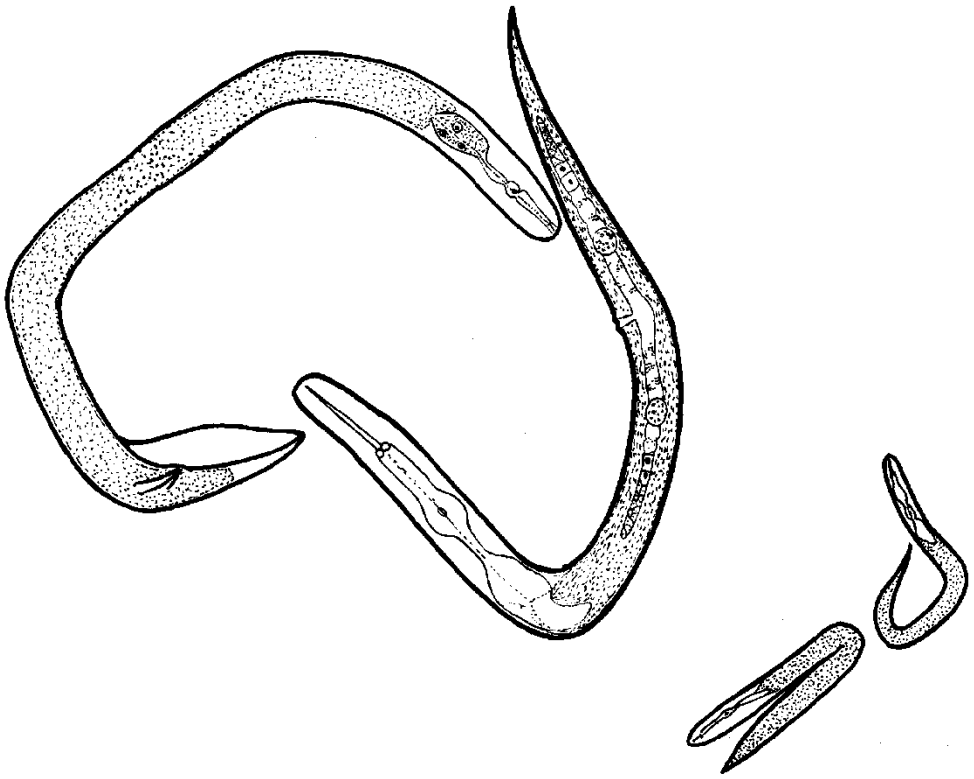
ISSN 2208-4312

AUSTRALASIAN NEMATOLOGY NEWSLETTER



Published by: Australasian Association of Nematologists

VOLUME 32 NO. 12 **JULY 2021**

From the Editor

A big thank you to all contributors for sharing your latest news and interesting research outcomes in this issue of the AAN Newsletter.

Articles on regional news, recent publications, announcements of new research projects, colleagues, visitors, students etc., research reports, conference or workshop reports, abstracts of recently submitted/accepted PhD theses, conference or workshop announcements and photos are welcome for publication in the AAN Newsletter. Contributions will be accepted at any time throughout the year so please forward articles and reports to me as they occur, with the deadline for the next issue in Dec 2021.

I look forward to receiving your contributions for future issues and keeping you up to date with the regional news of our AAN members.

Rebecca Zwart

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Association News

FROM THE PRESIDENT

The Olga Goss Travel Award for Nematology

In the absence of any feedback on the suggestion in the last newsletter, I have taken an executive decision and the proposed name for the award is now adopted. Thank you to Sarah Collins for the suggestion.

Given that as I write, almost everywhere in Australia is in lockdown and international travel is banned, when we will be able to make some meaningful awards under this scheme is very much up in the air (or more correctly, stranded on the ground). I would love to say that there will be a large amount available to make up for lost time once borders re-open, but the interest on which the fund relies is currently being paid at a pathetic rate. Nevertheless, there is some interest building up, so if 7ICN goes ahead as an in-person conference, then some more support should be available.

Other student events

With the postponement of 7ICN, the IFNS committee has been concerned that graduate students will not have any options for presenting their work. To improve this situation, a number of nematology societies organized virtual meetings particularly for students to present their work before the end of their candidatures where this is a requirement of their degrees. These events are continuing, although they may end soon as other countries vaccination rates allow in-person events. The SON, ONTA and ESN websites have more information.

CoVID and conferences

One of the normal venues for AAN meetings—the biennial APPS—is proceeding as an on-line only conference later this year in November. As with the past couple of APPS conferences, I am not aware of a nematology session being planned. It appears that it is too late to organize anything for the 2021 conference, it would seem that again there will be limited opportunity for nematologists to get together for either formal or informal meetings, or especially the dinner, normally associated with the general meeting. This is a great shame, and although there are very limited opportunities to do anything about it at the moment, I think we should plan for a grand get together when travel and in-person events are again allowed. To this end, I would really appreciate some feedback from anyone who has read this far on what is needed to help people get out to scientific meetings. Examples include special nematological symposia, invitations to present, associated training courses, assistance with travel, or even free dinners?

I believe there is research indicating that participating in meetings on-line is more tiring than in person, and less successful in enabling informal interactions, which is what makes personal meetings so much better.

