RUTGERS UNIVERSITY
Plant Diagnostic Laboratory
New Jersey Agricultural Experiment Station

Plant Diagnostic Laboratory

2024 Fiscal Year Report

(July 1, 2023 to June 30, 2024)

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2024 Fiscal Year
Rutgers Plant Diagnostic Laboratory
Annual Report

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Introduction

Rutgers Soil Testing and Plant Diagnostic Services are provided by Rutgers Cooperative Extension (RCE), the outreach component of the New Jersey Agricultural Experiment Station (NJAES) and the School of Environmental and Biological Sciences (SEBS). Located on the Cook Campus, these laboratories provide New Jersey citizens with chemical and mechanical analyses of soil and diagnoses of plant problems. Their mission is to provide such services in an accurate and timely manner to meet the increasing agricultural and environmental needs of the State. These goals are achieved in cooperation with extension and research faculty and staff at NJAES. This report summarizes the activities of the Plant Diagnostic Laboratory during the 2024 fiscal year.

History

The Rutgers Plant Diagnostic Laboratory and Nematode Detection Service (PDL) was established in 1991 by the dedicated efforts of RCE faculty members Dr. Ann B. Gould and Dr. Bruce B. Clarke, Specialists in Plant Pathology, Dr. Zane Helsel, former Director of Rutgers Cooperative Extension, and Dr. Karen Giroux, past Assistant Director of NJAES. The laboratory was housed in the former USDA post-harvest research laboratory and then Martin Hall on the Cook College campus until 2000 when it was relocated to the Ralph Geiger Turfgrass Education Center at Horticultural Research Farm II in North Brunswick, NJ. The Geiger Center was made possible through the vision and financial backing of Mr. Ralph Geiger and a large group of University and turf industry cooperators.

The PDL accepted its first samples on June 26, 1991, and has since examined 63,138 samples submitted for plant problem diagnosis, nematode analysis, or identification. The laboratory has become an integral part of RCE and SEBS/NJAES programs by providing diagnostic and educational services in support of the teaching, research, and outreach efforts of SEBS/NJAES.

Staff and Cooperators

PDL

Mr. Richard Buckley is the director of the Plant Diagnostic Laboratory. He was hired as a program associate in 1991 and has been in his current position since 1994. 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. He also received special training in nematode detection and identification from Clemson University. Mr. Buckley has work experience in diagnostics, soil testing, and field research, and is currently responsible for sample diagnosis, soil analysis for nematodes, and the day-to-day operation of the PDL. He also participates in research, teaching, and outreach activities.

Ms. Sabrina Tirpak, Laboratory Researcher II, has worked for the PDL since 1998. She received her B.S. in Plant Science, with an emphasis in horticulture and turf industries as well as a minor in entomology, from Rutgers University in May 2000. She also attended Clemson University for special training in nematode detection and identification. Ms. Tirpak has primary responsibility for insect and weed identification, rapid screening of disease samples using enzyme-based test kits, and assisting in all other aspects of laboratory operations. She also participates in research, teaching, and outreach activities.

Other Support

The PDL regularly employs Rutgers undergraduate students to assist in sample preparation, data entry, and clean-up. As the students help with many of the basic day-to-day tasks, they also gain invaluable laboratory experience that will contribute to career success after graduation.

The laboratories also benefit from the assistance of faculty in several departments, Centers, and Institutes at Rutgers University/SEBS. We owe a great deal of our success to the expertise of faculty in the departments of Plant Biology, Entomology, Ecology, Evolution and Natural Resources, and Agricultural and Resource Management Agents. We would also like to thank the staff of the Rutgers Office of Continuing Professional Education for their support and assistance with our educational programming.

Laboratory Policies

The PDL receives samples from a varied clientele. Sample submission forms, sampling instructions, and fee schedules are available on the NJAES website (www.njaes.rutgers.edu/services). Samples are submitted via United States Postal Service or by private delivery services directly to the laboratory. Many clients walk samples directly into the laboratory.

Samples are processed on a “first come, first served” basis. Detailed records are kept on all samples. A written response including the sample diagnosis, management and control recommendations, and other pertinent information is sent by email to the client.

Fiscal Year 2024 Report

Operations

During the 2024 fiscal year (July 1, 2023 to June 30, 2024), the PDL examined 1,653 specimens submitted for diagnosis, identification (insects, weeds, or fungi), or nematode assay (Table 1), representing a 3% increase (or 51 samples) from FY23. Samples (Figure 2) submitted for diagnosis (+135) and identification (+32) both increased in FY24. There was a decrease in nematode assays (-116) mostly because the Rutgers Fruit IPM program did not conduct its annual nematode survey for blueberry growers during FY24. In general, sample submissions remained steady for most of the year, peaking in the summer and declining during the winter. It is our view that 1,500 to 2,000 samples represent peak laboratory capacity, so at 1,653 sample submissions, the PDL was operating at the capacity of the laboratory to function efficiently.

Figure 1.

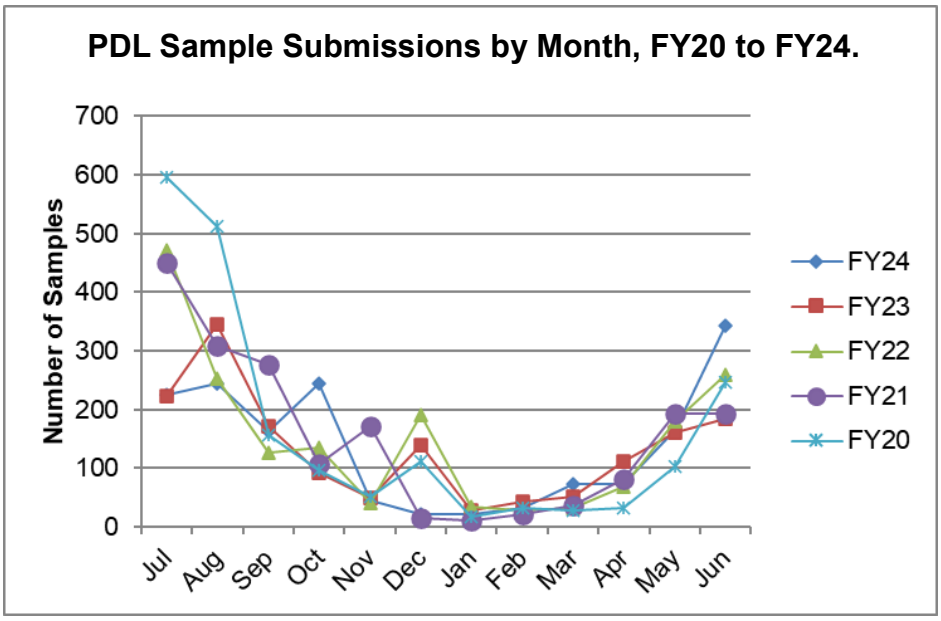
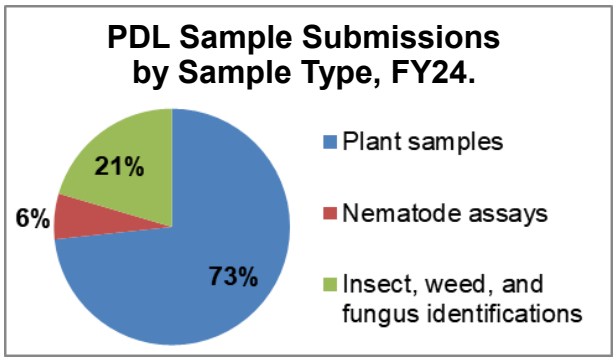


Table 1. PDL sample submissions by month, FY20 to FY24.

Month	FY20	FY21	FY22	FY23	FY24
July	596	451	471	223	226
August	513	308	254	345	244
September	156	276	126	172	164
October	96	107	136	93	245
November	52	171	41	50	54
December	112	16	190	140	21
January	18	11	34	27	22
February	32	22	29	44	32
March	27	36	33	52	72
April	33	82	68	112	73
May	103	193	180	160	166
June	246	192	260	184	343
Total	1984	1865	1822	1602	1653

Figure 2.



The specimens submitted to the PDL by sample type are presented in Figure 2. Most samples, 73% (1,212), were plant samples submitted for diagnosis, 20% (338) of the samples were insect, mold, or plant identifications and 6% (103) of the samples were for nematode analysis.

In Figure 3, samples submitted to the laboratory are presented by origin. In FY24, 88% of the plant submissions were from commercial clientele, 10% were from residential clientele, and 2% were submitted from research faculty at Rutgers University. Commercial plant managers benefit more financially from our services thus they submit the majority of samples to the laboratory. This distribution is consistent with other years.

In FY24, 90% of samples submitted for plant or insect identification were from commercial clients, 10% were residential in origin, and 0% (0 samples) were from research (Figure 3). Household or nuisance pests are the primary issues of concern for residential clients.

Of the nematode assays submitted, 99% of the samples were from commercial clients, with 1% (1 sample) from research, and 0% (0 samples) from residential clientele. We expect that the number of nematode samples submitted from residential clients will remain low or nonexistent, since much of this clientele is not familiar with nematode pests.

Samples from research programs represent a relatively small percentage of the total number of plant and soil samples received. However, research samples are an extremely important component of our submissions. Research samples allow the diagnosticians to cooperate with University faculty on problems of great importance to the State of New Jersey.

Turfgrass and ornamentals represent the largest agricultural commodities in New Jersey. In support of New Jersey as an urban agriculture state, it follows that the vast majority of samples (85%) were either turfgrass or ornamental plants (Figure 4). The wide variety of turf and ornamental species grown under diverse environmental conditions in our state results in a large number of problems not readily identifiable by growers or county faculty with these crops. Furthermore, extension faculty and staff who deal primarily with turfgrass and ornamental plants as commodities, as well as plant managers in the turf and ornamentals industries, readily adopted the user fee-based delivery of service. Alternatively, commercial growers of traditional agricultural crops have been slow to adopt a fee-for-service system. Certain RCE faculty and staff members in New Jersey's southern counties continue to provide free diagnostic services and do not advertise laboratory services to these growers. Inroads are being made with these commodity groups through the Vegetable and Fruit IPM groups, and it is our hope that sample submissions from traditional agricultural crops will increase in future years.

Traditionally, most of the soil samples submitted to the laboratory for nematode analysis were from golf turf managers. The Rutgers Fruit IPM program did not submit any nematode samples from blueberry growers in FY24. Golf turf represents most of the nematode samples from turfgrass

Figure 3.

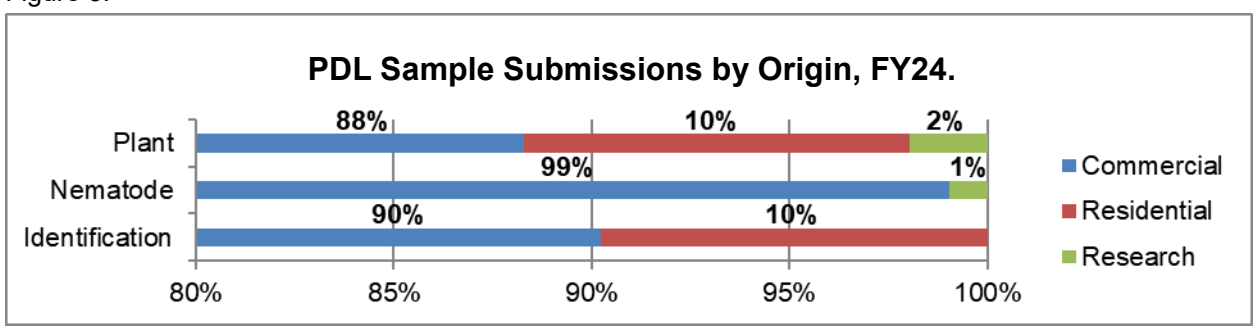


Figure 4.

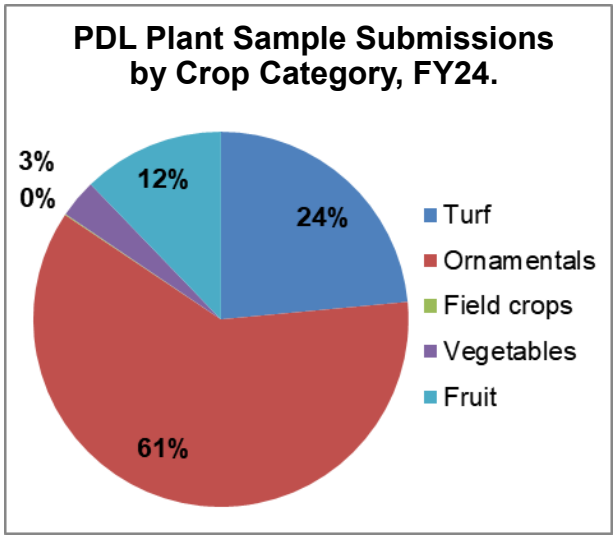
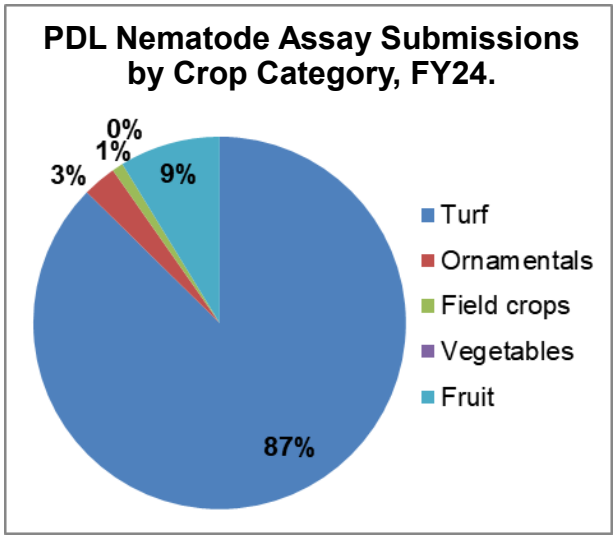


Figure 5.

