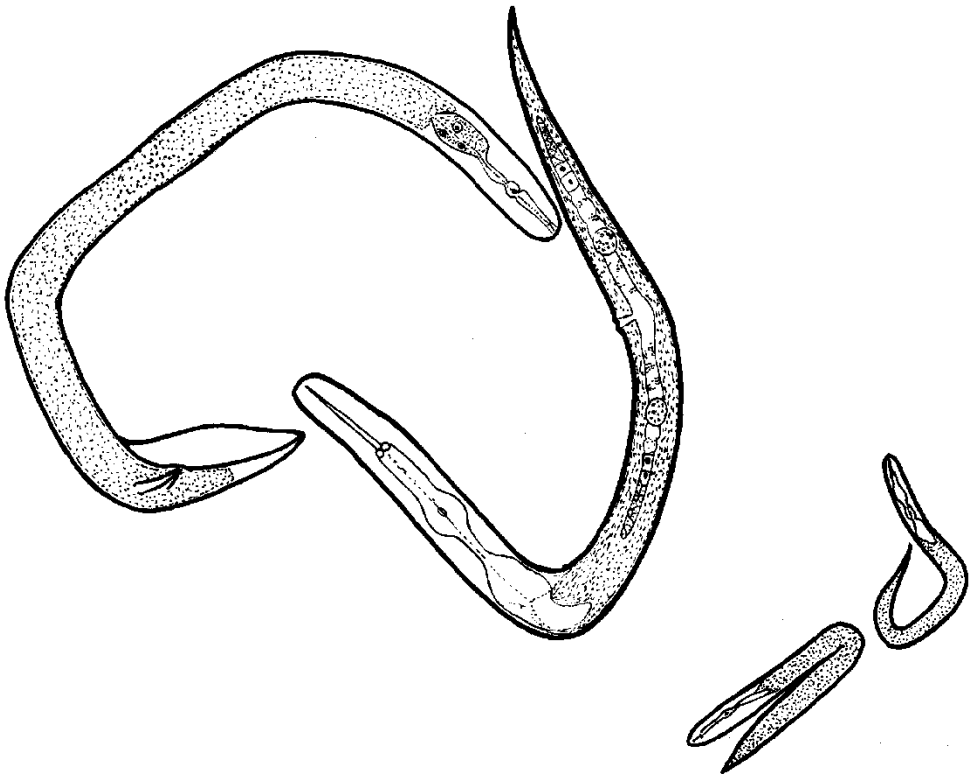
ISSN 2208-4312

AUSTRALASIAN NEMATOLOGY NEWSLETTER



Published by: **Australasian Association of Nematologists**

VOLUME 32 NO. 1 JANUARY 2021

From the Editor

Welcome to the first issue of the AAN newsletter for 2021. A big thank you to all contributors for sharing your latest news and research outcomes in this issue of the 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 July 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

A new award for nematology students

The lack of face-to-face meetings in 2020 has led to some deeper consideration of the AAN student travel awards which I generally remind people of in this bi-annual missive. To remind people, AAN has some money set aside from funds accumulated outside membership, the interest of which has provided travel awards for students to attend international and national conferences on an as-needs basis for the last decade or so. In early 2020, this fund awarded a total of over $3,000 to two students to attend the 7th International Congress of Nematology (7ICN) in France. Of course, 7ICN has not gone ahead, with the current plan having the congress on 1st to 6th May 2022, 2 years after the original dates. In the context of a PhD, this 2 years is a long time. The students, already well into their degrees, are not likely to still be students by then, and attendance at the conference would certainly be less help to their current projects. Furthermore, attendance at the international congress is not going to help their profiles for jobs as much.

As a practical response to these issues, the recipients of the awards are being encouraged to use their awards for attendance at virtual conferences, which will be we hope a greater benefit.

This alternative to the original is, the committee hopes, useful in promoting nematology. However, the benefits are not the same. All of this has prompted some thought about how to make the awards of more benefit to students of nematology. One suggestion is to give the awards a name so that the recipients can put something on their CV's that might help them in future funding or employment applications. In this context the committee considered that a named award similar to the "Allen Kerr Medal" issued by the APPS would be better than getting an "AAN student travel award".