I look forward to a rush of comments on potential topics, format and support for future meetings.

Mike Hodda

FROM THE TREASURERS

Fees for the AAN (Australasian Association of Nematologists) are due annually 1st July through to 30th June. The $15 + GST annual fee covers newsletter articles and information regarding nematology opportunities including specialised workshops.

If you are outstanding with your fees you will be contacted shortly for the previous year.

You can no longer pay through the APPS web site when registering your membership, all now come through the AAN bank account. We have had support for many years with APPS but they are no longer able to assist with this service due to logistics.

ONLY Payment Method

ANZ

Account Name: Australasian Association of Nematologists

BSB: 012-950

Account # 5180-07506

Looking forward to your continued support and the camaraderie the Nematology group brings.

Kind Regards

Katherine Linsell and Sue Pederick (Joint Treasurers AAN)

Regional News

NEWS FROM QUEENSLAND

Sugar Research Australia (SRA)

A new research trial has commenced at SRA's Woodford Pathology farm to screen >150 progeny originated from an introgression cross between an elite sugarcane variety and a highly resistant *Saccharum spontaneum* line for root-lesion nematode (*Pratylenchus zeae*). All sugarcane varieties tested to date are susceptible to this nematode, and this work is part of the process to introduce novel resistance into elite germplasm.

On 13 April 2021, Dr Shamsul Bhuiyan attended the 'Walk and Talk' event organized by the Herbert Cane Productivity Services Limited's (HCPSL) at the Ingham Show Ground. Approximately 100 cane growers attended the daylong program that covered a range of topics, such as, SRA's new varieties and variety management, use of pesticides, soil health, and use of mill mud and ash to improve soil health. Shamsul presented the recent nematode survey results from 56 locations of six cane productivity zones. Approximately 73% of the sugarcane fields surveyed had medium (484 nematodes/200g soil) to high (1137 nematodes/200 g soil) counts of root-lesion nematodes (*Pratylenchus* spp.). Nematode community analysis was used to determine the soil health of each surveyed sugarcane farm. Analyses revealed low maturity indices (MI and MI2-5) (<3.5) in all farms surveyed, which was indicative of low soil food web maturity and persistent use of chemical fertiliser. Soil food-web indices and metabolic footprints indices also indicated perturbation of sugarcane soil and a farming system dominated by herbivorous nematodes. It demonstrated that nematode community analysis can be used as indicators of soil health for the sugar industry as well as a monitoring tool to determine the effects of management practices.

Dr Bhuiyan presenting nematode survey results at the 'Walk and Talk' event, Ingham Show Ground.

Recently Dr Karen Aitken (CSIRO) submitted the final report of an SRA funded project 'A high throughput method for screening for root-knot and root lesion nematode resistance in sugarcane (project#2019401)'. Below is a short summary: The current screening method that is used to identify germplasm that contains resistance takes up to 16 weeks to obtain a result. A new screening method was developed in this project which takes three weeks to determine if a clone is resistant to or susceptible to root-knot and root-lesion nematodes. This new method has the potential to reduce the cost of screening for nematode resistance and to increase the number of sugarcane clones that can be screened in a year. This has an impact on the sugarcane breeding program as the more clones that are screened the faster a new resistant variety can be produced. The project also identified resistance in wild germplasm, *Saccharum spontaneum* and *Erianthus arundinaceus*. These clones have the potential to be used in an introgression breeding program to introgress resistance from the wild germplasm into sugarcane varieties. The new screening method developed in this project could potentially speed up the introgression process by enabling larger numbers of clones to be screened thus increasing the chance of success.

Recent publications

Bhuiyan SA and Garlick K (2020) Efficacy of copper -based Texel fabric in preventing root escape from pots and improving nematode resistance screening of sugarcane accession lines in glasshouse. *Plant Health Progress*, *21*(4), 345-349. doi:10.1094/PHP-07-20-0065-RS

Bhuiyan SA and Garlick K (2021) Evaluation of root-lesion nematode (*Pratylenchus zeae*) resistance assays for sugarcane accession lines. *Journal of Nematology* (in press).

Bhuiyan SA and Garlick K (2021) Evaluation of root-knot nematode resistance assays for sugarcane accession lines in Australia. *Journal of Nematology*, *53*, e2021-06. doi: 10.21307/jofnem-2021-006

Bhuiyan SA, Kylie G, Di Bella L, McVeigh E and Sefton M (2020) Nematode survey in the Herbert region to develop a nematode hazard index (HI) and evaluate soil health. *Proceedings of the Australian Society of Sugarcane Technologists, 42*.

McNeil MD, Bhuiyan S, Stiller J, Li, Drenth J, and Aitken KS (2020) Identification of SNP markers linked to resistance to root-knot nematode, *Meloidogyne javanica*, using transcriptome analysis (poster). *Proceedings of the Australian Society of Sugar Cane Technologists, 42*.

Final report

Aitken KS and Bhuiyan SA (2021) A high throughput method for screening for root-knot and root lesion nematode resistance in sugarcane: Final Report 2019/401, Sugar Research Australia Limited, Brisbane.