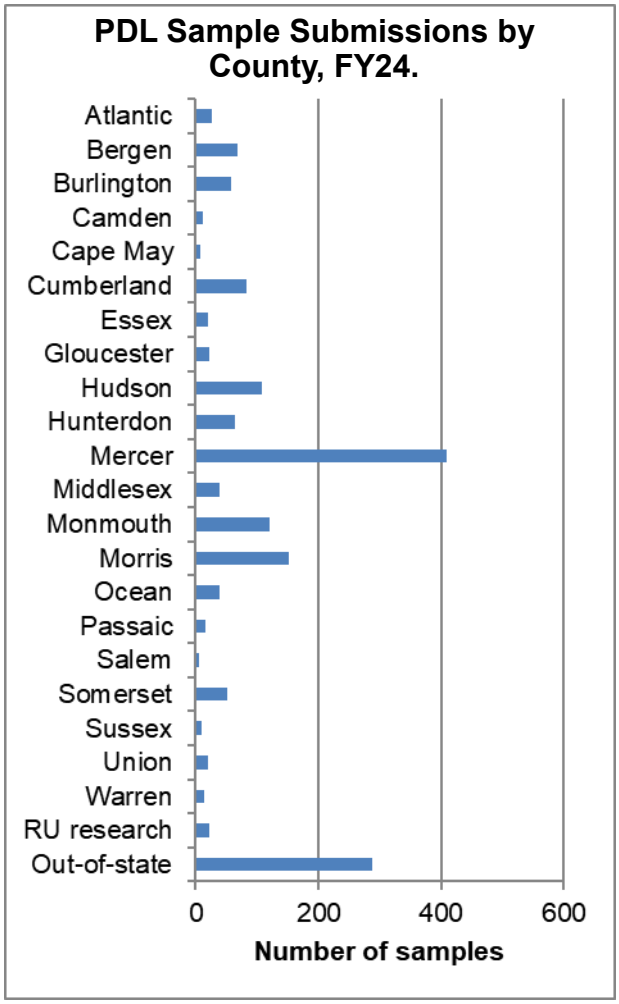


clientele. Problems in golf turf, particularly with nematodes, are more severe during seasons with considerable heat and drought stress, and it is those years that carry the highest submission totals.

Samples were submitted to the PDL from all counties in New Jersey (Figure 6). The majority of samples, however, were submitted from counties in close proximity to the laboratory. The probable explanation for this is that many citizens in central New Jersey contact Rutgers University directly for assistance with plant-related problems and are referred to the laboratory by the campus information service and through various academic departments. Samples were also abundant from counties with dense populations that have disease problems associated with turf and ornamentals in residential landscapes or on golf courses. In addition, county profiles are also influenced by the presence or absence of staff in those offices. To some degree, the profile also identifies county faculty, staff and Master Gardener programs that promote and utilize PDL services.

Approximately 17% of the samples submitted for diagnosis to the laboratory were from out-of-state. The percent of out-of-state samples (+13) remained the same from the previous FY23. Of particular note, 48% of all turf samples were from out-of-state. Turf samples were submitted to the laboratory from 19 states in FY24. Turf samples were received from states as far away as Arizona, California, Connecticut, Delaware, Idaho, Indiana, Massachusetts, Maryland, Maine, New Hampshire, New York, Ohia, Pennsylvania, Texas, Vermont,

Figure 6.



Virginia, Washington, and Wyoming. New York and Pennsylvania provided the largest number of out-of-state samples.

Many golf turf professionals at other universities refer their clients to Rutgers for second opinions or when they are on leave. Dr. John Inguagiato at the University of Connecticut and Dr. Paul Vincelli at the University of Kentucky, both Rutgers graduates, refer clients to the PDL. Dr. Frank Rossi of Cornell University is also a great supporter of our program. He advocates and advertises laboratory services in his ShortCutt newsletter, which reaches more than 2,700 turf managers in New York State. Lastly, Mr. Buckley's and Ms. Tirpak's association with the Professional Golf Turf Management School allows for contact with as many as 90 potential new clients each year. Many of the students turn into regular patrons of the laboratory services. The charge for out-of-state samples is substantially higher to help defray the cost of in-state samples.

Of the samples submitted to the PDL for diagnosis or identification, 47% were associated with biotic disease-causing agents (Figure 7). Abiotic disease-causing factors (e.g., environmental extremes, nutrient deficiencies, poor cultural practices, poor soil conditions, etc.) accounted for another 21% of the laboratory diagnoses. Insect pest damage was diagnosed on 5% of the submissions. Identifications comprised 20% of the total number of samples submitted; of these, 19% (314) were arthropods, <1% (8) fungi, and 1% (16) were plants. Nematode detection accounted for the other 6% of submissions. The overall breakdown in sample submissions is typical of that reported by other diagnostic laboratories and reflects the normal seasonal totals for submissions to the Rutgers laboratory.

Insect samples account for most of the organisms identified by the laboratory. Many residential clients submit samples of stored product or nuisance pests that are found within the household.

Table 2. PDL sample submissions by county, FY20 to FY24.

In-state	FY20	FY21	FY22	FY23	FY24
Atlantic	61	24	23	143	26
Bergen	67	70	90	80	69
Burlington	75	77	61	58	58
Camden	11	10	4	14	12
Cape May	7	5	12	4	8
Cumberland	33	54	54	102	83
Essex	24	16	34	32	20
Gloucester	12	22	10	5	22
Hudson	32	33	83	31	107
Hunterdon	22	20	45	35	64
Mercer	585	449	330	301	410
Middlesex	51	42	73	37	38
Monmouth	164	200	218	120	121
Morris	234	216	210	155	152
Ocean	39	33	28	30	39
Passaic	20	24	13	10	15
Salem	32	2	11	1	6
Somerset	91	56	64	72	51
Sussex	14	8	6	16	9
Union	25	27	32	22	20
Warren	17	8	9	8	13
RU research	60	91	52	52	23
In-state total	1676	1487	1462	1328	1366
Out-of-state	308	378	360	274	287
Total	1984	1865	1822	1602	1653

Figure 7.

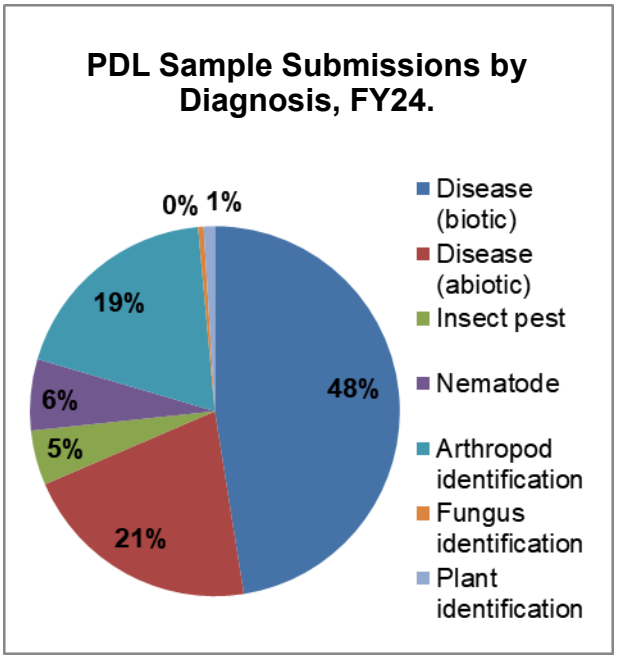
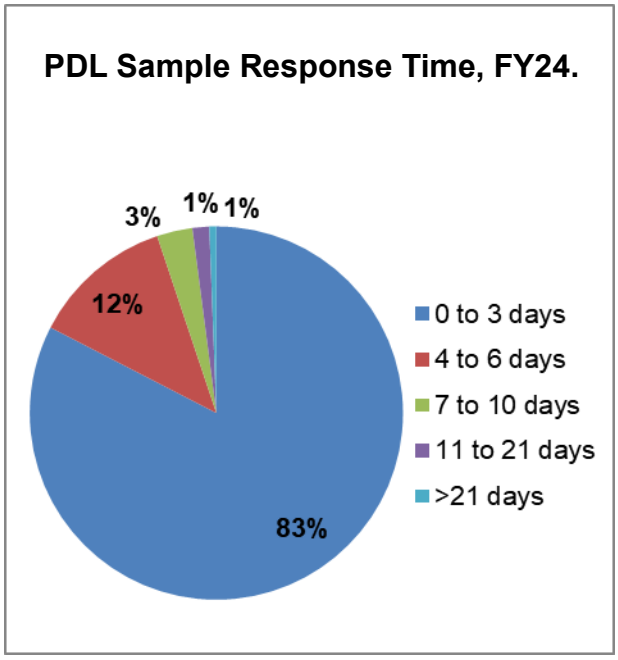


Figure 8.



The number of these samples has declined as the Department of Entomology has added an urban entomologist who offers the service free-of-charge. Arthropod identifications increased (+50) in FY24 largely because the number of trap catch samples from the state's CAPS and NJ State Forestry Services programs increased (+33).

Fungal identification is also a popular service for the laboratory. Samples from mold-infested houses remained steady in FY24 The submissions of samples for mold identification rise with media attention to the perceived health issues associated with mold-infested homes and the incidence of local flooding.

In FY24, a laboratory response was prepared in less than three days for most (83%) of the samples submitted (Figure 8), and 95% of our clients received a response in less than a week. A number of the samples (34) took longer than 10 days to diagnose. In these cases, special consultation (i.e. culturing or other lab tests) 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 of the nematode processing was finished in less than three days. The rapid response time is attributed largely to the expertise of our competent staff. Adequately trained staff is essential to the continued growth and efficient operation of the laboratory.

Teaching and Outreach

In addition to providing diagnostic services and soil analysis, the staff of the PDL provides significant educational and outreach services to RCE, SEBS/NJAES, and other agencies (Appendix 3). Many of these activities generated additional income for the laboratories. Collectively, Mr. Buckley and Ms. Tirpak presented 176 lectures in FY24 (Table 3).

Table 3. PDL Lectures by Audience, FY24.

Audience	Buckley	Tirpak	Total
RCE & OCPE	83	29	112
Industry	35	6	41
Master Gardener	8	12	20
College/University	1	2	3
Total	127	49	176

Richard Buckley

Mr. Buckley is an instructor in the Rutgers Professional Golf Turf Management Program. He taught four courses (Diseases of Turf; Diseases and Insect Pests of Ornamental Plants; Insect Pests in Fine Turf; and Principles of Pest Management on the Golf Course) in both the spring and fall sessions. This twice a year, 10-week teaching commitment consists of a total of 140 hours of con-

tact time per year. The teaching efforts by the PDL staff in the Professional Golf Turf Management School generate significant income for the laboratory. This income and client development source also helps support the PDL.

Mr. Buckley participated in several other OCPE short courses in FY24 including The Rutgers Professional Golf Turf Management Program: Three Week Preparatory Course. Mr. Buckley served as the course coordinator and lecturer for the Pest Management in Landscape Turf Short Course. This was the 30th year for this one-day program.

Mr. Buckley was an invited speaker in several RCE programs including the North Jersey Ornamental Horticulture Conference –Landscape Day. Lectures were given in support of the Hunterdon, Monmouth, and Morris Counties. He also participated in the Certified Gardener Training Program in Camden and Gloucester Counties.

Mr. Buckley participated as a guest speaker in one undergraduate course at Rutgers: Weeds, Diseases, and Insects of Plants (11:776:391).

Mr. Buckley was also an invited speaker for: New York State Turf and Landscape Association: Outdoor Conference and Trade Expo; NJ Shade Tree Federation: Annual Conference; West Virginia Golf Course Superintendents: Annual Turf Conference; Harrell's Wachusett Seminar; Delaware Ornamentals and Turf Workshop; Morris Arboretum School of Arboriculture; NYSTA/LIGCSAA Turf Education Day 2023; Golf Course Superintendents Association of New York: Annual Meeting and Education Event; New Jersey Green Expo—Turf and Landscape Conference; International Society of Arboriculture of PA/DE/NJ Pest Bull Session; Golf Course Superintendents Association of America: Western Washington Chapter; Metropolitan Golf Course Superintendents Association: Winter Educational Seminar and Trade Show; New York State Turf and Landscape Association: Professional Turf and Landscape Conference; New Jersey Christmas Tree Growers Association; Penn State Turf and Ornamentals School; New York State Arborists: Annual Conference and Expo; Fisher and Son: Annual Lawn, Landscape, and Sports Field Seminar; Reed and Perrine Turf and Ornamental Seminar; SiteOne University, New England Regional Turfgrass Conference and Show; New York State Turf Association: Webinar Archive, Licensed Tree Expert Prep Course; and the White Plains Urban Forestry Program.

