Joint S1092/NC1197 Multistate Project Meeting

Meeting minutes

November 14 and 15, 2024

**Members Present:**  S1092: William Rutter (SC, chair), Chang Liu (MS), Intiaz Chowdhury (GA), Johan Desaeger (FL), John Mueller (SC), Zane Grabau (FL), Jon Eisenback (VA), Tristan Watson (LA), Bisho Lawaju (AL). NC1197: Horacio Lopez-Nicora (OH), Haddish Melakeberhan (MI), Carl Bradley (KY), Guiping Yan (ND), Madalyn Shires (SD), Mandy Bish (MO), Nate Schroeder (IL), Tamara Jackson (NE), Lei Zhang (IN), Peter DiGennaro (WI), Senyu Chen (MN)

**Members Absent:**  Travis Faske (AR), Kathy Lawrence (AL), Terry Wheeler (TX), Henry Nguyen (MO), Paula Agudelo (SC), Dylan Mengal (NE)

**Dr. Will Rutter** (chair of S1092) welcomed all participants to the meeting. He introduced **Dr. Pat Wechter**, who gave an introduction and overview of the Clemson Coastal Research and Education Center (CREC), the facility where we are holding the meeting. In this, we learned that Clemson Univ. has 8 research farms and 18 labs across SC. CREC was established in 1929 and the USDA joined in 1934, making a partnership of 90 years!

Plant pathology is strongly represented at CREC, along with entomology, plant breeding, genetics, weed science, horticulture, and other disciplines. From Clemson, there are 7 total faculty at CREC, 12 grad students, 2 post docs. Research programs are starting to incorporate culinary components along with vegetable pathology and breeding.

Next, **Dr. Shaker Kousik** gave us an Introduction to the USDA U.S. Vegetable Lab. Dr. Kousik is the research leader and lab director for the U.S. Vegetable Lab here in Charleston. We learned that the guiding objective of the U.S. Vegetable Lab is to respond to the major agricultural problems experienced in the production and marketing of quality vegetables in the southeast and nationally. From the USDA, there are currently 8 full time scientists (several positions open too). Over 230 vegetable lines have been released from the work performed at this site in the last 50 years. For example, Charleston Gray watermelon, Charleston Hot RKN-resistant cayenne pepper, heat tolerant broccoli, and the sweetpotato ‘Ruddy’, which is resistant to sweetpotato weevil .

We then did a round of introductions for members both in-person and on Zoom.

**STATE REPORTS**

**Will Rutter** - South Carolina

Dr. Rutter presented on an automated RKN egg counting method developed by his team. This research frequently screens 100 plants at a time for RKN resistance, which is very labor and time intensive. One way to speed up current phenotyping methods is to automate the egg counting. The goal is to have the automated method to be faster than manual counting, but still accurate. He uses a Keyence BZ-X800 microscope, which can image each well of a 96 well plate. He and his team developed the automated egg counting via machine learning. Collaborated with Breeding Insight at Cornell to do the machine learning to develop egg counting software. YOLOv8 was the core model. He trained the model and then did a comparison with human counters, which resulted in a correlation of about 0.93 with a human counter, which is the same as human v. human! Will noted that diluting egg samples adds variability and error to the sample. The machine system has a higher level at which eggs can be counted, foregoing the need to dilute in most cases. Code is open source and available on GitHub. Potential for Breeding Insights to make this a web based tool.

**Homan Regmi** - South Carolina

Dr. Regmi presented on using Meloidogyne effectors to guide resistant breeding in pepper. Current resistance genes available in pepper include *Me1*, *N*, and *Me3*. Yet, how does M. incognita break these resistance genes? Greater understanding of this would help breed durability and increase our understanding of nematode biology. In the greenhouse, Dr. Regmi created resistance breaking nematode strains by inoculating a mother strain on two resistant hosts (with *N* and *Me3*) and a susceptible pepper host. He then tested the break strains on several different pepper lines to see if it also breaks other resistance genes. The *Me3* and *N* breaking strains could not reproduce on the pepper line containing *Me1*. He conducted genome sequencing of the breaking strains (PacBio) and found that there was one scaffold in the mother strain that was missing in the break strains. There were five genes in the mother strain that were absent in the break strains. Work was done to evaluate potential effectors that are absent in gDNA of the break strain, but are present in the mother strain.