Shamsul Bhuiyan

University of Southern Queensland (USQ)

Kirsty Owen and Martin Fiske worked on the GRDC funded project, Soilborne disease interactions in Australian farming systems (JPD1907-002RMX) in which field experiments were carried out across Australia by the national network of nematologists. One of the aims in the project was to develop methodology to test the interaction of a soilborne disease with the major *Pratylenchus* species in each Australian grain-production region. Within each region, a two-year experiment was carried out. In Queensland, we tested the interaction of (1) crown rot and *P. thornei* and (2) arbuscular mycorrhizal fungi (AMF) and *P. thornei*. For the experiments with crown rot, a range of *P. thornei* population densities was established by growing cereal cultivars ranging from resistant to susceptible. In the second year of the experiment, four rates of crown rot were added at sowing and the growth and yield of two wheat cultivars was measured across a range of both organisms simultaneously. In the other experiment, contrasting levels of AMF and *P. thornei* were established in the first year of the experiment by growing winter crops differed in their resistance or susceptibility to *P. thornei* and also had varying levels of dependence on AMF. Unfortunately the very dry season in the first year of the experiments limited the range of population densities of *P. thornei* established, and unusually for our region, there was no effect of *P. thornei* on the yield of an intolerant wheat cultivar in the second year of the experiment (which was also very dry). There was a negative linear effect of increasing rates of crown rot and a positive linear effect of AMF on the yield of the wheat cultivars. So, while no interactions of crown rot or AMF with *P. thornei* were discovered, we showed the potential of the method for future field experiments. A major component of the research was the application of novel statistical methods for design and analysis from our colleagues in the Statistics for the Australian Grain Industry, Clayton Forknall, Bethany Rognoni (Queensland Department of Agriculture and Fisheries) and Karyn Reeves (Department of Primary Industries and Regional Development, WA). The project was completed in June 2021 and brought to close a terrific collaboration of nematologists in the grains industry (and mycologists) in three projects over seven years. It has been stimulating to share and contrast our experiences in nematology and to get to know each other better as we worked towards a common goal of trying to understand and reduce the impact of root-lesion nematodes in the Australian grains industry.

Congratulations to Md. Motiur Rahaman on completing his PhD thesis-by-publication titled 'Elucidation of biochemical defence mechanisms in wheat (*Triticum aestivum* L.) against root-lesion nematode (*Pratylenchus thornei*)' under the supervision of Prof. John Thompson, Dr Rebecca Zwart, Dr Kirsty Owen and Assoc. Prof. Saman Seneweera. See the abstract of Motiur's thesis on pages 12-13.

The Higher Degree by Research students at USQ's Centre for Crop Health have recently pitched their research projects in short videos. Check out the pitches of the Crop Nematology team's research students Elaine Gough, Sonal Channale, Jason Sheedy, Neil Robinson and Hannah Rostad at https://www.usq.edu.au/research/institutes-centres/ilse/crop-health/phd-videos.

Recent Publications

Gough EC, Owen KJ, Zwart RS and Thompson JP (2021) Arbuscular mycorrhizal fungi acted synergistically with *Bradyrhizobium* sp. to improve nodulation, nitrogen fixation, plant growth and seed yield of mung bean (*Vigna radiata*) but increased the population density of the root-lesion nematode *Pratylenchus thornei*. *Plant Soil*. doi:10.1007/s11104-021-05007-7

Owen KJ, Fanning JP, Reeves KL, Hollaway GJ (2021) Consistent responses of yield and resistance of wheat cultivars to the root-lesion nematode, *Pratylenchus thornei,* in the Australian northern subtropical region, but not in the temperate southern region. *Plant Pathology*. doi: 10.1111/ppa.13417

Rahaman MM, Zwart RS, Rupasinghe WT, Hayden HL and Thompson JP (2021) Metabolomic profiling of wheat genotypes resistant and susceptible to root-lesion nematode *Pratylenchus thornei*. *Plant Molecular Biology*, *106*(4-5), 381-406. doi: 10.1007/s11103-021-01156-6.

Thompson JP and Clewett TG (2021) Impacts of root-lesion nematode (*Pratylenchus thornei*) on plant nutrition, biomass, grain yield and yield components of susceptible/intolerant wheat cultivars determined by nematicide applications. *Agronomy, 11*(2): 296. doi: 10.3390/agronomy11020296

Thompson JP and Clewett TG (2021) Investigating the impact of root-lesion nematodes (*Pratylenchus thornei*) and crown rot (*Fusarium pseudograminearum*) on diverse cereal cultivars in a conservation farming system. *Agronomy, 11*(5), 867. doi: 10.3390/agronomy11050867

Thompson JP, Sheedy JG, Robinson NA and Clewett TG (2021) Tolerance of wheat (*Triticum aestivum*) genotypes to root-lesion nematode (*Pratylenchus thornei*) in the subtropical grain region of eastern Australia. *Euphytica, 217*, 48. doi: 10.1007/s10681-020-02761-0

Kirsty Owen and Rebecca Zwart

NEWS FROM WESTERN AUSTRALIA

Department of Primary Industries and Regional Development, Western Australia (DPIRD)

2021 is proving to be another challenging but hopefully rewarding year for our plant pathology research group and for the DPIRD organisation as a whole. Our nematology research focus is changing. Our main series of collaborative national broadacre research projects concluded early in the year (DPIRD/GRDC). We are now concentrating on a number of Western Australian based Boosting Grains Science Partnership grants and smaller DPIRD/DRDC initiatives. We continue to work closely with WA broadacre growers and regional grower groups, with six of our nine field research trials based regionally on growers' paddocks. Additionally, we are delivering workshops to six WA grower groups through the Grower Group Alliance/DPIRD/GRDC collaboration of grower demonstration trials in a National Soilborne Disease Extension project.