Sabrina Tirpak

Ms. Sabrina Tirpak is responsible for teaching Turf Diseases and Turf Insects laboratory practicums in the Rutgers Professional Golf Turf Management School. She has approximately 60 hours of contact time per year in the turf school.

Ms. Tirpak participated in additional OCPE short courses in FY24. These courses included the Landscape Integrated Pest Management Short Course, and the Pest Management in Landscape Turf Short Course.

Ms. Tirpak also presented programs in support of the RCE of Hunterdon, Mercer, Monmouth, Morris, and Ocean County Master Gardener Programs.

Ms. Tirpak participated as a guest speaker in one undergraduate landscape course at the County College of Morris. She also lectured in the Weeds, Diseases and Insects of Plants (11:776:391) undergraduate course at Rutgers.

Ms. Tirpak was also an invited speaker for: New Jersey Green Expo—Turf and Landscape Conference; Borough of Riverdale Shade Tree Class; SynaTek Winter Seminar; New Jersey Chapter of the International Society of Arboriculture—Garden State Tree Conference; Licensed Tree Expert Prep Course.

Extension Publications

Mr. Buckley is a contributor to the Plant & Pest Advisory. The print version of the newsletter was transformed for the 2013 growing season into a blog format. A special section on the blog site was designated for Plant Diagnostic Laboratory activities. Mr. Buckley and Ms. Tirpak write brief posts on the disease and insect pests problems submitted to the laboratory. The Plant Diagnostic Laboratory's PPA blog posts can be found at plant-pest-advisory.rutgers.edu/category/plant-diagnostic-lab.

In collaborations with other Rutgers research and extension faculty and staff, Mr. Buckley contributed to a Cooperative Extension Bulletin about beech leaf disease (Appendix 4):

Epiphan J, Buckley R, Waller T, Dvorin R. *Beech Leaf Disease & Experimental Management Options* [Bulletin]. https://njaes.rutgers.edu/E376/

An abbreviated version of this bulletin was also published as an article in a green industry newsletter:

Epiphan J, Buckley R, Waller T, Dvorin R. (2024, June 16) Beech Leaf Disease Update 2024. *New Jersey Turfgrass Association Clippings*, Vol. 115 (*Issue 2 2024*), pages 20-22, https://issuu.com/cecepeabody/docs/clippings_2024_no2_d

Service

The PDL staff provided tours of the Ralph Geiger Turfgrass Education Center and the Plant Diagnostic Laboratory to numerous groups in FY24.

Mr. Buckley is a member of the Nursery Working Group initiated by Dr. Timothy Waller, County Agent from RCE of Cumberland County.

Mr. Buckley and Ms. Tirpak are members of the Cooperative Agricultural Pest Survey (CAPS) team. The CAPS program is a pest surveillance program managed by USDA-APHIS and state departments of agriculture. They are also members of the Forest, Landscape, and Agriculture Pest Roundtable (FLAPR) organized by the Rutgers Urban Forestry Program of NJAES. Universities, natural resource protection organizations, and industry groups are also partners of both groups.

Marketing

Laboratory services are advertised at grower meetings or other green industry events. Table-top and banner display units are used to advertise Soil Testing Laboratory and Plant Diagnostic Laboratory services. Staff from both the Soil Testing Laboratory and Plant Diagnostic Laboratory regularly attends and staffs a booth to explain laboratory services and sell soil test kits.

Print ads reflecting Plant Diagnostic and Soil Testing Laboratory services have been developed and deployed into several green industry publications. Lastly, PDL staff are frequent lecturers in regional green industry educational programs. These events have been an excellent option for capturing new clients and educating potential clients in laboratory services and submission protocols.

Income

The PDL is expected to recover all costs and be self-supporting. Laboratory clientele are charged a nominal fee for diagnostic and testing services, site visits, and for educational activities. Grant activity and cost-sharing arrangements also provide some degree of funding.

A sample submission form and the appropriate payment accompanied the majority of samples received by the PDL from residential clientele. The ability to accept payment via credit card has been a very successful tool in limiting the time necessary to collect our fees and has reduced losses due to non-payment. In many cases, commercial growers preferred to be invoiced, which costs laboratory personnel time and effort to collect. Internal transfer of funds was used to pay for the plant samples diagnosed for research programs at Rutgers University.

In FY24, $293,838.91 was generated from all PDL activities and revenue streams, which covered 84% of all costs. A complete breakout of all revenues and expenses is included in Appendix 2.

National Plant Diagnostic Network

In 2003, the PDL was invited to participate in the National Plant Diagnostic Network (NPDN). The NPDN is a coordinated network of plant diagnostic laboratories from land grant universities in the US. The network provides a cohesive distribution system to quickly detect pests and pathogens that have been deliberately or unintentionally introduced into agricultural and natural ecosystems. It is designed to be a key part of our homeland security effort to protect agriculture in the nation. Advantages of joining the system include rapid evaluation and reporting of potential bioterrorist threats and other high consequence diseases or pest problems; rapid response time for diagnosis; formal coordination of diagnostic labs within the NPDN; improved links with Federal and State regulatory agencies; and improved quality and uniformity of information associated with sample submission and reporting. The USDA provides grant monies as incentive to participate. Mr. Buckley is the principal investigator in the Rutgers subcontract.

Northeast Plant Diagnostic Network

The Northeast Plant Diagnostic Network (NEPDN) is the regional part of the National Plant Diagnostic Network that focuses on regional concerns regarding plant diseases and insect pests. The regional center for the NEPDN is Cornell University. The Rutgers PDL has been identified as a cooperating institution and participates as a subcontractor to the regional center at the University of Maine. Grant monies provided by the USDA through the NEPDN were used in FY24 to pay salaries, participate in professional training programs and meetings, and to purchase equipment and supplies to upgrade the laboratory's capability for accurate and timely diagnosis of plant problems. Upgrades to laboratory technologies improve communication with our local stakeholders, cooperators, and experts in the northeast regional and national networks. The capacity for improved communication facilitates the rapid dissemination of information concerning current plant disease and insect pest activity. The new equipment and upgrades in technology also provide the means to create modern educational resources for use in local and re-

gional training programs. Grant monies received for FY24 will be used to continue to upgrade laboratory capability to handle pathogens of consequence and other biohazards; attend training programs for insect and disease identification; hire labor to enter data into the National Plant Disease Information System.

Northeast IPM Program

The Rutgers Plant Diagnostic Laboratory's partnership with the NPDN has well equipped the laboratory to execute its mission. Trained staff, however, is necessary to ensure that we continue to play our part as a partner in the efforts of local and regional IPM programs, USDA-APHIS-PPQ, and CAPS to protect the agricultural interests in the region. Proper staffing is also critical in providing diagnostic services for the agricultural interests within the state and to maintain the strong historical relationships with Rutgers IPM and New Jersey Department of Agriculture programs. Grant monies received to that end will be used to cover a portion of the costs of one technical employee who is trained to perform basic diagnostic tasks including fungal culturing, insect identifications, ELISA, PCR, and other common tasks associated with insect pest and disease diagnostics. The technician will also train in SOPs for pests and diseases of concern in our region and will participate in ongoing training programs for Rutgers graduate and undergraduate students who are interested in IPM, diagnostics, and plant biosecurity.

Client Survey

Beginning in January of 2021 a client satisfaction survey was included with each emailed sample report. Survey data and comments are currently being collected to assist laboratory staff in evaluating the impact of our work. Survey responses collected during FY24 (53 responses) are included in Appendix 4 of this report.

Future Directions and Challenges

The top priority for FY25 will be to increase revenue and reduce expenses. To accomplish this, we will continue to promote laboratory services wherever possible. Increasing the awareness of laboratory services should bring increasing numbers of samples, however, our expectations are tempered in this regard due to the nature of the operation. Many factors outside of our control (ex. weather) strongly contribute to the need for laboratory services from season to season.

Despite continuing efforts to promote laboratory services, samples numbers from the turfgrass industry have plateaued or fallen in recent years. For many seasons, the Rutgers PDL was one of the only outlets for turf industry professionals to get quality turfgrass disease diagnosis. In the last decade, however, University laboratories in several states have adopted turfgrass diagnostics, chemical manufacturers and distributors have hired Ph. D. turfgrass pathologists to their sales staffs, and many private turf consultants have entered the market. These developments, as well as several other factors, have significantly diluted the number of turf samples coming into our laboratory from around the country. Any reduction in turf samples has an outsized impact on revenues. In order to combat this trend, we continue to engage with turf industry professional associations in education and awareness programs in the hopes of capturing new clients or re-engaging with old ones.

In the spring of 2019, PDL staff convened a focus group of laboratory stakeholders to discuss the laboratory fee schedule. The group consisted of golf course superintendents, lawn and landscape professionals, academic advisors, and chemical industry representatives. The group agreed that prices were too low. Our fee schedule was adjusted accordingly and the new fees were implemented immediately to zero complaints. This was the first fee increase since 2006. We expect to reconvene the group in the winter of 2024/2025 to discuss price increases for the 2025 growing season.

In 2022, the NPDN established a Core standard to require all NPDN member laboratories to commit to excellence in plant diagnostics by achieving core accreditation. The purpose of the NPDN Core standard is to provide an overarching framework that helps laboratories to maintain a high level of professionalism and quality of diagnostic results. The Rutgers PDL intends to achieve the Core standard and has been attending regular monthly meetings with other NEPDN diagnosticians to that end. We expect that this process will take several years.

In recent years, there has been an exponential increase in the number of plant pathogen diagnostic protocols using nucleic acid tools. These advances in science have led a rapid transition to molecular diagnostics at many Land Grant University diagnostic facilities. The Rutgers PDL recognizes the need to incorporate these tools into our routine laboratory practices. To that end, the NJAES administration has provided funding to purchase new equipment that will help us begin the transition to more modern diagnostic tools. An isothermal fluorometer that performs amplification and detection of nucleic acid was purchased in FY24 and is in use for detection of certain pathogens.

Funding has always been the fundamental challenge to the success of the Plant Diagnostic Laboratory. Salaries are the main cost driver for the operation. The need to increase revenues each year to meet increasing salaries is unsustainable. If the New Jersey Agricultural Experiment Station and Rutgers Cooperative Extension deem that a plant diagnostic facility is indispensable to our mission, then the salaries of all full-time employees must be paid and guaranteed by the administration. We are one of the only diagnostic facilities in the country that must cover our own salary expenses to operate. Our cost structure and funding model is foreign to most of our colleagues. As a result, many of our colleagues diagnose samples for free or at modest fees compared to our laboratory for the services they offer. This makes competing for samples in their states impossible and is a financial incentive for New Jersey green industry professionals to send samples to out-of-state facilities, which limits our ability to increase revenues.

Because our ability to control salary costs is so limited, we have had to forgo student employees in the laboratory post-pandemic to counter the salary creep of our full-time employees. Furthermore, over the years, more and more administrative tasks have been passed down to the laboratory from the business office. As a result, a considerable amount of time is spent by Mr. Buckley and Ms. Tirpak doing routine laboratory chores rather than pursuing diagnostics, educational outreach activities, and professional development. Funding our salaries will allow us to re-staff the laboratory with student and administrative help and to upgrade our capabilities as diagnosticians.

Diversity, Equity, and Inclusion

The Rutgers PDL has a long history of hiring underrepresented minority students as laboratory technicians. The experience gained in our laboratory has enabled many of them to gain University credits toward their degrees and has led to graduate school positions. Several of our black, Asian, and female technicians now have excellent, successful jobs in the green industry. Administrative support via salary support will enable us to continue this tradition of training and promoting underrepresented populations into the historically white, male dominated green industry professions.

Appendix 1.

PLANT DIAGNOSTIC LABORATORY - FEE SCHEDULE

All fees are per sample. Please visit **www.njaes.rutgers.edu/services** for sampling instructions.

STANDARD SAMPLE (most samples except fine turf)

In-state	$50
Out-of-state	$100

FINE AND SPORTS TURF

In-state	
Disease/insect diagnosis	$100
Disease/insect diagnosis & nematode assay*	$150
Out-of-state	
Disease/insect diagnosis	$120
Disease/insect diagnosis & nematode assay*	$200

*** Combination price applies only to samples from same location (i.e. the same green, field, etc.)**

NEMATODE ASSAY

In-state (except fine turf)	$50
In-state fine turf	$75
Out-of-state	$100

FUNGUS AND MOLD IDENTIFICATION

In-state microscopic identification	$50
Out-of-state microscopic identification	$100

INSECT IDENTIFICATION

In-state	$50
Out-of-state	$100

PLANT AND WEED IDENTIFICATION

In-state	$50
Out-of-state	$100

SPECIAL TESTS AND SERVICES*

Endophyte screening

Fungicide resistance testing

Pesticide residue and contaminant testing

Site consultation

Speaker request

Virus testing

***Please call ahead to discuss available tests, fees, and specifics.**

OTHER SERVICES NEGOTIABLE. CONTRACTS AND VOLUME DISCOUNTS ARE AVAILABLE.
ALL FEES ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Appendix 2. Plant Diagnostic Laboratory Budget

Table A2.1. Expenses, PDL-FY24.

Salaries and benefits	
(full and part time staff)	$320,445.00
Supplies and services	
Diagnostic and testing supplies	
Printing and marketing	
References	
Equipment maintenance	
Office supplies	
Credit card fees	$26,395.82
Communications	
Telephone/fax	
Postage	$1,954.10
Travel	
Paid talks and professional meetings	$2,249.19
Total operating costs	$351,044.11

Table A2.2. Income, PDL-FY24.

