



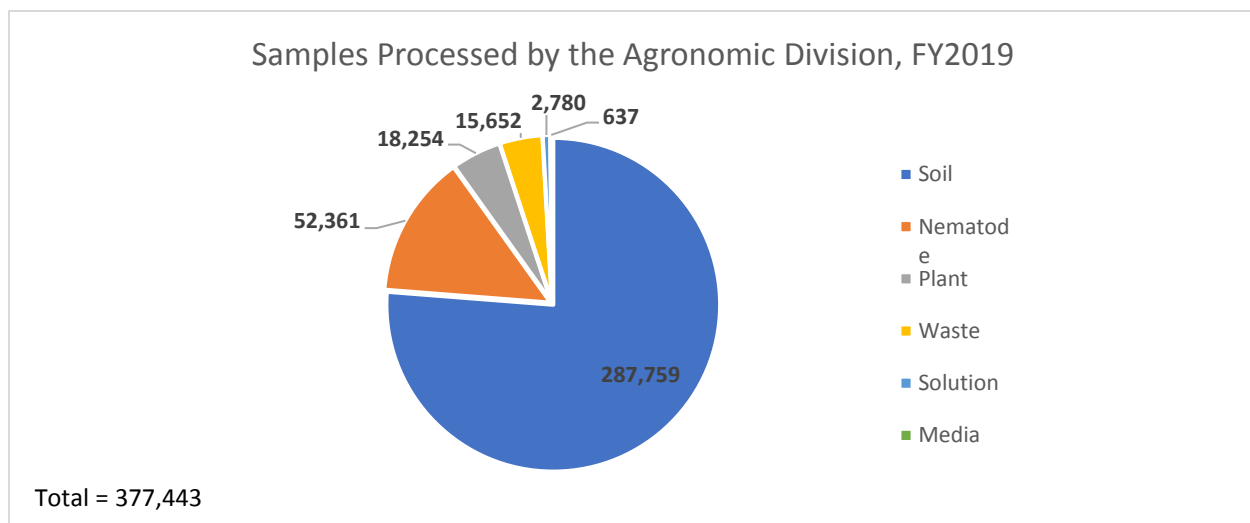
Agronomic Division — 2019 Annual Report

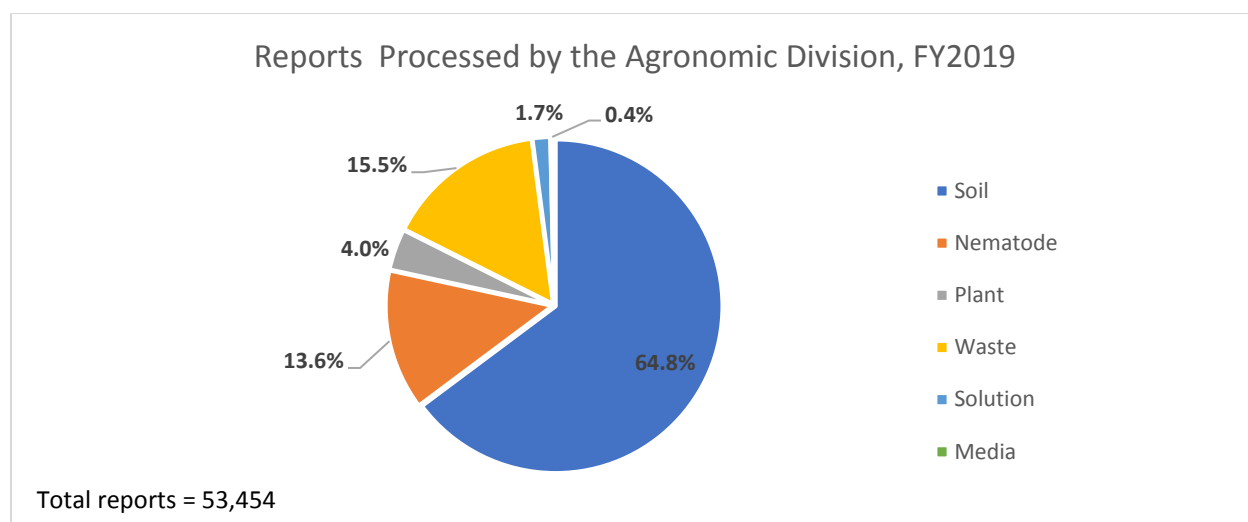
Colleen Hudak-Wise, Ph.D., director, (919) 733-2655

Introduction

The Agronomic Services Division's mandate is to provide all North Carolina residents with diagnostic and advisory services that increase agricultural productivity, promote responsible land management and safeguard environmental quality. The Agronomic Services Division is the largest publicly operated agronomic laboratory in the country, offering the following laboratory services: soil testing, plant tissue analysis, waste analysis, solution analysis, soilless media analysis and nematode assay.

The Agronomic Division's laboratories processed 377,443 total samples during FY2019, which is approximately a 4% decrease over the previous year. Over 53,000 reports with test results and recommendations were prepared for clients during FY 2019.





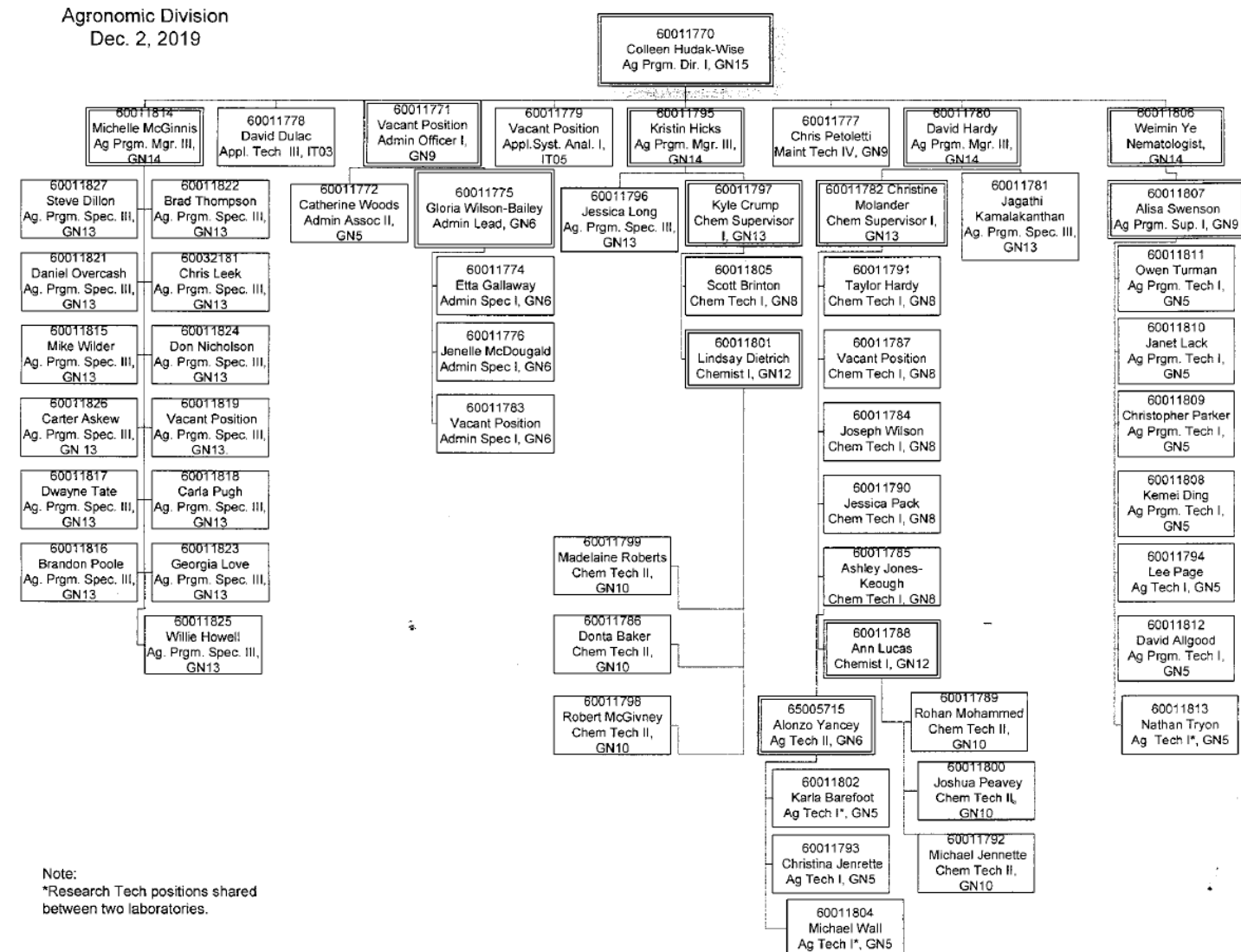
Other notable events for 2019 include

- 1) Participation in the NC Star Public Sector Safety Program for the tenth year.
- 2) A third pH robot was purchased and put into production for the Soil Testing Lab.
- 3) The Soil Testing Lab switched from barium chloride to calcium chloride in the Mehlich pH buffer to eliminate production of a hazardous waste.
- 4) The Plant/Waste/Solution/Media Section achieved a new record for the number of samples analyzed in a single year, with 37,323 samples processed in FY2019
- 5) Dr. Kristin Hicks, the Plant/Waste/Solution/Media Section Chief, was named to the national board of the Soil and Plant Analysis Council (SPAC) in early 2019. SPAC partnered this year with the Illinois Soil Testing Association (ISTA) to establish a new international Plant Analysis Certification (PAC) program, with Dr. Hicks as its Vice-Chair.
- 6) The Nematode Lab staff received NCDA&CS's "Excellence in Team Accomplishment Award" on June 7, 2019.
- 7) The Nematode Assay Section successfully completed a state-wide survey on sweet potato root knot nematode with collaboration with the NCDA&CS Plant Industry Division.
- 8) The Nematode Assay Section processed at least 2,900 nematode molecular diagnostic samples for the growers of North Carolina.
- 9) Dr. Michelle McGinnis and the Field Services Section conducted research in conjunction with N.C. State University's Crop and Soil Sciences Department on optimizing nitrogen and potassium rates for industrial hemp production.

