NC1197: Practical Management of Nematodes on Corn, Soybeans, and Other Crops of Regional Importance
Meeting Minutes
July 14, 2023

The 2023 meeting was held in-person and available online (Zoom) for members that were unable to attend in-person. The meeting was held at the Graduate Hotel in Columbus, OH on July 14, 2023.

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The meeting started at 8:00 AM, with the chair, Guiping Yan, and local arrangements coordinator, Haddish Melakeberhan, welcoming the attendees. This was followed by introductions.

Participants:
Carl Bradley, University of Kentucky
Emmanuel Byamukama, USDA-NIFA (online)
Peter Digennaro, University of Florida (soon moving to the University of Wisconsin)
Lauren Docherty, University of Minnesota
Jaeyeong Han, University of Illinois
Tamra Jackson-Ziems, University of Nebraska (online)
Horacio Lopez-Nicora, Ohio State University
Ann MacGuidwin, University of Wisconsin (online)
Derek McLean, University of Nebraska (Administrative Advisor)
Haddish Melakeberhan, Michigan State University
Nathan Schroeder, University of Illinois
Shahid Siddique, University of California-Davis
Madalyn Shires, South Dakota State University (online)
Christopher Taylor, Ohio State University
Albert Tenuta, Ontario Ministry of Agriculture, Food and Rural Affairs
Guiping Yan, North Dakota State University
Lei Zhang, Purdue University

Derek McLean, Administrative Advisor to NC1197, provided an overview of multistate projects and the North Central Regional Association of State Agricultural Experiment Station Directors (NCRA) and discussed the role of NCRA Regional Administrators (Christina Hamilton and Jeanette Thurston). He updated the attendees on the status of NC1197, where the NC1197 project was resubmitted two years ago, and that a mid-term report will be due in early 2024. The next renewal for NC1197 will be in 2025. He emphasized the importance of focusing on impacts for the NC1197 annual report and asked the group to consider having an impact writing training session at a future meeting. The annual report needs to focus on collaborative work and impacts (3-5 pages total). The economic impact of NC1197 would be important to include in the annual report as well. He also asked the group to consider applying for the Excellence in Multistate Research Award.

Emmanuel Byamukama, USDA-NIFA, provided updates to the group. He encouraged attendees to register for and participate in NIFA listening sessions. He also encouraged attendees to apply for NIFA funding. Funding programs to consider are the Applied Research and Development Program (ARDP) (nematode management fits within this program with amounts up to $200,000 for one state and $320,000 for multiple states), the AFRI A112 Program, Pests and Beneficial Species in Agricultural Production Systems, and the AFRI Critical Agriculture Research and Extension (CARE) Program (up to $300,000 and 1-3 years). He encouraged attendees to volunteer to serve on review panels (create login on NIFA site and create an account to peer-review for NIFA), and for attendees to subscribe to the NIFA newsletter and updates.

State Reports followed with each member attending providing a brief report on nematode research in their state.

- **Ann MacGuidwin,** provided a report for Wisconsin. In her report, Ann mentioned that she was retiring, and that Peter Digennaro (currently at University of Florida) will be the new plant nematologist for the University of Wisconsin. From nematode surveys in Wisconsin soybean fields, the most prevalent nematode in soybean is *Pratylenchus*. From 6,971 soil samples from 1,743 farms (2012-2021), 92% had *Pratylenchus* and 36% had soybean cyst nematode (SCN). Yield loss due to *P. penetrans* on soybean was 2.8-7.6%. Modeling from greenhouse data showed that there was a 0.01987% yield loss per nematode (initial population, Pi), and the field model showed a 0.02930$ yield loss per nematode (Pi). She recommended that sampling for *Pratylenchus* should include both soil and roots. For SCN in Wisconsin, HG Type 2 is most prevalent (53% of 505 HG Type tests performed 2006-2019).
- **Peter Digennaro,** provided a brief report on his research interests and what he plans to do when he moves to the University of Wisconsin. He is interested in collaborating with others in the NC1197 group. He has research interests in the major areas of developing molecular techniques, foundational knowledge of host resistance, and nematode biology.
- **Lei Zhang,** provided a report for Indiana. His research at Purdue includes conducting an updated survey of SCN virulence types in Indiana (HG Types), and he is adding PI 567516C to the indicator lines for his HG Type Testing. In Indiana, 88% of SCN populations are virulent to PI 88788 (FI average = 43%), 0% were HG Type 0, 14% were virulent to PI 548402 (Peking), and 19% were virulent to PI 567516C.