Sample fees	$83,420.00
Lecture fees	
OCPE and other honoraria	$26,000.00
Grants and contracts	
NPDN	$25,000.00
IPM	$34,088.84
Other	
Salaries (NJAES/RCE)	$124,784.44
Total actual income	$293,838.91

Table A2.3. Estimated expenses, PDL-FY25.

Salary and benefit costs	$385,000.00
Supplies and services	$15,000.00
Communications, marketing and travel	$5,000.00
Total potential cost FY25	$405,000.00

Table A2.4. Estimated income, PDL-FY25.

Plant Health Samples	
2000 @ $55 average fee per sample	$110,000.00
Lecture fees	
OCPE and other honoraria	$25,000.00
Cost recovery	
Grant and contracts	$60,000.00
Salaries (NJAES/RCE)	$227,000.00
Total potential income FY25	$422,000.00

Appendix 3.
Table A3.1. Complete listing of lectures presented by Richard J. Buckley, PDL Director, FY24.

Date	Title	Audience	Location	Par-ticipants[1]
07/19/23	The Trouble with Arborvitae (1.5hr)	Master Gardener Training Program	Monmouth County	H
08/15/23	2023 Landscape Problems Year in Review (1hr)	New York State Turf and Landscape Association: Outdoor Conference & Trade Expo	Hartsdale, NY	A,I,L,T
10/09/23	#1. Principles of Pest Management: Introduction to Integrated Pest Management (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/09/23	#1. Turf Diseases. Turf Diseases: Principles of Plant Pathology (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/10/23	#1. Diseases and Insect Pests of Ornamentals: Abiotic Stress in Trees (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/10/23	#1: Insects in Fine Turf: Introduction to Entomology; Insect Structure and Function (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/16/23	#2. Principles of Pest Management: IPM Basics: Considerations for Setting up a Program (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/16/23	#2. Turf Diseases: Introduction to Mycology and Fungal Structures (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/17/23	#2. Diseases and Insect Pests of Ornamentals: Scouting Tips for Landscapes; Pesticide Review (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/17/23	#2. Insects in Fine Turf: Insect Classification; Orders (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/23/23	#3. Principles of Pest Management: Principles of Insect Pest and Disease Control (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/23/23	#3. Turf Diseases: The Red Thread Syndrome; Snow Molds (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/24/23	#3. Diseases and Insect Pests of Ornamentals: New Plant Pathogens: Bacteria, Phytoplasma, Virus, Parasitic Plants (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/24/23	#3. Insects in Fine Turf: Insect Growth and Development; Insect Behavior (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/26/23	2023 Dead Tree Review: The View from the Diagnostic Lab (1hr)	NJ Shade Tree Federation: Annual Conference	Camden, County	A
10/30/23	#4. Principles of Pest Management: Cultural Control (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/30/23	#4. Turf Diseases: Diseases Caused by Algae and Other Related Organisms; Slime Molds (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/31/23	#4. Diseases and Insect Pests of Ornamentals: Leaf Spots, Anthracnose, and Stem Diseases (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T

Appendix 3. (Continued)
Table A3.1. (Continued)

Date	Title	Audience	Location	Par-ticipants[1]
10/31/23	#4. Insects in Fine Turf: IPM Basics: A Review of Scouting Techniques and Insecticides (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/02/23	#5. Insects in Fine Turf: Nematodes (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/06/23	#5. Principles of Pest Management: Fungicide Selection and Use (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/06/23	#5. Turf Diseases: Diseases Caused by Species of the Fungus Rhizoctonia; Fairy Ring (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/07/23	Current Concepts in Snow Mold Control (1hr)	West Virginia Golf Course Superintendents: Annual Turf Conference	Roanoke, WV	I,T
11/07/23	Leaf Spot Diseases in Turf (1hr)	West Virginia Golf Course Superintendents: Annual Turf Conference	Roanoke, WV	I,T
11/09/23	#5. Diseases and Insect Pests of Ornamentals: Root Rots and Vascular Wilt Diseases (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/13/23	#6. Principles of Pest Management: Fungicide Selection and Use (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/13/23	#6. Turf Diseases: Root-infecting Patch Diseases (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/14/23	2023 Dead Golf Turf Year in Review: The Diagnostician's Point of View (1hr)	Harrell's Wachusett Seminar	Worcester, MA	I,T
11/15/23	#6. Diseases and Insect Pests of Ornamentals: Rusts, Mildews, and Molds; Mites(2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/15/23	#6. Insects in Fine Turf: Coleoptera--Scarabs: The White Grub Complex (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/16/23	New and Emerging Diseases and Insects in the Urban Forest (1hr)	Delaware Ornamentals and Turf Workshop	Hockessin, DE	A,I,L,T
11/16/23	Diagnostic Tips for the Problem Lawn (1hr)	Delaware Ornamentals and Turf Workshop	Hockessin, DE	A,I,L,T
11/20/23	#7. Principles of Pest Management: Insecticide Selection and Use (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/20/23	#7. Turf Diseases: Anthracnose; “Helminthosporium” Leaf Spots (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/21/23	#7. Diseases and Insect Pests of Ornamentals: Suckers: Scale, Bugs, Hoppers, and Plant Lice (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/21/23	#7. Insects in Fine Turf: Coleoptera--Weevils: Annual Bluegrass Weevil; Billbugs (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/27/23	#8. Principles of Pest Management: The Least Toxic Alternative (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/27/23	#8. Turf Diseases: Dollar Spot; Gray Leaf Spot (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T

Appendix 3. (Continued)
Table A3.1. (Continued)

Date	Title	Audience	Location	Par-ticipants[1]
11/28/23	#8. Diseases and Insect Pests of Ornamentals: Borers: Round-headed and Flat-headed Borers; Gall Makers and Miners (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/28/23	#8. Insects in Fine Turf: Lepidoptera: Armyworms, Cutworms, and Sod Webworms (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/29/23	Insect Pests in the Urban Forest (6hr)	Morris Arboretum School of Arboriculture	Philadelphia, PA	A,L
11/30/23	32 Years of the Plant Diagnostic Lab at Rutgers: Trends in Turf Disease Diagnosis (1hr)	NYSTA /LIGCSAA Turf Education Day 2023	Hauppauge, NY	T
12/04/23	#9. Principles of Pest Management: Commercial Biocontrol and Biocontrol Concepts (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
12/04/23	#9. Turf Diseases: Rust, Smut, Mildews and Other Minor Leaf Blighting Diseases (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
12/05/23	32 Years of the Plant Diagnostic Lab at Rutgers: Trends in Turf Disease Diagnosis (1hr)	Golf Course Superintendents Association of New York: Annual Meeting and Education Event	Syracuse, NY	T
12/06/23	Rust Never Sleeps: The Gymnosporangium Rusts (0.5hr)	New Jersey Green Expo—Turf and Landscape Conference	Atlantic City, NJ	I,L,T
12/06/23	Rust Never Sleeps: The Puccinia Rusts (0.5hr)	New Jersey Green Expo—Turf and Landscape Conference	Atlantic City, NJ	I,L,T
12/06/23	2023 Dead Tree Review: The View from the Diagnostic Lab (1hr)	New Jersey Green Expo—Turf and Landscape Conference	Atlantic City, NJ	I,L,T
12/07/23	New and Emerging Diseases and Insects in the Urban Forest (0.5hr)	New Jersey Green Expo—Turf and Landscape Conference	Atlantic City, NJ	I,L,T
12/07/23	Leaf Spot Diseases in Turf (1hr)	New Jersey Green Expo—Turf and Landscape Conference	Atlantic City, NJ	I,L,T
12/07/23	Pythium Diseases in the Landscape (1hr)	New Jersey Green Expo—Turf and Landscape Conference	Atlantic City, NJ	I,L,T
12/08/23	#9. Diseases and Insect Pests of Ornamentals: Borers: Weevils, Bark Beetles, and Clear-winged Moths (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
12/08/23	#9. Insects in Fine Turf: Hemiptera: Chinch Bugs; Ground Pearls (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
12/11/23	#10. Principles of Pest Management: Scouting Your Golf Course (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
12/11/23	#10. Turf Diseases: Abiotic Stress in Turfgrass (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
12/12/23	#10. Insects in Fine Turf: Regional Concerns: Mole Crickets and Crane Flies (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T

Appendix 3. (Continued)
Table A3.1. (Continued)

Date	Title	Audience	Location	Par-ticipants[1]
12/12/23	#10. Diseases and Insect Pests of Ornamentals: Leaf Feeders: Lepids, Sawfly, and Weevils (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
12/14/23	Pest Bull Session: Tree Diseases Update (2hr)	International Society of Arboriculture of PA/DE/NJ	Bryn Mawr, PA	A
12/18/23	Basic Plant Pathology and the Art of the Diagnosis (3hr)	Master Gardener Training Program	Morris County	H
12/23/23	Summer Patch and Friends (1hr)	Western Washington Golf Course Superintendents Association	online	T
01/08/24	#1. Diseases and Insect Pests of Ornamentals: Abiotic Stress in Trees (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/08/24	#1: Insects in Fine Turf: Introduction to Entomology; Insect Structure and Function (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/09/24	#1. Principles of Pest Management: Introduction to Integrated Pest Management (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/09/24	#1. Turf Diseases. Turf Diseases: Principles of Plant Pathology (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/10/24	32 Years of the Plant Diagnostic Lab at Rutgers: Trends in Turf Disease Diagnosis (0.5hr)	Metropolitan Golf Course Superintendents Assoc.: Winter Educational Seminar and Trade Show	Rye, NY	I,T
01/10/24	Disease or Drought: Temperature and Moisture Stress in Turf (1hr)	New York State Turf and Landscape Association: Professional Turf & Landscape Conference	Westchester, NY	A,I,L,T
01/11/24	Dead Plant Update: 2023 in the Plant Diagnostic Laboratory (1hr)	North Jersey Ornamental Horticulture Conference: Landscape Day	Morris County	L,T
01/15/24	#2. Diseases and Insect Pests of Ornamentals: Scouting Tips for Landscapes; Pesticide Review (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/15/24	#2. Insects in Fine Turf: Insect Classification; Orders (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/16/24	#2. Principles of Pest Management: IPM Basics: Considerations for Setting up a Program (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/16/24	#2. Turf Diseases: Introduction to Mycology and Fungal Structures (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/18/24	The Complete Turf Disease for Golf Courses (2hr) Three Week Course	RU Professional Golf Turf Management Program:	Middlesex County	T
01/19/24	The Complete Turf Disease for Golf Courses (2hr) Three Week Course	RU Professional Golf Turf Management Program:	Middlesex County	T
01/22/24	#3. Diseases and Insect Pests of Ornamentals: New Plant Pathogens: Bacteria, Phytoplasma, Virus, Parasitic Plants (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T

Appendix 3. (Continued)
Table A3.1. (Continued)

Date	Title	Audience	Location	Par-ticipants[1]
01/22/24	#3. Insects in Fine Turf: Insect Growth and Development; Insect Behavior (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/23/24	#3. Principles of Pest Management: Principles of Insect Pest and Disease Control (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/23/24	#3. Turf Diseases: The Red Thread Syndrome; Snow Molds (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/24/24	The Complete Turf Disease for Golf Courses (1.5hr)	RU Professional Golf Turf Management Program: Three Week Course	Middlesex County	T
01/27/24	Christmas Tree Disease Update (1hr)	New Jersey Christmas Tree Growers Association	Burlington County	L,N
01/29/24	Dead Plant Update: 2023 in the Plant Diagnostic Laboratory (1hr)	Penn State Turf and Ornamentals School	Grantville, PA	A,L,N,T
01/30/24	#4. Principles of Pest Management: Cultural Control (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/30/24	#4. Turf Diseases: Diseases Caused by Algae and Other Related Organisms; Slime Molds (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/31/24	#4. Diseases and Insect Pests of Ornamentals: Leaf Spots, Anthracnose, and Stem Diseases (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/31/24	#4. Insects in Fine Turf: IPM Basics: A Review of Scouting Techniques and Insecticides (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/04/24	Insects that Suck: Scale (1hr)	New York State Arborists: Annual Conference and Expo	Suffern, NY	A
02/04/24	The Trouble with Beech: Beech Leaf Disease (1hr)	New York State Arborists: Annual Conference and Expo	Suffern, NY	A
02/05/24	#5. Diseases and Insect Pests of Ornamentals: Root Rots and Vascular Wilt Diseases (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/05/24	#5. Insects in Fine Turf: Nematodes (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/06/24	#5. Principles of Pest Management: Fungicide Selection and Use (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/06/24	#5. Turf Diseases: Diseases Caused by Species of the Fungus Rhizoctonia; Fairy Ring (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/08/24	Basic Plant Pathology and the Art of the Diagnosis (3hr)	Certified Gardener Training Program	Camden, County	H
02/12/24	#6. Diseases and Insect Pests of Ornamentals: Rusts, Mildews, and Molds; Mites (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/12/24	#6. Insects in Fine Turf: Coleoptera--Scarabs: The White Grub Complex (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T

Appendix 3. (Continued)
Table A3.1. (Continued)