Personnel

The Division has 57 full-time permanent positions: 16 office positions, including administrative support, information technology, maintenance and leadership positions; 28 laboratory staff

distributed among three laboratories (Soil Testing, Nematode Assay and Plant/Waste/Solution/Media) and 13 regional agronomists who make up the Field Services Section. Regional agronomists are assigned to territories consisting of 5 to 11 counties; they conduct grower consultations to help diagnose nutrient and/or nematode problems and to offer expert advice regarding plant nutrient management for waste management plans. The Agronomic Services Division’s organizational chart as of December 2, 2019, and the Field Services Territorial Map, as of November 1, 2019, follow.



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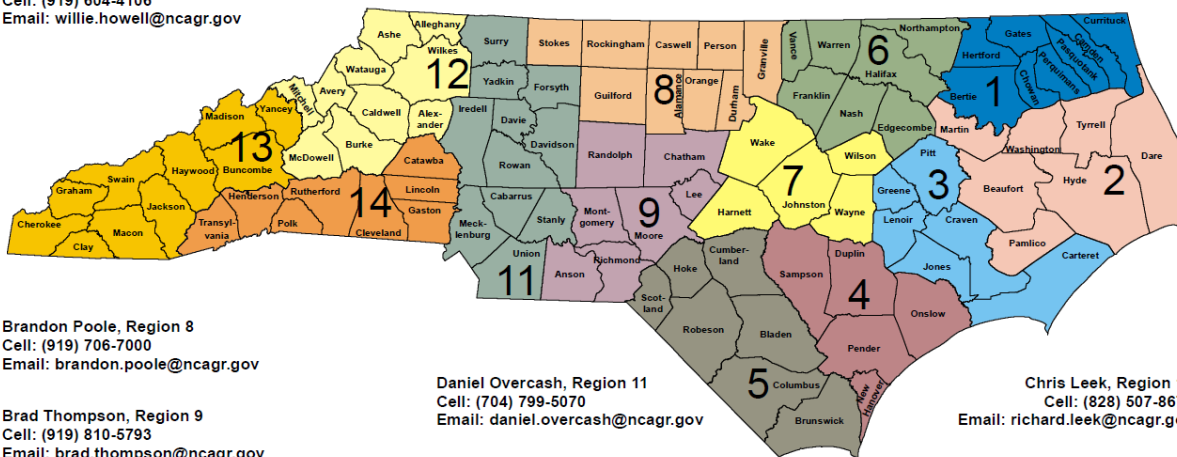
NCDA&CS Agronomic Division Field Services

November 2019

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Staff turnover during 2019 included several key positions. The following is a description of the personnel changes that took place during 2019.

Personnel Changes for Calendar Year 2019 (Permanent Staff)

- Administrative Associate II (Receptionist) – 60011772
October 2018 – Diane Fly resigned (promoted with NCDA&CS)
March 2019 – Catherine Woods hired
- Agricultural Program Specialist III (Regional Agronomist) - 60011825
October 2018 -- W. Tyler Whaley resigned
May 2019 – William Howell hired
- Agricultural Program Specialist III (Regional Agronomist) - 60011826
March 2018 – Jacob Searcy passed away

March 2019 – Carter Askew hired

- Agricultural Program Specialist III (Regional Agronomist) - 60011822
January 2019 – Josh Mays resigned
May 2019 – Brad Thompson hired
- Agricultural Program Specialist III (Regional Agronomist) - 60011796
February 2019 – Hunter Landis resigned
May 2019 – Jessica Long hired
- Agricultural Technician I – 60011813
December 2018 – Troy Spindler resigned
March 2019 – Nathan Tryon hired
- Agricultural Technician I -60011793
March 2019 - Samuel Jarman dismissed
June 2019 – Christina Jenrette hired
- Administrative Officer I -- 60011771
September 2019 – Lori Pfister resigned
- Administrative Specialist I (Data Entry Lead) – 60011783
December 2018 – Michelle Coleman dismissed
June 2019 – Lucy Funicello hired
November 2019 – Lucy Funicello resigned
- Administrative Lead – 60011775
June 2019 – Rebecca Boone resigned
October 2019 – Gloria Wilson-Bailey hired
- Application Technician II – 60011778
July 2018 – Jeffrey Stines resigned
June 2019 – David Dulac hired
- Application Systems Analyst I - 60011779
September 2019 – Jeff Vitalis resigned
- Chemistry Technician I – 60011787
May 2019 – Aldo Hernandez dismissed
December 2019 – Christina Jenrette promoted from 60011793

Funding

The Agronomic Services Division’s expenditures for FY2019 were more than \$5.2 million. Sources of funding included State Appropriations, expedited soil shippers, peak-season soil fees, fertilizer and lime taxes and “other” sample fees (nematode, plant, waste, solution and media samples). The tonnage assessment for fertilizers and lime sold in North Carolina is set at

\$.50/ton; the Agronomic Services Division gets a percentage of these receipts.

FY2019 Sources of Funding

State Appropriations, \$3,550,076 (68%)

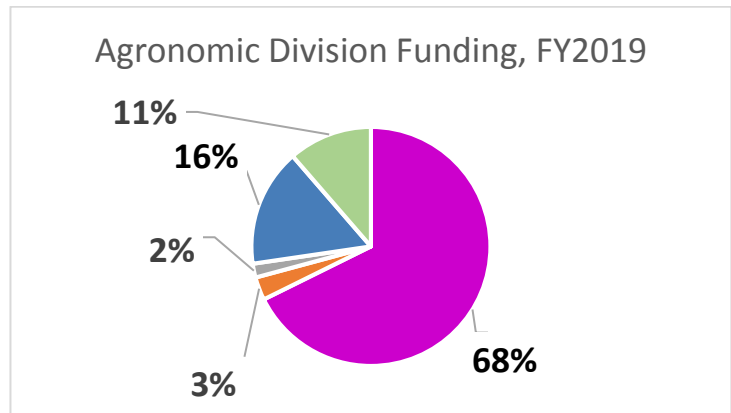
Peak-season Soil Fees, \$169,880 (3%)

Expedited Soil Fees, 98,420 (2%)

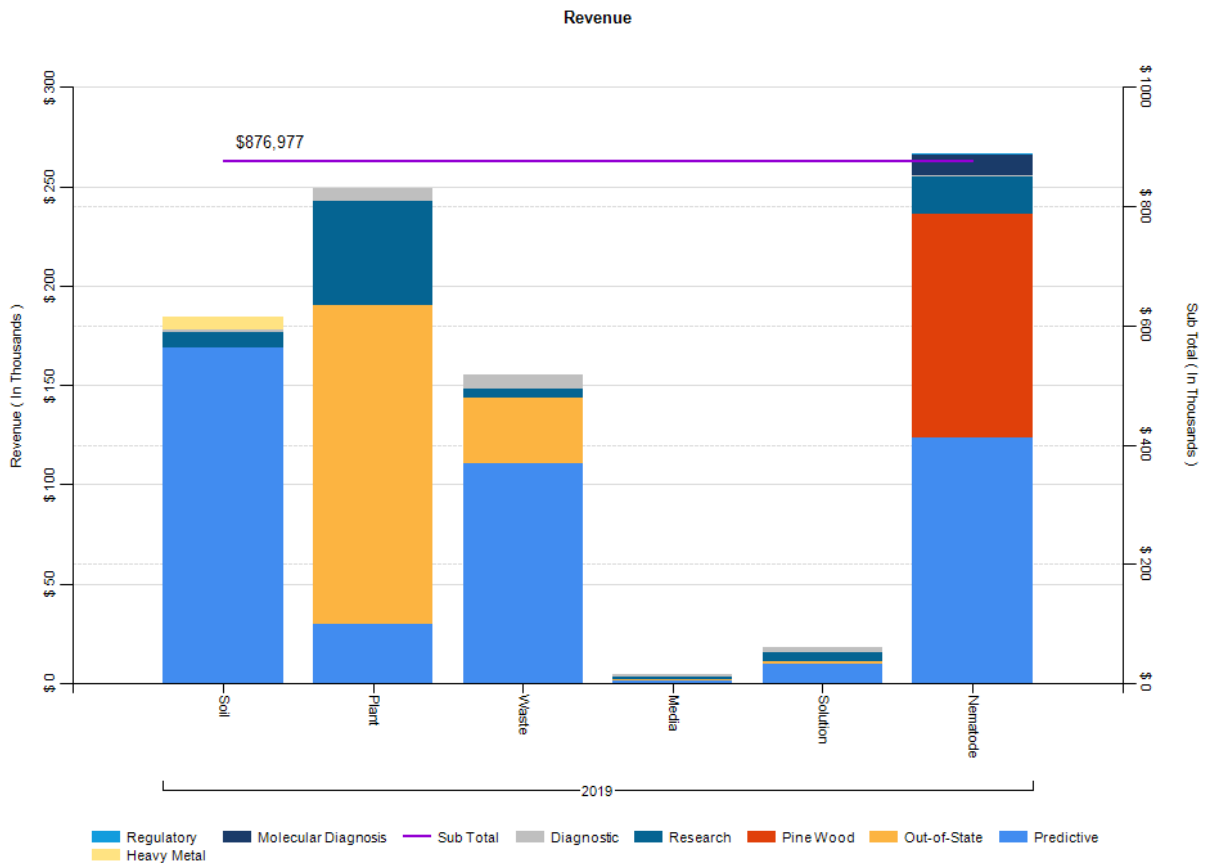
Other Sample Fees, \$836,776 (16%)

Fertilizer & Lime Taxes, \$595,783 (11%)

Total Budget: \$5,244,739



The chart below shows the FY2019 revenue generated by routine samples.



