



Carrie Lapaire Harmon

Senior Associate-In Extension Scientist

Detection and diagnosis of emerging and endemic plant diseases

Bldg 1291, the Plant Diagnostic Center

<https://plantpath.ifas.ufl.edu/people/faculty-pages/carrie-harmon/>

Educational background:

- Ph.D., 2013, Plant Pathology, University of Florida
- M.S., 2002, Plant Pathology, Purdue University
- B.S., 2000, Plant and Soil Sciences, University of Massachusetts

Employment:

- 2016-present, Senior Associate-In Extension Scientist, University of Florida, Department of Plant Pathology, UF-IFAS
- 2010-2016, Associate-In Extension Scientist, University of Florida, Department of Plant Pathology, UF-IFAS
- 2003-2010, Assistant-In Extension Scientist, University of Florida, Department of Plant Pathology, UF-IFAS
- 2009-present, Director, Plant Diagnostic Center, UF-IFAS
- 2003-present, Associate Director of the Southern Plant Diagnostic Network, University of Florida, Department of Plant Pathology, UF-IFAS
- 2019-present, Executive Director, National Plant Diagnostic Network (rotating, 2-year term)

Current FTE: 80% Extension, 20% Research

Teaching (2009 - present):

PLP 6942, Professional Internship in the Plant Disease Clinic, all semesters (current)

PLP 6291, Plant Disease Diagnosis, spring semesters (current)

PLP 6105, Plant Disease Management (until 2019)

Service

UF Faculty Senate, member, IFAS Representative for a three-year-term started Fall 2017

UF Land Use Committee, vice-chair 2020, three-year term, started Fall 2017

DPM Plant Pathology comprehensive exam committee member

PLP Web Committee

IFAS Shared Services Center Faculty Advisory Group

Mentoring (committee membership):

- Nick Goltz, DPM (Chair)
- Amanda Long, DPM and MS in Environmental Horticulture (Member)
- James Fulton, PhD in Plant Pathology (Member)
- Deanna Bayo, PhD in Plant Pathology (Member)
- John Bonkowski, DPM (graduated 2016, employed at Purdue University Diagnostic Lab) (Member)

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- Lisbeth Espinosa, DPM (graduated December 2017, employed as faculty in Ecuador) (Member)
- Chris Kerr, DPM (graduated December 2016, employed at FDACS) (Member)
- Rosa Raudales, PhD (graduated 2016 in Env. Hort.) (Member)
- Alicyn Ryan, DPM (graduated 2015, employed at UMaine, Orono, as diagnostic lab director and Assistant Professor) (Member)

Extension:

Plant disease epidemics and exotic plant pathogen introductions can result in serious economic and environmental damages to agricultural, horticultural, and natural environs in Florida and the US. IFAS faculty and their clientele need to be kept up-to-date on the changing status of important plant diseases and available detection and diagnosis methods. As a sentinel state, Florida is uniquely situated to be a leader in new pathogen visual and lab-based diagnostic information, and the UF/IFAS Plant Diagnostic Center serves as the hub lab for the Southern Plant Diagnostic Network (SPDN), providing training and leadership in this area. Detection and diagnosis protocols for new diseases are important for diagnosticians in UF IFAS and other regional Plant Disease Clinics and for scouts and other clientele in the field. Development and delivery of plant problem detection, diagnosis and application information to clientele includes print, teleconference, conference and classroom media such as PowerPoint and hands-on demonstrations. The SPDN is an integral part of the National Plant Diagnostic Network (NPDN) and partner with land-grant university extension across the US, USDA-NIFA, USDA-APHIS, other USDA programs, state plant departments of agriculture, the National IPM Centers, and industry. Coordination of the SPDN has afforded me the opportunity to develop a robust diagnostic training system. My contribution to the IFAS Extension system and to diagnostic laboratories in the US and abroad has been the delivery of concise, practical, and hands-on training in plant health diagnostic concepts and methods.