What's new in Research at DPIRD?

Our team is collaborating in two cross-disciplinary research initiatives investigating changes to a soil's biology following major modifications to the soil profile. Growers in Western Australia have widely adopted mechanical soil amelioration and liming to manage subsoil constraints like acidity, compaction, water repellence and herbicide-resistant weeds. Our investigation uses common mechanical soil amelioration techniques, including soil mixing (ripping and spading), soil inversion (mouldboarding and one-way plough) and deep ripping, all of which lead to various degrees of soil mixing, creating a changed soil profile. Little was known about the changes in diversity, distribution and long-term survival of the soil's biology including soilborne pathogens, nematodes and weed seeds that occur in response to deep soil amelioration. This is an exciting new area of research as we investigate changes and potential interactions in soil biology, chemistry and the soil profile's physical properties after soil amelioration (see photo below). The collaborative nature of the projects is stimulating as we interact more closely with agronomy, soil science and weed science colleagues.

All hands on deck for deep soil sampling 2020! Sarah Collins is helped by technicians from Nematology, Soil Science and Fungal Root Pathology to get the job done (L to R: Kanch Wickramarachchi, Campbell Eaton, Jono Swift, Cameron Lewis, Sarah Collins, McKenzie Layman, Steve Rossi, and Kris Gajda).

Pratylenchus quasitereoides national variety trials (NVT) testing for wheat and barley variety resistance have commenced for the third year. We also secured DPIRD small project funds to screen oat varieties this year. This research includes both glasshouse and field experiments. *Pratylenchus quasitereoides* continues to resist all of our attempts to find a suitable culturing method. As you can imagine, this makes inoculum provision for glasshouse trials challenging. So far Helen Hunter, our nematology specialist technician, has

inoculated carrots, our usual culturing method, a number of times. She's also tried to interest the nematodes in multiplying in parsnips, swede, turnip, sweet potato and radish. So far *P. quasitereoides* has resisted all methods. If any of you in our wider community have fresh suggestions for innovative nematode culturing methods we would love to hear from you.

New e-Book publication launched in March

Daniel Hüberli and I are very happy with our efforts as co-authors in the latest E-Book publication **Soil Quality: 5 Soil Biology** along with Fran Hoyle, Dan Murphy and Deirdre Gleeson from University of Western Australia (UWA). Daniel, our DPIRD soilborne fungi specialist concentrated on fungal plant pathogens while I wrote about nematodes and their varied roles in our soil's biological ecosystems. This is the fifth publication in a free EBook series by SoilsWest, a research partnership between UWA, DPIRD and GRDC. The E-Books aim to provide students, growers, consultants and academics with information on multifunctional role of soil and its inhabitants. It provides easy to read information on beneficial and disease-causing organisms and the influence of the environment and management on soil habitats which impacts soil production and resilience.

The Soil Quality: 5 Soil Biology E-Bbook is available at no cost via Apple Books, along with the first four publications in the series. Our book features great graphics, short videos and audio from consultants, farmers and research scientists https://books.apple.com/au/book/soil-quality-5-soil-biology/id1554057153. The other publications in the series so far are:

1. Constraints to Plant Production
2. Integrated Soil Management
3. Soil Organic Matter
4. Soil Acidity

They are a great resource!

Will the new blue roof on DPIRD's main campus in South Perth hold the buildings in one piece?

Have you heard that we are finally destined to have new facilities for DPIRD in Perth metro? Well let's hope so. After what we call 'the great flood' in June 2020, WA State Government can no longer ignore building failures and hazards around the 60-year-old site at our main campus in South Perth. Widespread building closures across the campus took place over the following months after staff appeals to Worksafe culminated in a large number of official exclusion notices. DPIRD staff have been squirrelled away in outbuildings, sheds, temporary offices and at home ever since.

In September 2020, the State Government approved funding of $19.5 million for DPIRD's immediate accommodation needs to ensure functional laboratories/technical facilities and offices are in place while the longer-term site selection and planning is undertaken. Remediation works in South Perth to improve staff safety and ensure facilities remain usable for those staying on site for the next few years are underway (see Photo below). This includes reducing airborne asbestos hazards by plugging the holes and painting the roofs with acrylic coating, reducing electrocution, reducing gas hazards by installing emergency gas shut-off valves in labs and installing fire detectors. Our offices and laboratories are currently getting 'deep cleaned'. Laboratories can reopen for the most part but it's no longer considered safe for us to work in the offices that some of us have had for twenty or more years. We suppose looking back, that we all get use to making the best of what we have.

Asbestos roofs at DPIRD South Perth get painted with Acrylic coating aiming to stabilise airborne asbestos fibre contamination.

