**Project/Activity Number:** S-1092

**Project/Activity Title:** Biology, ecology, and management of emerging nematode threats in the Southern United States.

**Period Covered:** October 1, 2023 to September 30, 2024

**Date of This Report:** January 15, 2025

**Annual Meeting Date(s):** November 14-15, 2024

**ALABAMA**

**Participants:** Lawrence, Kathy (lawrekk@auburn.edu) and Lawaju, Bisho Ram (brl0024@auburn.edu) – Auburn University

**Objective 3. Develop and evaluate integrated nematode management tactics for emerging nematode diseases.**

**Activities:** Cotton variety trials were conducted in fields infested with *Meloidogyne incognita* and *Rotylenchulus reniformis* to assess their impact on nematode populations and cotton yield.

**Output:** The results showed that *M. incognita* populations were reduced by 89% in the nematode-resistant DP 2141NR variety compared to the high-yielding susceptible varieties DP 2038, DP 2131, and DP 2349. The DP 2141NR variety also produced an increased yield of 668 lb/acre at a 40% lint rate, which, at $0.71 per pound, would result in an additional $190 per acre. In the *R. reniformis* field, the resistant DP 2141NR variety had 80% lower nematode populations and supported an increased yield of 1,126 lb/acre at a 40% lint rate, resulting in an additional $319 per acre at the same cotton price.

Phytogen is introducing seven new cotton varieties with three genes for resistance to *Meloidogyne incognita* and *Rotylenchulus reniformis*. These new varieties were compared to the market-dominating susceptible variety, PHY 340. In the *M. incognita* field, the resistant varieties achieved an average seed cotton yield increase of 815 lb/acre over PHY 340. At a 40% lint rate and a cotton price of $0.71 per pound, this resulted in an additional 326 lb lint/acre, valued at $231 per acre. In the *R. reniformis* field, the resistant varieties showed an average seed cotton yield increase of 1,012 lb/acre over PHY 340, resulting in an additional 404 lb lint/acre, valued at $287 per acre.

**Activities:** Field experiments were conducted to evaluate cotton variety performance with and without supplemental nematicide applications in soils infested with *Meloidogyne incognita* and *Rotylenchulus reniformis*. These trials aimed to analyze nematode population responses and measure cotton yield outcomes.

**Output:** Cotton varieties from Phytogen, Deltapine, NextGen, Stoneville, and Armor were planted in *Rotylenchulus reniformis*-infested fields to assess their impacts on nematode reproduction and lint yield. On average, nematode-resistant varieties produced 595 pounds more lint per acre than susceptible varieties, even without nematicide application. At a lint percentage of 40% and a cotton price of $0.71 per pound, selecting resistant varieties alone provided an additional $169 per acre. Furthermore, applying aldicarb to resistant varieties increased lint production by an additional 308 pounds per acre, adding $218 per acre in revenue. Notably, three newly developed ThryVon cotton varieties, engineered for thrip resistance, showed unexpectedly high levels of *R. reniformis* reproduction.

**Outcome:** Field demonstrations and podcasts aligned with Objective 1 helped disseminate these findings effectively.

**Impacts:**
At statewide field events and live demonstrations, 143 farmers, extension specialists, and consultants observed the cotton variety trials in person. In addition, the cotton variety selection podcast was downloaded 1,277 times, significantly extending the research's reach. This evidence-based information equips growers to make location-specific decisions about cotton varieties and nematode management strategies for the upcoming growing season.

**Publications:**

*Peer-reviewed*

Sudha Acharya, Hallie A. Troell, Rebecca L. Billingsley, Kathy S. Lawrence, Daniel S. McKirgan, Nadim W. Alkharouf, Vincent P. Klink. 2024. *Glycine max* polygalacturonase inhibiting protein 11 (*Gm*PGIP11) functions in the root to suppress *Heterodera glycines* parasitism. Plant Physiology and Biochemistry 0981-9428/2024. <https://doi.org/10.1016/j.plaphy.2024.108755>

Miranda Otero, Ambika Pokhrel, Seungyeon Seo, Laura Wendell, Amber Smith, Kathy S. Lawrence, Jeffrey J. Coleman.2024. Evaluation of genetic diversity, haplotype, and virulence of *Fusarium oxysporum* f. sp. *vasinfectum* Alabama field isolates. Phytopathology 114 01 July 2024

Summarized distribution of the reniform nematode, *Rotylenchulus reniformis*, in field crops in the United States. 2024. Plant Health Progress 25 accepted 19 Sept 24

Richard O. Murphy, Janiyah S. Cotton, Isabella M. Owens, Jazmine D. Carroll, 5 Kathleen M. Martin, David Held, Kathy Lawrence, John F. Beckmann. 2024 Fast Screening Libraries of Plant Growth Promoting Rhizobacteria (PGPRs) for 2 Insecticidal Activity. Microbial Biotechnology. (Submitted)

Schloemer, Claire M., Graham, Scott H., and Lawrence, Kathy S**.**  2024. Sweetpotato pest challenges and management options. Journal of Integrated Pest Management. (Submitted)

Schloemer, Claire M., Scott H. Graham, Koon-Hui Wang, Brent S. Sipes, and Kathy S. Lawrence. 2024. Evaluation of cover crops and biopesticides to manage *Meloidogyne incognita* and insect pest damage in organic sweetpotatoes. Journal of Nematology (Submitted).

 *Abstracts*

Schloemer, Claire, K.S. Lawrence, S.H. Graham,  K-H. Wang, B. Sipes. 2024. Taking it to the field: organic management of *M. incognita* in sweetpotato using winter cover crops and biological control. Nematropica.

Schloemer, Claire, K.S. Lawrence, S.H. Graham, Bisho Lawaju, K-H. Wang, B. Sipes. 2024. Winter cover crops and biological products to manage *Meloidogyne incognita* and promote soil health in sweetpotato. Journal of Nematology 56:131-132. <https://sciendo.com/article/10.2478/jofnem-2024-0036>.

Schloemer, Claire, K.S. Lawrence, S.H. Graham, B. Sipes and K-H. Wang. 2024. Soil health as affected by winter cover crops on sweetpotato yield in Southern U.S. Journal of Nematology 56:129-130. <https://sciendo.com/article/10.2478/jofnem-2024-0036>.

*Extension and Outreach*

Lawrence, Kathy, and C. Schloemer. 2024. Evaluation of resistant and susceptible cotton varieties with nematicides in root-knot nematode infested field in central Alabama, 2023. Report 18:N013. The American Phytopathological Society, St. Paul, MN. <https://www.plantmanagementnetwork.org/pub/trial/pdmr/volume18/abstracts/N013.asp>

Lawrence, Kathy, and C. Schloemer. 2024. Evaluation of resistant and susceptible cotton varieties with and without nematicides in reniform nematode infested field in north Alabama, 2023. Report 18:N005. The American Phytopathological Society, St. Paul, MN. <https://www.plantmanagementnetwork.org/pub/trial/pdmr/volume18/abstracts/N005.asp>

Lawrence, Kathy, and C. Schloemer. 2024. Evaluation of resistant and susceptible cotton varieties with nematicides in reniform nematode infested field in north Alabama, 2023. Report 18:N012. The American Phytopathological Society, St. Paul, MN. <https://www.plantmanagementnetwork.org/pub/trial/pdmr/volume18/abstracts/N012.asp>

Lawrence, Kathy, H. Jordan, E. Francisco, and C. Schloemer. 2024. Evaluation of soybean varieties yield when challenged with the root-knot nematode in central Alabama, 2023. Report 18:N006. The American Phytopathological Society, St. Paul, MN. <https://www.plantmanagementnetwork.org/pub/trial/pdmr/volume18/abstracts/N006.asp>

Schloemer, C.M., S. H. Graham, and K. S. Lawrence. 2024. Evaluation of biological control products and winter cover crops to manage *Meloidogyne incognita* on sweetpotato, 2023. Report No. 18:N055. The American Phytopathological Society, St. Paul, MN. <https://www.plantmanagementnetwork.org/pub/trial/pdmr/volume17/abstracts/N055.asp>

Ali, Akhtar, T. W. Allen, K. Bissonnette, R, C, Kemerait, Kathy Lawrence, D. McDonald, C. Monclova-Santana, J. Muller, P. Price, M. Prorock, I. Small, T. Spurlock, A. Strauer-Scherer, M. Purvis, D. Ezell, A. Tolbert, R. Hoyle, M. Bish, B. Wilson, H. M. Kelly. 2023. Assessing the impact of foliar diseases through spore trapping in commercial settings. Proceedings of the 2024. Beltwide Cotton Conference Vol. 1:1-4. National Cotton Council of America, Memphis, TN. <https://www.cotton.org/beltwide/proceedings/2024/event-data/pdf/a031/fl029>

Lawrence, K. S. and B. Lawaju.  2024.“Cotton varieties with Reniform nematode resistant genes update.” Tennessee Valley Research and Extension Center Field Day. July 31st, 2024. *15-minute oral presentation and walk through the variety test. 63* attendees.

