

RUTGERS

New Jersey Agricultural
Experiment Station

Rutgers Soil Testing and Plant Diagnostic Services

2018 Fiscal Year Report (July 1, 2017 to June 30, 2018)

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2018 Fiscal Year

Rutgers Soil Testing and Plant Diagnostic Services

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 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 these laboratories during the 2018 fiscal year.

History

The Rutgers Soil Testing Laboratory

Soil testing at Rutgers has a history as long as the NJAES has been in existence. As early as the 1860s, George H. Cook was involved in the chemical analysis of soils and fertilizers. E.B. Voorhees followed Cook as director of the Experiment Station and became famous for applying chemistry to soil fertility issues. By 1940 when the Department of Soils was formed, soil testing for the public had begun in earnest as thousands of samples were analyzed for elemental deficiencies, acidity levels, and organic matter content. After the Departments of Soils merged with Farm Crops to form the Department of Soils and Crops in 1963, Dr. Dennis Markus became director of the public soil testing laboratory in the new department. When Dr. Markus retired in 1984, Dr. Harry Motto guided laboratory operations until his own retirement in 1996. Under the subsequent leadership of Dr. Stephanie Murphy, the Rutgers Soil Testing Laboratory (STL) has processed over 189,000 soil samples for chemical and physical analysis and continues to play an integral role in soil nutrient management, engineering, and environmental assessments for the public and for RCE and SEBS/NJAES programs. Since January 2006, the STL has been located in Rutgers' Administrative Services Building II on US Route 1 in New Brunswick, NJ: administratively, the STL is part of the Plant Biology Department.

The Rutgers Plant Diagnostic Laboratory and Nematode Detection Service

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 51,324 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, Principal Laboratory Technician, 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.

STL

Dr. Stephanie Murphy is the director of the STL. She has served the University in this capacity since 1996 after several years as a post-doctoral research associate and instructor within the De-

partment of Environmental Sciences. Dr. Murphy has a Ph.D. in Soil Science from Michigan State University, an M.S. in Soil Management and Conservation from Purdue University, and a B.S. in Agronomy from Ohio State University. She is a member of the American Society of Agronomy, the Soil Science Society of America, the Soil & Water Conservation Society, and the New Jersey Association of Professional Soil Scientists. Dr. Murphy is responsible for the day-to-day operations of the STL and participates in research, teaching, and outreach activities.

Mr. Steve Griglak, Principal Laboratory Technician, has worked in the STL since 1995. He received his B.S. in Environmental Science from Rutgers University in May 1998. Mr. Griglak's primary duties include the extraction and analysis of soil nutrients and the coordination and performance of the various special tests offered by the laboratory. He is also responsible for the maintenance and repair of laboratory equipment and testing devices.

Ms. Terriann DiLalo has been a part-time administrative assistant for the STL since 2002. She is responsible for data entry, report generation, invoice processing, record keeping, and supply procurement.

Ms. Phyllis Breeman has been with the STL as a laboratory technician since 2011. Ms. Breeman is a native of New Jersey and earned a B.S. in Geology from Richard Stockton University and an M.S. in soil science from the University of Arizona. She processes soil samples, performs soil tests, provides customer service, and works closely with student assistants.

Other Support

Both the STL and the PDL employ several Rutgers undergraduate students each year 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/School of Environmental and Biological Sciences (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, and we also acknowledge

members of the SEBS/NJAES Office of Communications for their support and assistance.

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). Sample submission forms are also available in local County Agricultural offices and by FAX directly from the PDL. Samples are submitted either by mail to a post office box in Milltown or by private delivery service directly to the laboratory. Many PDL 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.

Like the PDL, the STL receives samples from a varied clientele, and fee schedules, sampling instructions, and submission forms are available on the NJAES website www.njaes.rutgers.edu/services. Soil samples can be submitted in soil test kits, available for purchase from RCE County Offices, which include a submission form, sampling instructions, and a mailing bag to contain the soil sample and paperwork. Standard soil fertility testing (defined as pH, P, K, Mg, Ca, Cu, Mn, Zn, Fe, and B) is included with the purchase of the kit. Additional special tests not included in the standard assay can be requested on the submission form at additional cost. Samples may be submitted without the soil test kits as long as appropriate identifying information and pre-payment is included. Results for any tests not pre-paid will be withheld until payment has been received.

Soil samples are generally processed according to order of entry into the laboratory. Sample analysis can be prioritized, however, by paying a special express processing fee. Upon the completion of the tests, a report is generated and delivered by email or postal mail. General recommendations for limestone and fertilizer are provided on standard test reports for most New Jersey plantings. The client must supply appropriate planting information to receive fertility guidelines. The appropriate county RCE office receives a copy of soil test reports for farmer, homeowner, and landscaping clients for better service to the client and more outreach opportunities for RCE.

Fiscal Year 2018 Report

Operations

PDL

During the 2018 fiscal year (July 1, 2017 to June 30, 2018), the PDL examined 1,768 specimens submitted for diagnosis, identification

(insects, weeds, or fungi), or nematode assay (Table 1), representing a 21% decrease (or 484 samples) from FY18. Samples (Figure 2) submitted for diagnosis (-205) decreased and nematode analysis (+1) increased in FY18. There was a decrease in insect identifications (-280) mostly from Cooperative Agricultural Pest Survey (CAPS) and NJ State Forestry Services trap catches. In general, sample submissions remained steady for most of the year,

Figure 1.

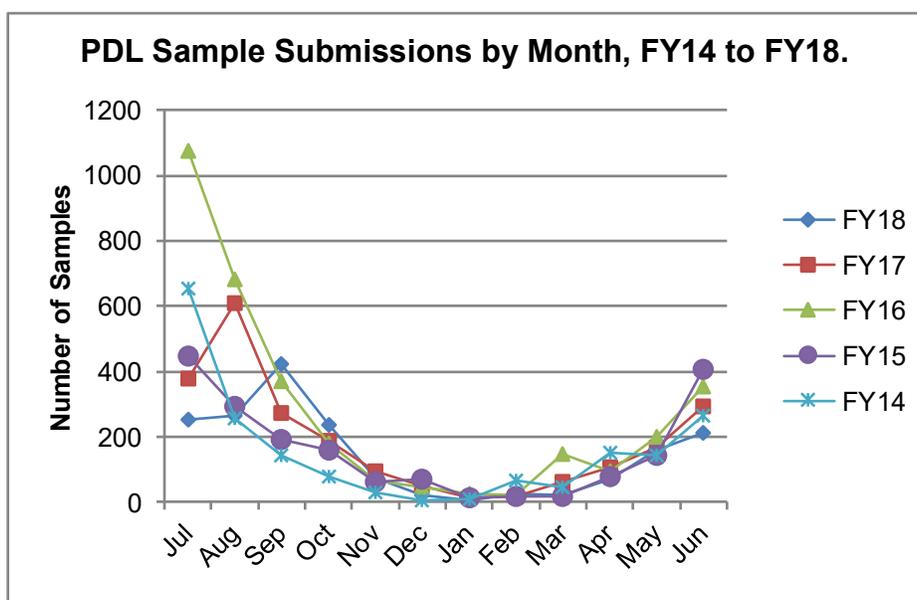
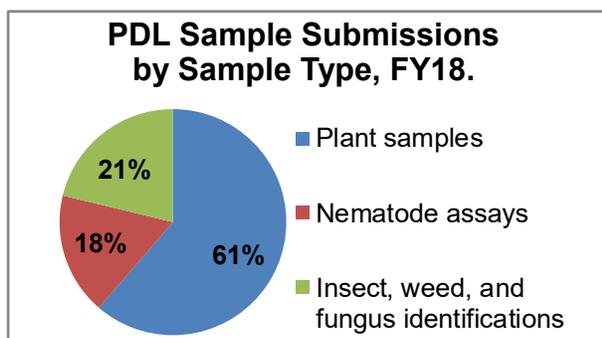


Table 1. PDL sample submissions by month, FY14 to FY18.

Month	FY14	FY15	FY16	FY17	FY18
July	655	449	1076	380	252
August	258	294	681	609	266
September	145	190	371	272	424
October	77	158	178	188	236
November	30	60	66	93	74
December	6	69	47	50	20
January	10	12	24	14	6
February	68	16	21	16	25
March	44	19	148	62	21
April	150	80	96	105	71
May	143	142	201	168	161
June	266	407	353	295	212
Total	1852	1896	3262	2252	1768

Figure 2.



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 1,768 sample submissions, the PDL was operating within the capacity of the laboratory to function efficiently.

The specimens submitted to the PDL by sample type are presented in Figure 2. Most samples, 61% (1,084), were plant samples submitted for diagnosis, 21% (375) of the samples were insect, mold, or plant identifications and 18% (309) of the samples were for nematode analysis.

In Figure 3, samples submitted to the laboratory are presented by origin. In FY18, 85% of the plant submissions were from commercial clientele, 11% were from residential clientele, and 4% 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 FY18, 85% of samples submitted for plant or insect identification were from commercial clients, and 14% were residential in origin (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% (2 samples)

from research, and <1% (2 samples) from residential clientele. We expect that the number of nematode samples submitted from residential clients (2) will remain low or nonexistent, since much of this clientele is not familiar with nematode pests.

In general, 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 (93%) 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 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; however, nematode samples from growers establishing vineyards were also very common. A large portion of the nematode

Figure 3.

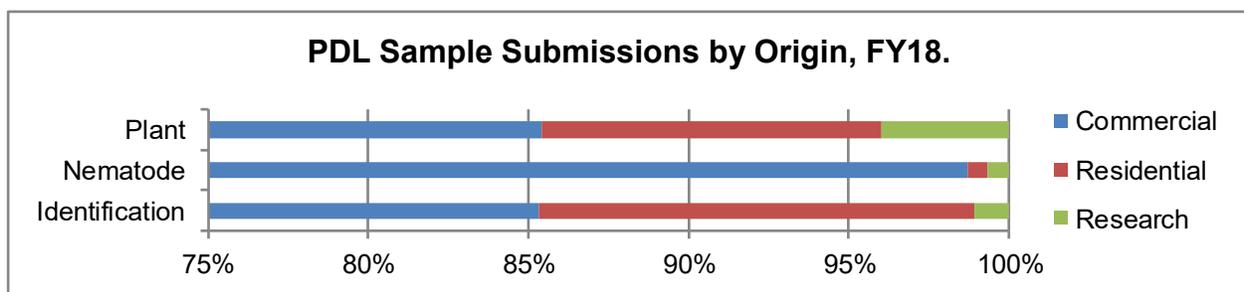


Figure 4.

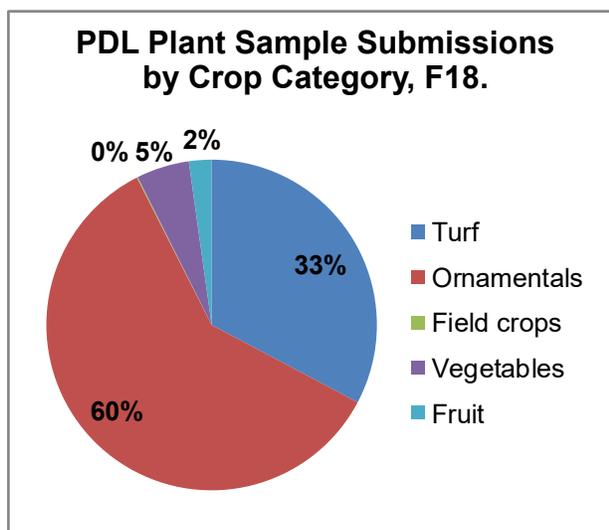
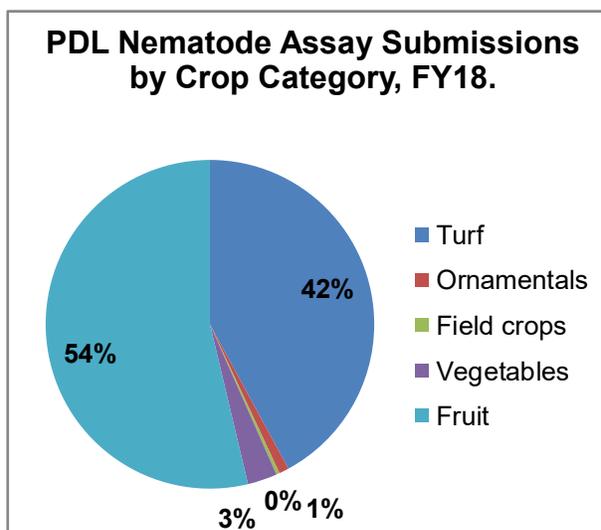


Figure 5.