Laboratory Services

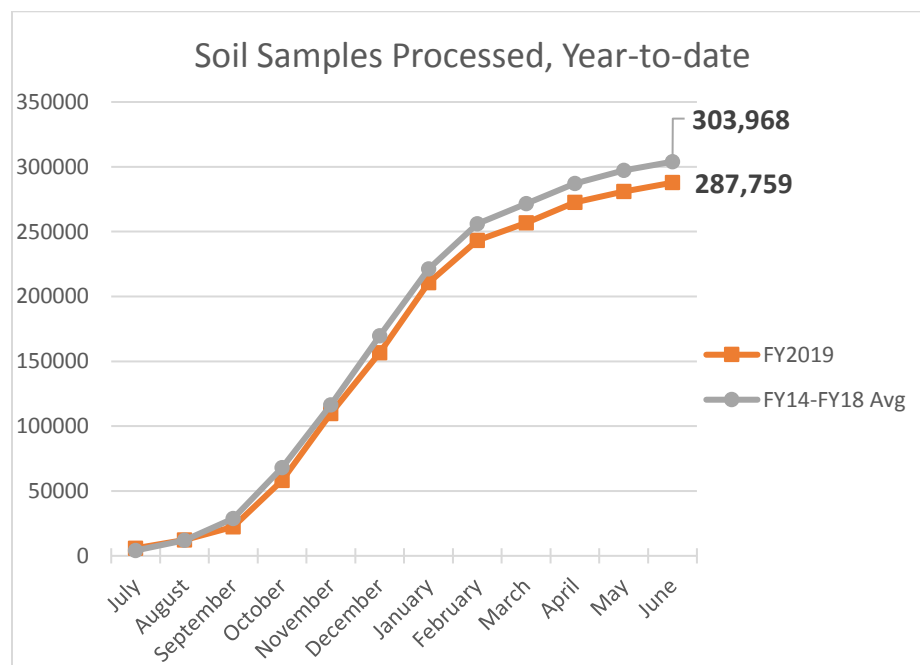
Quality Analysis/Quality Control

The Soil Testing and Plant/Waste/Solution/Media Advisory Laboratories participate in several external quality control programs. Annual analysis of unknown samples provided by an accredited proficiency testing provider is part of the laboratory recertification process by the DEQ Division of Water Resources' Laboratory Certification Branch. The Agronomic Division passed its proficiency testing in 2019 and is certified through 2020.

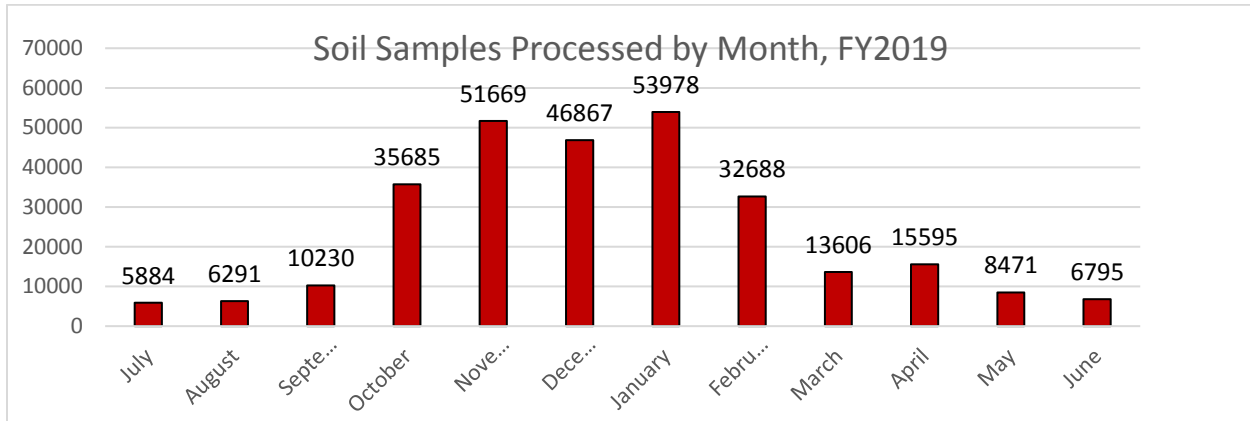
The Agronomic Division also voluntarily participated in the following inter-laboratory, proficiency testing and certification programs during 2019:

1. North American Proficiency Testing Program (NAPT) – soil analyses
2. North American Proficiency Testing Program (NAPT) – plant tissue and solution analyses
3. Manure Analysis Program (MAP) – manure analyses
4. Agricultural Laboratory Proficiency program (ALP) – soil analyses

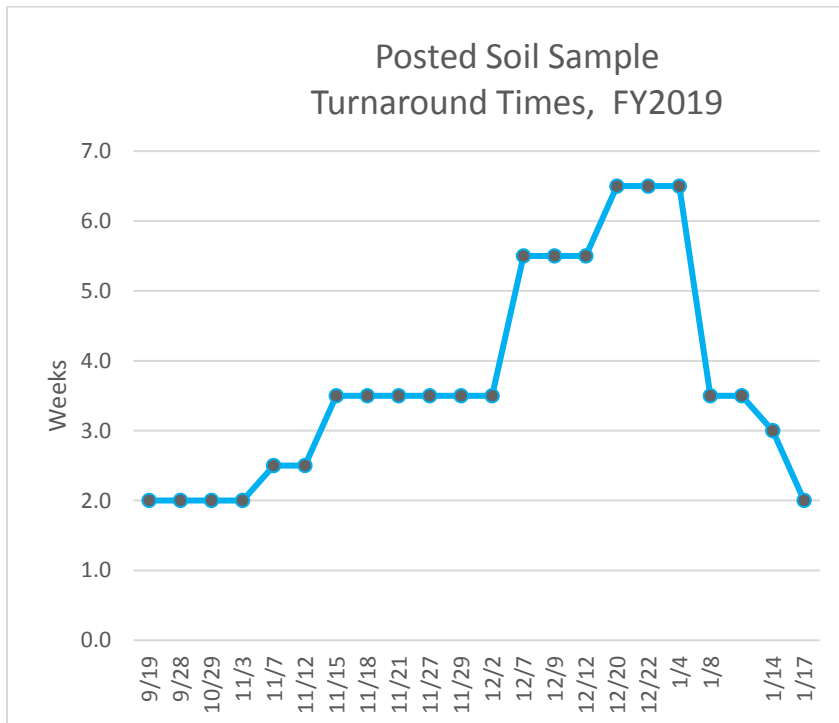
The **Soil Testing Section**, under the direction of David H. Hardy, Ph.D., analyzed 287,759 soil samples in FY2019: 282,635 predictive; 1,221 diagnostic; 1,576 research; 2,003 internal; 268 heavy metals; and 56 witchweed. The Soil Testing Lab issued a total of 34,635 reports for fertilizer/lime recommendations. Total sample volume for FY2019 was down about 5% compared to the average of the previous five fiscal years.



A total of \$169,880 was collected in peak-season soil testing fees (\$4.00/sample) for samples submitted December 15, 2018 through March 31, 2019. Peak-season samples (42,470) represented 15% of the total sample volume analyzed by the Soil Testing Lab. As seen below, the peak-season fee achieved its intended purpose, to distribute the workload for the Soil Testing Lab more evenly across the year. January 2019 was the busiest month of FY2019, with 53,978 soil samples being analyzed.



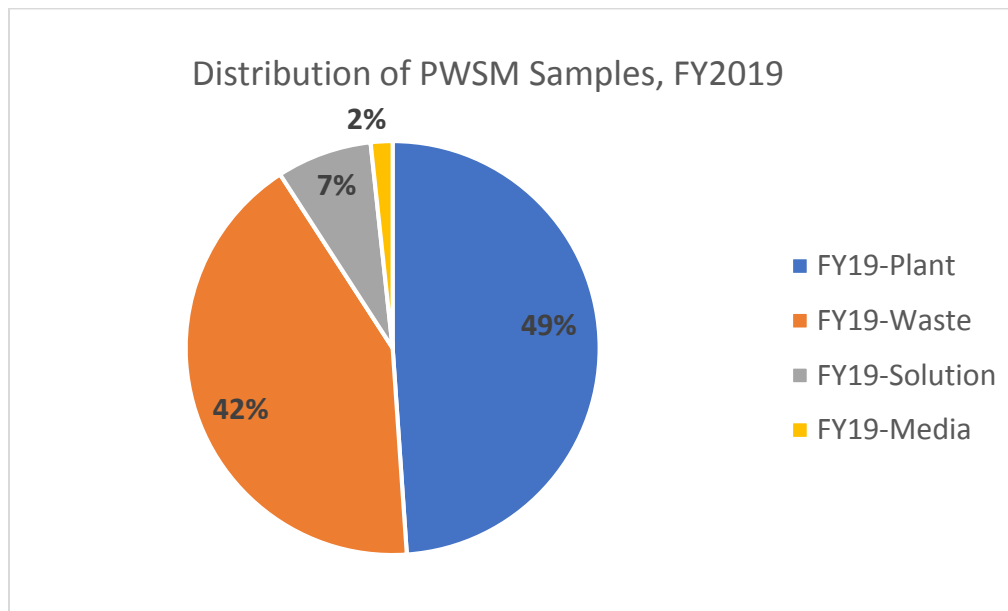
In general, the sample turnaround times were very acceptable for growers during FY2019. Soil sample turnaround for predictive samples plateaued at six and half weeks on December 20, 2018 but then dropped back down to two weeks by January 17, 2019.