So what to name the award? The suggestion is to call it the **Olga Goss Award for Nematology** in recognition of a vastly under-appreciated pioneer of nematology. For a brief biography of Olga see https://www.appsnet.org/Awards/goss.pdf. Significantly, the origin of this biography is a list of 50 significant figures in WA agriculture, of which Olga is the only female! (http://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?filename=8&article=1005&context=books&type=additional). Thank you to another under-appreciated WA female nematologist, Sarah Collins, for this suggestion.

I or any of the other members of the AAN committee would welcome thoughts on this suggestion with the proviso that if you don't like it you should suggest something better.

Availability of the award

What with the lack of in-person meetings last year, the committee have decided that the awards will be available for use in funding virtual meeting attendance as well as traditional face-to-face meetings (should any go ahead this year). The conditions are the same as previously: send me a note any time outlining what you want the money for, how much, and a brief summary of the benefits, and you will probably get at least partial funding because of the high success rate. Students may like to consider this with respect to the proposed ASDS meeting proposed for Cairns in mid 2022.

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 alleviate this a number of nematology societies are organizing virtual meetings particularly for students to present their work before the end of their candidatures where this is a requirement of their degrees. See the SON and ESN web sites for more information or contact me and I can put you in touch with the organizers.

Future of nematology in Australia

It is really good to see some new faces in nematology coming in, as presented elsewhere in this newsletter. The latest addition is especially welcome as it is at postdoctoral fellow level. The challenge though is to ensure the long-term viability of the careers of these young researchers. With everyone under financial pressure there are plenty of incentives to chase any money around and compete by over-promising on under-funded short-term projects, which may not maximize the ultimate benefits over longer terms. Over the past years, I have conducted a number of reviews of collections, human capability and other diagnostic resources, and been struck by the different roles played by large national institutions like CSIRO compared to state agriculture departments, universities, and smaller private consultants. It seemed to me that all these different players were complementary and necessary to deal with the many biosecurity, crop protection, trade, training, and scientific issues that nematodes throw at Australasia. In addition to achieving much more by using the different strengths of the different institutions, it seemed that by working collaboratively nematologists might have a better chance of obtaining more long-term funding that will encourage and enable the next generation of nematologists to come through. This is what AAN was set up for, and in the absence of face-to-face meetings, I hope that AAN can still achieve this.

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

University of Southern Queensland

Roslyn Reen was awarded her Master of Science (Research) in February last year. Ros presented her research results at the GRDC Research Update in Goondiwindi, "Can Wild Chickpeas from Turkey provide nematode resistance?" in one of the last face-to-face gatherings that occurred in 2020. Ros also received 3rd place in the 2020 Publication Excellence Awards for her paper "Novel sources of resistance to root-lesion nematode (*Pratylenchus thornei*) in a new collection of wild *Cicer* species (*C. reticulatum* and *C. echinospermum*) to improve resistance in cultivated chickpea *C. arietinum*." *Phytopathology* 109: 1270-1279.

Also linked to the wild *Cicer* project is Hannah Rostad's Masters of Advanced Science Research on "Resistance of wild relatives (*Cicer reticulatum* and *C. echinospermum*) of chickpea (*C. arietinum*) to the root-lesion nematode *Pratylenchus neglectus*". Hannah passed her confirmation of candidature in 2020 and her final experiments are currently being processed and analysed. The research on chickpeas also was featured in the local TV news with Ros and Rebecca Zwart.