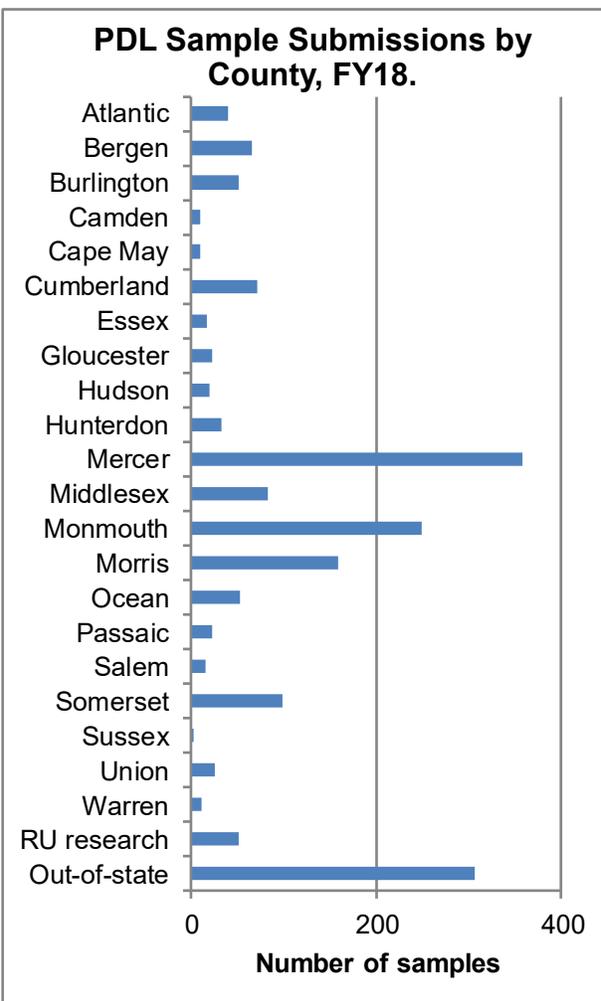


samples in FY18 were submitted to the laboratory through the Rutgers Fruit IPM program from blueberry growers. Golf turf represents most of the nematode samples from turfgrass clientele. Although the numbers are significant, interest in nematode detection on golf turf has waned as control options have been removed from the market. 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 and 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 is equal to FY18—but a decrease of 82 samples. Of particular note, 48% of all turf samples were from out-of-state. Golf turf samples were submitted to the la-

Figure 6.



laboratory from 15 states in FY18. Turf samples were received from states as far away as Alabama, California, Colorado, Connecticut, Maryland, Minnesota, North Carolina, Ohio, Ontario, Oregon, Pennsylvania, and West Virginia. New York, Maryland, and Virginia provide the largest number of out-of-state samples. Because of his national reputation and his strong support for the laboratory, Dr. Bruce Clarke has helped the Rutgers laboratory develop into one of the premier golf turf diagnostic facilities in the country. Many golf course superintendents contact Dr. Clarke for help, who always forwards them to the laboratory for diagnostic services. Because there are very few laboratories in the country that diagnose turfgrass diseases, these superintendents have continued to submit samples to the PDL. Many golf turf professionals at other universities often 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

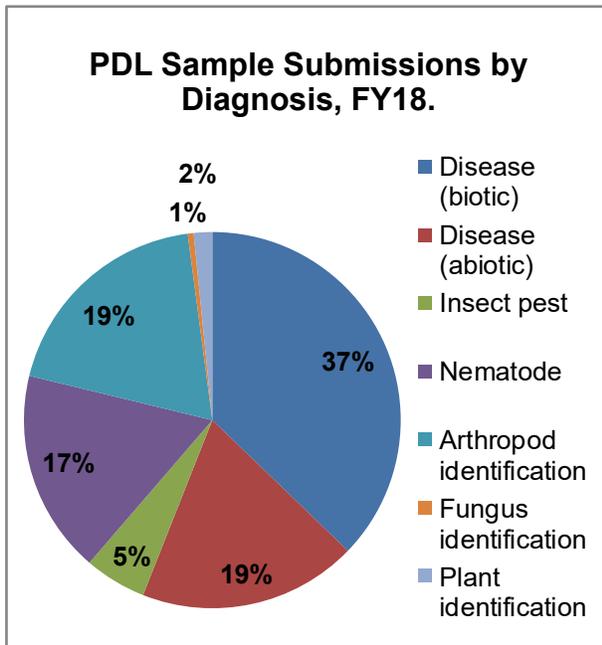
Rutgers graduates, refer clients to the PDL. Dr. Frank Rossi of Cornell University is also a great supporter of our program. He advocates and advertises laboratory services in his ShortCutt newsletter, which reaches more than 2,700 turf managers in New York State. Lastly, Mr. Buckley's association with 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, 37% 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 19% of the laboratory diagnoses. Insect pest damage was diagnosed on 5% of the submissions.

Table 2. PDL sample submissions by county, FY14 to FY18.

In-state	FY14	FY15	FY16	FY17	FY18
Atlantic	103	94	102	43	39
Bergen	81	55	69	84	65
Burlington	119	89	79	66	51
Camden	48	25	47	36	10
Cape May	5	11	3	11	9
Cumberland	68	58	75	85	71
Essex	41	40	42	101	17
Gloucester	25	18	17	10	23
Hudson	35	3	12	21	19
Hunterdon	27	34	42	23	32
Mercer	250	446	1528	607	358
Middlesex	109	104	114	106	82
Monmouth	90	74	180	202	249
Morris	154	140	199	169	159
Ocean	42	37	65	47	53
Passaic	26	46	66	35	23
Salem	3	7	20	20	51
Somerset	84	102	120	108	15
Sussex	3	12	15	6	98
Union	28	27	13	18	2
Warren	2	8	11	5	25
RU research	90	178	195	61	11
In-state total	1433	1608	3014	1864	1462
Out-of-state	419	288	248	388	306
Total	1852	1896	3262	2252	1768

Figure 7.

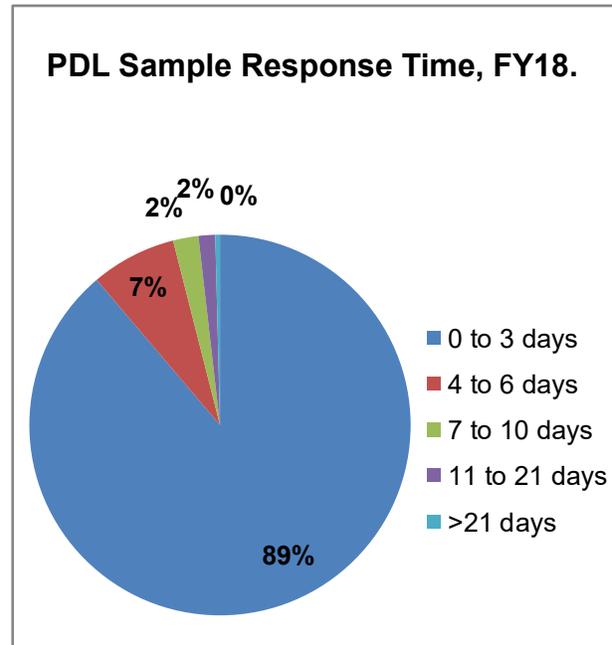


Identifications comprised 22% of the total number of samples submitted; of these, 19% (338) were arthropods, 1% (9) fungi, and 2% (28) were plants. Nematode detection accounted for the other 17% of submissions. The overall breakdown in sample submissions is typical of that reported by other diagnostic 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. 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 decreased in FY18 because the number of trap catch samples from the state's CAPS and NJ State Forestry Services programs decreased (-201).

Fungal identification is also a popular service for the laboratory. Samples from mold-infested houses remained steady in FY18. 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.

Figure 8.



In FY18, a laboratory response was prepared in less than three days for most (89%) of the samples submitted (Figure 8), and 96% of our clients received a response in less than a week. A number of the samples (32) 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.

Figure 9.

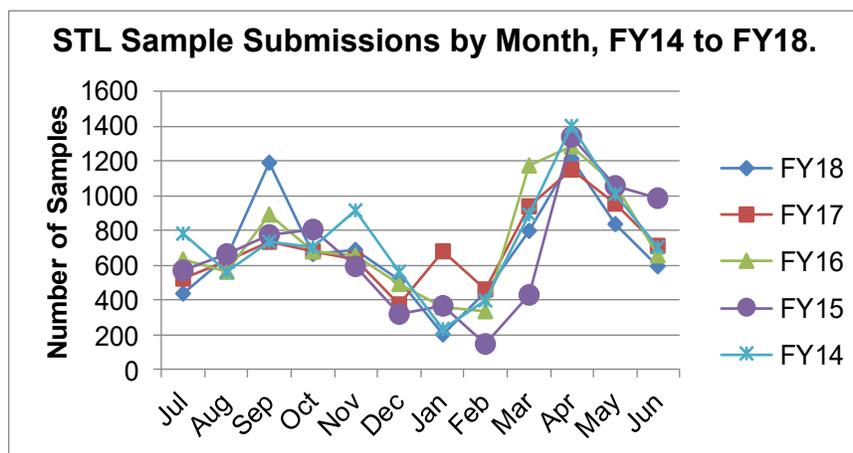


Table 3. STL sample submissions by month, FY14 to FY18.

Month	FY14	FY15	FY16	FY17	FY18
July	781	574	632	525	438
August	559	667	559	623	649
September	735	772	890	735	1190
October	704	805	678	681	664
November	915	596	653	631	686
December	564	323	492	375	515
January	234	363	360	677	206
February	398	151	335	457	443
March	890	430	1170	937	795
April	1403	1341	1280	1152	1214
May	1009	1055	1064	955	838
June	707	988	656	715	595
Total	8899	8065	8769	8463	8233

STL

The STL processed 8,233 samples of soil, compost, and irrigation water in FY18 (Table 3). The total number of samples received decreased 2.7% (230 samples) compared to FY17. Of the total soil samples submitted to the STL for analysis in FY18, 50% were for the standard soil analysis (only) and 50% included requests for additional special tests (Figure 10). The number of special tests indicates the additional work load, which is not simply related to sample numbers. Sample response time is influenced by many factors, including the total number of submissions and the number of special tests requested each month.

As usual (Figure 9, Table 3), sample submissions were greatest in spring, peaking in April, in preparation for the growing season. The typical secondary surge of samples usually associated with early fall lawn fertilization occurred in September. Turf fertilization is prohibited after November 15 for the general public and after December 1 for certified turfgrass professionals.

In FY18, soil samples from residential clientele represented 30% of the total number of soil samples (Figure 11). Commercial growers, including the producers of fruit and vegetables crops, submit-

Figure 10.