Lawrence, K. S. and B. Lawaju.  2024**.** “Root knot nematode resistant cotton variety update.” 46th Annual Central Crops Field Tour. August 1st, 2023. *10-minute oral presentation.* 80 attendees.

Cotton Specialists Corner Podcast; “Cotton Nematode Management across the U.S. Cotton Belt”

Drs. Steve Brown, Kathy Lawrence, Terry Wheeler, and Heather Kelly. Feb. 6, 2024, 1277 downloads.

<https://www.planthealthexchange.org/Pages/default.aspx>

I See Dead Plants Podcaster "Reniform Nematode in Cotton" Iowa I See Dead Plants Podcaster

Interviewee: Dr. Kathy Lawrence

 [https://iastate.box.com/s/5hzrupbz3oe1x7zt3yb3w35bg0jo9ga6](https://nam11.safelinks.protection.outlook.com/?url=https%3A%2F%2Fiastate.box.com%2Fs%2F5hzrupbz3oe1x7zt3yb3w35bg0jo9ga6&data=05%7C02%7Clawrekk%40auburn.edu%7Cc54f54c6156847edf20a08dcc7aad484%7Cccb6deedbd294b388979d72780f62d3b%7C0%7C0%7C638604783741498034%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C0%7C%7C%7C&sdata=8mfdFK0NqrFLBxJbPYulsuaK9cgEjNgqNjfzvVKOzz4%3D&reserved=0)

Feel-free to go into more details as outlined => <https://nimss.org/seas/52418>

**ARKANSAS**

**Participants:** Faske, Travis (tfaske@uada.edu) – University of Arkansas

**Objective 3. Develop and evaluate integrated nematode management tactics for emerging nematode diseases.**

* Fifty-six commercially available soybeancultivars marketed for use in southern root-knot nematode-infested fields were evaluated in a uniform field trial to assess nematode susceptibility and yield potential. Additionally, 153 entries from the UA Soybean Official Variety Trial were screened in the same field.
* Twenty-five commercially available seed- and soil-applied nematicides were assessed in on-farm field studies for their efficacy in managing nematodes in corn, cotton, and soybean.
* The nematicide cyclobutrifluram was tested in the laboratory and field to evaluate standard nematode behavioral responses to this new product and its impact on yield protection in the field.

**Publications:**

*Peer reviewed*

Brown, K., and **Faske, T. R.** 2024. Sensitivity of *Meloidogyne incognita* and *Rotylenchulus reniformis* to cyclobutrifluram. Plant Disease 108:3400-3405. <https://doi.org/10.1094/PDIS-04-24-0936-RE>

**Faske, T. R.**, Watson, T., Desaeger, J., Duffeck, M. R., Eisenback, J. D., Floyd, C., Grabau, Z., Hajihassani, A., Kelly, H., Kemerait, R., Lawrence, K., Mueller, D., Smith, M., Wheeler, T., and Ye, W. 2024. Summarized distribution of the reniform nematode, *Rotylenchulus reniformis*, in field crops in the United States. Plant Health Progress 25:506-508. <https://doi.org/10.1094/PHP-06-24-0059-BR>

*Peer Reviewed Extension Articles*

**Faske, T.**, and Sisson, A. 2024. Cotton disease loss estimates from the United States - 2023. Crop Protection Network. CPN-7001-23. <https://doi.org/10.31274/cpn-20240219-0>

**Faske, T.**, Watson, T., Wheeler, T., and Grabau, Z. 2024. An overview of reniform nematode. Crop Protection Network. CPN-7002. <http://doi.org/10.31274/cpn-20241118-0>

Sikora, E., **Faske, T.**, Spurlock, T., Koehler-Betts, A., Grabu, Z., Small, I., Kemerait, B., Mederos, S., Bond, J., Telenko, D., Mueller, D., Sisson, A., Onofre, R., Bradley, C., Padgett, B., Price, P., Watson, T., Chilvers, M., Malvick, D., Allen, T., Lux, L., Duffeck, M., Tenuta, A., Collins, A., Esker, P., Roth, G., Mueller, J., Plumblee, M., Shires, M., Kelly, H., Isakeit, T., Langston, D., Zeng, Y., and Smith, D. 2024a. Soybean disease loss estimates from the United States and Ontario, Canada - 2023. Crop Protection Network. CPN-1018-23. <https://doi.org/10.31274/cpn-20240315-0>

Sikora, E., **Faske, T.**, Meyer, R., Koehler-Betts, A., Kemerait, B., Telenko, D., Robertson, A., Mueller, D., Sisson, A., Onofre, R., Wise, K, Price, P., Chilvers, M., Malvick, D., Allen, T., Bish, M., Jackson-Ziems, T., Broderick, K., Bergstrom, G., Heiniger, R., Ahumada, D., Friskop, A., Pierce, P., Duffeck, M., Tenuta, A., Roth, G., Collins, A., Mueller, J., Plumblee, M., Shires, M., Kelly, H., Isakeit, T., Anderson, N., Langston, D., Zeng, Y., and Smith, D. 2024b. Corn disease loss estimates from the United States and Ontario, Canada - 2023. Crop Protection Network. CPN-2007-23. <https://doi.org/10.31274/cpn-20240315-1>

*Technical Articles*

Emerson, M., Baker, B., **Faske, T. R.**, 2023. Field performance of thirty-six soybean varieties marketed as resistant to southern root-knot nematode, 2022. Pp. 59-62. *in* Soybean Research Studies, 2022. AAESRS 698.

Emerson, M., Baker, B., and **Faske, T. R.** 2024. Field Efficacy of soil-applied fluopyram at low nematode densities in corn. Pg. 18-21. *in* Corn and Grain Sorghum Research Studies 2023. AAESRS 704.

**Faske, T. R.**, Emerson, M., and Baker, B. 2024. Evaluation of six nematicides on two cotton cultivars in a field infested with *Meloidogyne incognita* in Arkansas, 2023. Plant Disease Management Reports 18: N018.

**FLORIDA**

**Participants:** Grabau, Zane (zgrabau@ufl.edu)- University of Florida

**Objective 2. Investigate the ecological and epidemiological factors contributing to the distribution, dissemination and pathogenicity of developing nematode diseases.**

**Objective 3. Develop and evaluate integrated nematode management tactics for emerging nematode diseases.**

* In addition to publications and abstract listed below, 8 field or greenhouse trials were conducted in support of objectives 2 and 3.

**Publications:**

**Z.J. Grabau**. 2024. *What is the Most Cost-Effective Nematicide for Managing*

 *Sting Nematode in Potato?* Panhandle Ag e-News.

 https://nwdistrict.ifas.ufl.edu/phag/2024/08/09/what-is-the-most-cost-effective-

 nematicide-for-managing-sting-nematode-in-potato/

**Z.J. Grabau**. 2024. *Resistant cotton cultivars and nematicides can help manage*

 *reniform nematode.* Panhandle Ag e-News.

 https://nwdistrict.ifas.ufl.edu/phag/2024/02/16/resistant-cotton-cultivars-and-

 nematicides-can-help-manage-reniform-nematode/

*Peer Reviewed*

L.A. Schumacher, H-L. Liao, I.M. Small, and **Z.J. Grabau**. 2024. Vertical distribution of plant-parasitic nematodes in peanut-cotton cropping systems. *Applied Soil Ecology.* 200: article 105445. https://doi.org/10.1016/j.apsoil.2024.105445

L.A. Schumacher, I.M. Small, and **Z.J. Grabau**. 2024. The influence of irrigation, crop rotation, and fluopyram nematicide on peanut yield and the nematode community. *Nematropica.* 54:96-110.

**Z.J. Grabau**, R. Sandoval-Ruiz, and C. Liu. 2024. Fumigation using 1,3-Dichloropropene manages *Meloidogyne enterolobii* in sweetpotato more effectively than fluorinated nematicides. *Plant Disease.* 108:2162-269. https://doi.org/10.1094/PDIS-12-23-2726-RE

M. Wolday Tsegay, M.O. Wallau, C. Liu, J.C.B. Dubeux Jr., and **Z.J. Grabau.** 2024. Crop rotation for management of plant-parasitic nematodes in forage corn production. *Agronomy Journal.* 116: 313-325. https://doi.org/10.1002/agj2.21522

**Z.J. Grabau**, R. Sandoval-Ruiz­, and C. Liu. 2024. Management of *Meloidogyne arenaria* in peanut production using resistance or nematicides. *Nematropica.* 54: 1-14.

*Abstracts*

Z.J. Grabau, R. Sandoval-Ruiz, and C. Liu. 2024. Assessing cost effectiveness of nematicide rates and chemistries for sting nematode management in Florida potato. Journal of Nematology. 56: article e2024-1 page 57.

S. Budhathoki, Z.J. Grabau, and G. Maltais-Landry. Effects of cover cropping systems on soil nematode community composition in organic vegetable production. Journal of Nematology. 56: article e2024-1 page 26.