PhD student, Md Motiur Rahaman submitted his thesis on "Elucidation of biochemical defence mechanisms in wheat (*Triticum aestivum*) against root-lesion nematode (*Pratylenchus thornei*)" for examination in December last year. He has a manuscript "Metabolomic profiling of resistant and susceptible wheat genotypes infested with the root-lesion nematode *Pratylenchus thornei*", which has been accepted for publication in Plant Molecular Biology, following some minor revisions. Motiur was also one of the recipients of the Centre for Crop Health Postgraduate Publication Award in 2020. And we were all surprised and very happy to learn that Motiur was married in Sydney just before Christmas to fellow nematologist Dr Jebin Akhter who recently completed her PhD with Mike Jones's group. Congratulations Jebin and Motiur!

Elaine Gough continued to enthral both growers and researchers with presentations on her PhD research on the interaction of *Pratylenchus thornei*, arbuscular mycorrhizal fungi and rhizobia. Elaine presented online at the GRDC Research Update in August. At the SUNFix symposium, she was awarded the Alan Gibson Memorial Prize for her presentation. Elaine is working hard on her final two publications and will submit her thesis in 2021.

Jason Sheedy and his team on the GRDC funded project "Genetic control of nematode species affecting major crops - Germplasm enhancement for nematode control in cereals and pulses" is in the final year of the project.

All GRDC chickpea, wheat and barley National Variety Trials (NVT) were sown to evaluate commercial varieties and breeding lines for tolerance to *Pratylenchus thornei* and *P. neglectus.* Due to insufficient soil stored water at our dedicated research site at Formartin, most *P. thornei* tolerance trials were relocated from there to the GRDC owned research farm, Tosari, on Queensland's Darling Downs. A return of good soil moisture at sowing and early incrop rainfall was very welcome at our *P. neglectus* site, yielding better than first thought. Another component of NVT is our continuation of glasshouse screening program to test wheat, barley, chickpea, field pea, faba bean and oat varieties for resistance to both *P. thornei* and *P. neglectus*. All of these trials contribute to the NVT national consensus ratings of crop varieties delivered to growers through the NVT website and winter crop sowing guides. Available at https://grdc.com.au/resources-and-publications/all-publications/publications/2020/2020-queensland-winter-crop-sowing-guide

Kirsty Owen and Martin Fiske have completed a very dry winter season with field experiments looking to develop methodology to investigate the interaction of (i) crown rot and *P. thornei* and (ii) AMF and *P. thornei* on the effect of wheat plant growth and yield and changes in population densities of the pathogens and AMF (GRDC project JPD1907-002RMX). The final soil samples will be collected shortly following some good summer rainfall, which has softened the soil and will make sample collection a breeze. All of the nematologists in our team (and our trial co-operators) are hoping to start the winter season with a full profile of water.

Neil Robinson, Michelle Thompson and Rebecca Zwart stimulated interest in nematology – "Root-lesion nematodes and broad acre cropping" by delivering a practical workshop for 3rd year USQ students at the end of last year. Our recorded lecture from the previous year was available to students to learn more about our research. As a result we have a new student Begita Adhikari joining our group this year for her Masters.

Extension and conference presentations:

Gough E, Owen K, Zwart R, Marchuk A, Thompson J (2020) Exploring interactions of arbuscular mycorrhizal fungi (AMF), rhizobia and root-lesion nematode (*Pratylenchus thornei*) in mung bean. GRDC Update, 18th August, online. https://grdc.com.au/events/past-events/2020/august/grdc-update-live-stream-mungbean-variety,-rhizobium-and-nematodes

Gough E, Owen K, Zwart R, Thompson J (2020) "The good, the bad and the mung bean. Complex interactions between mycorrhizal fungi, rhizobia and root-lesion nematodes and their effects on nitrogen fixation and yield of mung bean". SUNFix symposium (on-line). 5th November 2020.

Robinson N, Sheedy J (2020) 'Greenness' indicates tolerance in wheat varieties, GRDC Ground Cover 14 August 2020. https://groundcover.grdc.com.au/innovation/precision-agriculture-and-machinery/greenness-indicates-tolerance-in-wheat-varieties

Kirsty Owen

NEWS FROM VICTORIA

Agriculture Victoria, Horsham

To say 2020 was a challenging year for all would be a gross understatement and I am happy to see it finally behind us. As we navigated the challenges of sowing field trials while working from home, we also welcomed a new staff member. Andrew Hallett started with us in a technical role to support the ever-evolving Plant Pathology team here in Horsham. Andrew has worked for us as a casual for the past couple of years and it is good to welcome him as an official member of the team.