In the past six months more than 600 staff have been relocated across two office spaces in the inner city. Once all staff movements are complete, only employees with a direct need to use laboratory, glasshouse and equipment will remain present on the campus. Our plant pathology group along with 200 other staff in research, biosecurity and quarantine will continue to inhabit a campus that used to house over 1000 DPIRD staff. Wish us luck that the $1 million allocated to DPIRD executive by State Government to prepare a business case for permanent laboratory and research facilities is successful.

I feel proud looking at the quality research that our plant pathology research group have achieved since the beginning of 2020. I think that it's a real testimony to our tenacity and commitment to our research that the restrictions from a world-wide pandemic and loss of our DPIRD 'home' have not held us back.

Recent Publications

EBook

Murphy D, Hoyle F, Collins S, Huberli D and Geelson D (2021) *Soil Biology*. Soil Quality EBook. Soils West. Download from Apple Books. https://books.apple.com/au/book/soil-quality/id1554057153

Grower Group Research Books

Mwenda G, Collins S, Mia S, Zaicou-Kunesch C, Wilkinson C, Huberli D, Borger C, Reynolds C, Kelly S, Kupsch M, Wickramarachchi K, Hampson E, Hunter H, van Burgel A and Davies S (2021) Impact of soil amelioration on soilborne pathogens, nematode pests and weeds. *Liebe Group Research Booklet 2020*.

GRDC Updates (Grower and Advisor)

Collins S, Mwenda G, Wilkinson C, Hüberli D**,** Kelly S, Reynolds C, Kupsch M, Wickramarachchi K, Hunter H, Zaicou-Kunesch C, van Burgel A, Linsell K, and Davies S (2021) Soil amelioration alters soil biology, soilborne disease and nematode pests of cereal crops. What are the implications? In: 2021 Grains Research Updates, 22 - 23 February, Perth, Western Australia.

Collins S, Mwenda G, Wilkinson C, Hüberli D, Kelly S, Reynolds C, Kupsch M, Wickramarachchi K, Hunter H, Zaicou-Kunesch C, van Burgel A, Linsell K and Davies S (2021) Soil amelioration alters soil biology, soilborne disease and nematode pests of cereal crops. What are the implications? In: 2021 Grains Research Updates, 17 March, Geraldton, Western Australia.

Collins S, Linsell K, Wilkinson C, Gontar B, Wright D, Mwenda G, Hüberli D, Connor M, Kelly S, Hunter H and Davies S (2021) Much to tell – 'Soil biology after amelioration' and what we found in the 'DPIRD Root Disease Survey.' In: 2021 Grains Research Updates, 3 March, Albany, Western Australia.

Hüberli D, Collins S, Mwenda G, Wilkinson C, Gajda K, Kelly S, Hunter H, Reynolds C, Kupsch M, Wickramarachchi K, Zaicou-Kunesch C, van Burgel A and Davies S (2021) Rhizoctonia in ameliorated and non-ameliorated soils. In: 2021 Grains Research Updates, 12 March, Merredin, Western Australia.

Collins S, Wilkinson C, Huberli D, Davies S and Mwenda G (2020) Deep soil amelioration – creating a new soil environment. What happens to living components of soil? *DPIRD Industry Day*, Optus Stadium, Burswood. 1 December 2020.

Press Articles

Collins S, Mwenda G, Wilkinson C, Hüberli D, Kelly S, Reynolds C, Kupsch M, Wickramarachchi K, Hunter H, Zaicou-Kunesch C, van Burgel A, Linsell K and Davies S (2021) Soilborne solutions to boost grain yields. *Farm Weekly*, 26 February 2021. https://www.farmweekly.com.au/story/7141509/soilborne-solutions-to-boost-grain-yields/?cs=5170

Collins S (2021) Project drills into soil amelioration. Farm Weekly Newspaper. 8 Feb 2021. https://www.farmweekly.com.au/story/7115168/project-drills-into-soil-amelioration/

Murphy D, Hoyle F, Collins S, Huberli D, and Geelson D (2021) New ebook digs deep on soil information. *Farm Weekly*, 25 February 2021 p23.

Happy researching!

Sarah Collins

Murdoch University

The Crop Biotechnology Research Group continues to undertake R&D in plant nematology.

Current PhD projects

Saiful Islam: 'Functional analysis of putative parasitism effector genes of Root-Lesion Nematodes *(Pratylenchus spp.):* developing potato *(Solanum tuberosum)* resistance using RNA interference'. Having carried out a survey of nematode present in potato fields in WA with Iqbal Hussein, Saiful is now focussing on isolating and characterising effector genes from *P. penetrans*. With Adj A/Prof Steve Milroy.

Iqbal Hussein: 'Biofumigant crops to suppress plant pathogenic nematodes in potato farming systems of WA'. Iqbal is now focusing on developing *in vitro* systems to study compounds which attract, repel or inhibit growth of *P. penetrans*. With Adj A/Prof Steve Milroy.

Sasha Anne Somashakaram: 'Biological control of crop pests using next-generation biopesticides for horticultural and broadacre crops'. Sasha is working to develop methods to deliver dsRNA exogenously to plants for nematode control, including the systemic movement of RNA in treated plants. With Dr John Fosu-Nyako.

