers Nematode Detection Service, consult Rutgers Cooperative Extension publication FS757, "Proper Sampling of Soil and Plant Tissue for Detection of Plant Parasitic Nematodes," for further information.

MANAGEMENT AND CONTROL

Since pine wilt disease is more prevalent in trees suffering from abiotic stresses, the maintenance of plant vigor through proper pruning, irrigation, and fertility is of primary importance. Healthy trees are also less susceptible to invasion by beetles. Routine, prompt removal of dead and dying plant material will reduce populations of both the nematode and its beetle vector.

Trees affected by pine wilt must be removed and burned (if permissible) or buried. Protection of trees from beetle vectors with insecticides may also afford some control. For current management recommendations, contact your local County Extension Office.

750-0895

RUTGERS COOPERATIVE EXTENSION
N.J. AGRICULTURAL EXPERIMENT STATION
RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY
NEW BRUNSWICK

Distributed in cooperation with U.S. Department of Agriculture in furtherance of the Acts of Congress of May 8 and June 30, 1914. Cooperative Extension work in agriculture, home economics, and 4-H, Zane R. Helsel, director of Extension. Rutgers Cooperative Extension provides information and educational services to all people without regard to sex, race, color, national origin, disability or handicap, or age. Rutgers Cooperative Extension is an Equal Opportunity Employer.

FS798

RUTGERS COOPERATIVE EXTENSION

NEW JERSEY AGRICULTURAL EXPERIMENT STATION

Plant Disease Control

An Integrated Approach to Red Thread and Pink Patch Disease Control in Landscape Turf

William T. Hlubik, Middlesex County Agricultural Agent
Richard Buckley, Coordinator, Plant Diagnostic Laboratory

Red Thread Syndrome refers to two separate turf diseases (red thread disease and pink patch disease) which may display similar symptoms and may or may not be present simultaneously on infected turf. Red thread is more common and often more severe than pink patch on susceptible varieties.

Hosts

Although all turfgrass is susceptible to red thread disease, perennial ryegrass is the most susceptible turfgrass species. Fine fescues vary in susceptibility to red thread with creeping red fescue being the most susceptible and hard fescues having greater resistance to this disease. Red thread can also be found on other grasses, however, the disease is usually less severe. Pink patch disease affects the same hosts as red thread but is much less common and normally less severe than red thread.

Causal Agents

Red thread is caused by the fungus *Laetisaria fuciformis* (McAlpine) Burdsall and pink patch is caused by the fungus *Limonomyces roseipellis* Stalpers & Loerakker.

Diagnosing Red Thread Syndrome

Where to Look

Slow growing turf that is under stress is more susceptible to red thread. Red thread and pink patch may appear first in areas with nitrogen deficiencies.

When to Look

Red thread is often one of the first diseases observed in the spring. The disease normally occurs during the cooler temperatures in the spring or fall, however, it has been observed throughout the year. Pink patch normally occurs under warmer temperatures of later spring or summer but can be observed at other times as well. The best time to observe symptoms of either disease is in the early morning when dew is present or any time the air is saturated with moisture.

What to Look For: Symptoms and Signs

Small to large (2 inches to 2 feet), circular to irregular shaped, water-soaked patches appear and die rapidly. Patches may eventually coalesce into one or more larger patches. Pink patch is normally slower to develop and patches remain smaller than red thread. Infected patches may appear pink to reddish in color.

✓ Leaf blights—First observable symptoms are tan colored blades of grass. The tan blades are mixed with live green blades which creates a diffuse, scorched or ragged appearance. Blades die from the tip back.

✓ Only red thread disease has pink to pale red sclerotia or fungal thread-like growths that resemble antlers and can extend 1/4-inch or more beyond the tip of the grass blades. The reddish antler-like threads are more easily observed in the early morning dew or any time moisture is present.

✓ Pink patch infected grass blades eventually become covered with a pink to reddish gelatinous growth of fungal mycelium that initially forms along leaf margins.