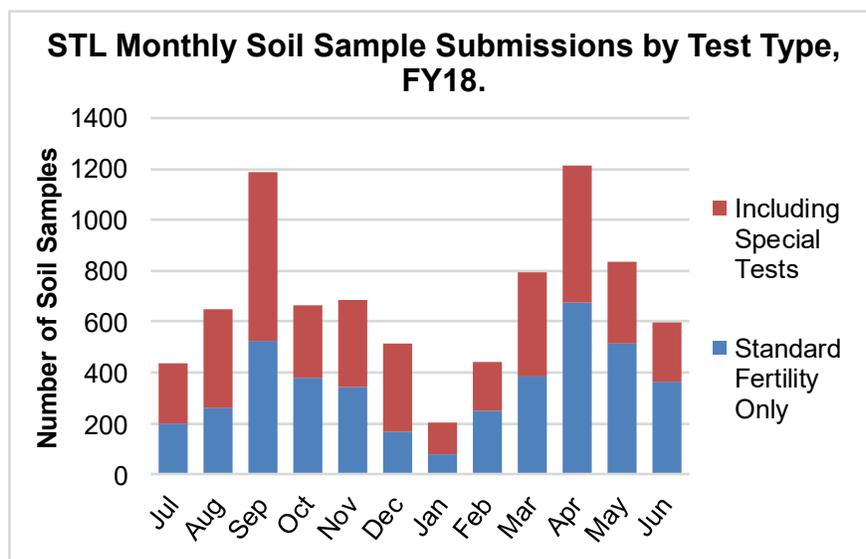
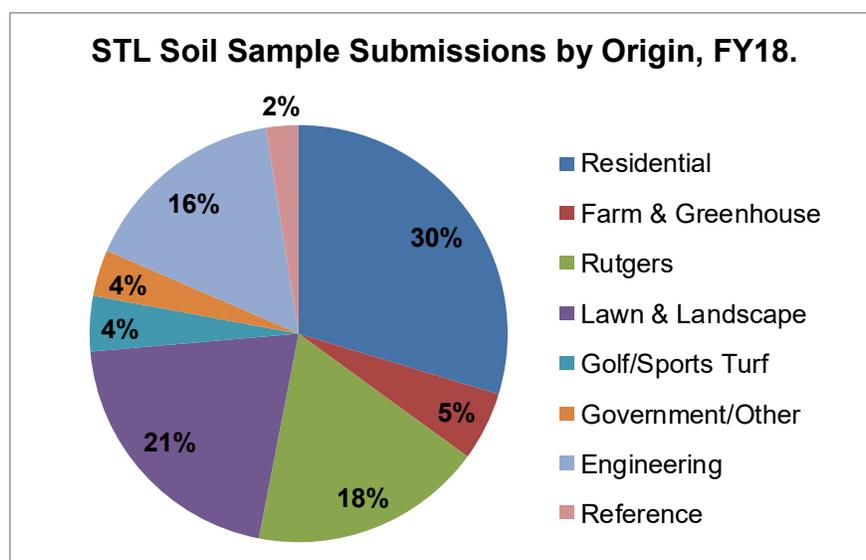


Figure 11.



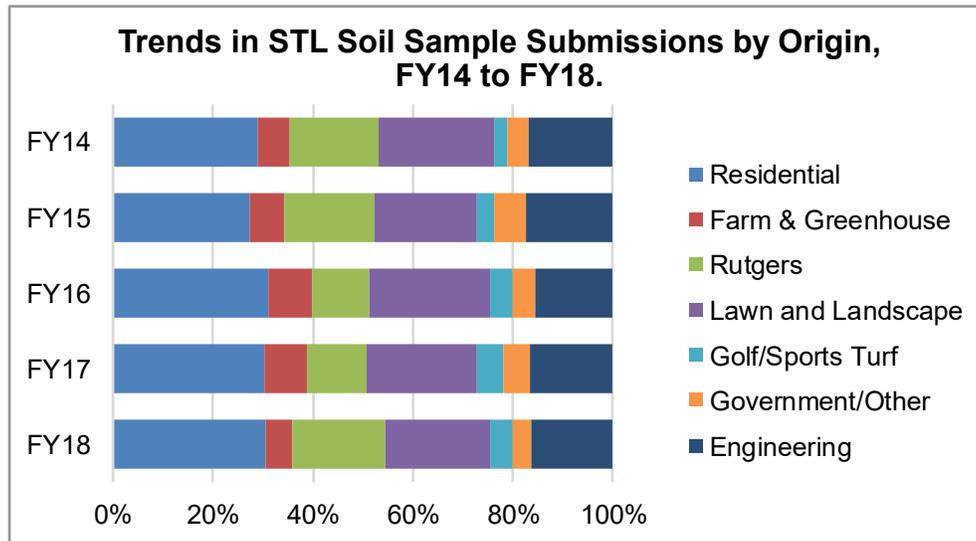
ted 5% of samples; samples from landscape professionals represented 21%; and golf course samples and athletic field samples represented 4% of the total. Samples from engineering firms comprised 16% of the workload, 18% of the samples were from research or Cooperative Extension programs at Rutgers, and 4% were from government agencies, school districts and non-profits. Soil samples from residential clientele remain the majority of laboratory submissions. Samples from landscape professionals and environmental/engineering companies are important due to large numbers of samples submitted and more frequent need for special tests. Special test requests provide clear financial

benefit to the lab, helping to maintain necessary income. However, turnaround time is affected when laboratory staff workload is heavily laden with more labor-intensive special tests, with more time required to complete analyses and distribute soil test reports.

Looking back five years, annual numbers of samples submitted by various clientele groups show no clear or consistent trends as percentages of the total sample load (Figure 12).

Samples were submitted to the STL from all counties in New Jersey (Figure 13, Table 4). Many

Figure 12.



samples were submitted from counties in close proximity to the laboratory (Mercer, Monmouth); however, because most samples for soil testing are delivered by mail (facilitated by soil testing kits sold by the county offices of RCE), public access to the laboratory is less of a factor for sample submissions than those destined for the PDL. County profiles, therefore, often reflect RCE county faculty with robust home horticulture programs that actively utilize and promote STL services or those with outreach events (Master Gardener events, fairs, field days, etc.) that provide opportunities to promote soil testing. To some degree, population centers also help describe the influx of samples. Landscapers (etc.) who work across several counties have the effect of inflating the sample numbers for their “home” county. Similarly, engineering or environmental firms submit samples from a central office that may not conform to the location where the soil was sampled, but in these cases a county affiliation is not usually identified. Such soil samples are usually submitted for “topsoil” quality control/assurance with required specifications, and recommendations are only occasionally requested. Notice that three New York county Cooperative Extension offices (Ulster, Westchester, and Sullivan Counties) have adopted Rutgers STL since Cornell University closed its public service laboratory.

For efficiency in accumulating laboratory data and generating reports for clients, an internet-based laboratory database was developed and customized for Rutgers STL by Robert Muldowney of the NJAES IT staff; he has spent countless hours revising and upgrading the system as well as responding to emergency help questions or issues. The database is designed to handle the multitude

Figure 13.

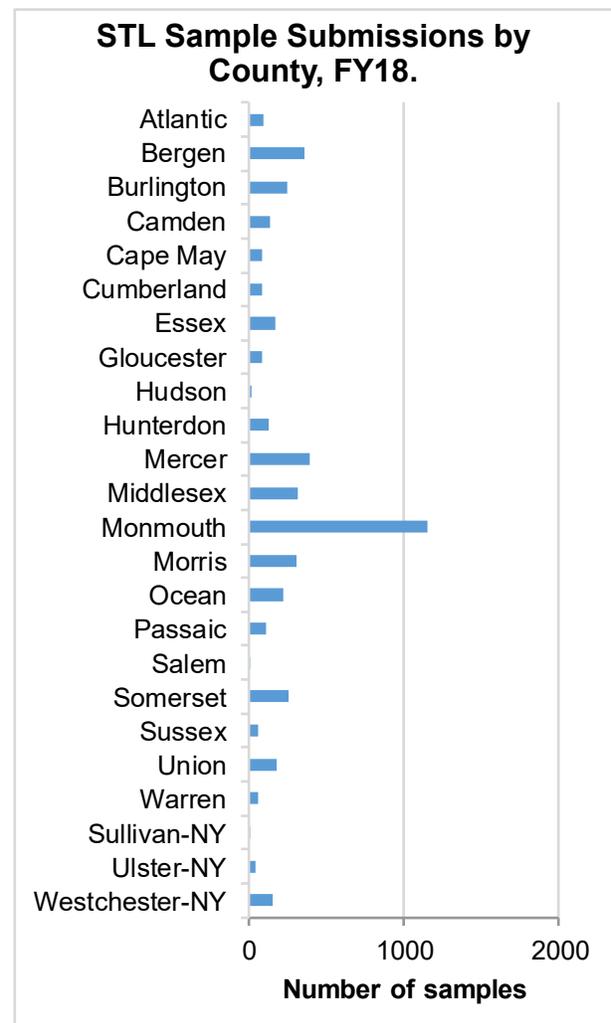


Table 4. STL soil sample submissions by county, FY14 to FY18.

In-state	FY14	FY15	FY16	FY17	FY18
Atlantic	111	119	119	112	95
Bergen	229	329	355	284	360
Burlington	251	181	317	251	245
Camden	180	145	141	197	137
Cape May	114	69	118	100	85
Cumberland	102	90	78	71	85
Essex	194	120	162	117	168
Gloucester	135	109	147	148	88
Hudson	11	13	12	27	14
Hunterdon	137	144	169	190	131
Mercer	546	440	473	405	392
Middlesex	330	301	337	291	320
Monmouth	1396	979	1413	1557	1154
Morris	337	313	375	291	309
Ocean	235	202	228	192	227
Passaic	106	83	97	113	110
Salem	15	5	6	16	1
Somerset	250	235	296	250	253
Sussex	108	99	163	105	59
Union	163	168	157	199	184
Warren	72	77	86	57	58
New York State	209	205	253	154	195
Reference	193	157	188	197	202
Unspecified	3475	3632	3037	3139	3361
Total	8899	8065	8769	8463	8233

Figure 14. Percentages of soil samples within macronutrient classes.

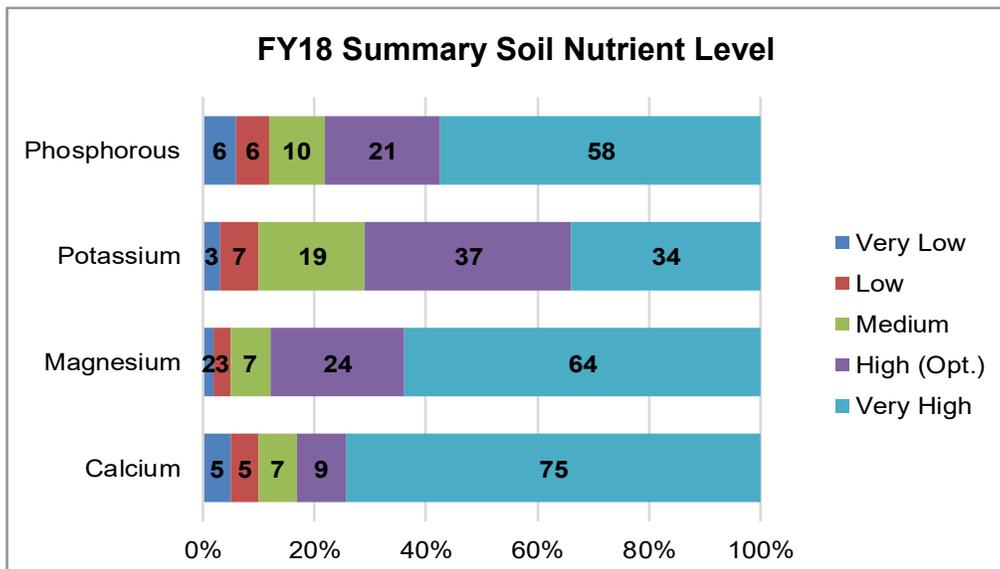
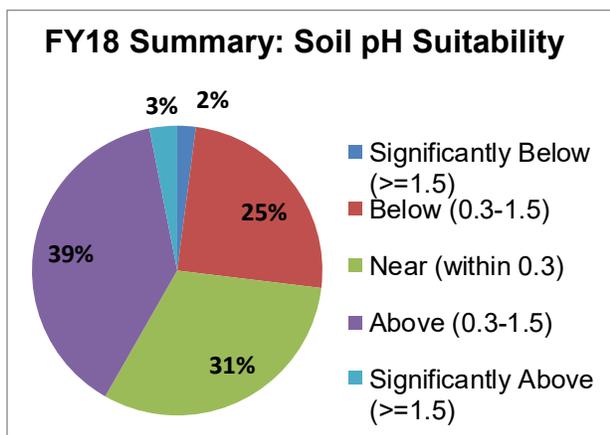


Figure 15. Soil pH of samples submitted in FY18.



of various sample types in terms of test data and complex reporting requirements, including data summaries such as provided here for FY18. The database also serves to deliver soil test reports to clients by email.