**John Mueller** - South Carolina

Dr. Mueller presented on RKN survey work in SC. In 2024, 53 grower fields were sampled, including field pea, corn, cotton, and soybean. Of these, 17 fields were positive for RKN and the species were determined. Of those, 11 were *M. incognita* and 6 were *M. arenaria* (race 2 that does not go to peanut). Most of the *M. incognita* were found on soybean that were supposed to be resistant to *M. incognita* (race unknown). Dr. Meuller also updated us on the progress to build a Containment Field Facility for GRKN research in SC. They received funding of $1.2 M congressionally directed spending to spend on equipment and facilities. The site is dedicated to work on veggies, but also cover crops and field crops (cotton and soybean), as well as nematicide trials. The site will be located at the Edisto REC in Blackville, SC and includes 10 acres inside a fence. The site will be excellent for long term trials. They anticipate start inoculating in March 2025. There is also a similar field nearby that is infested with *M. incognita*, so parallel trials of *M.i.* and *M.e.* could both be done at Edisto.

**Horacio Lopez-Nicora** – Ohio

Dr. Lopez-Nicora presented on practical management of nematodes on crops of regional importance. SCN continues to be a major problem in Ohio soybeans. Growers can submit samples to Horacio’s lab to process free of charge. Through this, these farm samples have been useful for acquiring field SCN populations and researching questions such as why some fields have very high population densities whereas others do not. In Ohio, there is a shift from HG Type 0 to HG Type 2. HG Type 2.5.7 is very prevalent in Ohio. Dr. Lopez-Nicora introduced use to the SCN Profit Checker, an online tool launched this year by the SCN Coalition for helping producers determine the impact of SCN on yields. His team is also screening for SCN resistance in greenhouse trials. They are screening commercial cultivars against HG Type 2.5.7 to assist farmers in selecting appropriate cultivars. They’ve also evaluated some seed treatment nematicides for SCN management, but unfortunately no strong response.

Dr. Lopez-Nicora is also part of the new leadership and vision within the SCN Coalition. There are plans to revise the nematode management guides – Horacio and the leadership may reach out to you if you can help with the guide revisions.

**Bisho Lawaju** – Alabama

In 2024, the Alabama team at Auburn conducted field trials with resistant and susceptible cotton varieties, with or without nematicide, under *M. incognita* pressure. In these trials, Velum, CoPeO and CoPeO+Velum all increased cotton seed yield over the non-treated control. A similar trial was conducted under *R. reniformis* pressure, and in this trial, Velum increased yield. Several PhytoGen cotton varieties were tested under *M. incognita* pressure, and also reniform infested fields. In both cases, the genetically resistant lines yielded higher than the susceptible control. In an additional trial, two cotton varieties were tested under reniform pressure, with or without Aldicarb in-furrow. The aldicarb plots had more vigorous growth and lower reniform density at harvest. The Alabama team also conducted field trials to evaluate soybean varieties in MG 4- 7 in trials under RKN pressure. There were significant differences in terms of yield, but not of gall severity ratings.

Lastly, Dr. Lawaju updated us on tracking plant-parasitic nematodes in Alabama. Their lab is receiving soil samples from growers throughout the state. From these, they are finding Reniform and RKN (the species are mainly *M.i.* and *M.a.*).

**Haddish Melakeberhan** - Michigan

Dr. Melakeberha gave a report on the Michigan’s Agricultural Nematology Lab. Are we exploiting the soil food web model’s power as a soil health diagnostic tool? A focus across all of the NC1197 objectives is to identify suitable and sustainable soil health conditions. Soil health components include biological, physiochemical, nutritional, structural and water holding capacity.