Z.J. Grabau, R. Sandoval-Ruiz, and C. Liu. 2024. Efficacy of resistant cultivars and nematicide application for managing reniform nematode in cotton. Journal of Nematology. 56: article e2024-1 page 58.

D. Jacobs, J. Deseager, M. Lusk, and Z.J. Grabau. 2024. Vegetable farm cover crop practices to improve nematode management, nitrogen utilization and to support water quality improvement in Florida. Journal of Nematology. 56: article e2024-1 page 69.

**Participants:** Desaeger, Johan (jad@ufl.edu) and Jacobs, Dustin – University of Florida

**Objective 1. Understand the fundamental biology and genetics that underlie the evolving nematode threats to agriculture in the Southern region.**

The presence and distribution of *Meloidgyne enterolobii* in central and south Florida was investigated by collecting 304 root samples from commercial small fruit and vegetable fields, research sites and community gardens. 247 samples were positive for Meloidogyne species, with the most common species being *M. incognita* and *M. enterolobii* (each 76 positives). M.e. was especially prevalent in Asian vegetables grown on small to medium-size Vietnamese farms. Phylogenetic analysis of the populations indicated limited genetic variability among the populations. The results were summarized in a recently submitted manuscript to the Journal of Nematology. A previous M.e. survey (Brito et al., 2001) focused more on nurseries. This was the first survey focusing on commercial vegetables fields. The prevalence of *M. enterolobii* in these fields has important implications for nematode management, the most important being that M.e. will overcome existing resistance genes in crops like tomato, pepper and sweetpotato.

Other potential nematode threats that were identified included stubby root nematodes (SRN, *Nanidorus minor*), which is becoming more common in tomato and strawberry fields in Florida. SRN were found in 60% of the soil samples and visible damage due to SRN was found in two fields. This is the first report of direct damage of SRN to strawberry (publication #5).

In organic strawberry fields, which are becoming more important in Florida due to demand from retailers, sting nematode (*Belonolaimus longicaudatus*) has emerged as the number one overall pest.

**Objective 2. Investigate the ecological and epidemiological factors contributing to the distribution, dissemination and pathogenicity of developing nematode diseases.**

A recent survey of nematodes in Florida strawberry fields has shown that nematodes like northern root-knot (*Meloidogyne hapla*) and northern lesion (*Pratylenchus penetrans*) have become increasingly common in Florida strawberry fields. We also conducted a survey of strawberry transplants coming into Florida from different nurseries, mostly from Canada and California, which indicated the presence of these nematodes on transplants and that they are the likely the main source of introduction of these ‘northern’ nematodes into Florida. Significant damage of *M. hapla* has recently been observed in several fields both to strawberry and many vegetables growing after strawberry. This issue stresses the need for effective nematode management in both nurseries and production fields, and the importance of both these types of growers to work together. We have shared this information at grower’s meetings in Florida and plan to do the same regarding the nursery growers.

**Objective 3. Develop and evaluate integrated nematode management tactics for emerging nematode diseases.**

Management tactics that were evaluated included nematicide evaluations (chemical and biological products), cover crops and different cultivars. Eight greenhouse and six vegetable field trials (tomato, cucurbits and strawberry) were conducted at the GCREC research station and farm evaluating new chemical and biological products and strawberry cultivars. Highlights were (1) that a combination of two biological control agents (Purpureocillium lilicanum + Bacillus amyloliquefaciens) was more effective in reducing M.e. than when the agents were applied by themselves (publication # 4); and (2) that for drip-applied chemical nematicides, two drip tapes improved performance of fluopyram (and somewhat fluensulfone and metam), but not of oxamyl and fluazaindolizine (publication #1).

All the currently planted strawberry cultivars in Florida were shown to be highly susceptible to sting nematode (publication # 7,8).

Cover crops were evaluated for their impact on nematodes and nitrogen leaching in a tomato cropping system (abstract # 7) and anaerobic soil disinfestation (ASD) as a management option for organic strawberries (Abstract #10). These data are still being analyzed and more trials are ongoing.

New information on nematode management gives us a better understanding of how biological nematode control products work and how combinations or mixtures can improve their efficacy. For chemical nematicides, our research showed that application methodology can differ according to physical and chemical properties of the nematicide, especially in the case of drip-applied nematicides that have low water solubility, such as fluopyram.

Cover crops and ASD have shown promise both in terms of nematode management and crop productivity, and we continue to work on these strategies.

For transplants, thermotherapy using steam has shown it can be an effective means of eliminating or reducing nematodes inside strawberry transplants (Khanal et al., 2020, Journal of Nematology), but as of now there is no infrastructure to do this on a large scale.

Our management studies are focused on developing more integrated nematode management (INM) programs, including pre-and post-plant strategies, chemical and biological products, cultural practices and genetic solutions. We are making significant progress in this field and now starting to see implementation of some of these INM practices by growers in Florida.

**Publications:**

*Peer-reviewed*

Bui H and **Desaeger J** (2023). Efficacy of five nematicides against root-knot nematode when applied via single and double drip tapes in a Florida sandy soil. *Pest Management Science*, 79:4474-4480. <https://doi.org/10.1002/ps.7649>

**Desaeger J**, Coburn J, Freeman J and Brym Z (2023). Plant-parasitic nematodes associated with *Cannabis sativa* in Florida. *Journal of Nematology*, 55, 10 pg. <https://doi.org/10.2478/jofnem-2023-0018>Faske T, Mueller J, Becker O, Bernard E, Bradley C, Bond J, **Desaeger J**, Eisenback J, Grabau Z, Hu J, Kemerait R, Koehler A, Lawrence K, Mehl H, Rudolph R, Sikora E, Thomas S, Walker N, Wheeler T, Wrather A, Ye W, and Zhang L (2023). Summarized Distribution of the Southern Root-Knot Nematode, *Meloidogyne incognita*, in Field Crops in the United States. Plant Health progress, 3 pg. <https://doi.org/10.1094/PHP-04-23-0031-BR>

Faske T, Watson T, **Desaeger J**, Duffeck M, Eisenback J, Floyd C, Grabau Z, Hajihassani A, Kelly H, Kemerait R, Lawrence K, Mueller J, Smith M, Wheeler T, and Ye W (2024). Summarized Distribution of the Reniform Nematode, *Rotylenchulus reniformis*, in Field Crops in the United States. *Plant Health progress* **Published Online:**22 Jul 2024 <https://doi.org/10.1094/PHP-06-24-0059-BR>.

Lopes de Paula L, Campos VP, Terra WC, de Brum D, Jacobs D, Bui H, **Desaeger J** (2024). The combination of *Bacillus amyloliquefaciens* and *Purpureocillium lilacinum* in the control of *Meloidogyne enterolobii*, *Biological Control* 189: 9 pp. <https://doi.org/10.1016/j.biocontrol.2023.105438>

Oliveira C, Inserra R and **Desaeger J** (2023). First report of direct damage caused by stubby-root nematode, *Nanidorus minor*, to strawberry (*Fragaria x ananassa*), in Florida. Journal of Nematology, 55, 4 pp. [https://doi.org/10.2478%2Fjofnem-2023-0016](https://doi.org/10.2478/jofnem-2023-0016)

Oliveira CJG, Riva GG, Brito JA, Xue R, and **Desaeger J** (2023). First Report of Meloidogyne javanica Infecting Strawberry (Fragaria × ananassa) in the United States. Journal of Nematology, 55, 4 pg. <https://doi.org/10.2478/jofnem-2023-0034>

Oliveira C G, Peres N & **Desaeger J** (2023). Nematode population dynamics and plant steaming effects on strawberry cultivars under organic field conditions in Florida. Nematology, 26(2): 227-238. <https://doi.org/10.1163/15685411-bja10304>

Oliveira CJ G, van Santen E, Marin M, Schumacher LA, Peres NA and Desaeger J (2023). Susceptibility and interaction of Belonolaimus longicaudatus with Phytophthora cactorum on different strawberry cultivars. Nematology, pg 1-12. <https://doi.org/10.1163/15685411-bja10237>

Sikora R, Helder J, Molendijk L, **Desaeger J**, Eves-van den Akker S and Mahlein A (2023). Integrated nematode management in a world in transition: constraints, policy, processes and technologies for the future. Annual Review of Phytopathology, 61:209-230. <https://doi.org/10.1146/annurev-phyto-021622-113058>

*Abstracts*

Bui HX, and Desaeger JA (2024). Efficacy of fluopyram and fluensulfone on sting nematode (*Belonolaimus longicaudatus*) in Florida strawberry. The 63rd Annual SON Conference, Park City, Utah, Aug 4-9, 2024. (Poster). [https://doi.org/10.2478/jofnem-2024-0036](https://nam10.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdoi.org%2F10.2478%2Fjofnem-2024-0036&data=05%7C02%7Cjad%40ufl.edu%7C7a85814826dc415cf7a508dd0e36069f%7C0d4da0f84a314d76ace60a62331e1b84%7C0%7C0%7C638682347378734760%7CUnknown%7CTWFpbGZsb3d8eyJFbXB0eU1hcGkiOnRydWUsIlYiOiIwLjAuMDAwMCIsIlAiOiJXaW4zMiIsIkFOIjoiTWFpbCIsIldUIjoyfQ%3D%3D%7C0%7C%7C%7C&sdata=1iCEvJWGkAhgK8DaXPej2LHQ3bRWuUvhIr%2FuusI9mG8%3D&reserved=0)

Desaeger J, Agudelo P, Chowdhury I, Corbin J, Gorny A, Grabau Z, Mueller J, Quesada-Ocampo L, Riva G, Rutter W, Wadl P and Ye W (2024). Distribution of Meloidogyne enterolobii in vegetable crops in the southeastern United States. 35th Symposium of the European Society of Nematologists (ESN), Cordoba, Spain, April 15-19, 2024.