Target and Primary audiences: My extension presentations focus on delivery of research-generated data, detection information, and diagnostic resources at two levels, namely extension faculty and agricultural professionals, and diagnostic personnel. Extension faculty and their clientele include county extension agents in Florida and other US states, ornamental professionals, crop consultants for major agronomic and ornamental products, and natural area professionals such as municipal and state foresters, arborists, etc. Seven ports, three climate zones, and the designation as a major producer of US ornamentals and fresh produce make the state of Florida particularly vulnerable and probable as a place of introduction of new invasive species. Several new plant pathogens have been introduced since I began my extension program, so I have focused my extension duties to address those needs. The specific diseases include Tomato Brown Rugose Fruit Virus, soybean rust, sudden oak death, citrus greening, gladiolus rust, laurel wilt, SCMV in St. Augustinegrass, and bacterial diseases of blueberry. Data generated by UF and other research institutions are combined with detection and diagnosis information and management options to give each audience the practical information needed to make sound plant health management decisions, preserving human and ecological health for the citizens of Florida and other states.

Objectives:

- Develop improved procedures and techniques for identifying and monitoring pests
- Deliver plant problem detection, diagnosis and application information to clientele

- Develop and deliver “desktop diagnosis” training to PCOs, Master Gardeners, and extension agents to support their onsite plant management efforts and client communications.

Topics covered by my extension program include

- Methods of diagnosis, prevention, treatment, control, and eradication of pests
- Methods for risk assessment, surveillance, and prevention of foreign pathogens
- Mechanisms involved in transmission of diseases to plants
- Prevention and mitigation techniques
- Monitoring and sampling
- Diagnostic services, including DDIS and eXtension’s AskAnExpert, identification and diagnosis, interpretation of diagnostic results and UF-IFAS research-based management recommendations

Educational Methods: My extension programming for the past ten years has included plant disease detection and diagnosis presentations in in-service training events, demonstrations, group facilitation events, digital diagnoses and presentations at more than 150 extension meetings such as the Trees Florida Conference, Advanced Master Gardener Training, District Extension annual meetings and other extension faculty meetings and training sessions. Through these presentations and extension-related documents, phone calls, emails, and interactions at the Plant Diagnostic Center, I have made several-thousand contacts with extension clientele in Florida and beyond.

Since May 2009, I have served as Director of the UF-IFAS Extension Plant Diagnostic Center in Gainesville. Prior to this official designation, and since then, I worked extensively with the diagnosticians in the Gainesville clinic to increase the type and number of techniques utilized and services offered, including APHIS-CPHST NPPLAP Provisional Approval for diagnosis of Sudden Oak Death and Citrus Greening. Funds from the Southern Plant Diagnostic Network and other USDA grants have supported the purchase and upgrade of equipment including microscopes, PCR thermocyclers, sterile transfer hoods, a lyophilizer, and cold storage of reagents and samples; several of these pieces of equipment are used by multiple programs within the department. Additionally, my grant funds have supported student and hourly staff in the clinic, assisting with diagnostics of important pathogens in samples from Florida and other US states, and throughout the world. 2019 was a banner year for samples; we received 2,933 samples from 59 of our 67 counties, 22 US states, and 17 countries. Additionally, we processed 3,642 tomato samples from 6 states for TMV during an APHIS-driven survey for Tomato Brown Rugose Fruit Virus.

International extension activities:

I have been integrally involved in development and dissemination of diagnostician training since 2006 in Eastern Europe and the Americas, focusing primarily on the Caribbean, Central America, and South America. Through work funded primarily by USDA-Foreign Agriculture Service (USDA-FAS) and USAID, I have conducted assessments of diagnostic capacity in six countries, and have trained diagnosticians from more than two-dozen countries. I started work in Bangladesh in 2014, and Trinidad and Tobago in 2016, broadening the scope of capacity-building to include a new region and building on successes with the International Plant Diagnostic Network (IPDN) and past USDA-FAS projects. In 2019, I led a week-long hands-on capacity-building lab course for 20 diagnostic professionals from the Caribbean. My primary goal in these activities is to expand diagnostic capacity abroad to increase global food security and safeguard American agriculture and natural ecosystems. Hands-on training in specific and

general detection methods is my primary means of augmenting diagnostic capacity in those countries, and has provided a natural segue into conversations about detection data sharing and regional collaborations. These topics are central to sustainability of any capacity-building or diagnostic successes in the US and abroad.