Disease Cycle

The red antler-like threads of the red thread fungus are produced at the tips of infected grass blades and are called sclerotia. The sclerotia of the fungus can survive through unfavorable environmental conditions on infected leaves or in the thatch. The sclerotia (red threads) can withstand a wide temperature range and may remain viable for up to two years. The sclerotia can be spread by wind, water, equipment, animals, or people and resume growth once environmental conditions become favorable. Cool, (60 to 75 deg. F) wet, and extended periods of overcast weather in the spring and fall provide ideal conditions for disease development. However, red thread can survive and cause damage at temperatures from 33 to 90 deg. F. The red thread fungus penetrates leaf blades and may kill infected leaves within 2 days from initial infection. The potential for disease development and spread increases when the grass is growing slowly due to factors such as low temperatures, drought, inadequate fertility, plant growth regulators, or other diseases.

Cultural Management and Disease Control

A sound integrated disease-management program optimizes plant vigor. Fungicides alone may help to minimize short-term disease damage but provide a poor substitute for good cultural management. Proper cultural management can help to maintain plant vigor in order to minimize the extent of red thread damage to turfgrass. A healthy turfgrass can recover more rapidly from periodic red thread disease outbreaks.

Fertilizer and pH

The first step to prevent red thread and pink patch is to perform a soil test on the area in question in order to determine pH and nutrient levels. The key is to maintain adequate and balanced soil fertility levels in order to optimize plant health. The application of moderate amounts of nitrogen (1/2 to 1 lb. of actual nitrogen per 1,000 square feet) can often help to alleviate severe disease symptoms by increasing plant growth rates faster than the rate of disease spread. The addition of potassium with nitrogen applications has been shown to be more effective than nitrogen alone. However, excessive applications of nitrogen must be avoided in order to prevent other diseases. Avoid nitrogen applications when the grass is dormant. Maintain soil pH between 6.2 and 6.5. Deficiencies in soil potassium, phosphorus, calcium, and especially nitrogen have been correlated with severe red thread disease.

Irrigation

Prolonged periods of leaf moisture enhance the development of red thread disease. In order to deter disease development, irrigate deeply in the early morning hours and as infrequently as possible but often enough to prevent drought stress. Water requirements may vary depending on grass types, soil and environmental conditions but as a general rule, turfgrass may require 1 to 1-1/2 inches or more of water per week during the growing season on medium-textured, well-drained soils.

Mowing

Keep mower blades sharp and avoid mowing wet grass. Maintain Kentucky Bluegrass and Perennial Ryegrass at 2.5 to 3 inches in height and fescues at 3 to 3.5 inches. Raise mowing heights in the summer, during periods of heat stress or when disease symptoms are observed. Avoid close mowing on sensitive turf species, especially during the hot summer months. Pink patch causes greater damage to unmowed versus regularly mowed grass.

Thatch and Compaction

The red threads or sclerotia can survive in the thatch layer so thatch control can play an important role in disease prevention. Dethatch turf when the thatch layer exceeds 1/2- to 3/4-inch thickness. Soil compaction can reduce optimal turf growth and may contribute to disease development. Soil aeration can help to alleviate compaction problems. Dethatching and aeration procedures are best done in late summer or early fall.

Resistant Grass Varieties

The use of grass varieties resistant or less susceptible to red thread disease becomes increasingly important in areas with severe disease pressures. In general, perennial ryegrass and fine fescues are more susceptible to red thread than are other grass types. Grass varieties within each species may vary considerably in disease resistance under certain environmental conditions.

Perennial ryegrasses that have demonstrated significant resistance to red thread include: Affinity, Assure Dandy, Legacy, Manhattan II, Prelude II, Prism, Seville, and SR-4200.

Within the fine fescues, hard fescues tend to have greater red thread resistance than creeping red fescues. Fine fescues that have demonstrated resistance to red thread include the hard fescues: Discovery, SR 3100, Warwick, Nordic, Spartan, Reliant, SR 3000, and Ecostar.

Chemical Control

Refer to the latest fungicide recommendations available from your local county extension office. The combination of balanced fertility with systemic fungicide application has proven extremely effective in controlling red thread disease. If fungicides are used for disease control, apply them in the spring when the daytime temperatures average 60 to 75 degrees F. Always follow label recommendations.