Desaeger J**,** Bui H, Coburn J and Carter J (2024). Plant-parasitic nematodes infecting alternative crops in Florida. The 137th Annual Meeting of the Florida State Horticultural Society, June 9-11, 2024. Orlando, FL. [https://www.fshs.org/assets/2024conference/Book%20of%20Abstracts%20FSHS%202024.pdf](https://nam10.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.fshs.org%2Fassets%2F2024conference%2FBook%2520of%2520Abstracts%2520FSHS%25202024.pdf&data=05%7C02%7Cjad%40ufl.edu%7C7a85814826dc415cf7a508dd0e36069f%7C0d4da0f84a314d76ace60a62331e1b84%7C0%7C0%7C638682347378743548%7CUnknown%7CTWFpbGZsb3d8eyJFbXB0eU1hcGkiOnRydWUsIlYiOiIwLjAuMDAwMCIsIlAiOiJXaW4zMiIsIkFOIjoiTWFpbCIsIldUIjoyfQ%3D%3D%7C0%7C%7C%7C&sdata=UXOsQrfBv12zUEgrmWSRLKEFA2DAj5WDUlMO4qpWkX4%3D&reserved=0)

Desaeger J and Sikora R (2024). Biological and Chemical nematicides – not either or both differently. Society of Nematologists 64th Annual Conference, Park City, UT, August 5-18, 2024.

Desaeger J (2024). Nematode management in an unpredictable world – one-size-fits-none. Australian Soilborne Disease Symposium, Kingscliff NSW, Australia, August 26-30th, 2024.

Desaeger J (2024). Nematode management in strawberries. 39th Congresso Brasileiro de Nematologia and LIV ONTA Annual Meeting, Foz de Iguazu, Brasil, September 1-5, 2024.

Jacobs D, Desaeger J, Lusk M & Grabau Z (2024). Vegetable Farm Cover Crop Practices to Improve Nematode Management, Nitrogen Utilization, and Water Quality in Florida. Society of Nematologists 64th Annual Conference, Park City, UT, August 5-18, 2024.

Li, Yi; Huang, Kuan-Ming; Guan, Zhengfei; Desaeger**,** Johan; Bui, Hung Xuan (2024). To Fumigate or Not: Optimal Nematode Management Strategy for Florida Tomato Growers. Southern Agricultural Economics Association (SAEA) 56th Annual Meeting, Atlanta, GA, February 3-6, 2024.

Mayorga L, Medina K, and Desaeger J(2024). Effect of chitin amendment and *Purpureocillium lilacinum* against *Meloidogyne javanica*. Organization of Nematologists of Tropical Americas 54th Annual Conference, Foz do Iguazu, Brazil September 1-5, 2024

Moreira D, Desaeger J, and Avellaneda C (2021). Integrated Nematode Management on Watermelons in Honduras. Society of Nematologists 63rd Annual Conference, Park City, UT, August 4-9, 2024.

Noling J and Desaeger J (2024). Integrated Nematode Management Strategies In Florida: How The Integration Occurs. Society of Nematologists 64th Annual Conference, Park City, UT, August 5-18, 2024.

Porazinska DL, Gendron E, Oliveira C and Desaeger J (2024). Nematode communities from strawberry fields: a comparison between morphology and mitometagenomics. 35th Symposium of the European Society of Nematologists (ESN), Cordoba, Spain, April 15-19, 2024.

*Extension and Outreach*

Desaeger J (2023). Hops Nematode Update, Hops field day, GCREC, Balm, October 4, 2023.

Desaeger J (2023). Nematode management in vegetables. Diagnostic, Surveillance and Management Training Course for Economically Important Plant-parasitic nematodes - Greater Caribbean Safeguarding Initiative (GCSI), October 25, 2023.

Desaeger J (2023). Cover crops for nematode management. Florida Ag Expo, UF/IFAS Gulf Coast Research and Education Center Wimauma, FL, November 9, 2023.

Desaeger J (2023). Foliar Nematodes in Strawberries Seminario “Nemátodos de la frutilla Aphelenchoides fragariae”, Servicio Agrícola y Ganadero (SAG), San Pedro, Chile, 24 de Noviembre, 2023.

Desaeger J (2023). Nasty Nematodes Can Steal Yields if Not Monitored and Managed (interview). December 13, 2023. *Specialty Crop Grower*. <https://specialtycropgrower.com/plant-parasitic-nematodes-florida/>

Desaeger J (2023). Plant Parasitic Nematodes in Agriculture, indestructible, misunderstood and underestimated. Webinar for Certis USA Biologicals, December 15, 2023.

Desaeger J (2024). Nematode survey in Florida strawberry fields and nursery transplants. FSGA Strawberry Nursery Conference, UF/IFAS Gulf Coast Research and Education Center, January 10, 2024.

Desaeger J (2024). Nematode Management with fumigants in vegetable crops. Southeastern Fruit and Vegetable Conference, Savannah, GA, January 11-14, 2024.

Desaeger J (2024). Salibro in Florida vegetables and Strawberry. Salibro Research Exchange, Bowling Green, FL, February 28, 2024.

Desaeger J (2024). Five years of organic strawberry research at GCREC … @#$%&!. FSGA 39th Annual Agritech Trade Show, Plant City, FL, May 7-8, 2024.

Desaeger J (2024). Hops Nematode Update, Hops field day, GCREC, Balm, June 5, 2024.

Desaeger J (2024). FIND*Me* –five years of Focused Investigations on the Distribution and management of *Meloidogyne enterolobii* in the southeastern United States. Multi Pest Info Session, 23 AUGUST 2024, DAF Research Station, 49 Ashfield Road, Kalkie, QLD, Australia.

**Participants:** Hajihassani, Abolfazl (ahajihassani@ufl.edu) – University of Florida

**Objective 2. Investigate the ecological and epidemiological factors contributing to the distribution, dissemination and pathogenicity of developing nematode diseases.**

From July 2022 to September 2023, 65 fruit tree orchards (eighteen avocados, seventeen guavas, nine mameys, five longans, four starfruits, three mangoes, three lychees, two dragon fruits, two passion fruit, one papaya, and one banana) were randomly selected for sampling in Homestead, Florida, to determine the incidence and distribution of PPNs. The frequency of occurrence (%), mean relative abundance and maximum relative abundance (per 100 cm3 of soil ) of the 10 different PPN genera detected in 11 different fruit tree species are as follows: *Rotylenchulus* spp. (incidence, 73.8%; mean, 67.4; maximum, 900), *Mesocriconema* spp. (49.2%; 33.4; 490), *Helicotylenchus* spp. (46.2%; 19.6; 185), *Meloidogyne* spp. (30.8%; 11.9; 260), *Pratylenchus* spp. (21.5%; 1.3; 20), *Xiphinema* spp. (18.4%; 1.0; 16), *Hoplolaimus* spp. (13.8%; 2.9; 72), *Tylenchorrhynchus* spp. (12.3%; 3.3; 102), *Trichodorus* spp. (12.3%; 1.0; 28), and *Ditylenchus* spp. (4.6%; 0.5; 26). Principal component analyses indicated that fruit tree type (host), soil texture, and organic matter significantly influenced the distribution and population density of PPNs. Reniform, lance, and root-lesion nematode abundance and distribution were more associated with avocado; root-knot (RKN) and spiral nematodes were associated with guava and dragon fruits, while ring and spiral nematodes were more associated with lychees, longans, and mangoes. Multiple regression models indicated that the presence of RKNs was influenced by an increment in sand content and the age of the orchards. Additionally, the fruit tree variety and organic matter influenced the abundance of reniform nematode in avocados.

Root-knot nematode species associated with different tropical fruits in Florida were identified using species-specific primers and sequencing based on the 28S and ITS of rDNA and mitochondrial region. *Meloidogyne incognita* was found infecting passion fruit and papaya in North and Central Florida, respectively. Over 80% of guava groves in Miami-Dade County in South Florida were found highly infested with *M. enterolobii*. This nematode species was also detected parasitizing dragon fruit (pitaya) in the Homestead region in South Florida. Contaminated nursery stock has likely contributed to the severe infestation of *M. enterolobii* in guava and dragon fruit groves across various locations in Florida. The nematode issue in tropical fruits is likely to escalate into a major concern in the next few years because of the unavailability of chemical nematicides for use in tropical fruits in Florida. Monitoring and surveillance of these plant health issues are crucial, and effective control approaches should be developed to mitigate their impact.