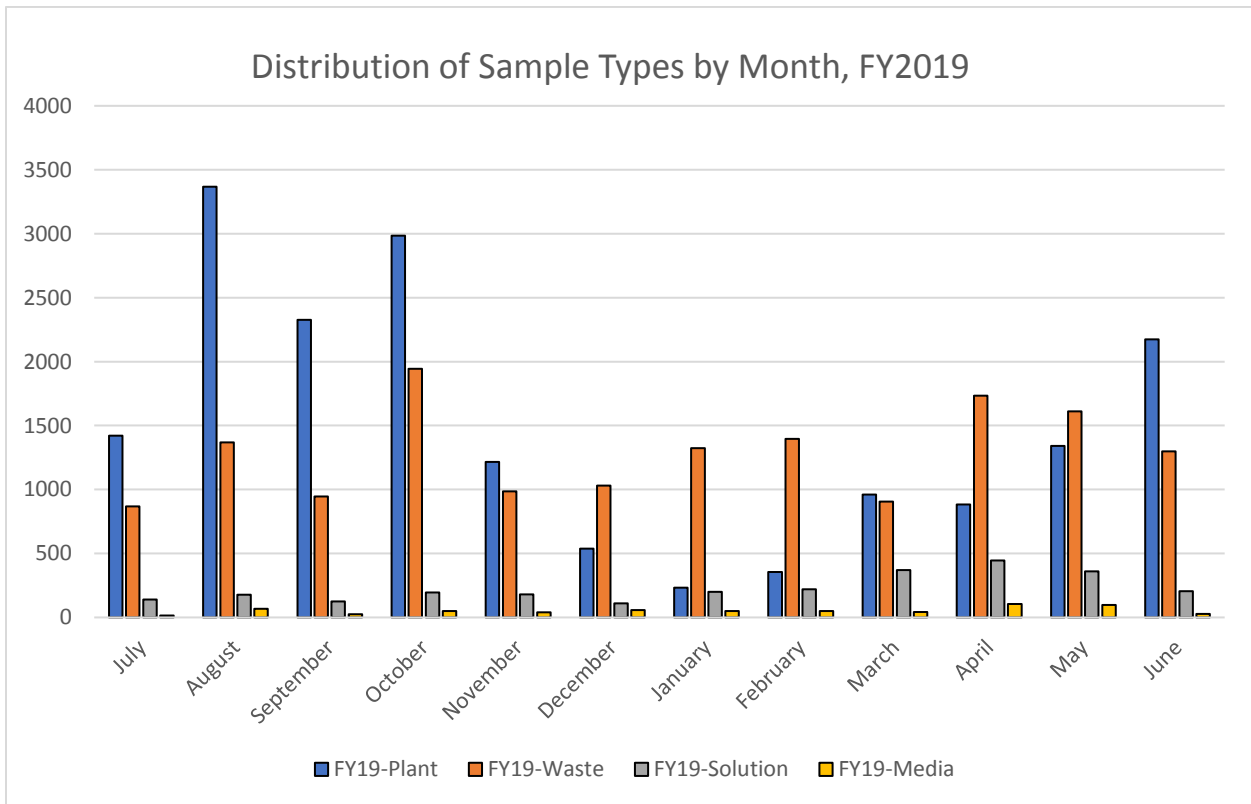
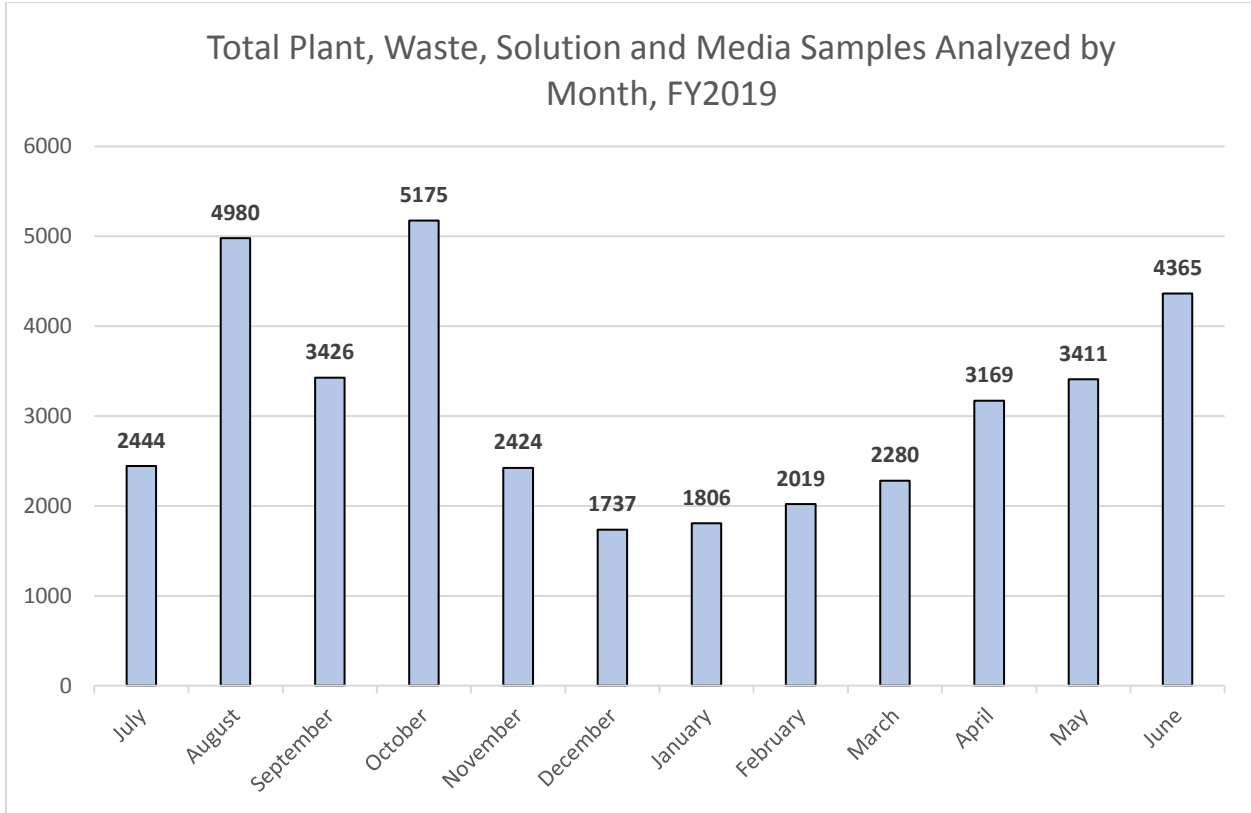


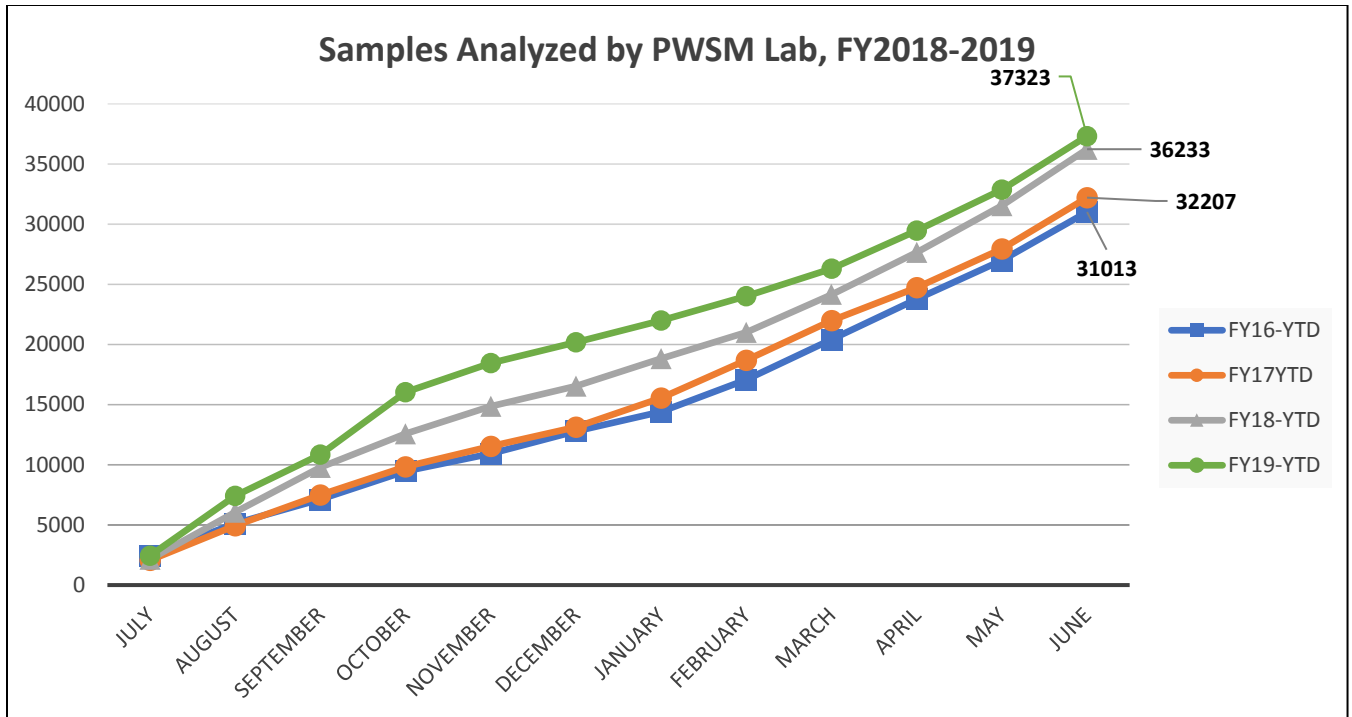
For high-volume customers wanting a guaranteed turnaround time of 7 to 10 business days, a limited number of “expedited shippers” were sold at \$200 each. Each expedited shipper holds 36 soil samples. During FY2019, 492 expedited shippers were sold to clients.