A discussion followed Dr. Zhang's report about HG Types and Female Indices (FI). The group discussed at what FIs is PI 88788 still relatively effective. Discussion evolved that FI of 70-80% on PI 88788 would be very aggressive, but that FI of 30% means that PI 88788 is still providing value. It will be important to continue discussing the importance of FI when discussing the results of HG Type Tests to farmers.

- **Lauren Docherty,** provided a report for Minnesota. Research at the University of Minnesota includes characterizing SCN inbred lines developed from field populations in Minnesota. From a modified HG Type Test conducted on SCN populations from Minnesota, 50% were virulent to PI 88788 and 23% were virulent to Peking, and that very few were virulent to both PI 88788 and Peking. She also provided an update on genome sequencing to identify candidate virulence genes and provided an update on

studies evaluating the effect of SCN on field pennycress, which is a new crop being developed in the upper Midwest that is a host of SCN.

- **Nathan Schroeder,** provided a report for Illinois. His research includes field testing various seed treatments, which have shown limited efficacy against nematodes on corn. His research has shown good in vitro toxicity of fluopyram on *Pratylenchus penetrans* but not good field efficacy. The Worm Atlas database will be moving to the University of Illinois and other species besides *Caenorhabditis elegans* will be added. His program is analyzing electron micrograph (EM) images using artificial intelligence and will be digitizing, curating, and annotating 10,000s of EMs. Research on nervous system evolution has shown a fair amount of variation of nervous systems across nematode species (variability within basal clades). His program was able to get *Mononchus aquaticus* (predatory nematode) in culture, which has many more neurons than *C. elegans*.

- **Jaeyeong Han,** provided an update on his research in the Schroeder laboratory at the University of Illinois. His work includes reconstruction of the esophageal connectome of *Heterodera glycines*.

- **Shahid Siddique,** provided an update on his research at the University of California-Davis. His research includes utilizing the Arabidopsis-cyst nematode interaction as a model system to identify nematode-origin proteins that are present in infected root samples, but absent in uninfected control roots. This work is the first attempt to identify nematode secretory proteins from the host proteome. His program is currently identifying host genes in major crop plants, such as soybean, that are targeted by essential nematode secretory proteins.

- **Christopher Taylor,** provided an update on his research of biological control of nematodes at the Ohio State University. His research is characterizing *Pseudomonas* for control of nematodes via production of toxic volatiles. He is researching the factors that might be involved in reducing the efficacy of biocontrol agents in the field, when they have been shown to work well under greenhouse conditions. His research also includes work on *Aphelencoides* species (fungal eating nematodes), nemtaodes to control biofilms in hydroponic systems, and *Pleurotus* species (oyster mushrooms) for the control of plant-parasitic nematodes.

- **Horacio Lopez-Nicora,** provided a report for Ohio. His research has shown that 85% of SCN populations in Ohio have >10% reproduction on PI 88788. His research also includes evaluating the source of SCN resistance (Peking and PI 88788) and the effect of ILEVO seed treatment on SCN management in the field.

- **Madalyn Shires,** provided a report for South Dakota. She has been providing webinars covering the dangers of SCN in South Dakota and has developed a state Extension publication that promotes SCN testing. She has been promoting SCN testing through a SDSU Plant Diagnostic Clinic booth at 10 different state events that reached 2,500 people and promoting SCN and HG Type testing through multiple local radio stations and local newspapers that reached 75,000 people. In South Dakota, 20% of the SCN population was HG Type 2.