Four criconematid nematodes were also identified using taxonomic and molecular-based analysis in three avocado orchards in the Homestead region in Florida, USA. Two of the populations were identified as *Criconema mutabile* and *Mesocriconema basili*, whereas the other two populations were identified as *Criconemoides* sp. and *Ogma* sp. The population densities of two of these ring nematode species were significantly high in the soil, warranting further research for their potential to cause damage to avocados.

**Objective 3. Develop and evaluate integrated nematode management tactics for emerging nematode diseases.**

* A significant nematode infestation has been reported in the United States, marking the first recorded occurrence of root-knot nematodes in dragon fruit and passion fruit. Specifically, *Meloidogyne enterolobii* was found to infect dragon fruit, while *M. incognita* was identified in passion fruit.
* Two ring nematode species, *Criconema mutabile* and *Mesocriconema basili*, have been detected in Florida for the first time. They were found on avocado trees.

**Publications:**

*Peer Reviewed*

Gitonga, D., Kasam, R., Lesa, M., Hajihassani, A. 2024. First report of guava root-knot nematode, *Meloidogyne enterolobii*, on dragon fruit in the United States. New Disease Reports. 50, e12297. https://doi.org/10.1002/ndr2.12297

Singh, P.R., Gitonga, D., and Hajihassani, A. 2024. Four Criconematid species from avocado orchards in Florida, USA. Nematology. 26. https://doi.org/10.1163/15685411-bja10330

Singh, P.R. and Hajihassani, A. 2024. A taxonomic update on *Tylenchorhynchus annulatus* (Nematoda: Dolichodoridae), a widely distributed stunt nematode species. Nematology. 26: 341-349. <https://doi.org/10.1163/15685411-bja10312>

Hajihassani, A., Kasam, R., and Gitonga, D. First report of southern root-knot nematode, Meloidogyne incognita, infecting papaya in Florida, USA. Australasian Plant Disease Notes 19 (24). <https://doi.org/10.1007/s13314-024-00547-0>

Gitonga, D., Singh, P.R. and Hajihassani, A. 2023. Detection of guava root-knot nematode, *Meloidogyne enterolobii* infecting *Psidium guajava* orchards in Homestead, Florida. Australasian Plant Disease Notes 18 (20). https://doi.org/10.1007/s13314-023-00506-1

Hajihassani, A., Singh, P.R. and Gitonga, D. 2023. The root-knot nematode *Meloidogyne incognita* infects passion fruit in the USA. Australasian Plant Disease Notes 18 (7). https://doi.org/10.1007/s13314-023-00493-3

*Abstracts*

Larkin, J, Kassam, R., Crow, W., and Hajihassani, A. Exploring the diversity of turfgrass-associated entomopathogenic nematodes and their symbiotic bacteria in Florida for utilization of bacterial metabolites for nematode control. Annual Meeting of the Society of Nematologists. August 4-9, 2024, Park City, Utah.

Kassam, R., Rao U., and Hajihassani A. Novel bacteria for biological control of root-knot nematode, *Meloidogyne incognita*. Annual Meeting of the Society of Nematologists. August 4-9, 2024, Park City, Utah.

Jagdale, G. B., Wong, C., Hajihassani, A., and Shapiro-Ilan, D. Influence of entomopathogenic nematode antagonism against root-knot nematode, *Meloidogyne javanica* in tomato under greenhouse conditions. APS Annual Meeting (Plant Health). July 27-30, Memphis, Tennessee.

Gitonga, D., Carrillo D., and A. Hajihassani. Influence of ecological and edaphic factors on plant-parasitic nematodes associated with tropical fruit trees in south Florida. Annual Meeting of the Society of Nematologists. August 4-9, 2024, Park City, Utah.

Lasa, M. and A. Hajihassani. Evaluation of different nematicide rates and application intervals against plant-parasitic nematodes associated with turfgrass in south Florida. Annual Meeting of the Society of Nematologists. August 4-9, 2024, Park City, Utah.

Larkin, J, and Hajihassani, A. Utilizing seasonal population dynamics of plant-parasitic nematodes for improved management strategies in southern Florida golf courses. Annual Meeting of the Society of Nematologists. August 4-9, 2024, Park City, Utah.

Jagdale, G., Hajihassani, A., and Shapiro-Ilan, D. Efficacy of organic nematicides against *Meloidogyne incognita* infecting cucumbers under field conditions. Annual Meeting of the Society of Nematologists. August 4-9, 2024, Park City, Utah.

**GEORGIA**

**Participants:** Chowdhury, Intiaz (intiaz.chowdhury@uga.edu) – University of Georgia

**Objective 1. Understand the fundamental biology and genetics that underlie the evolving nematode threats to agriculture in the Southern region.**

Among plant-parasitic nematodes, root-knot nematodes (RKN, *Meloidogyne* spp.) are considered the most devastating group. However, the severity of RKN damage can vary depending on the species present. In Georgia, several aggressive species were recently detected for the first time. Notably, Guava root-knot nematode (GRKN; *M. enterolobii*) was found in Lowndes and Tattnall counties, while Peach root-knot nematode (PRKN; *M. floridensis*) was detected in Crisp, Dooly, Turner, Ware, and Wilcox counties.

 Guava root-knot nematode was detected in the heart of the Vidalia onion production region of Georgia, but its impact on onions remains unclear. Hence, we conducted a greenhouse study to evaluate the susceptibility of commercial onion cultivars, including six vidalia onion cultivars (‘Sapelo’, ‘Sweet Magnolia’, ‘Tania’, ‘Vidora’, ‘Rio del Sol’, and ‘NUN 1011’), three red onion cultivars (‘Red Halen’, ‘Red Duke’, and ‘Red Maiden’), and one white onion cultivar (‘Monjablanca’). Our results showed that all onion types were suitable hosts for GRKN, with significant variation in susceptibility among cultivars. Significant bulb weight reduction was observed in all three red onion cultivars and a Vidalia onion cultivar ‘NUN 1011’, though a general trend of yield reduction was seen in all onion cultivars. These results indicate that GRKN poses a potential risk to onion production. However, a survey of 80 additional fields from Tattnall and neighboring counties detected only SRKN, suggesting that GRKN has not yet become widespread in the region.

**Objective 2. Investigate the ecological and epidemiological factors contributing to the distribution, dissemination and pathogenicity of developing nematode diseases.**

Crop rotation with non-host or poor-host crops is a key strategy for managing RKN. We conducted a greenhouse study to assess the susceptibility of nine major vegetable crops, including beet, broccoli, cabbage, cantaloupe, carrot, pepper, snap bean, squash, and tomato, to GRKN, PRKN and SRKN. The study revealed that all tested crops were susceptible to GRKN. Moreover, GRKN had a higher reproduction factor than SRKN and PRKN across most crops, suggesting its potential to outcompete them in mixed populations. Notably, pepper appeared to be a non-host or poor host for PRKN, highlighting its suitability as a rotational crop in PRKN-infested fields.

**Objective 3. Develop and evaluate integrated nematode management tactics for emerging nematode diseases.**

Although numerous studies have led to the development of robust chemical management strategies for SRKN, few have evaluated nematicides against GRKN and PRKN. Moreover, no studies in the literature have specifically addressed the chemical management of Georgia-specific isolates of GRKN and PRKN. Hence, we conducted laboratory and greenhouse studies to comparatively assess the sensitivity of SRKN, GRKN, and PRKN to the non-fumigant nematicides Salibro, Nimitz, Velum Prime, and Vydate. Our results indicated that GRKN had significantly lower sensitivity to these nematicides than SRKN and PRKN. However, all four nematicides effectively suppressed GRKN and PRKN reproduction, infectivity, and mobility. Nonetheless, further field research is needed to evaluate the efficacy of these chemicals against Georgia-specific isolates of these nematode species.

**Publications:**

N/A

*Refereed journal articles:*

N/A

*Abstracts:*

N/A

**LOUISIANA**

**Participants:** Watson, Tristan (TWatson@agcenter.lsu.edu) – LSU AgCenter

**Objective 3. Develop and evaluate integrated nematode management tactics for emerging nematode diseases.**

A small-plot (4 rows wide 35 feet long) field study was conducted at the Northeast Research Station in St. Joseph, LA to evaluate new sources of cotton host resistance and in-furrow nematicides for reniform nematode management. Cotton cultivars examined included Phytogen PHY340 (susceptible) and Phytogen PHY411 (resistant). For each cultivar examined, soil treatments included: (1) an untreated control, (2) Velum at 6.85 fl oz/A, (3) AgLogic 15G at 7 lb/A, and (4) Averland FC at 3.5 fl oz/A. Soil population densities of *R. reniformis* were monitored at the time of planting, 28 days after planting, 56 days after planting, and at harvest. Approximately 12 soil cores were collected at random from the middle two rows of each plot, placed in a plastic bag, and transported to the LSU AgCenter Nematode Advisory Service for quantification using an elutriator and centrifugal floatation technique. At 56 days, five cotton plants were randomly collected from the middle two rows of each plot for analysis of egg production using dilute sodium hypochlorite. Cotton was harvested from the middle two rows on October 25, 2024. By 28 days after planting, reniform nematode soil population densities were greatest in the PHY340 cultivar without nematicide application and were lower (52%) in treatments that included PHY411 with a nematicide. By 56 days after planting, the PHY340+Averland, PHY411, and PHY411+Aglogic treatments had 57% fewer nematodes in soil relative to PHY340 alone. By harvest, soil population densities were not impacted by treatment. All nematicide treatments reduced nematode egg production, regardless of cultivar. There was a 28% increase in seed cotton yield when Velum was applied, regardless of cultivar choice.