The **Plant/Waste/Solution/Media (PWSM) Section**, under the direction of Kristin Hicks, Ph.D., issued a total of 11,543 reports during FY2019. These reports gave recommendations for 18,254 plant tissue samples; 15,652 waste samples; 2,780 solution samples; and 637 soilless media samples in FY2019. Due to the time-sensitive nature of PWSM samples, the following turnaround times were adhered to: plant, 2 days; media and solution, 3 to 4 days; and waste, 7 to 10 days.

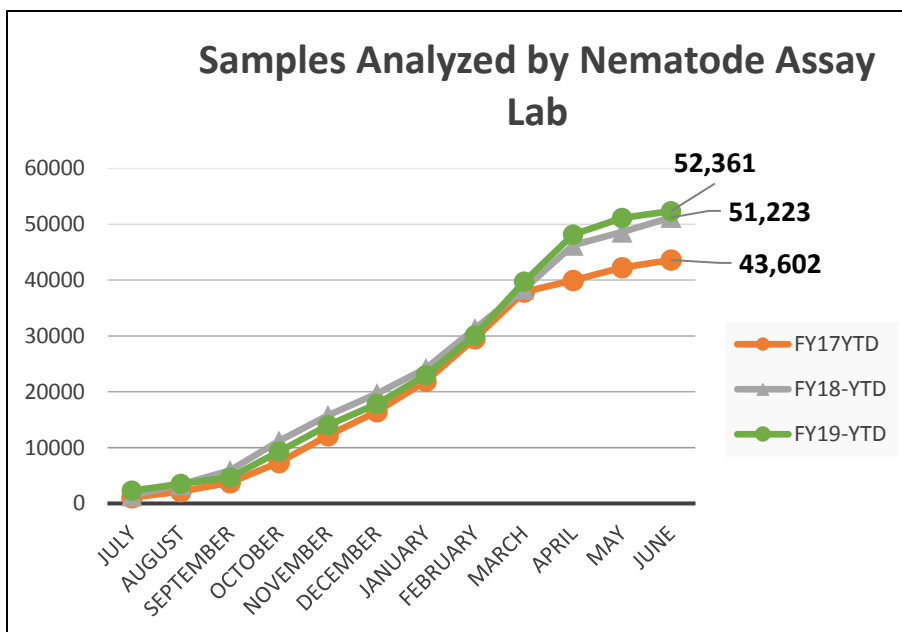
Although the PWSM Laboratory had a large number of samples submitted year-round, the busiest month for the PWSM Section was October, with 5,175 samples analyzed, followed by August with 4,980 samples. In total, 37,323 samples were processed during FY2019, making this the largest sample volume handled by the PWSM Lab since FY2002.

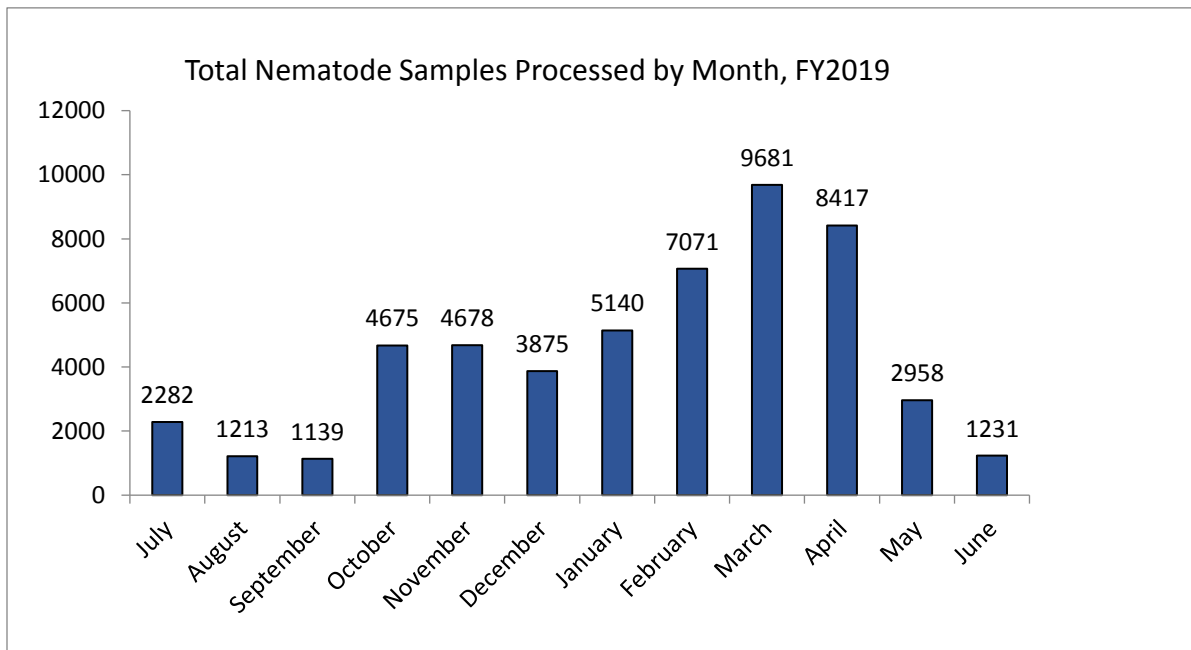
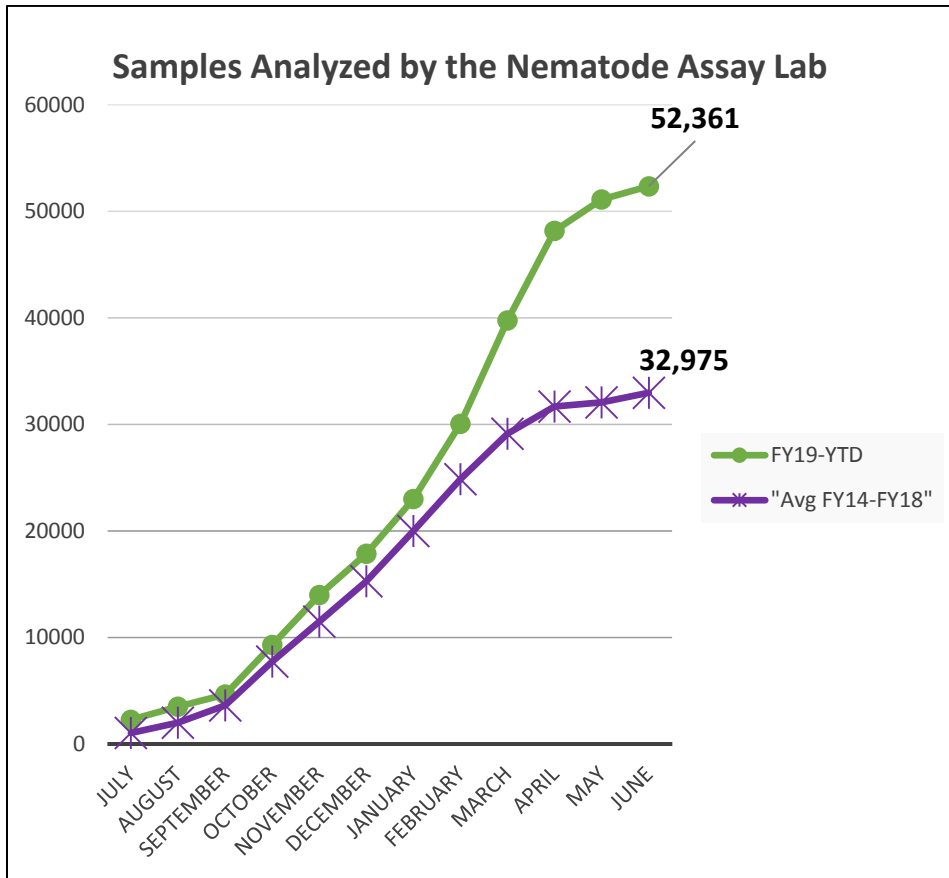