Maria Maqsood: 'Towards understanding common mechanisms of nematode and insect effectors for plant parasitism'. Maria is in currently in Pakistan, unable to undertake lab work. With Dr Sadia Iqbal.

Rhys Copeland: 'Determining the spatial distribution of *Pratylenchus quasitereoides/Pratylenchus curvicauda* in the WA wheatbelt, and understanding how they find host roots'. Rhys has a background of research in plant-pathogen interactions, having completed an Honour's research project at the University in 2017 focusing on identifying and characterising putative parasitism genes of the root lesion nematode *Pratylenchus neglectus.* See an update on his project on page 11.

Michael Jones

PhD Thesis Update

DETERMINING THE SPATIAL DISTRIBUTION OF *PRATYLENCHYUS QUASITEROIDES/PRATYLENCHUS CURVICAUDA* IN THE WA WHEATBELT, AND UNDERSTANDING HOW THEY FIND HOST ROOTS

Rhys G. R. Copeland[1], Michael G K Jones[1], John Fosu-Nyarko[1] and Sarah Collins[2]

[1]Crop Biotechnology Research Group, Western Australian State Agricultural Biotechnology Centre, College of Science, Health, Engineering and Education, Murdoch University, Perth, WA 6150
[2]Department of Primary Industries and Regional Development, Perth, WA

The objectives of the project are:

1. To assess the presence, prevalence, and distribution of *P. quasitereoides* and/or *P. curvicauda* in five winter wheat and barley fields in WA.
2. To develop a method for culturing the nematodes *in vitro* and to establish a system for investigating gene function using RNA interference *(RNAi).*
3. To study genes expressed in the amphids of *P. quasitereoides* and/or *P. curvicauda*, and to determine the spatial expression and gene function of a selection of highly expressed genes.
4. To identify neurons in the amphids of the nematodes using electron microscopy and hybridisation techniques and to construct a three-dimensional image of *P. quasitereoides* and/or *P. curvicauda* amphidial neurons.

Root-lesion nematodes (RLN) (*Pratylenchus* spp.) are amongst the top three most economically important plant parasitic nematodes. They have wide host ranges, with estimated annual yield loss of between 15 and 50% in WA. It is important for pest management strategies to identify the species present accurately.

Pratylenchus curvicauda was recently characterised in soil samples from grain-growing areas of WA by Begum *et al*. (2019). These soils had been identified previously as containing *Pratylenchus quasitereoides*, however, Begum *et al*. (2019) found that *P. curvicauda* was the predominant species in the samples she studied. The first aim of this research is to re-assess the prevalence of *P. quasitereoides* and/or *P. curvicauda* in WA.

Genomic DNA was extracted from 50 RLNs isolated from soil samples collected from a cereal crop near Darkan, WA. Specific primers were used to amplify the D2-D3 region of the 28s rDNA sequence, and these amplicons were then cloned and sequenced. Phylogenetic relationships of the sequences with other *Pratylenchus* spp. were constructed by comparing them to a constructed database of 122 28S-D3 sequences representing 27 species of *Pratylenchus* spp. worldwide. Phylogenetic trees constructed with the sequences form this one sire aligned the samples with two *Pratylenchus* species, *P. penetrans* and *P. curvicauda*.

Of the phylogenetic analyses conducted from the Darkan site, sequences with a close relationship to that published for *P. quasitereoides* (Hodda etal, 2014) were not found. However, samples displayed close phylogenetic relationships with *P. curvicauda.* The current results support the findings of Begum *et al*. 2019 and suggest that *P. curvicauda* may be more widely distributed in WA. The identification of RLNs from Darkan with close sequence identity to *P. curvicauda* and *P. penetrans* but not *P. quasitereoides* may indicate that more RLN species are impacting broadacre crops in WA than previously thought. Recent data suggest that *P. quasitereoides* is present at other sites.

Acknowledgement: This project is funded by the Grains Research and Development Corporation (GRDC).

PhD Thesis Abstract

ELUCIDATION OF BIOCHEMICAL DEFENCE MECHANISMS IN WHEAT (*TRITICUM AESTIVUM* L.) AGAINST ROOT-LESION NEMATODE (*PRATYLENCHUS THORNEI*)

Md. Motiur Rahaman

University of Southern Queensland

Pratylenchus thornei is an economically damaging root-lesion nematode that has a worldwide distribution. It is one of the major threats for wheat production in Australia and is particularly damaging in the northern grains region of the country. This nematode causes nutrient deficiency and water stress in wheat, which results in yield loss. Recent studies suggest that resistance in wheat occurs post penetration of the nematodes into the roots. Little is known about the biomolecules responsible for providing defence against *P. thornei* in wheat. In this thesis, histopathology, comparative enzyme profiling and metabolomics studies were conducted to elucidate the potential defence mechanisms in wheat against *P. thornei* infestation. Mainly, two sources of resistance against *P. thornei* were used in this study for different experiments (i) GS50a and its derived lines (ii) synthetic hexaploid CPI133872 and its derived lines. These were compared with susceptible wheat genotypes that were parents of the resistant derivatives.