* All nematicide treatments (Velum, AgLgic 15G, and Averland FC) reduced *Rotylenchulus reniformis* egg production, regardless of cultivar planted.
* *Rotylenchulus reniformis* soil population densities and egg production were lower in plots planted with the resistant cultivar (PHY411) than the susceptible cultivar (PHY340).
* In-furrow application of Velum increased seed cotton yield by 28%, regardless of cultivar planted.
* Overall, the use of an in-furrow nematicide alongside host resistance provided the best yield and nematode suppression.

**Publications:**

N/A

*Peer Reviewed*

N/A

*Abstracts*

N/A

**MISSISSIPPI**

**Participants:**  Liu, Chang (cl2142@msstate.edu) – Mississippi State University

**Objective 2. Investigate the ecological and epidemiological factors contributing to the distribution, dissemination and pathogenicity of developing nematode diseases.**

* A state-wide survey investigating the distribution of plant-parasitic nematodes on soybeans in Mississippi was conducted.
* Population shift from dominant soybean cyst nematode to reniform nematode was observed, more survey will be followed to test this observation.
* HG Typing on soybean cyst nematode was conducted in Mississippi.

**Objective 3. Develop and evaluate integrated nematode management tactics for emerging nematode diseases.**

* One field trial testing non-fumigant nematicides efficacy at managing reniform nematode on sweetpotatoes in Mississippi was conducted.
* One field trial testing non-fumigant nematicides combined with biostimulants efficacy at managing root-knot nematode on soybean in Mississippi was conducted.
* One cover crop trial testing winter wheat, winter pea, canola and their mix at managing reniform nematode in sweetpotato production was initiated.
* One greenhouse trial testing non-fumigant nematicides as well as bio-products at managing reniform and root-knot nematode on sweetpotato was initiated.

**Publications:**

*Peer Reviewed*

Tsegay, M.W., Wallau, M.O., Liu, C., Dubeux, J.C., Grabau, Z.J. Crop rotation for management of plant‐parasitic nematodes in forage corn production. 2024, Agronomy Journal, 111, 313-325.

Grabau, Z.J., Sandoval Ruiz, R., Liu, C. Management of *Meloidogyne arenaria* in peanut production using resistance or nematicides. 2024, Nematropica, 54.

Grabau, Z.J., Sandoval Ruiz, R., Liu, C. Fumigation using 1,3-dichloropropene manages *Meloidogyne enterolobii* in sweetpotato more effectively than fluorinated nematicides. 2024. Plant Disease, 108, 2162-2169.

Wang, Y., Wu, P., Xu, J., Fu, R., Lin, Q., Liu, C., Wang, Y. Psyllid-mite interactions promote psyllid fecundity by selecting for a different life history. 2024. Pest Management Science. DOI 10.1002/ps.8539

*Abstracts*

Fumigant and non-fumigant nematicide efficacy at managing *Meloidogyne enterolobii* on sweetpotatoes. C.Liu and Z.J. Grabau. European Society of Nematologists Conference, Cordoba, Spain.

Integrated nematode management on sweetpotato in Florida. C. Liu and Z.J. Grabau. National Sweetpotato Growers Collaborative Meeting, New Orleans, Louisiana.

Resistant cultivars are more effective than nematicide appliction for managing reniform nematode in cotton. Grabau, Zane J., R. Sandoval-Ruiz, and C. Liu. Society of Nematologists Annual Meeting, Parker City, Utah.

Plant-parasitic nematode distribution on soybeans in Mississippi. C. Liu. Mississippi Society of Entomologists, Plant Pathologists and Nematologists annual meeting, Starkville, Mississippi.

Assessing cost effectiveness of nematicide rates and chemistries for sting nematode management in florida potato. Grabau, Zane J, R. Sandoval-Ruiz, and Chang Liu. Society of Nematologists' Annual Meeting. Park City, Utah.

**NORTH CAROLINA**

Gorny, Adrienne (agorny@ncsu.edu) – North Carolina State University

**Objective 2. Investigate the ecological and epidemiological factors contributing to the distribution, dissemination and pathogenicity of developing nematode diseases.**

* Conducted field nematicide tests in sweetpotato (n=2), soybean (n=3), and corn (n=1) to better understand the most efficacious chemical management options.

**Objective 3. Develop and evaluate integrated nematode management tactics for emerging nematode diseases.**

* A new diagnostic tool was researched for more rapid detection of Meloidogyne enterolobii, directly from galled sweetpotato roots. Galls are excised from the root, nematode DNA is captured on Whatman FTA cards, then amplified using recombinase polymerase amplification with M. enterolobii-specific primers. Then amplification products are visualized using lateral flow assay strips.

**Publications:**

*Peer Reviewed*

Fraher, S., Watson, M., Nguyen, H., Gorny, A.M., Kudenov, M., and Yencho, G.C. 2024. A comparison of three automated nematode egg counting approaches using machine learning, image analysis, and a hybrid model. *Plant Disease* First Look.  DOI: 10.1094/PDIS-01-24-0217-SR.

Wong, TW. S., Ye, W., Thiessen, L., Huseth, A.S., Gorny, A., and Quesada-Ocampo, L.M. 2024. Occurrence and distribution of *Meloidogyne* spp. in fields rotated with sweetpotato and host range evaluation of a North Carolina population of *Meloidogyne enterolobii*.  *Plant Disease* [First Look.]  DOI: 10.1094/PDIS-08-22-1877-RE.

Schwarz, T., Chitra, Jennings, K., and Gorny, A.M. 2024. Evaluation of weed species for host status to the root-knot nematodes *Meloidogyne enterolobii* and *M. incognita* race 4. *Journal of Nematology* 56:20240017.  DOI: 10.2478/jofnem-2024-0017.

Bonyak, H.C., Vann, M.C., Ye, W., Lewis, R.S., and Gorny, A.M. 2024. A 2-year, multi-county survey of plant-parasitic nematodes in North Carolina flue-cured tobacco. *Agronomy Journal* 116:1492-1503. DOI: 10.1002/agj2.21565.

*Peer Reviewed Extension Articles*

Dotray, J., Jeffreys, P.B., and Gorny, A.M.  2024. Evaluation of non-fumigant nematicides in sweetpotato production for management of *Meloidogyne enterolobii* in North Carolina, 2023.  *Plant Disease Management Reports.*  18:N010.

Jeffreys, P.B., Dotray, J., and Gorny, A.M.  2024. Evaluation of non-fumigant nematicides for management of sting nematode in soybean in North Carolina, 2023.  *Plant Disease Management Reports.* 18:N008.

*Abstracts*

N/A

**TEXAS**

**Participants:** Wheeler, Terry (ta-wheeler@tamu.edu) - Texas A&M AgriLife Research

**Objective 2. Investigate the ecological and epidemiological factors contributing to the distribution, dissemination and pathogenicity of developing nematode diseases.**

Fusarium wilt of cotton which is a disease complex caused by *Fusarium oxysporum* f. sp. *vasinfectum* races 1 and 2 (FOV1, FOV2), which interact with *Meloidogyne incognita*, has been of increased concern in the Southern High Plains of Texas. Historically, this disease has been problematic, particularly when new varieties are grown by producers in the region. A large increase in Fusarium wilt incidence and severity was observed around 2016-2020, when producers began using some new root-knot nematode resistant varieties (featuring 2-gene, homozygous and very high resistance). These newer varieties were developed by the use of marker assisted selection, and probably had less or possibly no plant selections that were actually made in root-knot nematode/Fusarium wilt fields. Previous to this time period, useful levels of Fusarium wilt resistance were present in other commercial varieties with partial resistance to root-knot nematode, and the assumption was made that the root-knot nematode resistance was responsible for the Fusarium wilt resistance. A greenhouse testing protocol was used with both FOV1 and 2 and *M*. *incognita* to determine if more recent commercial cotton varieties, including those with the RK1 and RK2 genes, had resistance to Fusarium wilt. An older variety ST 4946GLB2, which had not been developed by markers, had useful and repeatable levels of resistance to Fusarium wilt, and relatively weak resistance to root-knot nematode. More recent varieties with much higher root-knot nematode resistance (DP 1747NR B2XF, PHY 480 W3FE), were highly susceptible to Fusarium wilt. We have begun testing more recent varieties with varying levels of root-knot nematode resistance (DP 2143NR B3XF, PHY 332 W3FE, PHY 411 W3FE, FM 868AXTP), but none have shown the level of Fusarium wilt resistance of ST 4946GLB2. Root-knot nematode resistance is no longer associated with Fusarium wilt resistance in cotton. While nematode resistance is very useful to have in varieties, since this region has approximately 40% of the acres infested with *M*. *incognita*, it is important to identify any nematode resistant varieties that have high susceptibility to Fusarium wilt.