The Soil Food Web (SFW) as a diagnostic tool, SFW = suitable outcomes (abundance + functional groups). The SFW model identifies soil conditions by integrating biological, mathematical, and ecological principles. Dr. Melakeberhan presented a study: sandy loam soil, under cultivation of 6 years of corn and soybean. Treatments included rye cover crop and several rates of nitrogen. There was no effect of treatment, only time had a significant effect. In this study, the effect of tillage, cover crop, and nitrogen on beneficial nematodes was variable. The effects of these treatments on soil pH, SOM, and available N, no-till systems increase SOM and NO3. But overall, very messy data! The SFW model showed that the system was not optimized for nutrient cycling, and the model is useful for helping to address what conditions may need to be changed. You can check out more here: [www.hrt.msu.edu/haddish-melakeberhan](http://www.hrt.msu.edu/haddish-melakeberhan)

**Jon Eisenback** – Virginia

Dr. Eisenback gave a presentation and update on beech leaf disease, caused by Litylenchus crenatae. Characteristic symptoms of beech leaf disease include dark green stripes on the leaves. When the leaves first come out of the buds, no nematodes are present, which is why the cause of the disease went unknown for a long time. As the population level increases, the stripes become brown, and then crinkle, then the leaves fall off the trees. The nematode has spread to the north and east was very quick, yet spread to the south has been slower. It has likely spread by birds using the beech trees, and insects such as aphids, leafhoppers, and ants. Japanese beech, American beech, Chinese beech are all susceptible. In Japan, the nematode causes symptoms, but doesn’t cause the death of the tree.

Dr. Eisenback gave a demonstration of a useful tool called “NotebookLM” – you can upload a paper to the NotebookLM site and it produces a podcast from the paper at a level appropriate for a general audience.

Dr. Eisenback also updated us on a new species of round cyst nematode on boxwood found in downtown Charlottsville. Currently being described as a new Globodera species.

**Nathan Schroder** – Illinois

Dr. Schoder gave a presentation on results of an SCN survey in 2023-2024 funded by the Illinois Soybean Association (ISA). Although lots of samples were collected from across the state, no obvious trends to the survey of the map. Some areas had extremely high populations, next to areas with very low populations. Nathan’s team plans to continue it another year and also add HG typing.

Dr. Schoder started a very good discussion among members about thresholds. For the north central region, there is not much consensus on what “low” “moderate”, “high” or “extreme” populations are. Dr. Schoder compiled egg counts for recommended threshold levels for each state and there is little consensus. There was agreement among all members that there should be a discussion among the coalition on threshold levels.

**Chang Lui** – Mississippi

Dr. Lui gave an update on plant-parasitic nematode distribution and management in Mississippi and an introduction to her program. Her program is working on nematicide and crop variety testing, conducting cover crop and crop rotation studies, evaluating biological controls. She is working with soybean sweetpotato, and cotton, yet she is not limited to a certain set of crops.

Dr. Lui and her team is currently working on a nematode survey in soybean. Growers are submitting samples, and her team is going out to collect the samples. They are doing SCN HG typing and RKN speciation (however, few samples have been positive for RKN). Her team is also trying to identify disease suppressive soils. In total, they collected 205 samples from 15 counties, from which SCN was found in only 21 of the samples. This suggests a population shift because in the previous survey SCN was the most dominant. An additional project she is working on is testing non-fumigant nematicides, both in the field and greenhouse. Fluorinated nematicides have not yet been widely tested in MS. Dr. Lui is doing this work in sweetpotato initially. *M. enterolobii* has not been detected in MS, and reniform nematode is currently the most problematic in sweetpotato in MS. A third project she is working on is efficacy of cover crop on reniform nematode population in sweetpotato. Sunn Hemp is actually illegal in MS and AR (lol), so needs to figure out a different cover crop to work with!

As a new PI, Dr. Lui is interested in collaborating! Please reach out to her at cl2142@misstate.edu

**Carl Bradley** – Kentucky

Dr. Bradley presented a survey of SCN densities and HG types in Kentucky. THis survey has been conducted since 2018, and 488 samples collected from 35 counties. He has been focusing on determining HG type of some of the samples based on geographic distribution. About 40% of the fields have populations above 500 eggs, which is considered the threshold for yield loss in Kentucky. About 20% of samples had no detectible SCN eggs. Over 85% of those samples that were HG typed were 2.5.7. HG Type 5.7 was the next most common population at about 12%. Female index range of about 13-48% on PI88788.