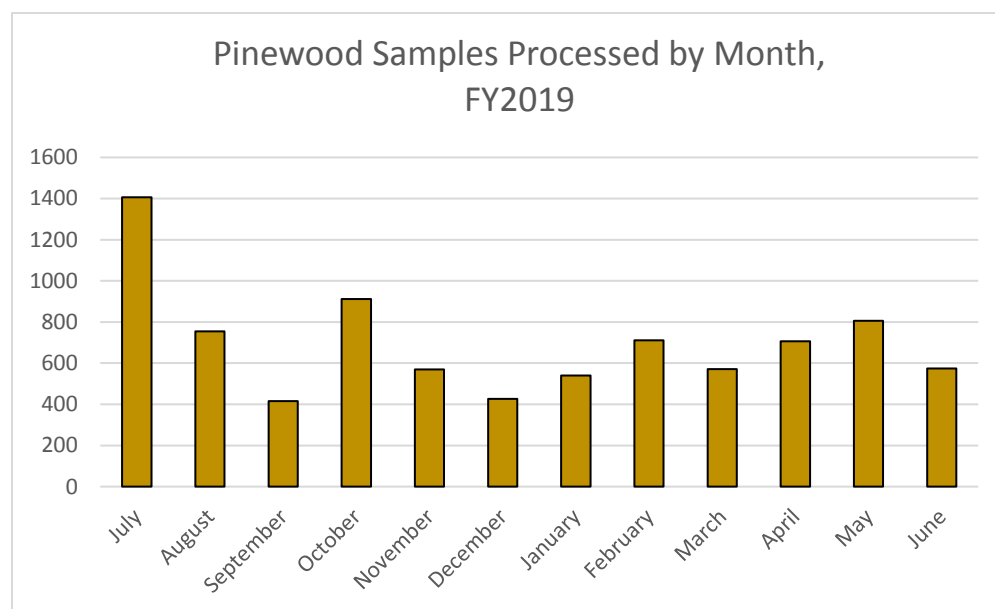
The Nematode Assay Section, under the direction of Weimin Ye, Ph.D., processed 52,361 samples and issued at least 7,276 reports in FY2019, making this a record-breaking year with at least 1,000 more samples processed than the next highest year (FY2018) and more than 19,000 more than the average of the previous five years (FY2014-2018). March was the busiest month in FY2019 for the lab, with 9,681 samples processed.





Most samples (38,918) were predictive in nature; other types included 1,874 research samples, 67 diagnostic samples, 150 internal samples, 2,894 molecular diagnostic samples and 94 regulatory samples from the NCDA&CS Plant Industry Division.

In addition, 8,379 pine wood samples were specifically tested for the presence of pinewood nematode, so shipments of lumber and wood products could be cleared for export from the United States. After a tariff was implemented by China in July 2019, there was a dramatic decline in monthly pinewood samples submitted to the Nematode Assay Lab. Pine wood nematode was detected in 181 samples, but this was only 2.16% of the total pine wood samples assayed. Pinewood samples made up 16.00 % of all nematode samples processed in FY2019, compared to 27.43% in FY2018.



In FY2019, the crop with the largest number of submitted samples was sweet potato, with 20,312 samples (39% of total sample volume), followed by soybean (9,843 samples and 19% of total).

Field Services

Field Services Section personnel, under the direction of Michelle McGinnis, Ph.D., made about 10,900 grower consults in FY2019, primarily to help diagnose nutrient and/or nematode problems. Regional agronomists handled more than 400 inquiries regarding environmental issues in FY2019— primarily waste management plan clarifications, regulatory updates and river basin oversight reviews — participated in at least 15 county Soil & Water local advisory committees and served on 17 boards, committees, or advisory groups.

- 1217 Interagency Guidance Committee – Willie Howell
- Buncombe County FARMS Board – Chris Leek
- Corn Growers Association of North Carolina Board – Don Nicholson

- Lee County Farm Bureau Board – Don Nicholson
- Madison County Ag Agencies Board – Chris Leek
- Mountain Research Station Field Day Planning Committee – Chris Leek
- NC Ag Foundation Board – Georgia Love
- NC Certified Crop Advisors Board – Michelle McGinnis
- NC Certified Crop Advisors Exam Committee – Michelle McGinnis
- NC Raspberry and Blackberry Growers Association Board – Steve Dillon
- NC Tomato Growers Association Board – Chris Leek
- Robeson County Crop Promotion Association Board – Georgia Love
- Robeson County Extension Field Crops Advisory Committee – Georgia Love (Chair)
- Rowan County Extension Advisory Council – Daniel Overcash
- Upper Mountain Research Station Research Greenhouse Facility Advisory Group – Dwayne Tate
- Wayne County Farm Bureau Board – Willie Howell
- Wilkes County/Roaring River Water Quality Initiative Advisory Committee – Dwayne Tate

Education & Outreach (calendar year summary)

Agronomic Division staff, especially the Field Services Section, reach thousands of growers and agricultural professionals through a wide range of educational activities. Honeywell provides funding for the distribution of a limited number of vouchers to cover the cost of plant tissue analysis as a means to introduce growers to this service. Regional agronomists play a key role in spreading the word about tissue testing and offering the free vouchers to interested growers.

In-house staff conducted at least 20 laboratory tours for farmers, master gardeners, agribusiness groups, scientists and students, with at least 326 participants (Appendix A.). Information on agronomic services was disseminated through more than 21 educational exhibits displayed at farm shows, field days, training events and professional meetings (Appendix B).

Outreach also included nine news releases (Appendix C) and at least 62 presentations on agronomic services were made to master gardeners, growers, commodity associations, conservation groups, and county and state organizations as well as to regional, national and international meetings (Appendix D). Ten external professional publications were published by staff in 2019 (Appendix E).

Research (calendar year summary)

Division staff routinely engage in cooperative studies with university personnel, farmers and industry specialists.

The **Soil Testing Section** cooperated in the following research projects during 2019:

- 1) A Lime Laboratory Incubation and Lime Rate Field Study, in cooperation with Crop and Soil Sciences at N.C. State University (NCSU) - Dr. David Hardy (NCDA&CS) and Drs.

Carl Crozier, John Havlin and David Jordan (NCSU). Project funding: Agronomic Division.

The **Plant/Waste/Solution/Media Testing Section** cooperated in the following research projects during 2019:

- 1) Nitrogen Rate Management for Malting Quality Barley in North Carolina in cooperation with the Crop and Soil Sciences Department at N.C. State University (NCSU), Years 2 & 3– Dr. Kristin Hicks (NCDA&CS); Dr. Amy Johnson (NCSU); Dr. Deanna Osmond (NCSU) and Josh Whelan (NCSU). Project funding: N.C. Tobacco Trust Fund Commission
- 2) Seasonal Variation in Blackberry Nutrient Concentration of Primocane and Floricane Leaves in Prime-Ark 45 and Traveler in Double and Single Cropping Systems in cooperation with the Horticultural Sciences Dept. at N.C. State University (NCSU), 2nd and final year– Dr. Kristin Hicks (NCDA&CS); Dr. Gina Fernandez (NCSU); Karen Blaedow (NCSU Extension); Daniel Shires (NCSU Extension); Steve Dillon (NCDA&CS). Project funding: Southern Region Small Fruits Consortium (SRSFC).

The **Nematode Assay Section** cooperated in the following research projects during 2019:

- 1) Statewide Survey on Sweet Potato Root Knot Nematode, in cooperation with the NCDA&CS Plant Industry – Dr. Weimin Ye (NCDA&CS). Project funding: NCDA&CS Department Level.
- 2) Molecular Characterisation and Diagnosis of Root-knot Nematodes (*Meloidogyne* spp.) from North Carolina, USA. – Dr. Weimin Ye (NCDA&CS).
- 3) New Nematicides for Sting Nematode Control on Turfgrass, in cooperation with Bayer Crop Science – Dr. Weimin Ye (NCDA&CS). Project funding: Bayer Crop Science.
- 4) Turfgrass Nematode Identification and Management in North Carolina, USA, in cooperation with the Entomology and Plant Pathology Department at N.C. State University (NCSU) – Dr. Weimin Ye (NCDA&CS) and Dr. Jim Kerns (NCSU)
- 5) Sweet Potato Nematode management in North Carolina, USA, in cooperation with the Entomology and Plant Pathology Department at N.C. State University (NCSU) – Dr. Weimin Ye (NCDA&CS) and Dr. Lina Quesada (NCSU).
- 6) Tobacco and Soybean Nematode Management in North Carolina, USA, in cooperation with the Entomology and Plant Pathology Department at N.C. State University (NCSU) – Dr. Weimin Ye (NCDA&CS); Dr. Lina Quesada (NCSU) and Dr. Lindsey Thiessen (NCSU).

The **Field Services Section** conducted or participated in at least three research and demonstration projects in 2019. These projects were designed primarily to optimize crop fertilization and nematode-management efforts.

- 1) Nitrogen Rate Management for Malting Quality Barley in North Carolina in cooperation with the Crop and Soil Sciences Department at N.C. State University (NCSU), Years 1 & 2– Dr. Kristin Hicks (NCDA&CS); Dr. Amy Johnson (NCSU); Dr. Deanna Osmond (NCSU) and Josh Whelan (NCSU). Project funding: N.C. Tobacco Trust Fund Commission.
- 2) Nitrogen and potassium rates for industrial hemp production in cooperation with the Crop and Soil Sciences Department at N.C. State University (NCSU) – Dr. Michelle McGinnis (NCDA&CS); Dr. Loren Fisher (NCSU); DR. Keith Edmisten (NCSU). Dr. Matthew Vann (NCSU) and Maggie Short (NCSU). Project funding: New and Emerging Crops Grant.
- 3) Effect of drying temperature on cannabinoid concentrations, mycotoxin levels, and yeast & mold levels of hemp grown for CBD extraction in cooperation with the Crop and Soil Sciences Department at N.C. State University (NCSU) – Dr. Michelle McGinnis (NCDA&CS); Brandon Poole (NCDA&CS), and Dr. Keith Edmisten (NCSU). Project funding: New and Emerging Crops Grant.

Safety Program

The Agronomic Services Division maintains a very active, employee-led safety program. The Division has been recognized as a Public-Sector Star site by the North Carolina Department of Labor (NCDOL) for the past ten years. All employees serve on one of eight safety teams: Safety Inspection & Compliance; Safety Program & Policy; Safety Information & Communication; Job Safety Analysis; Housekeeping and Wellness; Ergonomics; Environmental Management and Field Services.