Desktop publishing by the Cook College/NJAES Office of Communications and Public Affairs

750-9506

RUTGERS COOPERATIVE EXTENSION
N.J. AGRICULTURAL EXPERIMENT STATION
RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY
NEW BRUNSWICK

FS814

RUTGERS COOPERATIVE EXTENSION

NEW JERSEY AGRICULTURAL EXPERIMENT STATION

Plant Disease Control

MANAGING DISEASES OF LANDSCAPE TURF

Karen A. Plumley
Graduate Assistant
Plant Pathology

Richard J. Buckley, Coordinator
Rutgers Plant Diagnostic Laboratory

William T. Hlubik
Middlesex County
Agricultural Agent

Management of disease in landscape turf begins with a program of sound cultural practices. Turfgrass maintained in a healthy, vigorous condition is less susceptible to disease than stressed turf. In many cases, simple manipulations in management practices will greatly influence turf vigor and reduce the impact of a particular disease in a turf stand. The following are some guidelines to help maintain disease-free landscape turf.

SEED SELECTION

When establishing a turf stand, choose species that are well-adapted to the site and management objectives. Disease- and insect-resistant cultivars of most turf species are available and should be used as the basis for an integrated pest management program. Promote genetic diversity when seeding by blending and mixing high-quality, certified seed purchased from a reputable source.

FERTILITY

A balanced fertility program, based on the results of soil tests, will improve the vigor of plants and their ability to resist disease. Nitrogen fertilizers can have a significant effect on disease potential. Excessive applications of highly soluble nitrogen fertilizers can stimulate many diseases. Excessive applications promote succulent tissue that is easily penetrated by many fungi. Conversely, turfgrasses grown in nutrient-poor soils are susceptible to several other diseases. Applications of recommended amounts of nitrogen to N-deficient turf will stimulate the turfgrass to produce leaves faster than the fungus can blight them.

MOWING

Regular mowing is necessary to maintain the aesthetic qualities of a turf stand. However, mowing may favor disease by creating wounds through which a pathogen may enter and, in some cases, by providing the pathogen with a means of dissemination. Frequent mowing at improper heights consistently removes the most photosynthetically active tissue. This reduces carbohydrate production and limits the natural ability of turfgrasses to resist infection. Remove no more than 1/3 of the

(cont. on back page)

THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

COMMON DISEASES OF LANDSCAPE TURF

DISEASE	SYMPTOMS/SIGNS	HOST	SEASON	BEST MANAGEMENT
RED THREAD	Small, water-soaked patches. Antlerlike sclerotia on leaf tips.	bluegrass ryegrass fescues	early-spring to late-fall	Avoid low nitrogen, excess thatch, and drought stress.
LEAF SPOT and MELTING OUT	Oval, purple leaf spots. General thinning and yellowing.	bluegrass ryegrass fescues	early-spring to late-fall	Avoid high nitrogen, leaf wetness, and low mowing. Use resistant cultivars.
POWDERY MILDEW	White powdery spore masses on leaf blades.	bluegrass fescues	spring to fall	Avoid high nitrogen and low mowing. Use shade-tolerant cultivars.
NECROTIC RING SPOT	Rings of dead turf with green, healthy turf (or weeds) in the center. Root and crown rot.	bluegrass fine fescues	spring and fall	Avoid high nitrogen and drought stress. Overseed with ryegrass or tall fescue.
DOLLAR SPOT	Patches 2 to 3 inches in diameter. Hour-glass leaf lesions with bleached centers and orange borders.	bluegrass ryegrass fescues	late-spring to fall	Avoid low nitrogen, low mowing, thatch, leaf wetness and drought stress.
SLIME MOLDS	White, gray, brown, red, or yellow slimelike blobs of spores on leaf blades.	bluegrass ryegrass fescues	late-spring to fall	Remove spore masses by washing or raking. Control thatch.