Date	Title	Audience	Location	Par-ticipants[1]
02/13/24	#6. Principles of Pest Management: Fungicide Selection and Use (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/13/24	#6. Turf Diseases: Root-infecting Patch Diseases (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/19/24	#7. Diseases and Insect Pests of Ornamentals: Suckers: Scale, Bugs, Hoppers, and Plant Lice (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/19/24	#7. Insects in Fine Turf: Coleoptera--Weevils: Annual Bluegrass Weevil; Billbugs (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/20/24	#7. Principles of Pest Management: Insecticide Selection and Use (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/20/24	#7. Turf Diseases: Anthracnose; “Helminthosporium” Leaf Spots (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/21/24	Dead Plant Update: 2023 in the Plant Diagnostic Laboratory (1hr)	Fisher and Son: Annual Lawn, Landscape, and Sports Field Seminar	Malvern, PA	A,H,I, L,N,T
02/22/24	Leaf Spot Diseases in Turf: The Case for Proper Seed Selection (1hr)	Reed and Perrine Turf and Ornamental Seminar	Middlesex County	L,T
02/26/24	#8. Diseases and Insect Pests of Ornamentals: Borers: Round-headed and Flat-headed Borers; Gall Makers and Miners (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/26/24	#8. Insects in Fine Turf: Lepidoptera: Armyworms, Cutworms, and Sod Webworms (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/26/24	#9. Turf Diseases: Rust, Smut, Mildews and Other Minor Leaf Blighting Diseases (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/27/24	Leaf Spot Diseases in Turf: The Case for Proper Seed Selection (1hr)	SiteOne University	Saratoga, NY	A,H,I, L,N,T
02/27/24	Our Majestic Oaks and Their Achilles Heel (1hr)	SiteOne University	Saratoga, NY	A,H,I, L,N,T
02/28/24	#8. Principles of Pest Management: The Least Toxic Alternative (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/28/24	#8. Turf Diseases: Dollar Spot; Gray Leaf Spot (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/28/24	Boxwood Pests and Diseases (1.5hr)	Weeds, Diseases and Insects of Plants (11:776:391)	Middlesex County	C
02/29/24	Basic Plant Pathology and the Art of the Diagnosis (3hr)	Master Gardener Training Program	Monmouth County	H
03/04/24	Our Majestic Oaks and Their Achilles Heel (1hr)	SiteOne University	Rochester, NY	A,H,I, L,N,T
03/05/24	#9. Principles of Pest Management: Commercial Biocontrol and Biocontrol Concepts (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T

Appendix 3. (Continued)
Table A3.1. (Continued)

Date	Title	Audience	Location	Par-ticipants[1]
03/06/24	Diagnostic Tips for Problem Sports Fields (0.75hr)	New England Regional Turfgrass Conference and Show	Providence, RI	A,I,L,T
03/07/24	32 Years of the Plant Diagnostic Lab at Rutgers: Trends in Turf Disease Diagnosis (0.75hr)	New England Regional Turfgrass Conference and Show	Providence, RI	A,I,L,T
03/07/24	The Trouble with Beech: Beech Leaf Disease (1hr)	New England Regional Turfgrass Conference and Show	Providence, RI	A,I,L,T
03/11/24	#10. Insects in Fine Turf: Regional Concerns: Mole Crickets and Crane Flies (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
03/11/24	#10. Diseases and Insect Pests of Ornamentals: Leaf Feeders: Lepids, Sawfly, and Weevils (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
03/12/24	#10. Principles of Pest Management: Scouting Your Golf Course (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
03/12/24	#10. Turf Diseases: Abiotic Stress in Turfgrass (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
03/12/24	Pythium Diseases in Turfgrass (1hr)	New York State Turf Association: Webinar Archive	online	L,T
03/21/24	Key Insect Pests in New Jersey Landscapes (3hr)	Master Gardener Training Program	Monmouth County	H
03/22/24	Basic Turfgrass Disease: Pick Your Best Defense (2hr)	Pest Management of Landscape Turf Short Course	Middlesex County	L,T
04/02/24	Landscape Disease and Insect Show and Tell (3hr)	Master Gardener Training Program	Hunterdon County	H
04/17/24	Basic Plant Pathology and the Art of the Diagnosis (3hr)	Certified Gardener Training Program	Gloucester County	H
04/20/24	Basic Tree Disease Identification and Control (3hr)	Licensed Tree Expert Prep Course	Middlesex County	A,L
05/21/24	Diseases of Woody Ornamentals (6hr)	White Plains Urban Forestry Program	White Plains, NY	A,L
05/22/24	Boxwood Pests and Diseases (1.5hr)	Master Gardener Training Program	Monmouth County	H

[1] Audience Addressed: A=Arborists; C=College (Academic); Co=Construction; E=Engineers; F=Farmers; G=Greenhouse; H=Residential Clientele; Hf=Health Officers; I=Industry; L=Landscapers; N=Nursery Growers; S=State Officials; T=Turfgrass Managers; X=Christmas Tree Growers

Appendix 3.
Table A3.2. Complete listing of lectures presented by Sabrina Tirpak, PDL Laboratory Researcher II, FY24.

Date	Title	Audience	Location	Par-ticipants[1]
08/16/23	Spruce Insect Pest and Disease Problems (1hr)	Master Gardener Training Program	Monmouth County	H
10/12/23	Insights into a Career in Plant Diagnostics (2hr)	County College of Morris	Morris County	C
10/17/23	#1. Turf Disease Laboratory - Basic Mycology (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/18/23	#1. Turf Insect Laboratory - Structure and Function/ Insect Orders (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/19/23	Introduction to Entomology (3hr)	Master Gardener Training Program	Mercer County	H
10/24/23	#2. Turf Disease Laboratory - Introduction to Microscopy (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
10/31/23	Introduction to Entomology (3hr)	Master Gardener Training Program	Hunterdon County	H
11/01/23	#2. Turf Insect Laboratory - Metamorphosis and Behavior (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/07/23	#3. Turf Disease Laboratory - Recognizing Signs Produced by Turf Pathogens, Part 1 (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/13/23	Introduction to Entomology (3hr)	Master Gardener Training Program	Morris County	H
11/14/23	#3. Turf Insect Laboratory - Nematodes (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/16/23	Household Insect Pests (3hr)	Master Gardener Training Program	Mercer County	H
11/21/23	#4. Turf Insect Laboratory - White Grubs (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
11/22/23	#4. Turf Disease Laboratory - Recognizing Signs Produced by Turf Pathogens, Part 2 (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
12/05/23	Dead Turf Review: The Diagnostician's View (0.5hr)	New Jersey Green Expo—Turf and Landscape Conference	Atlantic City, NJ	I,L,T
12/05/23	Weed (not that kind!) Control in Landscape Turf (1hr)	New Jersey Green Expo—Turf and Landscape Conference	Atlantic City, NJ	I,L,T
12/07/23	#5. Turf Insect Laboratory - Using an Insect ID Key (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
12/08/23	#5. Turf Disease Laboratory - Recognizing Signs Produced by Turf Pathogens, Part 3 (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
12/12/23	#6. Turf Disease Laboratory - Lab Final: Diagnose the Problem (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
12/13/23	#6. Turf Insect Laboratory - Lab Final: Identifying Common Insects in Turf (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
12/19/23	Shade Tree Problems in the Urban Forest: The Old and the New (4hr)	Borough of Riverdale Shade Tree Class	Morris County	A,H,L
01/16/24	#1. Turf Insect Laboratory - Structure and Function/ Insect Orders (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/17/24	#1. Turf Disease Laboratory - Basic Mycology (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T

Appendix 3. (Continued)
Table A3.2. (Continued)

Date	Title	Audience	Location	Par-ticipants[1]
01/23/24	#2. Turf Insect Laboratory - Metamorphosis and Behavior (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
01/25/24	#2. Turf Disease Laboratory - Introduction to Microscopy (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/06/24	#3. Turf Insect Laboratory - Nematodes (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/07/24	#3. Turf Disease Laboratory - Recognizing Signs Produced by Turf Pathogens, Part 1 (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/20/24	Ornamental Pest Issues, A Diagnostician's Point of View (1hr)	SynaTek Winter Seminar	East Earl, PA	I,L,T
02/21/24	#4. Turf Insect Laboratory - White Grubs (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/22/24	#4. Turf Disease Laboratory - Recognizing Signs Produced by Turf Pathogens, Part 2 (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
02/26/24	Rhododendron Pests and Diseases (1.5hr)	Weeds, Diseases and Insects of Plants (11:776:391)	Middlesex County	C
02/27/24	Introduction to Entomology (3hr)	Master Gardener Training Program	Monmouth County	H
02/29/24	Dead Tree Update: The View from The Plant Diagnostic Lab (1hr)	Garden State Tree Conference	Atlantic City, NJ	A,I,L
03/04/24	#9. Diseases and Insect Pests of Ornamentals: Borers: Weevils, Bark Beetles, and Clear-winged Moths (2hr)	RU Professional Golf Turf Management Program	Middlesex County	T
03/04/24	#9. Insects in Fine Turf: Hemiptera: Chinch Bugs; Ground Pearls (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
03/05/24	#5. Turf Insect Laboratory - Using an Insect ID Key (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
03/06/24	#5. Turf Disease Laboratory - Recognizing Signs Produced by Turf Pathogens, Part 3 (3hr)	RU Professional Golf Turf Management Program	Middlesex County	T
03/11/24	Household Insect Pests (3hr)	Master Gardener Training Program	Morris County	H
03/12/24	#6. Turf Insect Laboratory - Lab Final: Identifying Common Insects in Turf (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
03/13/24	#6. Turf Disease Laboratory - Lab Final: Diagnose the Problem (1.5hr)	RU Professional Golf Turf Management Program	Middlesex County	T
03/14/24	The Plant Diagnostic Process (1.5hr)	Landscape Integrated Pest Management Short Course	Middlesex County	L,T
03/19/24	Key Insect Pests in New Jersey Landscapes (2.5hr)	Master Gardener Training Program	Ocean County	H
03/20/24	Tomato Troubles: Disorders & Diseases (1.5hr)	Master Gardener Training Program	Monmouth County	H
03/22/24	Turfgrass Pests: Leaf Feeding Insects and Grubs (2hr)	Pest Management of Landscape Turf Short Course	Middlesex County	L,T

Appendix 3. (Continued)
Table A3.2. (Continued)

Date	Title	Audience	Location	Par-ticipants[1]
03/26/24	Household Insect Pests (3hr)	Master Gardener Training Program	Monmouth County	H
04/02/24	Landscape Disease and Insect Show and Tell (3hr)	Master Gardener Training Program	Hunterdon County	H
04/04/24	Household Insect Pests (2.5hr)	Master Gardener Training Program	Ocean County	H
04/20/24	Key Insect Pests of Shade Trees (3.5hr)	Licensed Tree Expert Prep Course	Middlesex County	A,L
05/18/24	Plant Diagnostic Laboratory Informational Table (5hr)	RU Ready to Farm Equipment Day	Monmouth County	F

[1] Audience Addressed: A=Arborists; C=College (Academic); Co=Construction; E=Engineers; F=Farmers; G=Greenhouse; H=Residential Clientele; Hf=Health Officers; I=Industry; L=Landscapers; N=Nursery Growers; S=State Officials; T=Turfgrass Managers; X=Christmas Tree Growers

Appendix 4. Cooperative Extension Bulletin.

RUTGERS New Jersey Agricultural Experiment Station
COOPERATIVE EXTENSION

Bulletin E376

Beech Leaf Disease & Experimental Management Options

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Quick Facts

- Beech leaf disease (BLD) is a new disease to the United States; scientists have been working quickly to understand its pathogenesis and test treatment options to mitigate or control damage.
- BLD affects beech (*Fagus* spp.) tree species and has not been shown to infect any other genera. This disease poses no direct harm to humans.
- BLD causes rapid decline and mortality of American beech (*Fagus grandifolia*) and European beech (*F.sylvatica*); mortality can occur between 2 to 10 years depending on size. BLD has also been reported to impact Oriental beech (*F. orientalis*) and Chinese beech (*F. engleriana*).
- BLD is caused by an invasive nematode *Litylenchus crenatae* subsp. *mccannii* (*Lcm*; Figure 1). A nematode is a microscopic roundworm that cannot be seen with the naked eye.
- BLD is recognized best by opaque banding of diseased leaf tissue (Figure 2).
- Infection occurs in the leaf buds. *Lcm* does not infect woody tissue.
- Primary damage to leaf tissue occurs in the bud stage.
- Highly infected and damaged leaves become thickened, distorted, prematurely shed, and branch dieback ensues. Decline and mortality follow.
- Current treatment options are very new and considered experimental; adverse impacts are not yet known. Treatment options may change and improve in coming years.
- When treatment is not an option, mitigation steps are key to reducing negative environmental impacts from beech losses.

Figure 1. The beech leaf disease causing nematode *Litylenchus crenatae* subsp. *mccannii*, a foliar feeding microscopic roundworm. Photo Credit: Sabrina Tirpak, Rutgers Plant Diagnostics Laboratory.

Figure 2. Symptomatic beech leaves afflicted with beech leaf disease. These photos are taken against the light sky to show the opaque banding of diseased leaf tissue, an indicative symptom of BLD. Photo Credit: Jean Epiphan, Rutgers Cooperative Extension.