Research:

The goal of my research program is to provide applied answers to plant disease problems identified through extension activities as important for clientele in Florida and diagnosticians throughout the world. Specific goals of my program are to investigate new detection and diagnostic methods for important, emerging, or high-risk plant pathogens and diseases that threaten agriculture and ecosystems in the region I serve. Many of these projects and activities represent multi-discipline and/or multi-state collaborations. Several of the research projects resulted in publications in three of the major journals for plant pathology in the US: *Phytopathology*, *Plant Disease*, and *Plant Health Progress*, which are targeted to applied plant scientists and practitioners. My research projects all fall under detection, diagnosis, and management of emerging pathogens, in keeping with my main focus as Director of the Plant Diagnostic Center and Project Director of the Southern Plant Diagnostic Network.

Professional service:

- Expert panel member in diagnostic data, European Food Safety Authority (EFSA), 2016
- Panel manager for National Extension Integrated Pest Management Coordination and Support Program, USDA-NIFA, 2013, 2014
- Panel member for Regional Integrated Pest Management research and extension program, Southern Region IPM Center, 2013
- Anonymous reviewer of >25 articles submitted to *Plant Disease*, *Plant Health Progress*, MDPI – Pathogens section, open-access journal, (<https://www.mdpi.com>), and the Global Forum for Rural Advisory Services (www.g-fras.org)

Current funding (total for last 10 years: \$6,991,817)

<u>Project Title</u>	<u>PI/ CoPI</u>	<u>\$ total amount</u>	<u>\$ total to my program</u>	<u>Year-year</u>
The Southern Plant Diagnostic Network (USDA-NIFA)	PI	\$2,215,966	\$543,983	2016-2020
<i>Phytophthora ramorum</i> Program Diagnostic Support for APHIS Survey/Regulatory Incidents	PI	\$95,000	\$95,000	2019-2020
<i>Phytophthora ramorum</i> Program Diagnostic Support for APHIS Survey/Regulatory Incidents	PI	\$65,000	\$65,000	2018-2019
<i>Phytophthora ramorum</i> Program Diagnostic Support for APHIS	PI	\$26,000	\$26,000	2016-2018
Survey of solanaceous crops for <i>Liberibacter</i> species (Farm Bill)	PI	\$34,000	\$34,000	2014-2015
The Southern Plant Diagnostic Network (USDA-NIFA)	PI	\$1,378,532	\$601,506	2012-2016
<i>Phytophthora ramorum</i> sample diagnosis for PASS-NPPLAP (USDA-APHIS)	PI	\$26,000	\$26,000	2014-2016

Improvement and deployment of rapid standardized PCR diagnostic tools to increase diagnostic capacity for high-impact plant pathogens (AFRI)	PI	\$999,580	\$347,680	2010-2014
Diagnostic image series development for supporting IPM in the southern region (RIPM)	PI	\$83,000	\$15,000	2011-2014
Plant pest laboratory training in Peru (USDA-FAS)	PI	\$48,550	\$48,550	2011-2013
Plant pest diagnostic train-the-trainer Workshops in Honduras (USDA-FAS)	PI	\$29,397	\$29,397	2011-2013
Laurel wilt of avocado: Mitigation and management of an exotic, insect-vectored disease (SCRI)	Co-PI	\$1,967,863	\$20,000	2009-2014
Development of an online culture and morphology image reference tool for diagnosticians and identifiers (RIPM)	PI	\$22,929	\$18,929	2009-2011