**Objective 3. Develop and evaluate integrated nematode management tactics for emerging nematode diseases.**

Reniform nematode on cotton is the primary emerging nematode disease in the Southern High Plains of Texas, and elsewhere in the state. While spread of this nematode has been slow relative to other southern states, it does continue to be identified in new fields. Management for many years was with rotation out of cotton into nonhost crops like corn and sorghum. Starting around 2021, there was availability of two Deltapine varieties (DP 2143NR B3XF and DP 2141NR B3XF) and two Phytogen varieties (PHY 332 W3FE and PHY 443 W3FE), with both high resistance to root-knot nematode and one-gene resistance to reniform nematode. Since then, several more Phytogen varieties have been commercialized with root-knot and reniform nematode resistance genes (PHY 205 W3FE, PHY 411 W3FE, and PHY 475 W3FE). These varieties make a large difference in cotton yield in reniform nematode fields. However, there is still potential benefits to integrating crop rotation into the management of reniform nematode, to both reduce nematode population density, and delay the development of resistance breaking nematode populations. Irrigation pumping capacities continue to decline in the Southern High Plains of Texas, so rather than rotating to another crop, some producers utilize fallow ground rotation with cotton planted on half of a circle, and nothing planting on the other half. We began a study in 2020 to examine the impact of integrating fallow ground with resistant and susceptible varieties in the management of reniform nematode. The highest yielding and most profitable tactic is to grow continuous cotton using reniform nematode resistant varieties. This holds true for our test field, where the population is considered moderate. Work in the Rolling Plains by Reagan Noland in a high density reniform nematode site, indicated that cotton yields were much higher if resistant varieties were rotated with sorghum, than using continuous resistant varieties. So, my results may not be accurate for higher density fields. In addition, there were some negative results associated with fallow ground (F), including faster/higher buildup of the reniform nematode relative to the buildup following resistant (R) or susceptible (S) varieties. So a 2-yr combination of FR would have faster buildup of reniform nematode and lower cotton yields than RR. Similarly, a 2-year combination of FS, would result in faster buildup of reniform nematode in the second year (S) than SS. So, the fallow treatment, especially if no irrigation was applied, may have reduced natural biological control of the reniform nematode, and while more beneficial than continuous susceptible cotton varieties, were not as beneficial as predicted by their reduction in reniform nematode density (which did occur following fallow).

* Root-knot nematode resistance is no longer associated with Fusarium wilt resistance in recent commercial cotton varieties.
* Continuous planting of reniform nematode resistant varieties results in the highest cotton yields and best economic returns when comparing resistant and susceptible cotton rotations and weed-free fallow (under moderate reniform nematode pressure). However, this practice will increase the likeliness of resistance breaking nematode populations.

**Publications:**

*Peer Reviewed*

Dotray, J., J. Chagoya, T. A. Wheeler, and C. Monclova-Santana. 2024. Greenhouse screening of cotton varieties against Fusarium wilt complex. Plant Health Progress 25:410-417.

*Abstracts*

N/A

**VIRGINIA**

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**Objective 1. Understand the fundamental biology and genetics that underlie the evolving nematode threats to agriculture in the Southern region.**

**Beech Leaf Disease – an emerging threat to Virginia forests**

Beech leaf disease (BLD), caused by the nematode *Litylenchus crenatae* ssp*. mccannii*, is an emerging forest health issue with significant ecological and economic implications. First found in Ohio in 2012, BLD affects American beech (*Fagus grandifolia*) in North America, but can also attack European beech (*Fagus sylvatica*) and Asian beech (*Fagus orientalis*). The nematodes feed in the buds and leaves disrupting their development and causing dark banding between veins, leaf thickening, curling, and eventual canopy thinning. In small, understory trees, mortality can occur in 2-7 years. Since its first detection in Prince William County in Virginia in 2021, BLD has been progressively spreading into surrounding counties including Fairfax, Loudoun, Stafford, Clarke, and New Kent. The disease likely spreads through a combination of natural vectors, including wind, precipitation, birds, mammals, insects, and human activity. In Virginia, proactive monitoring and public reporting are key to managing its impact, since curative treatments are unavailable. Valuable horticultural specimens can be protected with three methods: 1) For trees 2-4 inches DBH, two applications of potassium phosphite or polyphosphate fertilizer at a rate of 2 oz. plus 14 oz. of water per inch DBH, 2) For large valuable trees, root flare injections into the xylem at a rate of 1.6 oz of Thiabenadazole every other year, and 3) For trees with a DBH greater than 4 inches DBH a foliar spray of isolated trees with the fungicide/nematicide, Fluopyram. Since beech trees play critical roles in forest ecosystems by providing habitat, influencing soil composition, and supporting biodiversity a better understanding of the epidemiology, spread, and control measures of this disease, is vital to mitigate its impacts and preserve beech-dominated forests. The final solution will probably be the selection and breeding of resistance trees.

**Objective 3. Develop and evaluate integrated nematode management tactics for emerging nematode diseases.**

**Bacterial isolate – a potentially important**

The discovery and application of a specific isolate of a beneficial bacterium for soybean production present transformative opportunities for sustainable agriculture. This promising candidate exhibits several multifunctional benefits including: 1) Promoting plant growth, 2) Enhancing nodulation efficiency, 3) Suppressing soybean cyst nematodes (SCN), 4) Killing root-knot nematode eggs and infective juveniles, and 5) Controlling soil-borne fungal pathogens. This bacterium likely interacts synergistically with soybean roots to boost nutrient uptake, stimulate biological nitrogen fixation through improved nodulation, and by the induction of Systemic Acquired Resistance. Its ability to inhibit SCN reduces crop yield losses, while its antifungal properties help manage diseases caused by pathogens such as *Sclerotium* spp. Harnessing such bacteria as bio-stimulants and bio-control agents could reduce reliance on chemical inputs, foster ecological balance, and significantly improve crop productivity and soil health. Further research into its mechanisms of action, large-scale application, and integration into farming systems is critical to unlocking its full potential for soybean production.

**Beech Leaf Disease**

* + Beech Leaf Disease (BLD) is caused by the nematode *Litylenchus crenatae ssp. mccannii* and has significant ecological and economic impacts.
	+ BLD was first discovered in Ohio in 2012 and affects American beech (*Fagus grandifolia*), European beech (*Fagus sylvatica*), and Asian beech (*Fagus orientalis*).
	+ Symptoms of BLD include dark banding between veins, leaf thickening, curling, and eventual canopy thinning.
	+ In smaller understory trees, mortality can occur within 2-7 years.
	+ In Virginia, BLD was first detected in Prince William County in 2021 and has since spread to Fairfax, Loudoun, Stafford, Clarke, and New Kent counties.
	+ The disease spreads through natural vectors like wind, precipitation, birds, mammals, insects, and human activity.
	+ Management strategies include potassium phosphite or polyphosphate fertilizer drenches for small trees.
	+ Management strategies include root flare injections with Thiabenadazole for large valuable trees.
	+ Management strategies include foliar sprays with Fluopyram for trees with a DBH greater than 4 inches.
	+ Management strategies include a long-term solution involves breeding and selecting resistant beech tree varieties.

**Beneficial bacterial strain for soybean**

• The discovery of a beneficial bacterial isolate presents significant opportunities for sustainable soybean agriculture.

• This bacterium **exhibits multifunctional benefits**, including:

 1. Promoting plant growth.

 2. Enhancing nodulation efficiency.

 3. Suppressing soybean cyst nematodes (SCN).

 4. Killing root-knot nematode eggs and infective juveniles.

 5. Controlling soil-borne fungal pathogens such as *Sclerotium* spp.

• It interacts synergistically with soybean roots to:

 1. Boost nutrient uptake.

 2. Stimulate biological nitrogen fixation through improved nodulation.

 3. Induce Systemic Acquired Resistance (SAR) in the plant.

 4 Inhibit SCN reduces crop yield losses.

5. Antifungal properties control root diseases.

• The bacterium could serve as both a bio-stimulant and a bio-control agent, reducing reliance on chemical inputs.

• Using this bacterium can foster ecological balance, enhance soil health, and increase soybean productivity.