“Standard” fertility analysis of soils includes soil pH and levels of nine nutrients. Samples must be dried, ground, and sieved (2mm) before further processing. The nutrients are extracted by a chemical solution called “Mehlich-3” and analyzed in the extractant solution by inductively coupled plasma, atomic emission spectrophotometry (ICP-AES).

Macronutrient data of soil samples received for fertility testing from July 2017 through June 2018 are summarized in Figure 14. Colored sections of bars indicate the proportion of samples that fell into the five categories of soil test levels, very low (on the left) to very high (on the right). High or very high levels of phosphorus (P) were measured in 79% of the samples tested, and potassium (K) levels were high or very high in 71% of the samples tested.

These data suggest the historical overuse of fertilizers containing P and K on soils that do not need them. This may be the result of fertilizer manufacturers promoting routine applications of their products without benefit of soil tests. Turfgrass products vary in levels of %N-%P₂O₅-%K₂O (fertilizer grade) in their four- or five-step programs according to season, and manufacturers do not have a wide variety of products that address variations in soil test levels. Over time, this has led to the high percentage of samples with excess P and K levels. Recent recognition of negative impacts of excess P on water quality has led to increased environmental regulations, including New Jersey’s turf fertilization law; fertilizer manufacturers have had to re-formulate products to provide zero- (or low-) P

contents, and now more no/low-P fertilizers are becoming commercially available. At the same time, it has become more difficult to find appropriate fertilizer ratios for soil areas deficient in P. Turfgrass “starter” fertilizer is the exception to the zero-phosphate legislation, but only one fertilizer grade is typically available per manufacturer, and grades differ between manufacturers. The limited availability in the retail fertilizer market of single nutrient materials, often recommended as a supplement to mixed, “complete” fertilizers (containing N, P, and K), is likely to exacerbate over-fertilization. That is, fertilizers with inappropriate analysis may be applied because the supplemental single-nutrient fertilizers cannot be found.

Calcium (Ca) and magnesium (Mg) are at high or very high levels in even greater percentages of the soil samples received in FY18, 84% and 88% respectively. The samples that these categories represent are often at or above the target soil pH because of limestone (CaCO₃ with various percentages of MgCO₃) applications. And yet there are samples that are deficient in one or both of those elements even when pH is optimum; gypsum (CaSO₄) or MgSO₄ are recommended amendments in those cases. Otherwise when soil pH is below optimum, limestone is recommended to address both soil pH and Ca or Mg deficiency.

While large percentages of samples received by the STL have high (optimum) or very high macronutrient levels, it would be unwise to conclude without benefit of soil test that fertilization is unnecessary for all NJ soils. Soil samples received represent a small percentage of actual land area, and the samples should not be assumed to accurately represent all areas (that is, these numbers do not represent random, unbiased sampling). Furthermore, for those soils that are deficient in any nutrient, proper fertilization would make a substantial improvement in production, quality, or health of the plant/crop.

Soil pH is another characteristic that is crucial to a soil’s fertility. Soil pH that is too high or too low can cause nutrients to be unavailable (insoluble or otherwise “tied-up”) even when present in sufficient amounts. The target pH is determined by the plant/crop being grown. While most plants “prefer” soil pH in the range 6.1 to 6.8, there are certain plants that are adapted to more acidic soil, the “acid-loving” plants. Other plants have greater requirement for calcium and consequently perform better at slightly higher soil pH. Soil test recommendations are customized to account for these differences. Furthermore, overly acidic soils can increase solubility/availability of soluble aluminum, an element harmful to plant roots. Adjusting the soil

pH benefits the plant by minimizing this stress as well.

Soil pH data of samples submitted to the STL in FY18 are in summarized Figure 15. The categories are based on the deviation from the target pH for the specified crop or planting. This demonstrates the need to optimize soil pH, either to apply limestone to raise pH or to acidify the soil. Therefore, it is clear that 31% of samples of those analyzed for pH during FY18 were “near” the target (within 0.3 pH units). Twenty-five percent of samples were “somewhat” (0.3 - 1.5 pH units) below the optimum pH range, and appropriate limestone recommendations (various rates depending on deviation from the target and buffering capacity of the soil) were provided except in cases where acid-producing soil is suspected (pH<4.0). Two percent of samples were significantly below (>1.5 units) the optimum pH range. On the alkaline side of the scale, 39% pH samples were 0.3 to 1.5 units higher than the optimum range. If pH is above optimum by less than 0.5, the advice is to do nothing and allow the natural soil processes which occur in New Jersey’s humid, temperate climate to acidify the soil over a season. Otherwise when pH is significantly higher than the target, acidification is recommended, with elemental sulfur being the preferred soil amendment. In extreme cases, such as the 3% of samples that were more than 1.5 units above the optimum range, it is advised that the cause of alkalinity be determined before recommendations are provided.

Teaching and Outreach

In addition to providing diagnostic services and soil analysis, the staff of the PDL and STL provides significant educational and outreach services to SEBS, NJAES/RCE, and other agencies (Appendix 3). Many of these activities generated additional income for the laboratories.

Richard Buckley

Mr. Buckley is an instructor in the Rutgers Professional Golf Turf Management School. 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 contact 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 FY18. These courses included: the Golf Turf Management School: Three Week Preparatory Course; Landscape Integrated Pest Management: An Intelligent Approach; Athletic Field Construction; and the Emergency Pesticide Credit Recertification Short Course.

Mr. Buckley served as the course coordinator and lecturer for the Pest Management in Landscape Turf Short Course. This was the 26th year for this one-day program. Mr. Buckley also coordinated and taught the Advanced Topics in Professional Grounds Maintenance: Turf Disease Short Course. This was the 20th time he planned and coordinated that short course.

Mr. Buckley participated as a guest speaker in the Nursery Crop Production 11:776:439 undergraduate course at Rutgers University. He team-taught the Rutgers three-credit undergraduate course, Diseases and Insect Pests of Ornamental Plants 11:776:391, with Dr. Ann Gould. This was the seventh semester that this course has been presented.

Mr. Buckley was an invited speaker in several RCE programs. Lectures were given in support of the Atlantic, Camden, Gloucester, Hunterdon, Essex, Monmouth, Morris, Ocean, Passaic, Somerset, and Union County Master Gardener Programs.

Mr. Buckley was also an invited speaker for: Burlington County Natural Sciences Club; New Jersey Shade Tree Federation Annual Conference; Friends of Frelinghuysen Arboretum; Metropolitan Golf Course Superintendents Association Fall Education Seminar; Delaware Nursery and Landscape Association 2017 Ornamental and Turf Workshop; Mercer County Sierra Club; North Jersey Ornamental Horticulture Conference; FALCAN / University of Maryland Pest Management Conference; Penn State 2018 Winter Turf and Ornamentals School; SavATree 2018 Sales Conferences in Palisades, NY and Danbury, CT; Northern Nurseries: Northern University; Reed and Perrine Turf and Ornamentals Seminar; Morris Arboretum School of Arboriculture; Golf Course Superintendents Association of New Jersey Spring Education Day; New York State Turf and Landscape Association Professional Conference and Trade Show; Penn-Del Chapter of the International Society of Arboriculture Pest Bull Session; Landscape Contractors Association of MD, DC, VA: Pesticide and Fertilizer Applicator Recertification Conference; Connecticut Grounds Keepers Association Turf and Landscape Conference; 29th Annual West Virginia Golf Course Superintendents Association and West Virginia PGA Turf Conference & Show; New Jersey Green Expo Turf and Landscape Conference; New

Jersey Nursery and Landscape Association Summer Meeting and NJ Plants Professional Landscape and Nursery Trade Show; SiteOne University programs in Batavia, Liverpool, and Saratoga, NY and Dover, DE; and the NJ Christmas Tree Growers Twilight Meetings in Passaic and Warren counties.

Sabrina Tirpak

Ms. Sabrina Tirpak is responsible for teaching Turf Diseases and Turf Insects laboratory practicum in the Rutgers Professional Golf Turf Management School. She has approximately 60 hours of contact time per year in the turf school. Other OCEPE programs in which she participated were Landscape Integrated Pest Management: An Intelligent Approach, and Pest Management in Landscape Turf Short Course.

Ms. Tirpak was an invited speaker for the RCE Central Jersey Ornamentals Institute. She also presented programs in support of the Essex, Monmouth, Passaic, and Ocean County Master Gardener Programs.

Ms. Tirpak participated as a guest speaker in two undergraduate and/or graduate courses at Rutgers: General Plant Pathology (11:776:302), and Diseases and Insects of Ornamental Plants (11:776:391). She also hosted students through the USGA Learning Science Through Golf STEM Academy for a tour of the PDL.

Ms. Tirpak was also an invited speaker for the New Jersey Green Expo Turf and Landscape Conference; Brooklyn Landscape Gardeners' Association Annual Seminar; Duke Community Gardens; and the Friends of the Frelinghuysen Arboretum.

Ms. Tirpak spent considerable time and effort in FY18 conducting review sessions for Rutgers Turf Club members participating in the Golf Course Superintendents Association of America Collegiate Turf Bowl. The Turf Bowl is held at the GCSAA annual meeting, most recently in San Antonio, TX.

Stephanie Murphy

Dr. Stephanie Murphy was an invited speaker in the Rutgers OCEPE Soils and Site Evaluation for Septic Disposal Systems and Stormwater BMPs short course. She also presented lectures in support of the Atlantic, Hunterdon, and Monmouth County Master Gardener Training Programs.

Dr. Murphy was also an invited presenter for the Rutgers Gardens Summerfest Ask the Experts Table; NJ Shade Tree Federation Annual Conference; Northeast Organic Farming Association of NJ Annual Winter Conference; NJ Flower and Garden

Show; MidAtlantic Soil Testing & Plant Analysis Working Group Meeting; and the NJ Environmental Health Association Conference.

Dr. Murphy taught the Rutgers three-credit undergraduate course Soils and Society (11:375:102) and was a guest lecturer in Landscape Architecture Construction. She also hosted students from Soil Fertility (11:776:440) and Soils and Water (11:375:360) for tours of the STL along with detailed explanations of soil testing theory and practices.