- **Haddish Melakeberhan,** provided a report for Michigan. His research includes evaluating parasitic variability in the northern root-knot nematode (NRKN) and SCN, which includes the relationship between NRKN distribution and soil health conditions, relationship between parasitic variability and soil health conditions, and the relationship

among parasitic variability, soil health conditions, and soil microbiome. His research also includes evaluating the effect of production practices on nematodes, nutrient cycling, and soil health. His program is developing and disseminating research-based information on soil health management to help improve soil structure, physiochemistry, water holding capacity, and nutrient cycling, to suppress pests and diseases while increasing beneficial organisms, and to improve biological functioning leading to improved biomass/crop yield.

- **Albert Tenuta,** provided a report for Ontario, Canada. He is involved with research programs that are surveying nematode populations in field and horticultural crops and HG Type Testing of SCN in Ontario soybean fields. In Ontario, HG Type 1 is present (up to 30-40% FI) and HG Type 2 is present (up to 60-70% FI). Other research includes cover crop effects on nematodes and seed treatment testing for nematode management.

- **Tamra Jackson-Ziems,** provided a report for Nebraska. Her research is evaluating population densities of plant parasitic nematodes associated with crown rot of corn and testing of seed treatments in corn for nematode management. Dylan Mengal, Extension Plant Pathologist at University of Nebraska, is working on SCN and conducting HG Type Testing to determine HG Types of SCN in the state.

- **Carl Bradley,** provided a report for Kentucky. His research includes a survey of SCN in Kentucky. This research has shown that SCN eggs were present in 80% of the soybean fields surveyed and that limited HG Type Testing showed that HG Type 2.5.7 (FI range of 13-48%) is most prevalent. A survey for vermiform nematodes in Kentucky soybean fields also is ongoing. So far the survey has found dagger, lance, root-knot, spiral, and stunt nematodes. The Bradley lab also is conducting field trials to evaluate the efficacy of seed treatments for management of SCN. **Kiersten Wise** (University of Kentucky) is leading research on plant-parasitic nematodes that affect corn in Kentucky. Her research includes surveying for plant-parasitic nematodes in Kentucky corn fields and evaluating nematode-protectant seed treatments in corn field research trials.

- **Guiping Yan,** provided a report for North Dakota. Her research is focused on SCN, root lesion nematodes, and stubby root nematodes. Her program identified a new root lesion nematode species of importance (*Pratylenchus dakotaensis*). Other research includes the whole genome assembly for stubby root nematode, evaluating cover crops for their response to SCN and root lesion nematode, screening soybean cultivars for SCN resistance, dry edible bean research with SCN, development of molecular assays for identification and quantification of plant parasitic nematodes, and field trials to evaluate efficacy of chemical nematicides for stubby root nematode management on potato.

The business meeting followed and time was given to **Emmanual Byamukama** (USDA-NIFA) and **Derek McLean** (Administrator Advisor) to provide additional comments. Emmanual Byamukama thanked everyone for their presentations. Derek McLean will help the group develop the report to be 3-5 pages. He commented that the report should highlight new equipment and facilities. He also mentioned that an impact statement consultant could come to the next meeting (would need about 2 hours reserved in the meeting for this), and that an infographic that displays NC1197's impact could be developed. It will be important to highlight the Worm Atlas for objective 3 in the report. It would also be good to highlight on-farm research and maintaining nematode collections.

A discussion about plans for the next meeting occurred. **Carl Bradley** made a motion to investigate meeting with the S1092 group in 2024. **Haddish Melakeberhan** seconded the motion. The motion passed unanimously.

Peter Digennaro was nominated and elected as the new secretary for NC1197, and **Carl Bradley** was elected as the new chair for NC1197.

A motion was made by **Nathan Schroeder** and seconded by **Shahid Siddique** to adjourn the meeting. The motion passed, and the meeting was adjourned at 5:30 PM.

The entire group expressed their gratitude to **Guiping Yan** and **Haddish Melakeberhan** for leading and arranging the meeting, respectively.

Respectfully submitted by Carl Bradley