Dr. Bradley also presented a survey of other PPN in soybean in KY. This survey was started in 2020 and is ongoing. Total of 45 soybean fields sampled, and lesion, lance, dagger, spiral and stunt were found, but no PPN at very high densities. *M. incognita* is present in KY in two counties along the Ohio River, only a few fields, which have very sandy soils. Dr. Bradley also mentioned that a survey in KY corn for nematodes conducted by Dr. Kirsten Wise. Found were lance, lesion, spiral, and stunt. Found RKN in corn in the same county as the *M. incognita* found in soybean.

**Adrienne Gorny** - North Carolina

Dr. Gorny presented updates from North Carolina field nematicide testing. M. enterolobii continues to be problematic in sweetpotato in North Carolina. Although nematicide trials conducted in 2024 have been harvested, the data has not yet been analyzed. However, trials results from 2023 showed that Telone II fumigant continues to provide decreased root galling and increased yields. The non-fumigant nematicide Salibro was tested at two different field sites in 2023, with variable results, suggesting that additional works needs to be performed to determine the optimal use rate and timing of this nematicide.

Dr. Gorny also presented updates on developing a rapid test for detection of *M. enterolobii* directly from sweetpotato galls. Current PCR tests performed by the NCDA&CS require dissecting adult females or J2s from soil samples, performing DNA extraction, standard PCR, and gel electrophoresis. Although this is a robust test, it takes considerable technician time. In developing a more rapid test, her team has been exploring Recombinase Polymerase Amplification (RPA), which is a rapid, isothermal amplification technique. Her team paired this with DNA extraction via Whatman FTA cards (where excised galls are smashed, dried, washed, and DNA eluted) and amplification visualization with universal lateral flow assay strips (Cytodiagnostics).

**Guiping Yan** - North Dakota

Dr. Yan provided updates on a large amount of resistance screening work her team has been conducting. She and her team screened 35 commercial soybean cultivars to HG Types 0, 7, 2.5.7 Some of these were resistant to HG Types 0 and 7. Her team also screened wheat cultivars and germplasm lines to Pratylenchus neglectus from ND. From this, one line was determined to be resistant. They also screened 21 potato cultivars for level of reproduction of dagger nematode (Xiphenema americanum). Dr. Yan’s group has also been evaluating cover crops as hosts and non-hosts to Pratylenchus penetrans in a white potato system.

Dr. Yan also updated us on development of a ddPCR for stubby root nematode (paratrichodorus allius). They’ve worked on optimization of annealing temperature, and extracting DNA directly from soil samples inoculated with P. allius.

 Lastly, Dr. Yan and her team have been evaluating the effects of different cover crops on hatching and penetration of SCN. The faba bean ‘Petite’ is a non-host of SCN and induced the greatest hatching of SCN - the nematodes did not develop in the faba bean roots, where as they do develop in the soybean control.

**Intiaz Chowdhury** - Georgia

Dr. Chowdhury gave an update on staying one-step ahead of emerging PPN in Georgia. Particularly, what is the threat of M. enterolobii and M. floridensis in GA? He presented on work evaluating the susceptibility of cotton varieties to *M.e.*, *M.i.*, and *M.f.*. All varieties were susceptible to *M.e.*, while all varieties were resistant to *M.f.*, but the gall severity was still high. Dr. Chowdhury presented a method/equation for comparing relative egg production across different trials, locations, and nematode isolates.

Dr. Chowdhury also presented results from a cucumber nematicide trial. In this trial, Nimitz performed the best in terms of RKN counts and reducing galling severity. They also tested split applications of Velum and Salibro - a split application of Velum was effective, but a split application of Salibro was less effective.