Extension Publications

Mr. Buckley is a regular 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. To date, the PDL has more than 350 unique subscribers to the site. Mr. Buckley and Ms. Tirpak wrote brief posts on the disease and insect pests problems submitted to the laboratory. Most of the articles submitted to the PPA blog were also submitted for publication in the Cornell University ShortCUTT turfgrass newsletter. The Plant Diagnostic Laboratory's PPA blog posts can be found at plant-pest-advisory.rutgers.edu/category/plant-diagnostic-lab.

Service

The PDL staff provided tours of the Ralph Geiger Turfgrass Education Center and the Plant Diagnostic Laboratory to numerous groups in FY18. In addition, the STL staff also provided tours of their lab for several programs.

Dr. Murphy has represented the Executive Dean of Cook College/School of Environmental and Biological Sciences on the New Jersey Department of Agriculture's State Soil Conservation Committee since 1998. Dr. Murphy also participated in the Future Farmers of America Land Judging Competition as soil pit monitor. She also led efforts to train Rutgers Grounds staff.

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

To help advertise laboratory services at grower meetings or other activities, two sets of table-top and banner display units are available on loan to anyone who wishes to advertise STL&PDL services. The laboratory staff is also willing to attend and staff an exhibit to explain laboratory services and sell soil test kits.

In FY18, this marketing initiative brought the display to the following programs: The 2017 Great Tomato Tasting; New Jersey Green Expo Turf and Landscape Conference; Frelinghuysen Arboretum's Community Garden Conference; Rutgers Home Gardeners School; Rutgers Gardens Summerfest; New Jersey Nursery and Landscape Association NJ Plants Show - Professional Landscape and Nursery Tradeshow; New Jersey Nursery and Landscape Association summer meeting at Rutgers Gardens; New Jersey Flower and Garden Show; New Jersey Nursery and Landscape Association Meeting; Rutgers Day (Ag Field Day); and the Rutgers Turf Field Days.

To increase visibility and market the Soil Testing Lab services, a Facebook page was created in November 2011; see www.facebook.com/RutgersSoilTestingLab. Photos from the lab were posted, and a link to the website is provided there. More-or-less frequent posts include updates about work at the lab, presentations at other venues, photos related to these activities, and related news articles or opportunities. The advantage to having a presence on Facebook is that visitors can "like" or "share" the page or post, which informs their "friends" about their interest in STL's page, causing some degree of "virality". Every post is matched with a spike in "views", and a large percentage of those are from the viral nature of Facebook (compared to standard website). Very detailed statistics are available regarding the page's postings, likes, friends, and so forth.

Income

The PDL and STL are expected to recover all costs and be self-supporting. Laboratory clientele are charged a nominal fee for diagnostic and testing services as well as for educational activities. Grant activity and cost-sharing arrangements also provide some degree of funding. PDL fees were last adjusted on July 1, 2006, and the STL increased their fees at that time and partially again on November 1, 2008. While the fee for the standard fertility test (and soil test kits) remained the same, fees for special tests were increased in June 2015. This was done to help meet rising costs

while not discouraging clients from testing for basic soil information and recommendations. Current fee schedules are reported in Appendix 1.

A sample submission form and the appropriate payment accompanied the majority of samples received by the PDL from residential clientele. A submission form accompanied most commercial samples; however, the majority of these submissions did not include payment. In most cases, commercial growers preferred to be sent a bill. Most soil testing laboratory samples require payment at submission or when the soil test kits are purchased in each county office, but invoicing of corporations or organizations has become more common. In this case, soil test results are not released until invoices are paid. Monies collected in the county are passed to the laboratory accounts by check or internal transfer. Internal transfer of funds was used to pay for the plant and soil samples diagnosed or tested for research programs at Rutgers University.

In FY18, \$292,123.73 was generated from all PDL activities and covered 100% of all costs. In FY18, \$400,525.49 was generated from all STL activities and covered 99% of all costs. A complete breakout of all PDL and STL revenues and expenses is included in Appendix 2 of this report.

PDL policy permits Rutgers employees, government agencies, County faculty, extension specialists, and selected government agencies to submit a small number of samples "free of charge." These samples are to be used for educational development and government service. The laboratory also receives a number of direct requests for free service from the public. In many cases, letters are sent to the "Department of Agriculture" or to some other vague address. These requests for information eventually find their way to the appropriate laboratory. The PDL processed 15 "no charge" samples in FY18. As per PDL policy, volume discounts are provided to companies submitting large numbers of samples as well as to grant-funded projects and those samples submitted from Federal and State agencies.

Future Directions

As in the past, the top priority for FY19 will be to increase revenue and reduce expenses. To accomplish this, we will continue to advertise laboratory services at trade shows, field days, fairs, and educational programs. Laboratory staff will be participating in several cost-sharing grant activities in FY19. These efforts and our continued cooperation with the Office of Continuing Professional Education are expected to generate additional funds.

Increasing advertising and awareness of laboratory services should bring increasing numbers of samples. Even with increased sample numbers, it may be necessary to increase some testing fees in FY19 to cover increasing costs.

Further development of the soil testing database continues, not only with regard to development of automated recommendations for additional crops but also in increasing laboratory efficiency. The newest soil test, soil CO₂ respiration, will continue to be publicized to increase awareness of this biological index of “soil health” and potential N mineralization. Finally, building on attentiveness to State regulation for turf fertilizer application, efforts to recruit landscaping professionals into the STL clientele continue and will encourage sampling during non-peak periods to spread the annual workload.

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 principle 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 Cornell. Grant monies provided by the USDA through the NEPDN were used in FY18 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 diag-

nosis 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 regional training programs. Grant monies received for FY19 will be used to continue to upgrade laboratory capability to handle pathogens of consequence and other bio-hazards; attend training programs for insect and disease identification; hire labor to enter data into the National Plant Disease Information System; and train Master Gardeners as first detectors.

Ramapo Tomato Sale

In the spring of 2008, the New Jersey Agriculture Experiment Station revived the hybrid tomato variety ‘Ramapo’. The staff of the PDL conducted the retail sale of the seed with Cindy Rovins. The variety ‘Moreton’ was added for the 2009 season, a “Rediscover the Jersey Tomato” t-shirt for 2010, and the variety ‘KC-146’ was introduced for 2013. The ‘Rutgers 250’ tomato seed variety was released for the 2016 growing season, coinciding with the 250th anniversary of Rutgers University, and a “Rediscover Jersey Strawberries” t-shirt was added for 2017. The ‘Pumpkin’ habanero pepper seeds were offered for sale to the public in 2018. Through FY18, the PDL has processed 16,174 orders for 45,000 packets of seeds. The t-shirts are extremely popular also with over 1,650 sold. Orders continue to come into the laboratory almost daily.

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	\$40
Out-of-state	\$95

FINE AND SPORTS TURF

In-state	
Disease/insect diagnosis	\$75
Disease/insect diagnosis & nematode assay*	\$120
Out-of-state	
Disease/insect diagnosis	\$95
Disease/insect diagnosis & nematode assay*	\$170

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

NEMATODE ASSAY

In-state (except fine turf)	\$30
In-state fine turf	\$60
Out-of-state	\$95

FUNGUS AND MOLD IDENTIFICATION

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

INSECT IDENTIFICATION

In-state	\$40
Out-of-state	\$95

PLANT AND WEED IDENTIFICATION

In-state	\$40
Out-of-state	\$95

SPECIAL TESTS

Fungicide resistance testing (per compound)	\$350
Call ahead to discuss specifics and multiple compound discounts.	
Virus testing	
Diagnostic screen	\$200
Individual test fee varies. Call ahead to discuss specifics.	
Endophyte screening	
In-state	\$75
Out-of-state	\$100
Pesticide residue and contaminant testing	
Call ahead to discuss available tests and fees.	

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

Appendix 1. (continued).

SOIL TESTING LABORATORY - FEE SCHEDULE

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

LANDSCAPE

Level 1 - Fertility Test: \$20 Nutrients, pH, recommendations

Level 2 - Problem Solver (soil/plant suitability test): \$53 Nutrients, pH, soluble salt level, organic matter content, soil textural class, recommendations

Level 3 - Topsoil Evaluation: \$86 Nutrients, pH, soluble salt level, organic matter content, percentages of sand/silt/clay, soil textural class, gravel content, recommendations

FARM

Farm Fertility Test: \$20 Nutrients, pH, estimated CEC & cation saturation, recommendations from RCE agent

Pre-sidedress Nitrate Test (only): \$20 Nitrate-nitrogen soil to determine mid-season fertilizer requirement. Results within 3 working days (assuming dry sample when received), report FAXed.

Full Farm Test: \$53 Nutrients, pH, estimated CEC & cation saturation, plant-available (inorganic) nitrogen, organic matter content, recommendations from RCE agent

GOLF & SPORTS TURF

Golf/Sports Turf Fertility Test: \$20 Nutrients, pH, estimated CEC & cation saturation, recommendations

Golf/Sports Total Turf Soil Test: \$53 Nutrients, pH, estimated CEC & cation saturation, soluble salt level, organic matter content, soil textural class, recommendations

Sand-based Root Zone Test: \$53 Nutrients, pH, estimated CEC & cation saturation, recommendations, soluble salt level, organic matter content by loss-on-ignition, percentage fines, recommendations

ORGANIC MEDIA

Greenhouse (soilless) Potting Media: \$55 Nutrients, pH, electrical conductivity, available nitrogen (nitrate and ammonium) by saturated media extract

Compost/Basic: \$66 pH, electrical conductivity, nitrate-nitrogen by saturated media extract, maturity index

Compost/Technical: \$138 pH, electrical conductivity, available nitrogen (nitrate and ammonium) by saturated media extract, organic matter content, total Kjeldahl nitrogen, C:N ratio, maturity index, moisture content, coarse/inert fragment content. Report FAXed.

Compost Available Nutrients: add \$17 (add to either compost test above) Water-soluble P, K, Ca, Mg, Cu, Mn, Zn, B, Fe by saturated media extract

Compost Total Nutrients: add \$55 (add to either compost test above) Total P, K, Ca, Mg, Cu, Mn, Zn, B, Mo in ashed compost sample

Notes: "Nutrients" refers to P, K, Ca, Mg, Cu, Mn, Zn, B, Fe. Cation saturation refers to calculated % of CEC for macronutrient cations: Ca, Mg, K. The pH test includes determination of lime requirement by Adams-Evans buffer. When not preceded by "percentages of sand/silt/clay", "soil textural class" refers to texture by feel (qualitative).

Appendix 1. (continued).

TECHNICAL TESTING

Permeability Class Rating: \$110 Percentages sand/silt/clay, sieve analysis of sand, gravel content. Report FAXed.

Acid-producing Soil Test: \$44 pH before and after oxidation, level of sulfate for determination of acid sulfide/sulfate soil or sediment. Report FAXed.

Technical Topsoil Evaluation: for blended/manufactured topsoil substitute \$92 Fertility, pH, soluble salt level, organic matter content, percentages of sand/silt/clay, soil textural class, gravel content, visual assessment. Report FAXed.

Ecological Research Test: \$125 Nutrients, pH, estimated CEC & cation saturation, soluble salts, organic matter content, percentages of sand/silt/clay, soil textural class, TKN, Inorganic N. Report FAXed.