DISEASE	SYMPTOMS/SIGNS	HOST	SEASON	BEST MANAGEMENT
BROWN PATCH	1 to 3 foot patches of thinning turf. Tan leaf lesion with dark border.	bluegrass ryegrass tall fescue	summer	Avoid high nitrogen, leaf wetness, and excess thatch.
SUMMER PATCH	Rings of dead turf with green, healthy turf (or weeds) in the center. Root rot.	bluegrass fine fescue	summer	Avoid high nitrogen, wet soil, compaction, and low mowing. Use resistant cultivars.
PYTHIUM BLIGHT	Rapid, greasy collapse of leaves. Cottony mycelium.	bluegrass ryegrass fescues	summer	Avoid high nitrogen and leaf wetness. Reduce thatch. Improve drainage.
FAIRY RINGS	Dark green rings 1 to 20 feet in diameter. Rings of mushrooms. Rings of dead turf.	bluegrass ryegrass fescues	spring, summer, and fall	Reduce thatch and avoid drought stress. Fertilize and rake mushrooms to mask.
RUST	Orange spore masses on leaf blades. General thinning and yellowing of turf.	bluegrass ryegrass fescues	fall and spring	Avoid low nitrogen and leaf wetness. Use resistant cultivars.
STRIPE SMUT	Black masses of spores on shredded leaves. General thinning.	bluegrass	fall and spring	Avoid high nitrogen. Use resistant cultivars.
PINK SNOW MOLD	1 to 5 inch patches of bronze turf. Gray to pink mycelial mass.	bluegrass ryegrass fescues	late-fall, winter, and spring	Avoid high nitrogen and thatch. Remove leaves and mow late into fall.

leaf tissue at each mowing. Keep mower blades sharp in order to encourage rapid healing of the cut grass. Mow turf when dry, especially when diseases are present. Mow at the recommended heights and raise the mowing height when the turf is under stress or displaying disease symptoms. Leaving clippings on the turf will prevent their introduction into the solid waste stream, will reduce yearly nitrogen needs, and will not contribute to thatch accumulation or disease development.

IRRIGATION

Free moisture is essential for disease progression. Turfgrasses grown under wet conditions develop succulent tissues that are easily penetrated by fungi. Water-logged soils inhibit gas exchange and result in dysfunctional roots. Drought stressed turf lacks vigor and is prone to disease. Deep, infrequent irrigation, only to avoid drought stress, will maintain the turf in good vigor and reduce the impact of many diseases. Water early in the morning to allow the leaves to dry before nightfall. Selective pruning of trees and shrubs around a turf area will promote light penetration and air circulation, which will also reduce humidity in the turf canopy.

AERIFICATION

Excessive thatch accumulation restricts root growth and favors drought stress. Many turfgrass pathogens survive as saprophytes in the thatch layer. Soil compaction also restricts water movement and air penetration into the root zone, eventually reducing root function and causing a decline in plant vigor and disease resistance. Limit foot and vehicular traffic on wet soils to prevent excessive compaction. Regular aerification in the fall or spring will reduce thatch accumulation and relieve compacted soils.

A healthy turfgrass can recover more rapidly from periodic disease outbreaks. Fungicides alone may help to minimize short-term disease damage but are not a substitute for proper cultural management. For further information, contact your local County Rutgers Cooperative Extension office.

750-0995

RUTGERS COOPERATIVE EXTENSION
N.J. AGRICULTURAL EXPERIMENT STATION
RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY
NEW BRUNSWICK

Distributed in cooperation with U.S. Department of Agriculture in furtherance of the Acts of Congress of May 8 and June 30, 1914. Cooperative Extension work in agriculture, home economics, and 4-H. Zane R. Helsel, director of Extension. Rutgers Cooperative Extension provides information and educational services to all people without regard to sex, race, color, national origin, disability or handicap, or age. Rutgers Cooperative Extension is an Equal Opportunity Employer.

RUTGERS COOPERATIVE EXTENSION
N.J. AGRICULTURAL EXPERIMENT STATION
RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY
NEW BRUNSWICK

Distributed in cooperation with U.S. Department of Agriculture in furtherance of the Acts of Congress of May 8 and June 30, 1914. Cooperative Extension work in agriculture, home economics, and 4-H. Zane R. Helsel, director of Extension. Rutgers Cooperative Extension provides information and educational services to all people without regard to sex, race, color, national origin, disability or handicap, or age. Rutgers Cooperative Extension is an Equal Opportunity Employer.