Pathology

Causal Agent

Beech leaf disease (BLD) is caused by an invasive nematode *Litylenchus crenatae* subsp. *mccannii* (*Lcm*; Figure 1). Nematodes are microscopic roundworms. Most nematodes are free-living, but some are parasites of animals and plants. Most plant parasitic nematodes live in soil moisture films and feed on plant roots. The nematode that causes BLD is unique in that it is found in the foliage of a tree rather than in the roots. This *Lcm* nematode is closely related to *Litylenchus crenatae* subsp. *crenatae* from Japan that causes galls in leaves of Japanese beech (*Fagus crenata*). The BLD-causing *Lcm* subspecies differs from *Lcc* in morphology, DNA, and host range. We assume that the BLD nematode is not native to North America. However, a Connecticut Agricultural Experiment Station researcher has partnered with USDA-ARS, USDA Forest Service, and researchers from Japan to determine the exact origin of the beech leaf disease nematode, *Litylenchus crenatae mccannii.*

Disease Distribution

In the United States, BLD was first discovered in 2012, in Cleveland Ohio. Since that time, the disease has spread from Michigan to Canada, Maine and south to Virginia (range as of Dec. 2023; Figure 3).

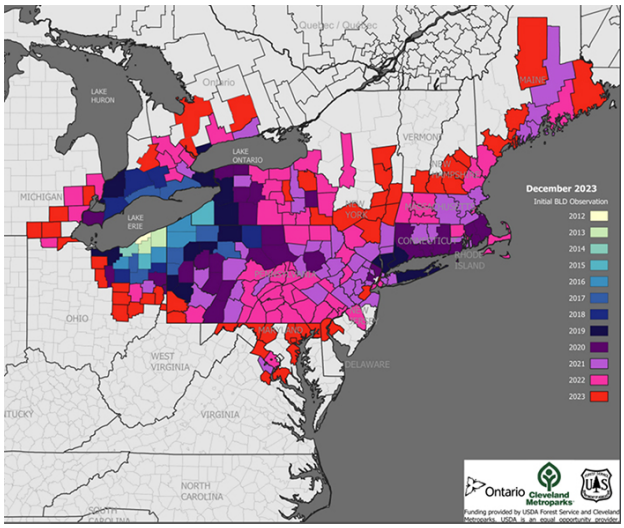

Figure 3. Beech Leaf Disease Range in North America as of December 2023. Credits: USDA Forest Service and Cleveland Metroparks.

Infection and Life Cycle

The *Lcm* nematode only infects beech species (*Fagus* spp.) and is limited to the leaf and leaf bud tissue. To date, the nematode has not been found in beech tree roots, trunks, or other woody tissue. The nematode overwinters in infected buds. In late-winter or early-spring, eggs are laid in the infested tissues and are moved within the leaves as they expand in the spring. Eggs have been shown to persist in aborted buds. Juvenile nematodes are found in symptomatic tissues by mid-summer and adult populations build within the mesophyll cells into the fall. As the season progresses, adult nematodes exit the leaf tissue and migrate to next year's leaf buds. So far, the most active movement of nematodes and infection are thought to occur from mid-summer to early fall. This is also the time that abiotic and biotic vectors may facilitate infection and spread.

Vectors

Recent research out of Penn State University has proven some transmission pathways during the second half of the growing season, when adult nematodes migrate. Wind, humidity, and precipitation have been shown to spread the *Lcm* nematode at least 38 feet from infected beech trees. Rain can flush high numbers of Lcm nematodes down to lower canopy levels. The native beech blight aphid (*Brylloprociphilus imbricator*) has been shown to carry live *Lcm* nematodes and disperse them. Furthermore, live *Lcm* nematodes can survive being passed through the digestive tracts of the white-marked tussock moth (*Orgyia leucostigma*) caterpillars found on American beech. Therefore, the excrement can disperse the nematodes. In addition, live *Lcm* nematodes have been recovered from spider webs in the lower canopy. As numerous species of wildlife utilize beech for habitat resources, the BLD vector pool has the potential to be very large.

USDA Forest Service pathologists found that several species of birds that eat beech buds can carry the *Lcm* nematode DNA in their plumage. These birds have the potential to carry the *Lcm* nematode long distances. Additionally, the movement of plant material by humans, particularly in asymptomatic nursery stock is also suspect. It is feared that BLD will spread throughout the full range of American beech and European beech in the United States and Canada.

Symptoms and Damage

BLD infection in leaves is recognized by banding of leaf tissue (Figure 2). When held up against a light source like the sky, the infected "bands" between the parallel veins appear opaque against the translucent unaffected tissue. The opaque leaf symptom of BLD helps to differentiate it from other beech leaf damaging agents. The infected banding can become thickened, hardened, and sometimes discolored or yellowed. The progression of leaf symptoms can be rapid from one year to the next (Figure 4). Highly infected leaves become malformed, thickened, shriveled, and shed. Defoliation generally occurs from the lower canopy and moves upwards (Figures 4 and 5). As the infection continues to progress, subsequent leaf buds can appear smaller, stunted, diminished, or may be aborted. Ultimately, crowns thin and branches begin to die back, leading to a rapid decline of the tree. Mortality can occur within 1 to 2 years in small saplings and in 6 to 10 years in larger mature trees.

Yale researchers found that thickened infected leaves have increased mass while they have decreased photosynthetic ability, stomatal conductance, and stomatal density. Therefore, infected leaves require more resources to sustain their mass, but have decreased function to photosynthesize and produce those resources. This dysfunction contributes to the mechanisms that cause rapid tree decline and demonstrates how affected beech essentially become starved of photosynthetic resources.

Figure 4. Visual difference between beech leaf disease infection from 2021 with <1% infected leaves (top), to 2022 with >50% infected leaves in the lower canopy (bottom), within the same American beech forest of Morristown National Historical Park, NJ. Photo Credit: Jean Epiphan, Rutgers Cooperative Extension.

Figure 5. Advanced beech leaf disease progression exhibited as defoliation of beech leaves, which usually occurs from the lower canopy upwards. Photo Credit: Colin Milde, Ramapo Tree & Shrub Care LLC.

Foliar Microbiome

USDA Forest Service, Penn State, and Holden Arboretum researchers found microbial differences between BLD affected leaves and unaffected leaves. Mites have been found intertwined with the Lcm nematodes in leaf tissue. Fungal communities and bacterial taxa differ between affected and unaffected leaves. One of the isolated bacterial genera found in affected leaves, Wolbachia sp., is a known nematode endosymbiont. Microbial co-factors may be contributing to BLD virulence by facilitating Lcm nematode feeding, reproduction, survival, or fitness.

Impacts

Ecological and Environmental

American beech is a common tree that is native to several forest types throughout its range from northern Florida up the East Coast to Southern Quebec and inland to the Mississippi River Valley. It is found in uplands and lowlands, in private yards, parks, conserved forest land, riparian forests, and inland seeps. American beech help maintain forest health, ecosystem functioning, habitat provision, and wildlife resources. The loss of these trees throughout its range will facilitate decline of forest quality, ecological function, populations of flora and fauna, and overall biodiversity.

American beech provides abundant resources for wildlife such as larval hosting for hundreds of species of beneficial insects that are essential parts of the forest food web. Beech nuts, a wildlife superfood, are sought-after by numerous forest mammals and birds. Beech provide vital nesting sites and shelter. Furthermore, an obligate epiphytic plant of beech, beech drops (*Epifagus virginiana*), provides floral resources to forest bees and ants. Without American beech as a resource, several wildlife and plant populations will be stressed, decline, or become extirpated.

As American beech leaves fall year after year on the forest floor, they create habitat for overwintering animals and insects, but that is not all. Beech leaves are high in lignan, which slows their decomposition and allows them to accumulate. This process also sustains soil quality and health for forest plants. This thick, tough leaf litter protects soil from erosion and drought. It helps inhibit the germination and infiltration of weeds and invasive plants into beech forests. Invasive worms that destroy forest soil quality, like the jumping worm (*Amynthas agrestis*), are suppressed by beech leaf litter. Without beech in our forests, soil and ecosystem health is at greater risk of degradation and mesophication.

Mature beech often develop abundant root sprouts that grow into stands of saplings (Figure 6). This dense, clonal growth habit provides many ecological services. The deep shade created helps cool our climate, the many leaves intercept rainwater which reduces stormwater runoff, and the shallow, dense root systems hold soil in place to prevent erosion, all of which helps protect our local water quality. These services are especially important where beech live along Category 1 streams and cold-water fisheries as they help conserve water quality. However, the predicted loss of beech will facilitate decline of these invaluable ecosystem services that protect terrestrial and aquatic habitat.

American beech is a long-lived (300–400 years), late successional species of climax forest types. It grows in the shade of mid-succession trees, provides deep shade at maturity, and inhibits growth of earlier succession flora as well as invasive plants. In New Jersey, beech occurs as late succession species in two major forest types, oak-hickory and northern hardwoods. For decades beech served as the last stronghold to maintain climax forest conditions as Eastern hemlock (*Tsuga canadensis*) populations declined due to invasive insects, while the range of sugar maple *(Acer saccharum*) and yellow birch (*Betula allenghaniensis*) transitions northward with climate change. The projected loss of beech due to BLD will shorten forest succession timelines by hundreds of years and enable an increased rate of disturbance cycles. The beech-dominated and associated climax forest condition will become diminished along with forest quality and ecosystem balance.

Figure 6. An unaffected mature beech among a dense stand of clonal saplings. Photo Credit: Jean Epiphan, Rutgers Cooperative Extension.

Socioeconomic

European beech in North America has often been planted in ornamental and formal gardens in developed landscapes. Cultivation of European beech began in the early 19th century and today there are numerous varieties including copper beech, fern-leaf, weeping, tricolor, golden, and the fastigiate form, Dawyck
beech. Oriental beech is commercially available but much less common in trade and landscapes in the United States. American beech has more recently become part of the native horticulture trade and is also planted for forest restoration. The loss of beech nursery stock has and will continue to negatively impact the green industry and agroforestry operations. The decline of beech will affect visual and aesthetic quality of ornamental landscapes which can impact property values. In ornamental settings, beech loss will decrease shade and cooling ecosystem services which facilitates the urban heat island effect.

Management

To date, there are no known quarantines in place for beech nursery stock or beech plant debris in the United States. However, it is best to refrain from transporting beech nursery stock or debris to reduce spread or transmission risk.

Several researchers are currently testing pruning methods and pesticide products to treat BLD. Some products have been shown to improve health and vigor of infected beech while other trialed products have known nematocidal activity for prevention and control of the Lcm and BLD. Efficacy data is limited at this time; several products have shown promise, but all are still considered experimental. In the race to save beech, many contractors have been using some of the treatment options listed below even though they are still considered experimental. There may be unknown risks that could cause harm to beech, the environment, or the treatments may prove to be ineffective long term. Be sure to read and follow the label; the label is the law.

Cultural Control

To date, cultural control options have not yet been shown to prevent disease. Pruning of initially infected leaves and small branches may slightly slow infection progression, but pruned trees can be re-infected. Pruning large branches of older beech may facilitate trunk decay and is not recommended. Pruning as part of a treatment plan is currently being researched, but there are no results to date. The nematode is not thought to survive in leaf litter, so raking and removing leaves from landscapes is not considered to be an effective control strategy.

Arboricultural Treatment

Polyphosphite-30® (Plant Food Company, Inc.)

Phosphite materials are thought to work by stimulating the natural defense response in treated trees. The application of phosphite fertilizers has shown promise for control. Cleveland Metroparks and Davey Tree Expert Company performed targeted soil drenches in the drip lines of infected American beech saplings 2"–4" DBH (diameter at breast height) have been shown to improve health and reduce BLD symptoms after 5 years. Newer trials with larger beech trees are ongoing and no results have yet been reported.

University of Rhode Island researchers suggest using 2 fl.oz. of PolyPhosphite-30® + 14 oz. water / 1" DBH. Adjustments are experimentally suggested for trees larger than 4" DBH; for every doubling of DBH greater than 4" increase the amount of phosphite by 1.5. However, high dosage can cause injury to treated trees and these higher rates have not been fully trialed. To properly apply the mixture to the soil, move leaf litter from the drip line area, moisten soil if it is dry, apply to soil area within the drip line avoiding roots, and then replace the leaf litter. Two applications are recommended between May and September at least one month apart, for example, May and July. The uptake of the materials can be enhanced by irrigating the trees after application, but do not overwater to create runoff. Lastly, the application of phosphite fertilizers do not require a pesticide applicator license, but materials labeled as fungicides do. The label is the law.
No trials of phosphite fungicides to treat BLD have been completed and there are no official results on efficacy, benefit, or harm to beech.

Fluopyram

Fluopyram is a group [7] succinate dehydrogenase inhibiting (SDHI) fungicide that acts as a nematicide. The Connecticut Agricultural Experiment Station and Bartlett Tree Experts performed several tests over the last 2 years. Fluopyram has been shown to significantly reduce nematode numbers in leaves and buds as well as improve canopy density. Fluopyram is one of the active ingredients in Broadform® (Envu Environmental Science US), which also includes the group [11], quinone outside inhibitor (QoI) fungicide, trifloxystrobin. Unlike fluopyram,

trifloxystrobin has not proven to have nematicide efficacy in any plant system. Broadform® is labelled for ornamental use only and has a 2ee exemption for use on beech and BLD in many states including New Jersey. Luna Experience® (Bayer Crop Science United States), another product containing fluopyram, is labelled strictly for agricultural beechnut use. Fluopyram cannot be applied near or over water.