INDIVIDUAL SOIL TESTS

Soil pH and Lime Requirement Only: \$15

Soluble Salt Test: \$11

Soil Solvita® CO₂: \$17

Soil Organic Matter Content: \$17

Loss-on-ignition Organic Matter: \$17

Soil Particle-Size Analysis: \$33 sand/silt/clay %

Inorganic Nitrogen: \$22 nitrate- and ammonium-nitrogen

Total (Kjeldahl) Nitrogen: \$22

Cation Exchange Capacity or Exchangeable Cations: \$55 Ca, Mg, K, & Na

Cation Exchange Capacity & Exchangeable Cations: \$83 percentages of Ca, Mg, K, & Na on exchange sites

Lead Screening by Mehlich 3: \$17 extractable lead (Pb) and estimated total lead; interpretation of relative risk

Soil Processing Fee: \$5

USDA Sieve Analysis of Sand: \$55 class percentages: very coarse, coarse, medium, fine, very fine; also gravel content

Custom Sieve Analysis: \$17/sieve client specified

Coarse Fragment Size Distribution: \$11 fractions greater than 1-inch, 1/2-inch, 1/4-inch, and 2mm

Soil Water Content, as received: \$11

OTHER ANALYSES

Water Analysis for Irrigation: \$22 pH; soluble salt content; soluble P, nitrate-nitrogen, & Fe

FEE ADJUSTMENTS

Express Processing: \$50 charge per sample. Turnaround time will depend on tests required and total number of samples in batch. Includes FAXing of report.

Special Reporting Requirements: \$200/hour calculated in 15 minute increments for example percent passing format for sieve analysis, calculation of coefficient of uniformity, particle size distribution graph, compliance of results to specifications, recommendations to meet specifications, critique of specifications

Appendix 2. Plant Diagnostic and Soil Testing Budgets

Table A2.1. Expenses, PDL-FY18.

Salaries and benefits (full and part time staff)	\$283,497.63
Supplies and services	
Diagnostic and testing supplies	
Printing and marketing	
References	
Equipment maintenance	
Office supplies	
Credit card fees	\$5,591.78
Communications	
Telephone/fax	
Postage	\$1,334.68
Travel	
Paid talks and professional meetings	\$1,699.64
Total operating costs	\$292,123.73

Table A2.2. Income, PDL-FY18.

Sample fees	\$66,481.00
Lecture fees	
OCPE and other honorarium	\$30,055.70
Grants and contracts	
NPDN	\$21,600.00
Ramapo Tomato	\$16,249.75
IPM	\$17,141.00
Other	
Salaries (NJAES/SEBS)	\$126,658.21
Total actual income	\$278,185.66

Table A2.3. Estimated expenses, PDL-FY19.

Salary and benefit costs	\$285,000.00
Supplies and services	\$10,000.00
Communications, marketing and travel	\$3,000.00
Total potential cost FY19	\$298,000.00

Table A2.4. Estimated income, PDL-FY19.

Plant Health Samples 2000 @ \$55 average fee per sample	\$110,000.00
Lecture fees	
OCPE and other honoraria	\$22,000.00
Cost recovery	
Grant and contracts	\$42,000.00
Salaries (NJAES/SEBS)	\$127,000.00
Total potential income FY19	\$301,000.00

Appendix 2. Plant Diagnostic and Soil Testing Budgets (continued).

Table A2.5. Expenses, STL-FY18.

Salaries and benefits (full and part time staff)	\$350,630.20
Supplies and services Lab chemicals and supplies Soil test kits Office supplies Computer maintenance Printing and marketing Credit card fees	\$29,927.41
Equipment/Maintenance Lab instruments repair Proficiency testing program Service contracts Software	\$21,970.56
Communications Telephone/fax Postage	\$764.29
Travel Paid talks and professional meetings	\$1,624.85
Total operating costs	\$404,917.31

Table A2.6. Income, STL-FY18.

Sample fees STL.....	\$343,917.79
Lecture fees OCPE and other honoraria	\$0
Other Salaries (NJAES/SEBS)	\$67,789.10
Grants Receivable Unbilled	-\$11,181.40
Total actual income	\$400,525.49

Table A2.7. Estimated expenses, STL-FY19.

Salary and benefit costs	\$355,000.00
Supplies and services.....	\$35,000.00
Equipment/Maintenance.....	\$20,000.00
Communications, marketing and travel	\$2,500.00
Total potential cost FY19.....	\$412,500.00

Table A2.8. Estimated income, STL-FY19.

Soil Analysis 9,600 @ \$36 average fee per sample	\$375,000.00
Lecture fees OCPE and other honoraria	\$0
Cost recovery Salaries (NJAES/SEBS)	\$68,000.00
Total potential income FY19.....	\$443,000.00

**Appendix 3.
Table A3.1. Complete listing of lectures presented by Richard J. Buckley, PDL Director, FY18.**

Date	Title	Audience	Location	Participants¹
08/16/17	Top 5 NJ Pests of 2017 (1hr)	New Jersey Nursery and Landscape Association	Cook Campus	A,I,L,T
09/21/17	Cultural Strategies to Manage Disease in Turf (.75hr)	SiteOne University: Saratoga, New York	Saratoga, NY	I,L,T
10/02/17	The Art and Science of Disease Diagnosis (3hr)	Master Gardeners Training Program	Morris County	H
10/04/17	Cultural Disease Control Strategies (1hr)	Emergency Pesticide Recertification Short Course	Cook Campus	I,L,T
10/07/17	Christmas Tree Pest Walk (1hr)	New Jersey Christmas Tree Growers Indian Summer Meeting	Warren County	X
10/09/17	Principles of Pest Management: What is IPM? (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
10/09/17	Turf Diseases: Basic Plant Pathology (2hr)	Professional Golf Turf Management School	Cook Campus	T
10/10/17	Insects in Fine Turf: Introduction to Entomology / Structure and Function (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
10/10/17	Diseases and Insect Pests of Ornamentals: New Plant Pathogens; Bacteria and Viruses (2hr)	Professional Golf Turf Management School	Cook Campus	T
10/11/17	Hold on to Your Ash! (1.5hr)	Burlington County Natural Sciences Club	Burlington County	H
10/16/17	Principles of Pest Management: IPM Basics (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
10/16/17	Turf Diseases: Basic Mycology (2hr)	Professional Golf Turf Management School	Cook Campus	T
10/17/17	Insects in Fine Turf: Insect Orders (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
10/17/17	Diseases and Insect Pests of Ornamentals: Abiotic Stress Disorders (2hr)	Professional Golf Turf Management School	Cook Campus	T
10/20/17	Hold on to Your Ash! (1hr)	NJ Shade Tree Federation Annual Conference	Camden County	A,I,L,H
10/23/17	Principles of Pest Management: Scouting (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
10/23/17	Turf Diseases: Red Thread / Snow Molds (2hr)	Professional Golf Turf Management School	Cook Campus	T
10/24/17	Insects in Fine Turf: Growth and Development / Behavior (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
10/24/17	Diseases and Insect Pests of Ornamentals: Leaf, Needle and Transition Diseases / Cankers (2hr)	Professional Golf Turf Management School	Cook Campus	T
10/25/17	Advanced Turf Disease Workshop (6hr)	Advanced Turf Disease Short Course	Cook Campus	I,L,T
10/26/17	The Art and Science of Disease Diagnosis (3hr)	Master Gardeners Training Program	Passaic County	H
10/27/17	Diseases and Insect Pests of Turf (3hr)	Emergency Pesticide Recertification Short Course	Cook Campus	I,L,T
10/30/17	Principles of Pest Management: Principles of Pest Control (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
10/30/17	Turf Diseases: Pythium Diseases / Yellow Tuft (2hr)	Professional Golf Turf Management School	Cook Campus	T
10/31/17	Insects in Fine Turf: Nematodes (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
10/31/17	Diseases and Insect Pests of Ornamentals: Molds, Mildews, and Rusts / Mites (2hr)	Professional Golf Turf Management School	Cook Campus	T
11/01/17	Anthracnose: The Scourge of the Modern Putting Green (1hr)	West Virginia Golf Course Superintendents Assoc.	Morgantown, WV	I,L,T
11/01/17	Dollar Spot: The Most Important Turf Disease (1hr)	West Virginia Golf Course Superintendents Assoc.	Morgantown, WV	I,L,T

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

Date	Title	Audience	Location	Participants¹
11/03/17	Diseases of Woody Ornamentals (1.5hr)	Friends of the Freilinghuysen Arboretum	Morris County	H
11/06/17	Principles of Pest Management: Cultural Strategies (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
11/06/17	Turf Diseases: Fairy Ring / Rhizoctonia Diseases (2hr)	Professional Golf Turf Management School	Cook Campus	T
11/07/17	Insects in Fine Turf: White Grubs (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
11/07/17	Diseases and Insect Pests of Ornamentals: Defoliators (2hr)	Professional Golf Turf Management School	Cook Campus	T
11/09/17	25 Years of the Plant Diagnostic Lab (1hr)	Metropolitan Golf Course Superintendents Association Fall Education Seminar	Fairfield, CT	I,T
11/13/17	Principles of Pest Management: Fungicide Selection (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
11/13/17	Turf Diseases: Root Infecting Patch Diseases / Bentgrass Dead Spot (2hr)	Professional Golf Turf Management School	Cook Campus	T
11/14/17	Insects in Fine Turf: Billbugs and Annual Bluegrass Weevils (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
11/14/17	Diseases and Insect Pests of Ornamentals: Sucking Insects (2hr)	Professional Golf Turf Management School	Cook Campus	T
11/15/17	Basic Turf Disease: Pick Your Best Defense (1hr)	Delaware Nursery and Landscape Association: 2017 Ornamental and Turf Workshop	Hockessin, DE	A,I,L,T
11/20/17	Principles of Pest Management: Insecticide Selection (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
11/20/17	Turf Diseases: Anthracnose / Dollar Spot / Copper Spot (2hr)	Professional Golf Turf Management School	Cook Campus	T
11/21/17	Insects in Fine Turf: Lepids in Turf (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
11/21/17	Diseases and Insect Pests of Ornamentals: Borers - Lepids (2hr)	Professional Golf Turf Management School	Cook Campus	T
11/27/17	Principles of Pest Management: Biorational Pesticides (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
11/27/17	Turf Diseases: Gray Leaf Spot / Leaf Spots (2hr)	Professional Golf Turf Management School	Cook Campus	T
11/28/17	Insects in Fine Turf: Chinch Bugs and Green Bugs (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
11/28/17	Diseases and Insect Pests of Ornamentals: Borers - Beetles (2hr)	Professional Golf Turf Management School	Cook Campus	T
12/04/17	Principles of Pest Management: Turf Diagnostic Tips (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
12/04/17	Turf Diseases: Rusts, Smuts, Molds, Mildews and Minor Leaf Blights (2hr)	Professional Golf Turf Management School	Cook Campus	T