**Nabin Poudel** - University of Georgia

Nabin is a Masters student working with Dr. Chowdhury. Nabin evaluated the reproduction of *M. enterolobii* on onion. Onion is a significant crop in Georgia, and is often rotated with sweetpotato - in this system, what is the risk posed to onion by *M.e.*? Nabin conducted a greenhouse trial in which he had inoculated onion and had non-inoculated controls to measure the impact of nematode impact on onion growth. All cultivars tested were susceptible to *M.e.*, and further it was noticed that *M.e.* may be more pathogenic to red onion than vidalia onion. Another experiment was performed to look at relative reproduction of *M.e.* and *M.f.* compared to *M.i.*. It was found that *M.e.* had a higher reproduction rate than *M.f.* and *M.i.*

Nabin was also interested in exploring whether *M.e.*, *M.f.*, and *M.i.* are equally susceptible to fluorinated nematicides and oxyaml, or if there is a differential response. In vitro assays suggest that *M.e.* is less sensitive than *M.f.* and *M.i.*

**Bonna Chowdhury** - University of Georgia

Bonna is a graduate student with Dr. Chowdhury, and presented her work on the occurrence and distribution of PPN in Georgia tobacco fields. She noted that PPN cause significant impacts on tobacco in GA, and to better measure this impact, she conducted a soil survey in 2023-2024. She collected soil samples from 217 tobacco fields and extracted nematodes. Soil property data was also collected. Bonna found that RKN was present at high levels in all the counties that were sampled, but reniform and stubby root had the lowest density. Lowndes County was found to be highly diverse in PPN composition. An analysis of the PPN, soil, and climate factors was performed - sandier soil was higher in RKN. Speciation of the RKN resulted in M.i. and M.j. from those samples that had RKN.

**Mandy Bish** - Missouri

Dr. Bish started by acknowledging the work of her colleague Dr. Jeff Barizon, who supports much of the day to day operations at SCN Diagnostics. She then presented updates on a 2024 survey of PPN in soybean in MO. In this survey, RKN was found in a couple of counties, and SCN was found in several counties at high threshold levels. She noted that the majority of commercial soybean in MO is PI88788 resistance, but little other resistance is available in farmers preferred maturity group. Dr. Bish’s team test some earlier maturity group with Peking resistance against HG Type 2.5.7. They found that the Peking lines performed better under SCN pressure.

Dr. Bish and her team is promoting the use of the SCN Profit Checker with stakeholders in MO. She noted that they are trying to build relationships with the Amish and Menonite communities in the state.

**Lei Zhang** - Indiana

Dr. Zhang provided updates on his work exploring biocontrol agents against SCN. The aim of his work is to test fungi associated with cysts for efficacy in managing SCN. Nearly 60 fungal species were identified to be in association with SCN cysts. Dr. Zhang’s lab is now screening these fungi for their effects. He and his team are using fungal filtrates to SCN egg viability and hatching - large vacuoles forming in eggs treated with the fungal filtrates indicates some activity. From these, 15 fungal species were selected for study on SCN J2s.

Dr. Zhang noted that future work will include investing the impact of soil properties on the fungal interactions, such as organic matter on efficiency of fungal or bacterial agents on SCN.

**Tristan Watson** - Louisiana

Dr. Watsan presented updates on reniform nematode management on LA sweetpotato and cotton. His team did survey work in LA, but did not find M. enterolobii (rather they did find M.i. and reniform nematode) in sweetpotato at high densities. Dr. Watson noted that regarding reniform nematode (RN) in sweetpotato, there are few above ground symptoms, but rather generally there are fewer storage roots. Dr. Watson and his team conducted on-farm nematicide trials to evaluate fumigant and non-fumigant nematicides for RN control. In this trial, soil RN populations at plant and at harvest were lowest following Telone and Kpam treatments. However, egg populations on the plant were lowest under Velum. All treatments had greater yield than the non-treated controls. Although there were numerical differences, there were no statistical differences between fumigant and non-fumigant treatments. In light of these results, Dr. Watson noted that when working with RN, it is important to measure both RN populations in the soil and egg populations on the roots. In the greenhouse, Dr. Watson’s team also conducted a screening for susceptibility of different sweetpotato cultivars to RN. Covington and Burgundy were highly susceptible to RN, whereas Bayou Bell was least susceptible.