Coverage is especially important with foliar-applied materials such as fluopyram, so high pressure sprayers may be needed for larger trees. Good candidate sites for fluopyram include beech with minimal dieback, beech hedges, specimens shorter than 30 feet, and mixed, young stands that are not dense beech plantings. Be aware that efficacy differs among differing site conditions. Research suggests that applications begin in late July with 4 applications at 21-day reapplication intervals. According to the label on Broadform®, if multiple applications are applied, a different product and active ingredient must be rotated in to minimize the potential for pesticide resistance. Reliant® is an option for this rotation.

Another consideration regarding efficacy is if there are nearby untreated hosts. Fluopyram treatments may fail or give less than desirable management if untreated beech are nearby.

Thiabendazole

Thiabendazole is a group [1] methyl bendimidazole fungicide that also has shown nematocidal properties on BLD. This material has been tested in American beech from 10–22" DBH. Preliminary trials suggest that it prevents dieback, reduces leaf symptoms, and reduces *Lcm* numbers in dormant buds, however trials are ongoing. Thiabendazole is the active ingredient of Arbotect 20-S® (Syngenta), which has historically been used to treat Dutch elm disease and sycamore anthracnose. Once properly diluted, Thiabendazole is injected directly into the vascular system of trees and the injection sites must be low on the root flare. Improper placement of injection sites increases the likelihood of decay and less than desirable uptake speed and effectiveness. Optimal treatment timing for macro-injections is after full leaf expansion. While most of the data is on Arbotect applied in August, it is expected that treatments earlier in the year would also be effective. Arbotect 20-S® currently has a 24c exemption for use on BLD in New Jersey, as well as New York, Massachusetts, Ohio and Pennsylvania with additional registrations pending. Application is limited to once every other year. This treatment option is best used for beech larger than 10 inches diameter with less than 50% dieback or defoliation.

Chitosan

Chitosan products are currently being trialed. At this time, it is unknown if they are effective, beneficial, or harmful to beech. No official results have been published.

Mitigation

If treatment is not an option, anticipate decline of beech. Tree decline could be slowed by reducing plant stress in ways mentioned below:

- Provide beech with ample water during times of drought.
- Remove invasive plants from the area that inhibit the success of beech.
- Do not mow or allow traffic under beech within the drip line to reduce soil compaction.
- Allow beech leaf litter to remain under the beech, within the drip line.
- If mulching, apply less than 2 inches of mulch and choose a naturally derived product; do not over-mulch or volcano mulch.

The most important method to mitigate the loss of beech in forests, rural, and suburban environments (not street trees) is to proactively underplant (and deer fence) with native cohort trees as the beech are declining. The tree species in the below list are the most vital to plant in New Jersey to mitigate beech losses. They cohesively provide stable wildlife resources including high protein food sources, slower decomposition rates of leaf litter that help maintain soil quality and habitat, and specifically black gum (*Nyssa sylvatica*) can grow in clonal groves that are structurally comparable to beech sapling groves.

- white oak (*Quercus alba*)
- chestnut oak (*Quercus montana*)
- swamp white oak (*Quercus bicolor*)
- shagbark hickory (*Carya ovata*)
- pignut hickory (*Carya glabra*)
- mockernut hickory (*Carya tomentosa*)
- bitternut hickory (*Carya cordiformis*)
- American holly (*Ilex opaca*)
- white pine (*Pinus strobus*)
- black gum (*Nyssa sylvatica*)

Make sure new tree plantings have the following attributes so they survive transplant shock, grow faster, live healthier, and aptly mitigate the loss of beech and their clonal groves of beech saplings.

- Local ecotypes sourced from your state or ecoregion.
- Smaller-sized stock grown in containers (tubeling or 1–7 gallon size).
- Protected from deer damage with physical barriers like 6ft wire mesh.
- Planted in dense stands of many trees (10–30) to replace one mature beech, 4–8ft spacing.

Controlling invasive plants in and around declining beech is also critical as they can rapidly invade in response to added light from beech canopy loss. The mitigation planting strategy listed above also helps to prevent invasive plant infiltration.

Additional Resources and Links

- Beech Leaf Disease Treatment Update (https://web.uri.edu/ipm/2023/04/beech-leaf-disease-in-ri-2023-update/). (Faubert, H.) Univ. Of Rhode Island.
- Frontiers in Forest Health: Beech Leaf Disease (https://psu.mediaspace.kaltura.com/media/1_3c3690gf). (Kantor & Goraya) Penn State.
- U.S. Forest Service factsheet: Pest Alert – Beech Leaf Disease (PDF) (https://www.nj.gov/dep/parksandforests/forest/foresthealth/beechleafdiseasepestalert-20220328.pdf).
- USDA Forest Service: Beech leaf disease: An emerging forest threat in Eastern U.S. (https://www.fs.usda.gov/inside-fs/delivering-mission/sustain/beech-leaf-disease-emerging-forest-threat-eastern-us)
- Rutgers Plant and Pest Advisory: Beech Leaf Disease in New Jersey (https://plant-pest-advisory.rutgers.edu/beech-leaf-disease-in-new-jersey).
- U.S.D.A. – Tellus: What's Killing Beech Trees? (https://tellus.ars.usda.gov/stories/articles/whats-killing-beech-trees)
- Bartlett Tree Experts – Research Laboratory Technical Report: Beech Leaf Disease (PDF) (https://www.bartlett.com/resources/beech%20leaf%20disease.pdf)
- Rutgers Earth Day Everyday Newsletter: Beech Leaf Disease: Is Saving Beech Out of Reach? (https://salem.njaes.rutgers.edu/2023/08/01/beech-leaf-disease-is-saving-beech-out-of-reach/)
- Audubon Magazine: A Fast-Spreading Disease Threatens a Foundational Tree of Eastern Forests (https://www.audubon.org/news/fast-spreading-disease-threatens-foundational-tree-eastern-forests).

Appendix 4. (Continued)

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Pathology

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May 2024

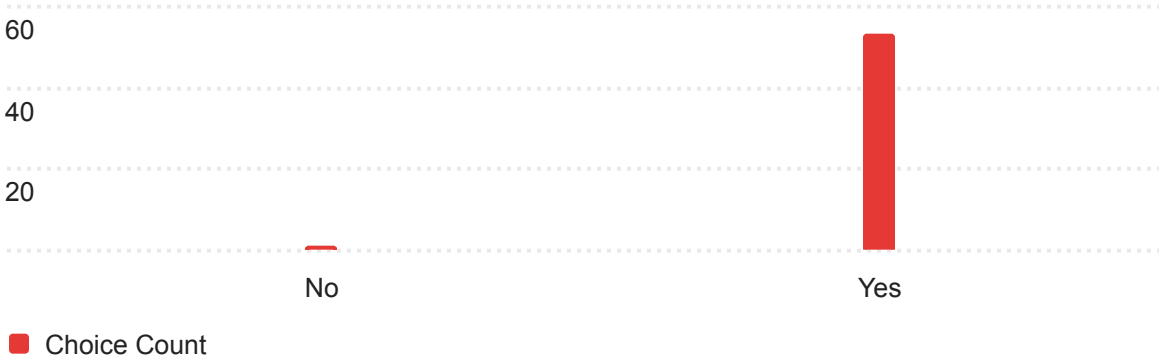
For more information: njaes.rutgers.edu.

Cooperating Agencies: Rutgers, The State University of New Jersey, U.S. Department of Agriculture, and Boards of County Commissioners. Rutgers Cooperative Extension, a unit of the Rutgers New Jersey Agricultural Experiment Station, is an equal opportunity program provider and employer.

Appendix 5. Plant Diagnostic Laboratory Client Survey, FY24.

Q1 - Did you receive the diagnostic report(s) in a timely manner?

53 Responses

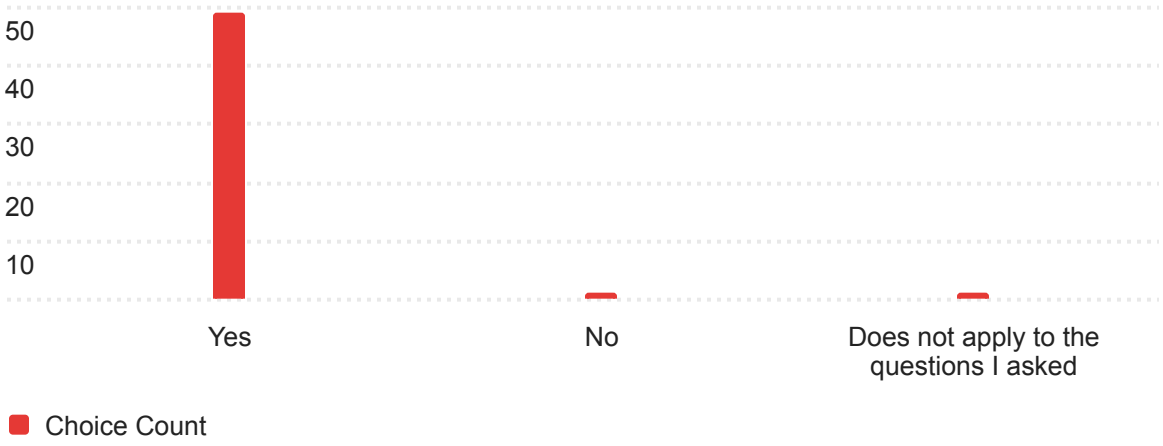


Q2 - Please describe the issue with the timeliness of your diagnostic report(s).

No data found - your filters may be too exclusive!

Q3 - Did the information provided help you to solve your problem?

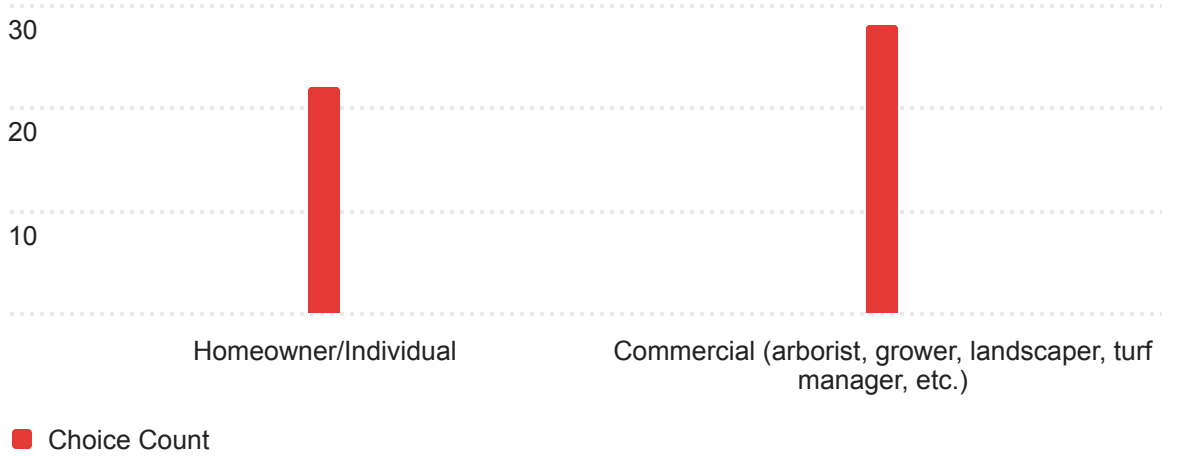
51 Responses



Appendix 5. (Continued)

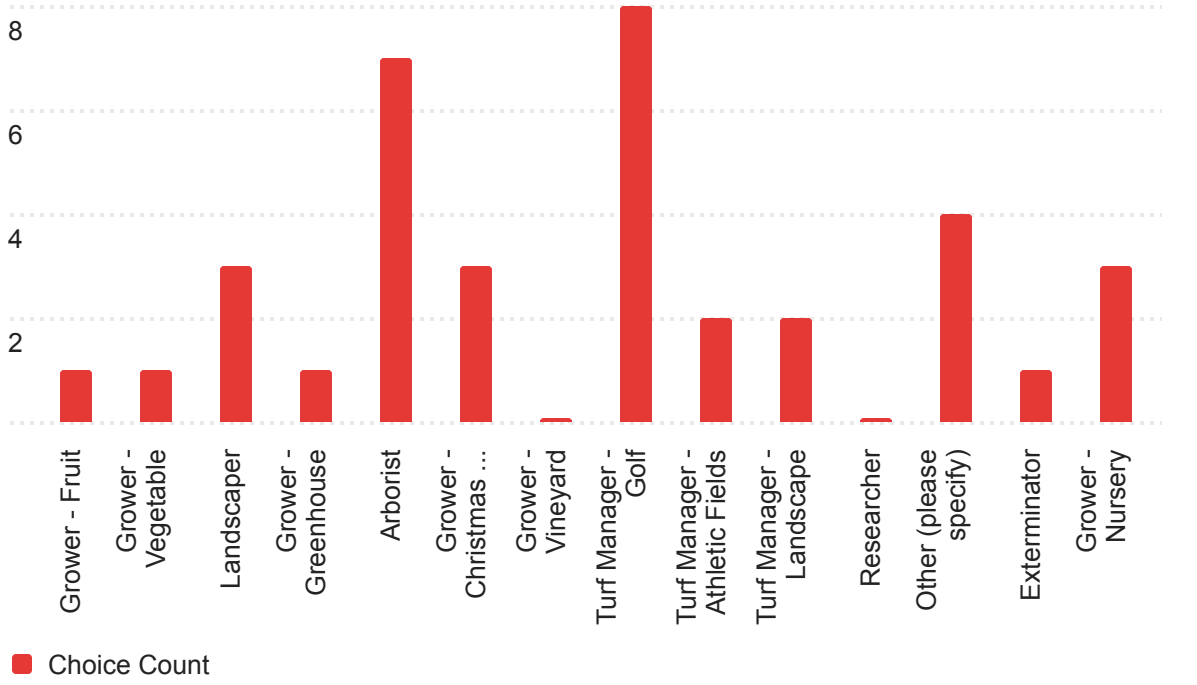
Q4 - As a client of the Rutgers Plant Diagnostic Laboratory, how is your role best described?