The Agronomic Services Division prepared a detailed annual report on its 2019 safety program and submitted it to NCDOL on February 15, 2020. Below are comments received from Morgan Brown, Star Program IH Consultant.

Thank you for your EXCELLENT submission of the Star Annual Report. I can always count on the Agronomics team to follow the guidelines and adequately summarize the previous year.

You all have a lot to be proud of in terms of your safety and health management systems and the employee involvement. I look forward to continuing to work with you all.

Appendix A. Laboratory Tours for Calendar Year 2019

	Tour Group	Tour Date
1.	Lee County Master Gardeners (5)	June 19, 2019
2.	USDA APHIS (5)	July 17, 2019
3.	NC Composting Council (45)	September 11, 2019
4.	Union County Master Gardeners (20)	September 18, 2019
5.	Vance & Warren County Master Gardeners (30)	October 1, 2019
6.	Hoke & Scotland County Master Gardeners (10)	October 17, 2019
7.	Soil Science Course, James Sprunt Community College (15)	October 21, 2019
8.	NCSU Plant Pathology Class #502 (12)	November 6, 2019
9.	NCSU Crop Science Class #214 (20)	November 7, 2019
10.	NCSU Soil Science Class #201 (20)	November 12, 2019
11.	NCSU Soil Science Class #201 (20)	November 13, 2019
12.	NCSU Soil Science Class #201 (20)	November 14, 2019 (AM)
13.	NCSU Soil Science Class #201 (20)	November 14, 2019 (PM)
14.	USDA-FAS Cochran Fellows from Algeria (5)	November 15, 2019
15.	Lenoir Community College Soil Science Class (16)	November 21, 2019
16.	NCDA&CS Research Stations Superintendents (40)	December 4, 2019
17.	NC Ag Consultants (10)	December 4, 2019
18.	Novozymes Scientists (5)	December 5, 2019
19.	Piedmont Community College Soil Science Class (4)	December 10, 2019
20.	Lucky Clay's Fresh (4)	December 17, 2019

Appendix B. Educational Exhibits for Calendar Year 2019

	2019 Educational Exhibits	Date
1.	NC Apple Growers Meeting (Asheville)	Jan 8-9, 2019
2.	SE Regional Fruit and Vegetable Conference (Savannah)	Jan 10-12, 2019
3.	NC Commodities Conference (Durham)	Jan 9-11, 2019
4.	NC Blueberry Council Open House and Trade Show (Fayetteville)	Jan 15-18, 2019
5.	Green & Growin' Show (Greensboro)	Jan 17-18, 2019
6.	NC Peach Society Annual Meeting (Carthage)	Jan 22, 2019
7.	Southern Farm Show (Raleigh)	Jan 31-Feb 1, 2019
8.	Henderson County Winter Apple School (Hendersonville)	Feb 6, 2019
9.	Organic Commodities & Livestock Conference (Mt. Olive)	Mar 7, 2019
10.	NC Commercial Blackberry & Raspberry Growers (Shelby)	Feb 15, 2019
11.	Small Farms & Opportunities Conference (Louisburg)	Feb 16, 2019
12.	Winter Vegetable/Tomato Conference (Asheville)	Feb 20-21, 2019
13.	NC Christmas Tree Association Winter Meeting (Blowing Rock)	Feb 21-22, 2019
14.	NE Ag Expo Field Day (Pasquotank)	July 26, 2019
15.	Blacklands Farm Managers Tour (Fairfield)	Aug 7, 2019
16.	Caldwell County Nurseryman's Association	Sept 8, 2019
17.	NC Christmas Tree Association Summer Meeting (Newland)	Aug 16-17, 2019
18.	NC Greenhouse Vegetable Growers Association (Raleigh)	Oct 29-30, 2019
19.	Sustainable Ag Conference	Nov 1-3, 2019
20.	SE Strawberry Expo (Raleigh)	Nov 6-8, 2019
21.	SE Vegetable & Fruit Expo (Wilmington)	Dec 5-7, 2019

Appendix C. News Releases and Interviews for Calendar Year 2019

1. Now is the time for tobacco transplant producers to test float bed water, Kristin Hicks Feb. 8, 2019
2. NCDA&CS heavy metal testing not designed for hemp production, David Hardy March 6, 2019
3. NCDA&CS agronomist offers home garden tips, Jagathi Kamalakanthan April 4, 2019
4. Optimize strawberry fertility with plant tissue testing, Kristin Hicks April 5, 2019
5. Agronomist explains the basics of soil pH and lime, Jagathi Kamalakanthan May 21, 2019
6. Study underway to help farmers produce malting barley for breweries, Kristin Hicks June 17, 2019
7. Price to increase Nov. 1 on nematode molecular diagnostic testing, Colleen Hudak-Wise Oct. 9, 2019
8. Agronomic Services Division offers nematode molecular diagnostic testing, Weimin Ye Nov. 8, 2019
9. Reminder: Peak-season soil testing period begins Nov. 27, David Hardy Nov. 26, 2019

Appendix D. Presentations for Calendar Year 2019

Soil Testing Section

- 1) Southern States Nutrient CCA Workshop (Raleigh, NC, January 8, 2019)
Presentation: *An Update on NCDA Soil Test K Recommendations for Corn and Soybeans*, D. Hardy
- 2) Plant food Association of North Carolina (Southern Pines, NC, January 9, 2019)
Presentation: *New Results for K Fertility for Corn and Soybeans*, D. Hardy
- 3) Soil Science Society of NC 62nd Annual Meeting (Raleigh, NC, January 23, 2019)
Presentation: *Approaches to Soil Testing: A Discussion of Philosophies*, D. Hardy
- 4) Mid-Atlantic Soil Testing and Plant Analysis Annual Meeting (Raleigh, NC, January 30, 2019)
Presentation: *The History of Soil Testing in North Carolina*, D. Hardy
- 5) Pasquotank Co. Grower Meeting (Elizabeth City, NC, February 5, 2019)
Presentation: *Understanding the Soil Test in North Carolina*, D. Hardy
- 6) Crop Science / Soil Science SSC 462 (Raleigh, NC, April 2, 2019)
Presentation: *A Step into the Working World Using Agronomic Services*, D. Hardy

Plant/Waste/Solution/Media Section

- 1) N.C. Peach Growers Association Meeting (Carthage, NC; January 21, 2019)
Presentation: *Peach Fertility in Plant Tissue*, K. Hicks
- 2) University of Mt. Olive Agricultural Education Capstone Training (Mount Olive, NC; February 14, 2019)
Presentation: *NCDA&CS Agronomic Lab Service*, K. Hicks
- 3) NCSU Hemp Field Day (Clayton, NC; August 30, 2019)
Presentation: *Industrial Hemp: Managing Fertility*, K. Hicks
- 4) Santee Certified Crop Advisor Workshop (Matthews, SC; November 20, 2019)
Presentation: *NCDA&CS Plant Tissue Analysis: Sampling, Troubleshooting & Interpretation*, K. Hicks
- 5) Santee Certified Crop Advisor Workshop (Matthews, SC; November 20, 2019)
Presentation: *NCDA&CS Agricultural Water Quality: Sampling, Troubleshooting & Interpretation*, K. Hicks
- 6) Santee Certified Crop Advisor Workshop (Matthews, SC; November 20, 2019)
Presentation: *NCDA&CS Developing Plant Sufficiency Ranges for Hemp*, K. Hicks

Nematode Assay Section

- 1) 58th Annual Meeting of the Society of Nematologists (Raleigh, NC; July 8-11, 2019)
Presentation: *Characterization of an emerging root-knot nematode Meloidogyne enterolobii in North Carolina, USA*, W. Ye

Field Services Section

- 1) Nutrien Grower Meeting (Elizabethtown; Jan 8, 2019)
Presentation: Hay Fertility and Nutrient Management Considerations for 2019, G. Love
- 2) Southeastern Apple Meeting (Asheville; Jan 9, 2019)
Presentation: Overview of Soil and Nematode Testing in Orchards, D. Tate and S. Dillon
- 3) Small Farm Winter Vegetable Production Update (Hendersonville; Jan 16, 2019)
Presentation: Soil Report Interpretation and Organic Inputs, S. Dillon
- 4) Bladen Waste Management Class (Elizabethtown; Jan 18, 2019)
Presentation: Tools for The Plan: Waste, Soil, and Plant Analysis, G. Love
- 5) Forage and Grasslands Council (Canton; Jan 22, 2019)
Presentation: Maintaining Forage Fertility to Reduce Weed Competition, C. Leek
- 6) Livestock Association Meeting (Elizabethtown; Jan 22, 2019)
Presentation: Grass Management Considerations for 2019, G. Love
- 7) High Country Hemp Meeting (Jefferson, Jan 25, 2019)
Presentation: Soil Fertility & Agronomic Considerations for High Country, D. Tate
- 8) Pasquotank Extension Meeting (Elizabeth City; Feb 5, 2019)
Presentation: Understanding Soil Test Reports – Part 1, How to package soil sample, C. Pugh
- 9) Granville County Hemp Production Meeting (Oxford; Feb 6, 2019)
Presentation: 2018 Hemp Production Observations and Thoughts Moving Forward, B. Poole
- 10) Surry County Master Gardeners (Dobson; Feb 12, 2019)
Presentation: Soil Testing and Interpretation, D. Overcash
- 11) Pasquotank Extension Meeting (Elizabeth City; Feb 21, 2019)
Presentation: Understanding Soil Test Reports – Part 2, How to change crops in and submit online, C. Pugh
- 12) Henderson County Apple School (Hendersonville; Feb 26, 2019)
Presentation: Deeper Look at Dual Season Strawberry Fertility, S. Dillon
- 13) Agri-Shops High Tunnel and Hemp Production Workshop (Newland; Feb 27, 2019)
Panel Member; Hemp Production, D. Tate