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

Date	Title	Audience	Location	Participants¹
12/05/17	Frackin' Your Fungicides (.5hr)	New Jersey Turfgrass Association Expo	Atlantic County	A,I,L,T
12/05/17	The Last Word on Emerald Ash Borer in NJ (1hr)	New Jersey Turfgrass Association Expo	Atlantic County	A,I,L,T
12/06/17	2017 Dead Turf Review (.5hr)	New Jersey Turfgrass Association Expo	Atlantic County	A,I,L,T
12/06/17	Organic vs Reduced Risk Landscape Management (.5hr)	New Jersey Turfgrass Association Expo	Atlantic County	A,I,L,T
12/07/17	Buckley's Bootcamp: Fundamentals of Tree Diseases (1.5hr)	New Jersey Turfgrass Association Expo	Atlantic County	A,I,L,T
12/07/17	Buckley's Boot Camp: Recognizing Abiotic Stress in Turf (2hr)	New Jersey Turfgrass Association Expo	Atlantic County	A,I,L,T
12/12/17	Insects in Fine Turf: Moles Crickets and Crane Flies (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
12/12/17	Diseases and Insect Pests of Ornamentals (2hr)	Professional Golf Turf Management School	Cook Campus	T
12/13/17	Are We Being Invaded? (1.5hr)	Mercer County Sierra Club	Mercer County	H
12/13/17	Pest Bull Session: Diseases of Shade Trees (2hr)	ISA of PA-DE-NJ	Philadelphia, PA	A
12/19/17	The Art and Science of Disease Diagnosis (3hr)	Master Gardeners Training Program	Hunterdon County	H
12/21/17	The Art and Science of Disease Diagnosis (3hr)	Master Gardeners Training Program	Essex County	H
01/08/18	Principles of Pest Management: What is IPM? (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
01/08/18	Turf Diseases: Basic Plant Pathology (2hr)	Professional Golf Turf Management School	Cook Campus	T
01/09/18	Insects in Fine Turf: Introduction to Entomology / Structure and Function (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
01/09/18	Diseases and Insect Pests of Ornamentals: New Plant Pathogens; Bacteria and Viruses (2hr)	Professional Golf Turf Management School	Cook Campus	T
01/10/18	Boxwood: Now You See Them, Soon You Won't (1hr)	North Jersey Ornamental Horticulture Conference	Morris County	I,L,T
01/11/18	The Art and Science of Disease Diagnosis (1.5hr)	Landscape IPM Short Course	Cook Campus	L,T
01/12/18	The Complete Turf Disease for Golf Courses (3hr)	Professional Golf Turf Management School: Three Week Course	Cook Campus	T
01/15/18	Principles of Pest Management: IPM Basics (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
01/15/18	Turf Diseases: Basic Mycology (2hr)	Professional Golf Turf Management School	Cook Campus	T
01/16/18	Insects in Fine Turf: Insect Orders (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
01/16/18	Diseases and Insect Pests of Ornamentals: Abiotic Stress Disorders (2hr)	Professional Golf Turf Management School	Cook Campus	T
01/17/18	The Complete Turf Disease for Golf Courses (3hr)	Professional Golf Turf Management School: Three Week Course	Cook Campus	T
01/19/18	Understanding White Grubs in the Mid Atlantic Region (1hr)	FALCAN / University of Maryland Pest Management Conference	Frederick, MD	I,L,T
01/22/18	Recognizing Abiotic Stress in Turf (1hr)	New York State Turf and Landscape Association Professional Conference and Trade Show	Yonkers, NY	C,I,H,G L,N,T

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

Date	Title	Audience	Location	Participants¹
01/22/18	Principles of Pest Management: Scouting (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
01/22/18	Turf Diseases: Red Thread / Snow Molds (2hr)	Professional Golf Turf Management School	Cook Campus	T
01/23/18	Understanding White Grubs in the Mid Atlantic Region (1hr)	SiteOne University: Dover	Dover, DE	I,L,T
01/26/18	Basic Turf Diseases: Pick Your Best Defense (1.5hr)	Pest Management in Landscape Turf Short Course	Cook Campus	L,T
01/26/18	The Complete White Grub (1hr)	Pest Management in Landscape Turf Short Course	Cook Campus	L,T
01/29/18	The Fungus Amongus: 2017 Year in Review (1hr)	Penn State: 2018 Winter Turf and Ornamentals School	Grantville, PA	I,L,T
01/30/18	2017 Plant Disease Review (1hr)	NJ Plants Professional Nursery and Landscape Show	Middlesex County	A,I,L,T
01/30/18	Insects in Fine Turf: Nematodes (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
01/30/18	Diseases and Insect Pests of Ornamentals: Molds, Mildews, and Rusts / Mites (2hr)	Professional Golf Turf Management School	Cook Campus	T
01/31/18	2017 Turf Disease Problem Review (1hr)	SavATree 2018 Sales Conference	Palisades, NY	I,L,T
02/05/18	Principles of Pest Management: Principles of Pest Control (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
02/05/18	Turf Diseases: Pythium Diseases / Yellow Tuft (2hr)	Professional Golf Turf Management School	Cook Campus	T
02/06/18	Insects in Fine Turf: White Grubs (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
02/06/18	Diseases and Insect Pests of Ornamentals: Defoliators (2hr)	Professional Golf Turf Management School	Cook Campus	T
02/06/18	The Art and Science of Disease Diagnosis (3hr)	Master Gardeners Training Program	Atlantic County	H
02/07/18	Boxwood: Now You See Them, Soon You Won't (1hr)	Northern Nurseries: Northern University	Warren County	I,G,L,N,T
02/12/18	Principles of Pest Management: Cultural Strategies (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
02/12/18	Turf Diseases: Fairy Ring / Rhizoctonia Diseases (2hr)	Professional Golf Turf Management School	Cook Campus	T
02/13/18	Insects in Fine Turf: Billbugs and Annual Bluegrass Weevils (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
02/13/18	Diseases and Insect Pests of Ornamentals: Sucking Insects (2hr)	Professional Golf Turf Management School	Cook Campus	T
02/13/18	Basic Turf Diseases: Pick Your Best Defense (1hr)	Athletic Field Construction Short Course	Cook Campus	T
02/14/18	Under the Radar Invasives (1.5hr)	Master Gardeners Training Program	Somerset County	H
02/15/18	Disease Consequences of the Low Input Lawn (.75hr)	LCA of MD-VA-DC Pesticide and Fertilizer Applicator Recertification Conference	Rockville, MD	I,L,T
02/15/18	Recognizing the Unanticipated Consequences in the Right of Way (.5hr)	LCA of MD-VA-DC Pesticide and Fertilizer Applicator Recertification Conference	Rockville, MD	I,L,T
02/19/18	Principles of Pest Management: Fungicide Selection (1.5hr)	Professional Golf Turf Management School	Cook Campus	T

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

Date	Title	Audience	Location	Participants¹
02/19/18	Turf Diseases: Root Infecting Patch Diseases / Bentgrass Dead Spot (2hr)	Professional Golf Turf Management School	Cook Campus	T
02/20/18	Insects in Fine Turf: Lepids in Turf (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
02/20/18	Diseases and Insect Pests of Ornamentals: Borers - Lepids (2hr)	Professional Golf Turf Management School	Cook Campus	T
02/22/18	2017 Plant Disease Review (1hr)	Reed and Perrine Turf and Ornamentals Seminar	Monmouth County	A,I,L,T
02/26/18	Principles of Pest Management: Insecticide Selection (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
02/26/18	Turf Diseases: Anthracnose / Dollar Spot / Copper Spot (2hr)	Professional Golf Turf Management School	Cook Campus	T
02/27/18	Insects in Fine Turf: Chinch Bugs and Green Bugs (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
02/27/18	Diseases and Insect Pests of Ornamentals: Borers - Beetles (2hr)	Professional Golf Turf Management School	Cook Campus	T
02/28/18	The Fungus Amongus: 2017 Year in Review (1hr)	Connecticut Grounds Keepers Association Turf and Landscape Conference	Cromwell, CT	I,G,L,N,T
03/01/18	2017 Turf Disease Problem Review (1hr)	SavATree 2018 Sales Conference	Danbury, CT	T
03/01/18	Insects that Suck: Scale (1.5hr)	SavATree 2018 Sales Conference	Danbury, CT	A,T
03/02/18	Principles of Pest Management: Biorational Pesticides (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
03/02/18	Turf Diseases: Gray Leaf Spot / Leaf Spots (2hr)	Professional Golf Turf Management School	Cook Campus	T
03/05/18	Principles of Pest Management: Turf Diagnostic Tips (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
03/05/18	Turf Diseases: Rusts, Smuts, Molds, Mildews and Minor Leaf Blights (2hr)	Professional Golf Turf Management School	Cook Campus	T
03/06/18	Insects in Fine Turf: Moles Crickets and Crane Flies (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
03/06/18	Diseases and Insect Pests of Ornamentals (2hr)	Professional Golf Turf Management School	Cook Campus	T
03/13/18	25 Years of the Plant Diagnostic Lab (1hr)	SiteOne University: Batavia New York	Batavia, NY	I,L,T
03/13/18	Leaf Feeding Insects and the Silver Bullet (.75hr)	SiteOne University: Batavia New York	Batavia, NY	I,L,T
03/14/18	25 Years of the Plant Diagnostic Lab (1hr)	SiteOne University: Liverpool	Liverpool, NY	I,L,T
03/14/18	Leaf Feeding Insects and the Silver Bullet (.75hr)	SiteOne University: Liverpool	Liverpool, NY	I,L,T
03/15/18	25 Years of the Plant Diagnostic Lab (1hr)	SiteOne University: Saratoga	Saratoga, NY	I,L,T
03/15/18	Leaf Feeding Insects and the Silver Bullet (.75hr)	SiteOne University: Saratoga	Saratoga, NY	I,L,T
03/20/18	Hands on Diagnostics Training (3hr)	Master Gardeners Training Program	Hunterdon County	H
03/23/18	Diseases of Shade Trees (6hr)	Morris Arboretum School of Arboriculture	Philadelphia, PA	A,C,L,N
03/27/18	The Art and Science of Disease Diagnosis (3hr)	Master Gardeners Training Program	Union County	H

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

Date	Title	Audience	Location	Participants ¹
03/28/18	Top Three for Putting Greens in NJ (1hr)	Golf Course Superintendents Association of NJ	Union County	T
03/29/18	The Art and Science of Disease Diagnosis (3hr)	Master Gardeners Training Program	Monmouth County	H
04/01/18	Might be Mites (1.3hr)	Disease and Insects of Ornamental Plants (11:770:391)	Cook Campus	C
04/04/18	Sucking Pests: Scale (1.3hr)	Disease and Insects of Ornamental Plants (11:770:391)	Cook Campus	C
04/04/18	The Art and Science of Disease Diagnosis (3hr)	Master Gardeners Training Program	Gloucester County	H
04/09/18	Sucking Pests: Hoppers and True Bugs (1.3hr)	Disease and Insects of Ornamental Plants (11:770:391)	Cook Campus	C
04/10/18	Key Insect Pests in New Jersey Landscapes (3hr)	Master Gardeners Training Program	Ocean County	H
04/11/18	Sucking Pests: Plant Lice (1.3hr)	Disease and Insects of Ornamental Plants (11:770:391)	Cook Campus	C
04/12/18	Key Insect Pests in New Jersey Landscapes (3hr)	Master Gardeners Training Program	Monmouth County	H
04/16/18	Borers: Curculionids, Leaf Miners, and Gall Makers (1.3hr)	Disease and Insects of Ornamental Plants (11:770:391)	Cook Campus	C
04/18/18	Basic Turf Problem Solving (3hr)	Master Gardeners Training Program	Gloucester County	H
04/19/18	Nursery Crop Disease Review (3hr)	Nursery Crop Production (11:770:439)	Cook Campus	C
04/20/18	Plants I Love to Hate! (1.5hr)	Master Gardeners Training Program	Gloucester County	H
04/23/18	Borers: Buprestids and Cerambycids (1.3hr)	Disease and Insects of Ornamental Plants (11:770:391)	Cook Campus	C
04/25/18	Borers: Scolytids (1.3hr)	Disease and Insects of Ornamental Plants (11:770:391)	Cook Campus	C
04/26/18	The Art and Science of Disease Diagnosis (3hr)	Master Gardeners Training Program	Camden County	H
04/30/18	Borers: Lepids; Defoliators: Chrysomelids and Curculionids (1.3hr)	Disease and Insects of Ornamental Plants (11:770:391)	Cook Campus	C
05/01/18	Key Insect Pests in New Jersey Landscapes (3hr)	Master Gardeners Training Program	Monmouth County	H
05/09/18	Defoliators: Lepids (1.3hr)	Disease and Insects of Ornamental Plants (11:770:391)	Cook Campus	C
06/13/18	2018 Insects and Disease Hour (1hr)	Master Gardeners Training Program	Hunterdon County	H
06/20/18	Plants I Love to Hate! (1hr)	Master Gardeners Training Program	Monmouth County	H
06/21/18	Christmas Tree Pest Walk (1hr)	New Jersey Christmas Tree Growers Twilight Meeting	Passaic County	X

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

Table A3.2. Complete listing of lectures presented by Sabrina Tirpak, PDL Principal Laboratory Technician, FY18.