Histopathological analysis was performed on one moderately resistant wheat genotype (QT8343; a GS50a derived line) and two susceptible wheat genotypes (Gatcher and Janz) to understand critical time points for reduced nematode reproduction in moderately resistant wheat cultivars. The significantly reduced nematode numbers were recorded inside QT8343 at 4 to 12 weeks post nematode inoculation (PNI). Clear differences were observed in both *P. thornei* nematode numbers and egg depositions at 8 weeks post nematode inoculation (PNI), with significantly ($P \leq 0.05$) fewer nematodes and eggs inside the roots of the moderately resistant genotype (QT8343) compared with the susceptible wheat genotypes (Gatcher and Janz). The results have suggested that 8 weeks PNI could be a critical time point for changes in nematode reproductions inside resistant wheat genotypes. No effect of nematode inoculation was found on total protein content, cell-wall bound phenolics and lignin, plant height, shoot and root biomass of moderately resistant and susceptible wheat genotypes, in this histopathological study.

The time point 8 weeks PNI was selected for further biochemical profiling of the wheat roots, namely, total phenol estimation, estimation of phenol oxidase activities and detailed metabolic profiling. The effects of total phenol and phenol oxidases in wheat defence against *P. thornei* were evaluated in 21 wheat genotypes ranging in susceptibility and resistance to *P. thornei.* Polyphenol oxidase (PPO) and peroxidase (POD) enzyme assays were optimised as there was no standardised protocol to test multiple samples at a time using a microplate reader. Higher constitutive levels of total phenols were found in resistant synthetic hexaploid wheats CPI133872 (576 µg gallic acid equivalent (GAE)/g root) and CPI133859 (518 µg GAE/g root) at 8 weeks PNI, compared with moderately resistant and susceptible bread wheat genotypes (192 to 390 µg GAE/g root). The activity of PPO was induced in response to *P. thornei* in resistant (CPI133872) and moderately resistant bread wheat genotypes (GS50a and its derivate QT8343), becoming maximal at 4 weeks PNI. The activity of POD was similarly induced in response to *P. thornei* in CPI133872 at 6 weeks PNI. Different genetic sources of resistance to *P. thornei* showed diverse defence mechanisms and differences in timing of responses. The results have suggested both higher levels of total phenol and phenol oxidases could be responsible for superior resistance in the synthetic hexaploid hexaploid CPI133872. In contrast, although total phenol contents in moderately resistant GS50a and its derived lines were comparable to susceptible wheat genotypes (Gatcher and Janz), the oxidised phenolic molecules due to

higher level of phenol oxidases in GS50a and its derived lines than in Gatcher and Janz could be responsible for providing defence against *P. thornei.*

Metabolomic profiling was performed with resistant (QT16528; an advanced breeding lines derived from the synthetic hexaploid CPI133872) and susceptible wheat genotypes (including Janz) to understand the role of wheat metabolites in resistance and susceptibility to *P. thornei*. Detailed untargeted metabolic profiling using high performance liquid chromatography (HPLC) mass spectrometry (MS) was performed on the wheat roots at 8 weeks PNI. The majority of metabolites potentially responsible for resistance in QT16258 were found to be constitutively expressed. Gossypetin-8-glucosides, desoxypeganine, and hirsutine metabolites which were significantly ($P \leq 0.01$) higher in concentration in QT16258 than Janz, could potentially act as acetyl choline esterase inhibitors of *P. thornei* to damage neural connections and restrict nematode motility inside QT16258 root tissue. Significantly expressed flavonoid metabolites such as quercetin-3,4'-O-di-beta-glucoside, myricetin-xyloside in QT16258 could have important roles in reducing *P. thornei* reproduction and egg deposition. Resistance in QT16258 could also be due to increased deposition of cutin, suberin and wax on the root cell walls to impede penetration of *P. thornei* and its movement inside the root. Some metabolites occurring at higher concentrations in susceptible Janz, including indole acetic acid and vanillin acetate conjugates could be attractants for *P. thornei* and phenolics, including coniferyl alcohol could be part of a hypersensitive browning reaction resulting from *P. thornei* invasion.

These findings suggest that phenolics in the presence of phenol oxidases can have important roles in wheat defence against *P. thornei*. Eight weeks post nematode inoculation is a critical time point for detailed biochemical studies as there were highly significant ($P \leq 0.05$) differences both in egg deposition and nematode numbers inside roots of resistant wheat genotypes. The defence in wheat against *P. thornei* is mostly constitutive and several biomolecules including metabolites and enzymes are likely to be acting together. Understanding the biochemical defence mechanisms in wheat against *P. thornei* could lead to novel nematode management tools to minimise plant damage and consequent loss in wheat yield from this nematode species.

Member Profile

NEW NEMATOLOGY PhD STUDENT AT AGRICULTURE VICTORIA

Akshita Jain

Hello folks! I am Akshita Jain and I gather great pleasure and honour to introduce myself to all of you. I was born and brought up in Delhi, the capital of India in a three-generation household. On my seventh birthday, I was gifted a red hard-bound encyclopedia and I remember being so fascinated with it that I would carry it everywhere, not knowing that it would lay the foundation of my scientific career.