Peer-reviewed Publications (2013 - present):

1. Fulton, J.C.; Klein-Gordon, J.; Bec, S.; Fayette, J.; Jones, J.B.; Garrett, K.A.; Harmon, C.L. 2020. Draft genome sequences of plant pathogenic *Klebsiella variicola* isolated from plantain in Haiti. In Press, accepted May 2020. MRA.
2. Fulton, J.C.; Bec, S.; Fayette, J.; Ploetz, R.C.; Garrett, K.A.; Harmon, C.L. 2020. First report of plantain soft rot caused by *Klebsiella variicola* in Haiti. Plant Disease. <https://doi.org/10.1094/PDIS-10-19-2105-PDN>.
3. Fayette, J.; Bec, S.; Loubeau, S.; Fulton, J.C.; Garrett, K.A.; Harmon, C.L. 2019. First Report of *Lasiodiplodia hormozganensis* Causing Fruit Rot of Eggplant in Haiti. Plant Disease, PDIS-05-19-1093-PDN.
4. Schubert, T, Jeyaprakash, A., and Harmon, C.L. 2018. Fundamentals and Advances in Plant Problem Diagnostics; *Chapter in Handbook of Florists' Crops Diseases and Handbook of Plant Disease Management*. McGovern, R.J. and Elmer, W.H. (Eds.) Springer International Publishing. Hardcover ISBN 978-3-319-39668-2. DOI 10.1007/978-3-319-32374-9_1-1.
5. Arous, S., Capobianco, H., Harmon, C.L., and Polston, J., 2018. Comparison of Genus-specific Primer Pairs in RT-PCR for the Broad-spectrum Detection of Viruses in the Genus Potyvirus by Plant Diagnostic Laboratories. J. Vir. Methods, 258: pp29-34. <https://doi.org/10.1016/j.jviromet.2018.05.003>
6. Harmon, C.; Timilsina, S.; Bonkowski, J.; Jones, D; Sun, X.; Ramos, L.; Bull, C.; Vallad, G.; Jones, J. (2018) Bacterial gall of *Loropetalum chinense* caused by *Pseudomonas amygdali* pv. *loropetali* pv.nov. Plant Dis. 102(4) pp799-806. <https://doi.org/10.1094/PDIS-04-17-0505-RE>
7. Norman, D.; Bocsanczy, A.M.B.; Harmon, P.F.; Harmon, C.L.; Khan, A. First report of bacterial wilt disease caused by *Ralstonia solanacearum* on blueberries (*Vaccinium corymbosum*) in Florida. Plant Disease 09/2017; <https://doi.org/10.1094/PDIS-06-17->

[0889-PDN](#)