Date	Title	Audience	Location	Participants¹
07/11/17	Plant Diagnostic Laboratory Tour (1hr)	USGA Learning Science Through Golf STEM Academy	Cook Campus	C
07/22/17	Common Insects Pests of Vegetables and Site Walk (3hr)	Duke Community Gardens Course	Somerset, NJ	H
10/18/17	Turf Disease Laboratory - Basic Mycology (3hr)	Professional Golf Turf Management School	Cook Campus	T
10/19/17	Turf Insect Laboratory - Insect Orders (3hr)	Professional Golf Turf Management School	Cook Campus	T
10/31/17	Turf Disease Laboratory - Introduction to Microscopy (3hr)	Professional Golf Turf Management School	Cook Campus	T
11/02/17	Turf Insect Laboratory - White Grubs (3hr)	Professional Golf Turf Management School	Cook Campus	T
11/02/17	Turfgrass Insects Review (2hr)	Rutgers Turf Club GCSAA Turf Bowl Review Session	Cook Campus	C
11/03/17	Insect Pests of Woody Ornamentals (1.5hr)	Friends of the Frelinghuysen Arboretum	Morris County	H,L
11/15/17	Turf Disease Laboratory - Turfgrass Pathogens (3hr)	Professional Golf Turf Management School	Cook Campus	T
11/16/17	Turf Insect Laboratory - Turfgrass Insect Pests (3hr)	Professional Golf Turf Management School	Cook Campus	T
11/20/17	The Art and Science of Disease Diagnosis (1.3hr)	General Plant Pathology (11:776:302)	Cook Campus	C
11/28/17	Turf Disease Laboratory - Turfgrass Pathogens (3hr)	Professional Golf Turf Management School	Cook Campus	T
11/30/17	Turf Insect Laboratory - Turfgrass Insect Pests (3hr)	Professional Golf Turf Management School	Cook Campus	T
12/05/17	Under the Radar Invasives - Part 1 (.5hr)	New Jersey Turfgrass Association Expo	Atlantic County	A,I,L,T
12/06/17	Under the Radar Invasives - Part 2 (.5hr)	New Jersey Turfgrass Association Expo	Atlantic County	A,I,L,T
12/06/17	Under the Radar Invasives - Part 3 (.5hr)	New Jersey Turfgrass Association Expo	Atlantic County	A,I,L,T
12/13/17	Turf Disease Laboratory - Review and Final (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
12/14/17	Turf Insect Laboratory - Review and Final (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
01/10/18	Key Insect Pests in New Jersey Landscapes (1.5hr)	Landscape IPM Short Course	Cook Campus	L,T
01/16/18	Turf Disease Laboratory - Basic Mycology (3hr)	Professional Golf Turf Management School	Cook Campus	T
01/18/18	Turf Insect Laboratory - Insect Orders (3hr)	Professional Golf Turf Management School	Cook Campus	T
01/23/18	Insects in Fine Turf: Growth and Development / Behavior (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
01/23/18	Diseases and Insect Pests of Ornamentals: Leaf, Needle and Transition Diseases / Cankers (2hr)	Professional Golf Turf Management School	Cook Campus	T
01/25/18	Household Insect Pests (3hr)	Master Gardeners Training Program	Passaic County	H
01/26/18	Leaf Feeding Insects and the Silver Bullet (1.5hr)	Pest Management in Landscape Turf Short Course	Cook Campus	T
01/30/18	Turf Disease Laboratory - Introduction to Microscopy (3hr)	Professional Golf Turf Management School	Cook Campus	T
02/01/18	Turf Insect Laboratory - White Grubs (3hr)	Professional Golf Turf Management School	Cook Campus	T
02/13/18	Turf Disease Laboratory - Turfgrass Pathogens (3hr)	Professional Golf Turf Management School	Cook Campus	T
02/15/18	Turf Insect Laboratory - Turfgrass Insect Pests (3hr)	Professional Golf Turf Management School	Cook Campus	T
02/26/18	Under the Radar Invasive Pests of the Northeast (1hr)	Brooklyn Landscape Gardeners' Association Annual Seminar	Brooklyn, NY	L,T

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

Date	Title	Audience	Location	Participants¹
02/27/18	Turf Disease Laboratory - Turfgrass Pathogens (3hr)	Professional Golf Turf Management School	Cook Campus	T
03/01/18	Management and Control Update on High Profile Pests in NJ (.75hr)	Central Jersey Turf and Ornamentals Institute	Monmouth County	I,L,T
03/01/18	Turf Insect Laboratory - Turfgrass Insect Pests (3hr)	Professional Golf Turf Management School	Cook Campus	T
03/08/18	Turf Insect Laboratory - Review and Final (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
03/14/18	Household Insect Pests (3hr)	Master Gardeners Training Program	West Orange, NJ	H
03/14/18	Turf Disease Laboratory - Review and Final (1.5hr)	Professional Golf Turf Management School	Cook Campus	T
03/19/18	Plant Diagnostic Laboratory Tour (1hr)	Master Gardeners Training Program	Cook Campus	H
03/29/18	Household Insect Pests (3hr)	Master Gardeners Training Program	Ocean County	H
04/18/18	Defoliators: Sawflies (1.3hr)	Disease and Insects of Ornamental Plants (11:770:391)	Cook Campus	C
04/18/18	Household Insect Pests (3hr)	Master Gardeners 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=Landscape; N=Nursery Growers; S=State Officials; T=Turfgrass Managers; X=Christmas Tree Growers

Table A3.3. Complete listing of lectures presented by Dr. Stephanie Murphy, STL Director, FY18.

Date	Title	Audience	Location	Participants¹
07/29/17	Ask the Experts (4hr)	Rutgers Gardens Summerfest	Cook Campus	H
08/16/17	Soil Amendments (1hr)	Master Gardener Training Program	Monmouth County	H
09/18/17	Soil Physical Properties: Soil Texture and the Textural Triangle (0.5hr)	Soils and Site Evaluation for Septic Disposal Systems and Stormwater BMPs Short Course	Cook Campus	Co, E, Hf
09/18/17	Field Exercise: Determining Soil Texture By Feel (0.75hr)	Soils and Site Evaluation for Septic Disposal Systems and Stormwater BMPs Short Course	Cook Campus	Co, E, Hf
09/19/17	Morphology and Treatment of Septic Effluent and Stormwater (0.5hr)	Soils and Site Evaluation for Septic Disposal Systems and Stormwater BMPs Short Course	Cook Campus	Co, E, Hf
09/20/17	Soil Water and "How Water Moves in the Soil (1hr)	Soils and Site Evaluation for Septic Disposal Systems and Stormwater BMPs Short Course	Cook Campus	Co, E, Hf
10/19/17	Practices to Improve Soil Health (1hr)	NJ Shade Tree Federation Annual Conference	Camden County	A, I, L, H
11/09/17	Soil Testing Laboratory Tour (2hr)	Soil Fertility (11:776:440)	Cook Campus	C
11/10/17	Soil Testing Laboratory Tour (2hr)	Soil Fertility (11:776:440)	Cook Campus	C
01/16/18	Soil Health for Plant Production (3hr)	Master Gardener Training Program	Atlantic County	H
01/25/18	Relevant Soil Factors (1hr)	Landscape Architecture Construction	Cook Campus	C
01/27/18	Reading Soil Test Reports (1.25hr)	Northeast Organic Farming Association of NJ Annual Winter Conference	Cook Campus	F
02/02/18	Soil Sampling Exercise (0.75hr)	Annual Winter Conference	Cook Campus	C
02/07/18	Soil Testing Laboratory Virtual Tour (0.5hr)	Landscape Architecture Mid-Atlantic Soil Testing and Plant Analysis Working Group	Cook Campus	I
02/14/18	Soil Testing and Recommendations (1hr)	Master Gardener Training Program	Hunterdon County	H
02/23/18	Soil Testing at Rutgers STL (1hr)	NJ Flower and Garden Show	Middlesex County	H
02/25/18	Soil Testing at Rutgers STL (1hr)	NJ Flower and Garden Show	Middlesex County	H
03/06/18	Soil Properties and Suitability for Septic System Use (1.5hr)	NJ Environmental Health Association Conference	Atlantic County	Hf
03/19/18	Soil Testing Laboratory Tour (2hr)	Master Gardener Training Program	Cook Campus	H
04/03/18	Soil Testing Laboratory Tour (2hr)	Soils and Water (11:375:360)	Cook Campus	C
04/06/18	Soil Testing Laboratory Tour (2hr)	Soils and Water (11:375:360)	Cook Campus	C
04/10/18	Soil Nitrogen (1.3hr)	Soils and Water (11:375:360)	Cook Campus	C
09/06/17	Lecture 1: Introduction: Definitions, Functions (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
09/11/17	Lecture 2: Soil Science History and Civilization, and Current Perspectives (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
09/13/17	Lecture 3: Variability of Soils. Genesis and Morphology. Classification. (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
09/18/17	Lecture 4: Mineral Components of Soil, Structure, Porosity (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
09/20/17	Lecture 5: Physical Degradation of Soil: Compaction, etc. (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C

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

Date	Title	Audience	Location	Participants,
09/25/17	Lecture 6: Soil Aeration, Processes, Status, Implications (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
09/27/17	Lecture 7: Field trip on Campus (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
10/02/17	Lecture 8: Soils Within the Hydrologic Cycle, Soil Water Retention/Drainage and Movement (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
10/04/17	Lecture 9: Soil-Plant-Atmosphere Continuum (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
10/09/17	Lecture 10: Soil Degradation: Erosion, Soil Conservation Efforts (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
10/11/17	Lecture 11: Soil as Habitat for Organisms. Primary Production and Energy Transfer (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
10/16/17	Lecture 12: Nutrient Cycling, Carbon Cycle, the Organic Component of Soil (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
10/30/17	Lecture 16: Soil Fertility, Supporting Vegetation, Essential Plant Nutrients (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
11/01/17	Lecture 17: Field trip on Campus (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
11/06/17	Lecture 18: Soil Reaction (pH): Factors, Importance, Management (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
11/08/17	Lecture 19: More Geo-chemical Cycling: P, K, and Selected Micronutrients (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
11/13/17	Lecture 20: Soil Degradation: Nutrient Depletion, Chemical Contamination (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
11/15/17	Lecture 21: Soil Degradation: Desertification, Salinity/Sodicity, Irrigation (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
11/20/17	Lecture 22: Heat Transfer in Soil, Soil and Climate (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
11/27/17	Lecture 23: Value of Soils' Ecosystem Services, Societal Costs of Degradation (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
11/29/17	Lecture 24: Soil for Infrastructure Support, Urban Soil, Use for Waste Disposal (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
12/04/17	Lecture 25: Soil Loss to Population/Infrastructure, Effect on Food Security, Soil Resiliency (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
12/06/17	Lecture 26: Efforts to Protect Soils, Soil's Relation to Human/Animal Health, Environmental Quality (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C
12/11/17	Lecture 27: Review of Soil Management for Sustainability, Quality Restoration/Remediation (1.3hr)	Soils and Society (11:375:102)	Cook Campus	C

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=Landscapeers; N=Nursery Growers; S=State Officials; T=Turfgrass Managers; X=Christmas Tree Growers



Plant Diagnostic Laboratory

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Soil Testing Laboratory

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