Dr. Watson is also part of the new leadership of the SCN Coalition, and is working on developing new soybean RN management guides. He may reach out to you for input!

**Tamara Jackson** - Nebraska

Dr. Jackson started by acknowledging the contributions of her collaborator Dr. Dylan Mengal, who wasn’t able to make it to the meeting. Dr. Mengal is new to UNL Extension Plant Pathology and part of the new leadership team at the SCN Coalition. Dr. Jackson presented on PPN in association with crown rot in Nebraska corn. Crown rot is a disease that displays rapid discoloration, early senescence, “ghosting”. The disease may be apparent very early in the season, where seedlings appear stunted, purple or chlorotic. Dr. Jackson noted that they’ve tried inoculating with different fungal species to recreate symptoms, but none of the fungal species tested reproduced the symptoms. Therefore, they were curious if plant-parasitic nematodes could be associated with the disease. Dr. Jackson and her team conducted a survey, collecting “ghost” plants and a neighboring healthy plant. Nematodes were extracted from each plant and soil fraction. More lesion nematodes were found in roots of symptomatic plants in 2022, but the trends were reversed in 2023. The survey is ongoing and more samples are incoming.

**Zane Grabau** - Florida

Dr. Grabau provided an overview of his research program on nematode management in North Florida field crops. He presented his work on sting nematode in white potato, including nematicide evaluation. Dr. Grabau’s team has done extensive work with evaluating nematicides for management of M. enterolobii in sweetpotato in North Florida. He presented his work on M. arenaria host resistance in peanut, and reniform nematode host resistance in cotton. Dr. Grabau’s team is also working with alternative crops such as carinata for reniform management. Carinata is used as a biofuel crop and may be promising for nematode management.

**Sabina Budhathoki -** University of Florida, Gainesville

Sabina is a graduate student with Dr. Grabau, and she presented on her work exploring brassica cover crop species for sting nematode management in potato production. Particularly, she is researching the application of brassicas as biofumigant or trap crops. There is currently a knowledge gap in how cover crops interact with sting nematode. In the greenhouse, three brassica cover crops (arugala, carinata, and caliente mustard) were tested for host status to sting nematode. For controls, sunn hemp was used as a poor host, and sorghum was used as a good host. All three brassica cover crops were found to be host to sting nematode.

Sabina’s next step was to evaluate the cover crops in the field. The tree cover crops were tested. Sunn hemp increased, while arugula decreased potato yield. Fumigation treatment also increased potato yield. Sabina concluded that brassica cover crops should be avoided in cases of sting nematode.

**S-1092 2024 Business Meeting (Charleston, SC, 11/15/2024)**

For the 2025 meeting, we discussed potentially meeting with the Western group, who may be meeting in Little Rock, AR. Depending on what time of year they are planning to meet, this could be an excellent opportunity and facilitate more collaboration with this group. **Dr. Adrienne Gorny** is the chair for 2025, and she will reach out to the Western group to determine if a joint meeting would be of interest.

**Dr. Intiaz Chowdhury** nominated himself to be the vice-chair for 2025 and incoming chair for 2026. A unanimous vote from all members present confirmed his position.

State Reports - **Dr. Will Rutter** will send out an email to all members reminding them to submit their state reports. Dr. Gorny will compile them and submit the composite report. These are due 60 days after the meeting.

**Dr. Will Rutter** will send out a follow up meeting survey to ask members their preferred time of year to meet.

**NC1197 2024 Business Meeting (Charleston, SC, 11/15/2024)**

**Attendees:**

In person: Carl Bradley (chair), Haddish Melakeberhan, Guiping Yan, Nathan Schroeder, Maddy Shires

Via Zoom: Senyu Chen, Peter DiGennaro, Kiersten Wise

Minutes: NES moved, HB seconded, approved unanimous

1) Discussion of having an impact statement writer. If interested should talk with AA early to do so.

2) Reminder to complete the Qualtrics survey.

3) Peter Digennaro nominated and elected unanimously as chair.

4) Maddy Shires nominated and seconded as secretary. Elected unanimously.

5) Discussion of meeting sites and dates: Decision made to table discussion and send out a poll.