 1. Further research is needed to:

 2. Understand its mechanisms of action.

 3. Explore large-scale applications.

 4. Integrate it into existing farming systems for maximum benefit.

**Publications:**

**Eisenback, J.** **D.** 2023. Nematode Trading Cards Decks 4-6. Mactode Publications: Blacksburg, VA and Amazon Kindle Press (Softcover ISBN 978-1-893961-59-3).

**Eisenback, J.** **D.** 2023. Nematode Trading Cards Decks 4-6. Mactode Publications: Blacksburg, VA and Amazon Kindle Press (Hardback ISBN 978-1-893961-58-6).

**Eisenback, J. D.** 2023. Life Cycle of the Root-knot Nematodes with Narration. Researchgate.net, Oct. 12, 2023.

*Peer Reviewed*

Travis R. Faske, Tristan Watson, Johan Desager, Maria Duffeck **Jonathan Eisenback,** Chase Floyd, Zane Grabau, Heather Kelly, Robert Kemerait, Kathy Lawrence, John Mueller, Maxwell Smith, Terry Wheeler, Weimin Ye. 2024. Summarized distribution of the reniform nematode, *Rotylenchulus reniformis*, in field crops in the United States. Plant Health Progress https://doi.org/10.1094/PHP-04-23-0031-BR

**Eisenback, J. D.,** Z. Chen, and M. White. 2024. Evaluating Vacuum and Steam Heat to Eliminate Pinewood Nematode in Naturally Infested Pine Logs. Journal of Nematology 56:e2024-2

Kantor, Camellia, **Jonathan D. Eisenback,** and Mihail Kantor. 2024. Biosecurity Risks to Human Food Supply Associated with Plant-Parasitic Nematodes. Frontiers in Plant Science 14:1195970. doi: 10.3389/fpls.2023.1195970

Shokoohi Ebrahim, and **Jonathan Eisenback.** 2023. Description of *Anaplectus* *deconincki* n. sp. from South Africa. Journal of Helminthology 97:1-12. https://doi.org/10.1017/S0022149X23000330

Vieira, Paulo, Mihail R. Kantor, Andrew Jansen, Zafar Handoo, and **Jonathan D. Eisenback.** 2023.Cellular insights of beech leaf disease reveal abnormal ectopic cell division of symptomatic interveinal leaf areas. PLOS One https://doi.org/10.1101/2023.06.22.546113

Vieira, Paulo, Mihail R. Kantor, Andrew Jansen, Zafar Handoo, and **Jonathan D. Eisenback.** 2023.Cellular insights of beech leaf disease reveal abnormal ectopic cell division of symptomatic interveinal leaf areas. BioRxiv https://doi.org/10.1101/2023.06.22.546113

Ebrahim Shokoohi, Joaquín Abolafia Antoinette Swart, Ngonidzashe Moyo,and **Jonathan Eisenback**. 2023. *Mesorhabditis sudafricana* n. sp. (Rhabditida, Mesorhabditidae), a new species with a short tail from South Africa. Nematology, May 2023:1-16. DOI: 10.1163/15685411-bja10254

Travis R. Faske, John Mueller, Ole Becker, Carl Bradley, Ernest C. Bernard, Jason Bond, Johan Desager, **Jonathan Eisenback**, Adrienne Gorny, Zane Grabau, Alex Hu, Robert Kemerait, Alyssa Koehler, Kathy Lawrence, Hillary Mehl, Edward J. Sikora, Steve Thomas, Nathan Walker, Terry Wheeler, Allen J. Wrather, and Lei Zhang. 2023. Current distribution of the southern root-knot nematode, *Meloidogyne incognita*, in the United States. Plant Health Progress https://doi.org/10.1094/PHP-04-23-0031-BR

Postnikova, Olga A., Brian M. Irish, **Jonathan Eisenback**, and Lev G. Nemchinov. 2023. Snake River alfalfa virus, a persistent virus infecting alfalfa (*Medicago sativa* L.) in Washington State, USA. Virology Journal 20:32. https://doi.org/10.1186/12985-023-01991-7

Pollock, Jill R., Charles S. Johnson**, J. D. Eisenback**, T. David Reed, and Noah Adamo. 2023. Effect of Soil Temperature on Reproduction of Root-knot Nematodes in Flue-cured Tobacco with Homozygous *Rk1* and/or *Rk2* Resistance Genes. Journal of Nematology e2023-1. Doi.org/10.2478/jofnem-2023-0032

*Abstracts*

**Eisenback, J. D.** 2024. Making and Printing 3D Models of Nematodes Workshop. 63rd Annual Meeting of the Society of Nematologists. Park City, Utah, Aug 7, 2024.

Mony, F.T.A., M. S. Ali, and **J. D. Eisenback**. 2024. Morphological characterization of *Ditylenchus dipsaci* on alfalfa in Virginia. SPES Symposium, Blacksburg, VA, Sept. 27.

Ali, Md. Sahadat, F. T. Z. Mony, **J. D. Eisenback**. 2024. The effect of a *Pseudomonas* strain of bacteria isolated from the roots of soybean nodules on root-knot nematode egg hatch and juvenile mortality. SPES Symposium, Blacksburg, VA, Sept. 27.

Tucker, M. A., J. D. Eisenback, and D. McCall. 2024. Evaluating plant growth regulator use with *Hoplolaimus galeatus* presence. SPES Symposium, Blacksburg, VA, Sept. 27.

**Eisenback, J. D.** 2024. Designing and printing 3D models of nematodes: Resources for Nematode Systematics Workshop. Society of Nematologists, Park City, UT. Aug 14, 2024. Journal of Nematology 56:30.

Ali, Md. Sahadat, F. T. Z. Mony, **J. D. Eisenback.** 2024. The effect of a *Pseudomonas* strain isolated from soybean nodules, on root-knot egg hatch and juvenile mortality. Society of Nematologists, Park City, UT. Aug 14, 2024. Journal of Nematology 56:30.

Mony, Fatima Tuz Zohora and**J. D. Eisenback**. A survey of plant-parasitic nematodes on alfalfa with an emphasis on *Ditylenchus dipsaci* in Virginia. Society of Nematologists, Park City, UT. Aug 14, 2024. Journal of Nematology 56:30.

**Eisenback, Jonathan**, Paulo Vieira, and Mihail Kantor. 2024. Beech Leaf Disease Begins its Invasion of Virginia Forests and Landscapes. 2024 Invasive Species Symposium, Invasive Species Working Group, Virginia Tech, Blacksburg, VA 24061, March 15.

Pfeiffer, D. G. and **J. D. Eisenback**.  2024. An examination of cuticular sensory structures of spotted lanternfly, *Lycorma delicatula* (White).  Entomological Society of America Eastern Branch. Morgantown WV. March 9-12.

Tucker, M., D. S. McCall, and **J. D.** **Eisenback.** 2023. Inter-lab Variability of Nematode Assays from Turfgrass Systems. ASA, CSSA, SSSA International Annual Meeting, St. Louis, MO. **(First Place)** https://scisoc.confex.com/scisoc/2023am/meetingapp.cgi/Paper/150486

Tucker, M., D. Haak, **J. D. Eisenback**, and D. S. McCall. 2023. A Molecular Approach to Objective *Hoplolaimus*nematode Diagnostics. ASA, CSSA, SSSA International Annual Meeting, St. Louis, MO. https://scisoc.confex.com/scisoc/2023am/meetingapp.cgi/Paper/150425

Tucker, M. Aaron, D. S. McCall, and **J. D. Eisenback.** 2023.Inter-lab variability of nematode assays from turfgrass systems. SPES Symposium, Blacksburg, VA, Oct. 5. **(Third Place)**

Mony, Fatima, and **J. D. Eisenback**. 2023. Survey of plant-parasitic nematodes on alfalfa in Virginia with an emphasis on *Ditylenchus* species. SPES Symposium, Blacksburg, VA, Oct. 5.

Tucker, M. Aaron, D. S. McCall, and **J. D. Eisenback.** 2023.A Numbers Game: Comparing Turfgrass Nematode Assay Efficiencies from Ten State Labs. Society of Nematologists, Columbus, OH July 10, 2023. Journal of Nematology 55:119.

**Eisenback, J. D.** 2023. Digital micrographs of nematodes – Making mosaic micrographs. Digital Resources for Nematode Systematics Workshop. Society of Nematologists, Columbus, OH July 10, 2023. Journal of Nematology 55:29.

**Eisenback, J. D.** 2023. Digital 3D model of nematodes – Modeling and Printing 3D Nematodes. Digital Resources for Nematode Systematics Workshop. Society of Nematologists, Columbus, OH July 10, 2023. Journal of Nematology 55:30

Kantor, Mihail, and **J. D. Eisenback**. 2023. Project Nematoda. Digital Resources for Nematode Systematics Workshop. Society of Nematologists, Columbus, OH July 10, 2023

Lev G. Nemchinov, Joseph Mowery, **Jonathan Eisenback**, Jonathan Shao, and Paulo Vieira. 2023. Cellular and Transcriptional Responses of Resistant and Susceptible Alfalfa Cultivars to the Root Lesion Nematode. January 13, 2023. Plant and Animal Genome 30.