With my passion for science and its various branches that I decided to pursue a bachelors in Life Science from Delhi University. Of the many subjects encountered during this time, it was plant biotechnology that most caught my attention. Fast forward three years, my interest in travel and zeal to explore biotechnology combined together brought me to Melbourne to pursue a master's degree in Biotechnology and Bioinformatics. With a little trepidation, I packed my bags and flew unaccompanied to Australia. Melbourne was an entirely new world, filled with independence and opportunities. During my first year of the masters course I was introduced to new techniques in biotechnology and bioinformatics that helped me shape my second year wherein I was able to successfully carve a niche by researching and producing a scientific thesis titled, "Genomic evaluation of *Spermospora avenae*, the causal agent of red leather leaf of oat" under the guidance of Dr. Ross Mann at Agriculture Victoria's Centre for AgriBioscience.

The pandemic provided unique challenges to be overcome to complete this project but, in the end, it was all worth it. My search for PhD opportunities was rewarded with an offer of a project at Agriculture Victoria Research where I am discovering the realm of cyst nematology. The PhD project focusses to build and improve Victoria's capability to detect and identify key plant parasitic cyst nematodes using molecular techniques. It aims at the optimisation of DNA extraction protocols suitable for next generation sequencing and for LAMP (loop mediated isothermal amplification) and the development of diagnostic molecular markers that can be used directly on soil or plant tissue to distinguish and recognise the target cyst nematodes that are impacting, or could impact if introduced, Australian agricultural production and restrict market access. I'm four months into the project and am mesmerized by nematodes and what they have to offer.

International Federation of Nematology Societies Update

At a virtual meeting of IFNS counsellors and officers-elect in September 2020, John Jones, Mike Hodda and Eric Grenier volunteered to explore the need and options for graduate students to present research results during 2021. In addition to having no meetings in 2020, a poll of the nematology societies two months ago reflected the uncertainty associated with meeting during the continuing pandemic. Just 5 of 18 nematology societies (RSN, CSPN, SON, NSSA, AAN) planned to hold on-site meetings later this year, and at least one of those (AAN) has now been changed to a virtual event. In addition, two entirely virtual student activities occurred this year - early career and student members of ESN organized and held a very successful virtual meeting in June and the Nathan A. Cobb Foundation again conducted a student video contest.

Given the limited interaction opportunities for nematology graduate students in many parts of the world, it was concluded that an IFNS program could provide an important outlet to communicate ongoing research activities. Eric Grenier organized rules and selection processes for a 3-Minute-Thesis™ competition to be announced very soon. The format is ideal for students to preview their research pursuits prior to the ICN next year and an ICN 2022 bursary will be awarded to a winning student.

A second activity proposed by John Jones was approved by the counsellors and is under development for early autumn. In a two-day virtual event, a series of workshops will be offered. Each topic will be addressed by two speakers who will be encouraged to look at and beyond their own research to highlight major opportunities/questions in the discipline.

The ICN 2022 Local Arrangements Committee met briefly in March and again in June this year to ensure that the information on the congress website (https://www.alphavisa.com/icn/2020/index.php) is current. Briefly, the website will become active again this autumn. Information about the scientific program and hotel accommodations will be sent to all registrants later this year when the worldwide situation regarding travel and meetings in 2022 becomes more apparent. The take-home information at this time is that Ernesto San Blas will work with the original session organizers and keynote speakers to revise the scientific program as closely as possible to that on the website (https://www.alphavisa.com/icn/2020/documents/overview.pdf). All presenters will have the opportunity to update their abstracts.

A frequently heard sentiment in Zoom meetings these days among Nematologists is that people cannot wait to rejoin and rejoice after so many months (years now) of isolation. The situation remains as serious as ever in many places, and we all wish the best for colleagues who are affected in a variety of ways by this pandemic. However, the outlook improves steadily, albeit too slowly, as behaviours change and vaccination rates increase. ICN 2022 awaits next year as an important opportunity for Nematologists to resume our lives together. Until then be safe and stay well!

Larry Duncan, Ernesto San Blas, Andreas Westphal

Nematology Conferences

THE 60TH ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS

Date: 12-15th September 2021
Venue: Gulf State Park, Alabama, plus virtual presentations option
Website: https://nematologists.org/event-3806763

23RD SYMPOSIUM OF THE NEMATOLOGICAL SOCIETY OF SOUTHERN AFRICA

Date:19-23rd September 2021
Venue: Waterval Country Lodge, Tulbagh, Western Cape, South Africa
Website: http://sanematodes.com/symposia/

2021 AUSTRALASIAN PLANT PATHOLOGY SOCIETY CONFERENCE

Date: 22nd November 2021
Venue: Online Conference
Website: https://appsnet.org/conference.html

7TH INTERNATIONAL CONGRESS OF NEMATOLOGY

Date: 1-6th May 2022
Venue: Antibes Juan-les-Pins, France
Website: https://www.alphavisa.com/icn/2020/index.php

11TH AUSTRALASIAN SOILBORNE DISEASES SYMPOSIUM

Date: Postponed to mid-late 2022
Venue: Hilton, Cairns
Website: http://asds2020.w.yrd.currinda.com/