8. Norman, D., Harmon, P., Harmon, C. (2017) *Ralstonia solanacearum*, a new pathogen of highbush blueberry. *Phytopathology* 103: S2.112.
9. Stubbs, E.A., Burkle, C.C., Hodges, A.C., Myers, B.E., Whilby, L., Poplin, A., Hoenisch, R., McCarthy, R., and Harmon, C.L. 2017. Increasing invasive plant pest early detection through interagency first detector education. *Journal of Extension*. 55:3 (3RIB1)
10. Narouei-Khandan, H.A.; Harmon, C.L.; Harmon, P.; Olmstead, J., and van Bruggen, A.H.C. Potential global distribution of blueberry twig blight (*Phomopsis vaccinii*) predicted by two species distribution modeling approaches. 2017. Paper presented at the XI International Vaccinium Symposium. *Acta Horticulturae* (meeting proceedings).
11. Narouei-Khandan, H.A.; Harmon, C.L.; Harmon, P.; Olmstead, J.; Zelenev, V.V.; van der Werf, W.; Worner S.P.; Senay, S.D., and van Bruggen, A.H.C. (2017). Potential global and regional geographic distribution of *Phomopsis vaccinii* on *Vaccinium* species projected by two species distribution models. *Eur. J. Plant Pathol.* 148(4):1-12. DOI 10.1007/s10658-017-1146-4. <http://rdcu.be/oCDP>
12. Meador, D. P., Fisher, P. R., Guy, C. L., Harmon, P. F., Peres, N. A., & Teplitski, M. (2016). Use of dehydrated agar to estimate microbial water quality for horticulture irrigation. *Journal of Environmental Quality*, 45(4), 1445-1451.
13. Londoño, M. A., Harmon, C. L., & Polston, J. E. (2016). Evaluation of recombinase polymerase amplification for detection of begomoviruses by plant diagnostic clinics. *Virology Journal*, 13(1): 1.
14. Nunez, G. H., Harmon, C. L., Olmstead, J. W., & Darnell, R. L. (2016). Root-level inoculation with iron-reducing microorganisms does not enhance iron uptake by southern highbush blueberry plants. *Rhizosphere*. <http://dx.doi.org/10.1016/j.rhisph.2016.09.001>
15. Ploetz, R. C., Thant, Y. Y., Hughes, M. A., Dreaden, T. J., Konkol, J., Kyaw, A., Smith, J. A., & Harmon, C. L. (2016). Laurel wilt, caused by *Raffaelea lauricola*, is detected for the first time outside the southeastern USA. *Plant Disease*, 100(10): 2166.
16. Schubert, T., Jeyaprakash, A., & Harmon, C. (2016). Fundamentals and Advances in Plant Problem Diagnostics. In McGovern, R.J. & Elmer, W.H. (Eds.), *Handbook of Florists' Crops Diseases*, 1-27. Cham, Switzerland: Springer International Publishing. doi:10.1007/978-3-319-32374-9_1-1
17. Elliott, M. L., Des Jardin, E. A., Harmon, C. L., & Bec, S. (2016). Confirmation of Fusarium wilt caused by *Fusarium oxysporum* f. sp. *palmarum* on × *Butyragrus nabonnandii* (mule palm) in Florida. *Plant Disease*. 101(2) <http://dx.doi.org/10.1094/PDIS-08-16-1099-PDN>
18. Aćimović, S. G., Harmon, C. L., Bec, S., Wyka, S., Broders, K., & Docola, J. J. (2016). First Report of *Diplodia corticola* Causing decline of red oak (*Quercus rubra*) trees in Maine. *Plant Disease*, 100(3): 649. <http://dx.doi.org/10.1094/PDIS-09-15-0994-PDN>
19. Harmon, C.L. and Bec, S. 2015. What's in a name? The dilemma of diagnostic identifications and databases. *In Proceedings of the International Plant Protection Congress*. August 2015. Berlin, Germany. [https://www.plantprotection.org/Meetings/InternationalCongress\(IPPC\)/XVIIIIPPC,Berlin,2427August2015.aspx](https://www.plantprotection.org/Meetings/InternationalCongress(IPPC)/XVIIIIPPC,Berlin,2427August2015.aspx)
20. vanBruggen, A., Sharma, K., Merritt, J., Ali, G., Dickstein, E., Harmon, C.L. (2014). Pests and diseases in ornamental greenhouse crops: International trade, diagnosis and

management, and audit-based certification systems. Department of Plant Pathology, Gainesville.

21. Dreaden, T. J., Davis, J. M., Harmon, C. L., Ploetz, R. C., Palmateer, A. J., Soltis, P. S., and Smith, J. A. (2014). Development of multilocus PCR assays for *Raffaelea lauricola*, causal agent of laurel wilt disease. *Plant Dis.* 98:379-383.
22. Bibbs, C.S., Vitoreli, A.M., Benny, G., Harmon, C.L., and Baldwin, R.W. (2013). Susceptibility of *Latrodectus geometricus* (Araneae: Theridea) to a *Mucor* strain discovered in North Central Florida, USA. *Florida Entomologist.* 96:3. 1052-1061