50 Responses



Q4.1 - Please check all that apply to describe yourself: - Selected Choice

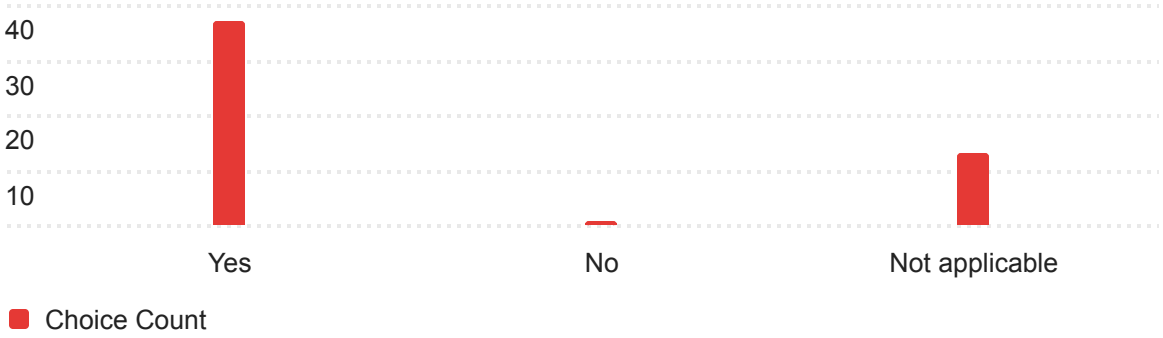
28 Responses



Appendix 5. (Continued)

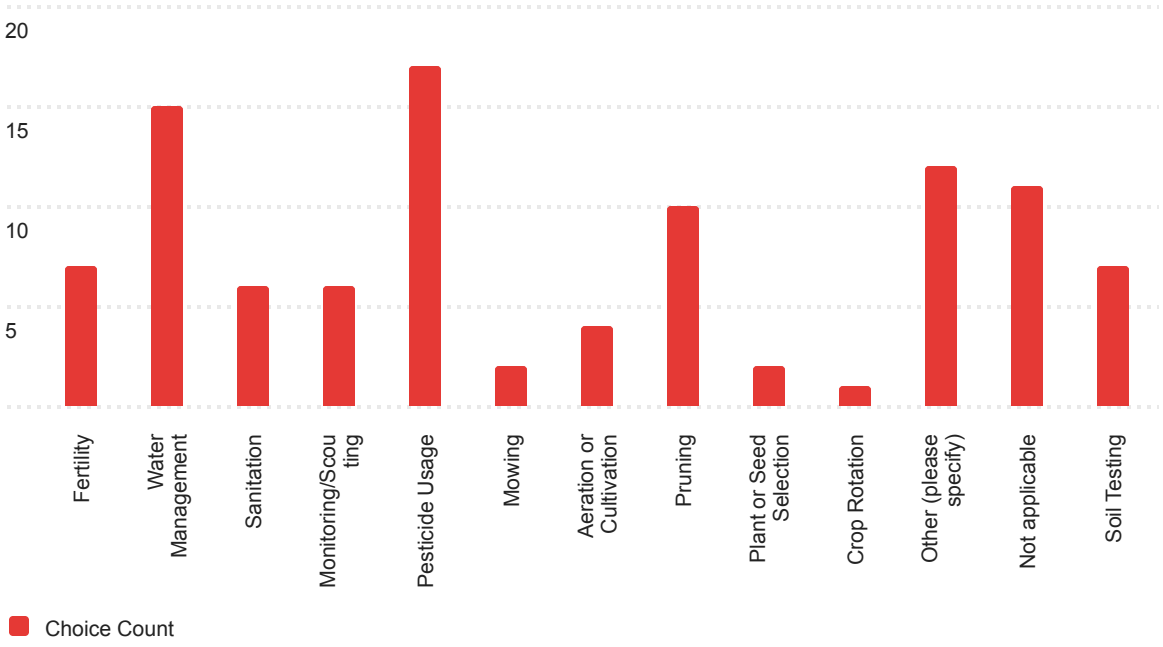
Q5 - Did the information provided help you to use Integrated Pest Management (IPM) strategies (cultural practices and use of least toxic pesticides as a last resort) to manage your pest or disease problem(s)?

50 Responses



Q6 - Did you implement or alter any management practice(s) based on recommendations in the diagnostic report(s)? Please select all that apply: - Selected Choice

48 Responses



Appendix 5. (Continued)

Q6_11_TEXT - Other (please specify) - Text

12 Responses

Other (please specify) - Text
Have not yet implemented a strategy
stopped using fungicide
All of the above
I need to understand where this pest is coming from before I can act on elimination.
I i haven’t yet had an opportunity to respond to the report but intend on following its suggestions.
already pruned dead wood, planning to enhance soil. Did not consider water management, so this will be an easy adjustment as a result of this test.
Prevention of mechanical/abiotic damage.
just received report
Am deciding how to proceed - just got the results today
Will use fungicide
Not yet... I need to see what Professor Flagler recommends
Mulching Root Zone

Q7C - If you implemented any of the practice(s) recommended, please select all of...

11 Responses

Field	1-10%	11-25%	26-50%	51-75%	76-100%
A reduction in potential plant loss	2	0	2	1	3
Increased yield	2	0	0	0	2
Reduced the amount of unnecessary inputs (pesticides, fertilizer, etc.)	2	2	1	0	3
Limited the spread of disease or insect pest	2	1	1	1	3
Reduced the impact on aesthetics	4	1	3	0	3
Increased profit	2	0	0	0	2
Increased quality of crop/plant	3	2	0	1	3

Appendix 5. (Continued)

Q7H - If you implemented any of the practice(s) recommended, please select all of...

4 Responses

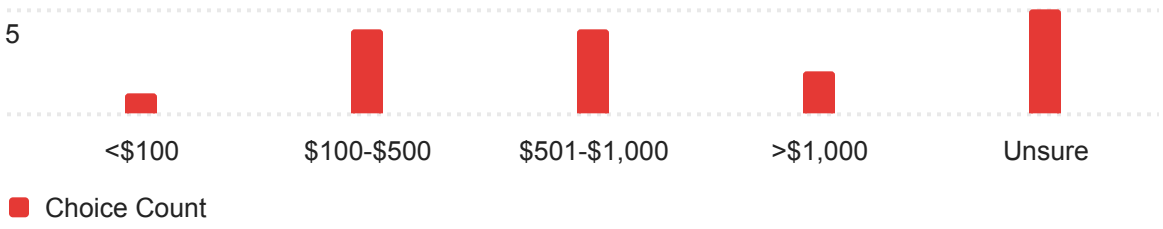
Field	1-10%	11-25%	26-50%	51-75%	76-100%
A reduction in plant death	0	0	0	0	1
Reduced the amount of unnecessary inputs (pesticides, fertilizer, etc.)	0	0	0	0	2
Limited the spread of disease or insect pest	0	0	0	0	2
Reduced the impact on aesthetics	0	0	0	0	2
Increased quality of crop/plant	0	0	0	0	1
Increased yield	0	0	0	0	0

Q8 - Were you able to reduce the use of pesticides as a result of the information provided in the diagnostic report(s)?

44 Responses

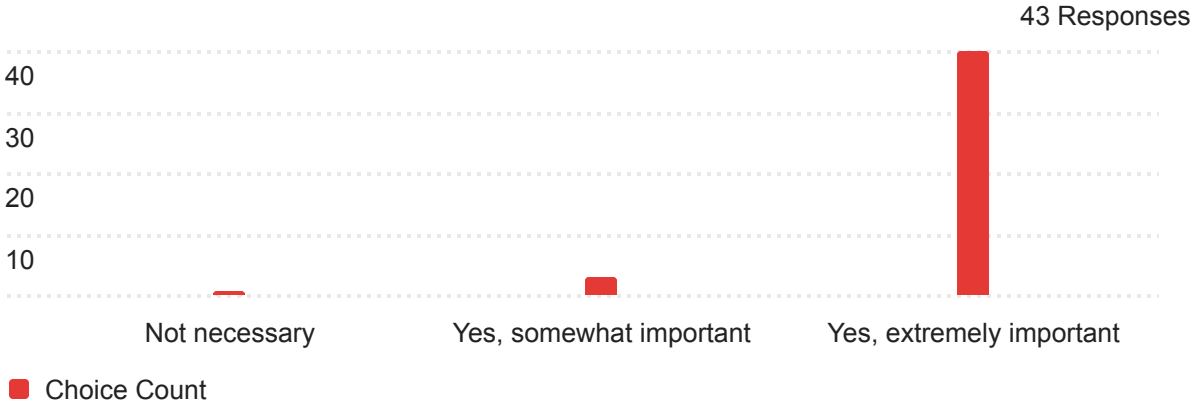
Q8.1 - What would be an estimate of the cost savings from reducing the use of pesticides as a result of the information provided?

16 Responses



Appendix 5. (Continued)

Q9 - Does the Rutgers Plant Diagnostic Laboratory provide a beneficial service for you?



Appendix 5. (Continued)

Q10 - If you would like to share any additional comments about the service you received from the Rutgers Plant Diagnostic Laboratory, please enter them below.

25 Responses

If you would like to share any additional comments about the service you received from the Rutgers Plant Diagnostic Laboratory, please enter them below.

Very timely response that will enable to implement solutions to the problems that my boxwood plants have had.

I am very grateful for this service and especially the timeliness of the turnaround. Not sure yet what I'm going to do about the area affected but will definitely not plant garlic there again. I may try replacing the soil since it's a small area. Monitoring with some other crops at the moment.

They weren't able to determine an exact cause for my dying birch trees. I'm sure they checked the samples I brought in but I don't know what to do next.

The support of the PDL is amazing. Their knowledge and expertise is a valuable tool that all superintendents and Sales reps should use!
Thank you for your help

Sabrina was very helpful, knowledgeable, professional and courteous. I was very glad to work with her.

Best Diagnostic Lab in the industry!

Great service, Everyone I talked to including salesmen of pesticides, other superintendents all said it was Take all patch. I thought Pythium root rot but was second guessing myself after everyone else thought different. Now I know and am not wasting product and turf quality chasing the wrong disease.
Thanks for the quick response and great service.

I would like to know what I can use to eliminate the pest in question? Traps, pesticides, or something else.

They make me look good.

I am so pleased with the results of this service, which far exceeded my expectations. It provided detailed analysis and suggestions which gives a landscaping novice like myself the confidence in addressing the issues with my boxwoods.

I greatly appreciate the extra level of confidence gained from this service while I work to enhance my own diagnostic skills.

Appendix 5. (Continued)

Rutgers Plant Diagnostic Laboratory is an indispensable resource for anyone interested in horticulture. I greatly appreciate the diligent work of the Laboratory staff, as they always provided prompt, accurate diagnosis of any sample I sent.

Thank you very much for this service. The analysis costs are most reasonable for the professional help/information received. The speed with which I received results was very helpful because it allowed me to make quick decisions about saving or not saving dahlia tubers.

First time using the lab. I will be using it much more in the future.

We are very fortunate to have this service available to help establish the origin of an ornamental tree's inability to thrive. The report we received was thorough and timely. Thank you.

Mailing in the sample is difficult and a strong disincentive to use Rutgers Labs. I can understand that you guys need to restrict the New Brunswick walk ins and time wasters but from our perspective it was always much more convenient for us to be able bring samples in. The doors being locked and no one answering the phones sends a strong message to Stay Away!

Very quick turn around with results same day

I was really happy with everything

World class diagnostic capability

I was very impressed with the speed and professionalism of your testing program. You provide a vital service to the survival and maintenance of the natural environment.

I'm very pleased with the service - great job - quick response - very nice !
I spoke with Sabrina who was very nice, helpful and caring! She is a great employee from my experinece with her.

I really appreciate the insect identification service the Rutgers Plant Diagnostic Laboratory offers. With the information the lab sent, I can now focus on addressing our issue based on the characteristics of the insect instead of taking a guess at what will help.

Quick, easy and accurate... I would also recommend you have your soil tested at the Rutgers Soil Testing Laboratory

If there are no pathogens found on a sample, i appreciate the thorough advise for keeping plants healthy so the outcome regarding plant health is better when the plant is exposed to extreme conditions.

Thanks to the lab for a very timely diagnosis. Never thought I'd see summer patch in Vermont on fescue.

RUTGERS UNIVERSITY
Plant Diagnostic Laboratory
New Jersey Agricultural Experiment Station

Plant Diagnostic Laboratory
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Rutgers, The State University of New Jersey
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