- 14) Ashe County Christmas Tree Meeting (Jefferson; Feb 28, 2019)
Presentation: Tissue Sampling as a Monitoring Tool, D. Tate
- 15) Robeson County Hemp Production Meeting (Lumberton; Mar 5, 2019)
Presentation: 2018 Hemp Production Observations, G. Love
- 16) Dare County Master Gardeners Training (Elizabeth City; Mar 6, 2019)
Presentation: Soils and Soil Testing, C. Pugh
- 17) Robeson County Crop Promotion Association Banquet (Lumberton; Mar 7, 2019)
Presentation: Presented award to Farm Family of the Year, G. Love
- 18) Guilford/Rockingham Spring Strawberry Meeting (Greensboro; Mar 13, 2019)
Presentation: Tissue Sampling for Strawberries/ Spring Fertility Management, B. Poole
- 19) Surface Irrigation System Operators Training School Field Day (Raleigh; Mar 19, 2019)
Field demonstration: NCDA Agronomic Lab Services, D. Nicholson
- 20) Cumberland County Hemp Production Meeting (Fayetteville; Mar 25, 2019)
Presentation: 2018 Hemp Production Observations, G. Love
- 21) Madison County Master Gardeners (Marshall; Mar 26, 2019)
Presentation: Soils, Soil Sampling and Composting, C. Leek
- 22) Central Carolina Community College Soils Class Guest Lecture (Pittsboro; April 1, 2019)
Presentation: Agronomic Lab Services and How to Get the Most Out of Them, B. Poole
- 23) Gates County High School Agriculture Class (Gatesville, Apr 4, 2019)
Presentation: Soil Sampling: How it is done, and why is it important, C. Askew
- 24) Land Application Training School (Raleigh; Apr 10, 2019)
Presentation: Agronomic Services for Land Application, M. McGinnis
- 25) Land Application Training School (Raleigh; Apr 11, 2019)
Field Demonstration: Agronomic Considerations, B. Poole
- 26) Scotland, Hoke, Richmond County Hemp Production Meeting (Laurinburg; May 5, 2019)
Presentation: 2018 Hemp Production Observations , G. Love
- 27) Surry County Master Gardeners (Dobson; May 6, 2019)
Presentation: Soil Testing and Interpretations, D. Overcash
- 28) Mountain Research Station Specialty Crops Field Day (Waynesville; Jul 18, 2019)
Field Demonstration: Tissue and Soil Sampling, D. Tate and C. Leek
- 29) Mountain Research Station Specialty Crops Field Day (Waynesville; Jul 18, 2019)
Presentation: Soil Sampling and How to Interpret Results, C. Leek

- 30) Mountain Research Station Field Day (Waynesville; Jul 18, 2019)
Field Demonstration: Drill Calibration Demo, C. Leek
- 31) Harnett County Hemp Meeting (Lillington; Aug 15, 2019)
Agronomic Concerns in Hemp, D. Nicholson
- 32) NC Christmas Tree Association Summer Meeting (Newland; Aug 16, 2019)
Presentation: Lowering pH in Fraser for Phytophthora Control, D. Tate and J. Moody
- 33) Nash Strawberry Pre-Plant Meeting (Nashville; Aug 29, 2019)
Panel Member: Strawberry Fertility, B. Poole
- 34) Extension Agent Hemp Training (Wake; Aug 30, 2019)
Presentation: Tissue Sampling and Nutrient Deficiencies, B. Poole
- 35) Brunswick County Master Gardener Soil Class (Bolivia; Sep 11, 2019)
Presentation: Soils and Soil Fertility for Homeowners, G. Love
- 36) Caswell County Cattleman's Association (Yanceyville; Sep 17, 2019)
Presentation: Managing Forage Fertility , B. Poole
- 37) Person County Hemp Field Day (Roxboro; Sep 18, 2019)
Presentation: Hemp Fertility and Most Prevalent Diseases, B. Poole
- 38) Rowan County Hemp Field Day (Salisbury; Sep 25, 2019)
Presentation: The Good and The Bad of Growing Hemp, D. Overcash
- 39) Hoke County Master Gardener Soil Class (Raeford; Sep 26, 2019)
Presentation: Soils and Soil Fertility for Homeowners, G. Love
- 40) Horse Pasture Workshop (Durham; Nov 02, 2019)
Presentation: Pasture Fertility, B. Poole
- 41) Amazing Grazing Conference (Nashville; Nov 04, 2019)
Presentation: Pasture / Forage Fertility, M. Wilder
- 42) NRCS Stanly County Field Day (Albemarle; Nov 04, 2019)
Presentation: Soil Sampling in Pastures, D. Overcash
- 43) Central Carolina Community College (Pittsboro; Nov 13, 2019)
Presentation: Understanding Your Soil Report, B. Thompson
- 44) Amazing Grazing Pasture Training (Morganton; Nov 15, 2019)
Presentation: Soil Fertility Considerations for Pasture Renovation, D. Tate
- 45) Rowan Co Cattlemen's Association (Salisbury; Dec 05, 2019)
Presentation: Nutrient Management in Grazing Pastures, D. Overcash

- 46) NC Vegetable Growers & NC Agribusiness Council Ag Expo (Wilmington; Dec 07, 2019)
Presentation: Floral Hemp Fertility Management with Plant Tissue Analysis, M. McGinnis
- 47) Ag-Pro Day (Goldsboro; Dec 11, 2019)
Presentation: Agronomic Considerations in Landscapes, D. Nicholson
- 48) Rowan Winter Hemp Meeting (Salisbury; Dec 16, 2019)
Presentation: The Good the Bad and the Money of Hemp, D. Overcash
- 49) Sampson County CES Animal Waste Operator Class (Clinton; Dec 17, 2019)
Presentation: Animal Waste Management: Tools to Maintain a Healthy Crop, W. Howell

Appendix E. Professional Publications (external) for Calendar Year 2019

Plant/Waste/Solution/Media Section

Landis, H. Hicks, K. Cockson, P. Henry, J., Smith, J. and B. Whipker. 2019. Expanding Leaf Tissue Nutrient Survey Ranges for Greenhouse Cannabidiol-Hemp. Chapter 10. In *Crop, Forage and Turfgrass Management*. Vol. 5, Issue 1. 1-3.

Whipker, B.E., Landis, H., Hicks, K., Owen, W.G. and McCall, I. 2019. Expanding leaf tissue nutrient survey standards for 74 floriculture species. In *Acta Hort.* Vol. 1266. 173-180

Nematode Assay Section

Davies, K.A., Bartholomaeus, F., Li, D.M., Zhao, Z.Q., Ye, W. & Giblin-Davis, R. 2019. *Ficophagus* (Nematoda: Aphelenchoididae) from sycones of *Ficus* subgenus *Urostigma*, sections *Malvanthera* and *Urostigma*, in eastern Australia. *Nematology* 22: <https://doi.org/10.1163/15685411-00003327>

Munawar, M, Miao, W, Ye, W. & Zheng, J. 2019. Updated description of *Paratylenchus lepidus* Raski 1975 and *P. minor* Sharma, Sharma and Khan, 1986 by integrating molecular and ultra-structural observations. *Journal of Nematology* 51: 1-13. DOI: 10.21307/jofnem-2019-071

Zhang, D., Zeng, W.S., Huang, J., Zeng, Y., Peng, Y., Ye, W., Huang J. & Giblin-Davis, R.M. 2019. *Ficophagus curtipes* n. sp. (Nematoda: Aphelenchoididae), an associate of *Ficus curtipes* in China. *Nematology* 21: 1091 - 1101. <https://doi.org/10.1163/15685411-00003277>

Zeng, Y.S., Huang, J., Zhang, D, Zeng, W.S., Shi, R., Zhang, Y., Peng, Y., Ye, W. & Giblin-Davis, R.M. 2019. *Ficophagus auriculatae* n. sp. (Nematoda: Aphelenchoididae), an associate of the *Ficus auriculata*-complex in China. *Nematology* 21: 497 - 508. DOI: 10.1163/15685411-00003230.

Ye, W., Robbins, R.T. & Kirkpatrick, T. 2019. Molecular characterization of root-knot nematodes (*Meloidogyne* spp.) from Arkansas, USA. *Scientific Reports* 9, 15680 [doi:10.1038/s41598-019-52118-4](https://doi.org/10.1038/s41598-019-52118-4)

Esmaeili, M., Heydari, R. & Ye, W. 2019. Molecular and morphological characterization of *Paurodontella composticola* n. sp. (Nematoda: Hexatylnina, Sphaerulariidae) from Iran. *Journal of Nematology* 51: 1 - 12. DOI: 10.21307/jofnem-2019-034

Esmaeili, M., Heydari, R., Golhasan, B. & Ye, W. 2019. Molecular phylogenetic study of *Bealius Massey & Hinds, 1970* (Nematoda: Hexatylnina: Sphaerulariidae), with description of *B. pinus* n. sp. from Iran. *Nematology* 21: 435-444. DOI 10.1163/15685411-00003224

Hajihassani, A., Ye, W. & Hampton, B.B. 2019. First report of *Meloidogyne javanica* on ginger and turmeric in the United States. *Journal of Nematology* 51 (6): 1 - 3. DOI: 10.21307/jofnem-2019-006