Despite the challenges offered from a global pandemic, we were able to successfully deliver on the project outputs and outcomes for the "Cereal and Pulse cultivar resistance ratings for the Southern region" project. This involved 5 years of work with 46 field trials conducted between South Australia and Victoria. Strategies and methods developed in this project have been used in the development of a new NVT project, which has now completed its first of 5 years. We are continuing to screen a variety of pulse cultivars to *P. neglectus* and *P. thornei*, with the first results to be published in 2021 NVT Disease Guides.

We are also approaching the end of the soilborne diseases project. The final trials have been harvested and final reports are being prepared. In the two short years we have seen significant yield losses from *Pratylenchus neglectus*, *P. thornei* and crown rot. We have also conducted surveys in the Wimmera and Mallee regions of Victoria to identify potential soilborne disease threats to pulse and oilseed production. Results from the 2019 survey can be found at https://extensionaus.com.au/FieldCropDiseasesVic/soil-borne-diseases-in-vic-pulse-and-oilseed/ and I'd like to thank all of the agronomists and growers that have contributed to the survey over the past two years. We will be looking at collating and analysing the 2020 survey results and will make that available in the next few months.

Jonathan Baker

NEWS FROM WESTERN AUSTRALIA

Murdoch University

The Crop Biotechnology Research Group at Murdoch University continues to undertake R&D in plant nematology. Current projects include:

Murdoch University International Postgraduate Studentships

Maria Maqsood: Towards understanding common mechanisms of nematode and insect effectors for plant parasitism. Unfortunately, Maria has been in lockdown in Pakistan since last March because of the Covid pandemic, so most of her time has been spent writing.

Saiful Islam: Functional analysis of putative parasitism effector genes of Root-Lesion Nematodes (*Pratylenchus* spp.): developing potato (*Solanum tuberosum*) resistant to these nematodes using RNA interference. As part of 'Potato Research WA', Saiful has undertaken a series of surveys of the potato growing regions of WA to determine what plant nematodes are present – his focus is on *P. penetrans*. He is learning how to extract and identify nematodes, both morphometrically and using molecular tests, and identifying potential target genes.

Iqbal Hussein: Biofumigant crops to suppress plant pathogenic nematodes in potato farming systems of WA. Also under the 'Potato Research WA' banner, together with Saiful, Iqbal has been visiting potato fields as part of the nematode survey. In his work, the aim is to study whether biofumigant crops can suppress nematode numbers, and to study which compounds attract or repel nematodes.

Murdoch Postgraduate Studentship and WA Government support

Sasha Anne Somashakaram: Biological control of crop pests using next-generation biopesticides for horticultural and broadacre crops. Sasha is trying to develop methods to deliver dsRNA exogenously to plants, using absorbance to nanoparticles to stabilise the dsRNA. She is also looking at systemic movement of fluorescently labelled RNA in treated plants.

GRDC Postgraduate Scholarship

Rhys Copeland: Determining the spatial distribution of *P. quasitereoides*/*P. curvicauda* in the WA wheatbelt, and understanding how these nematodes find host roots as a means to developing new methods of control. Rhys has been collecting cereal plant root and soil samples to identify major root-lesion nematodes and their distribution in WA. In the first part of his project, with Sarah Collins at DPIRD, he is hoping to determine the relative abundance/presence of *P. quasitereoides* and *P. curvicauda*. This work is a follow up on the publication Begum, F., Fosu-Nyarko, J, Sharma, S., Macleod, B., Collins, S. and Jones, M.G.K., Serendipitous identification of *Pratylenchus curvicauda* from the grainbelt of Western Australia, Journal of Nematology, 51, 2019. In the second part, he will be looking at the sensory organs of RLNs, and what compounds attract and repel these nematodes.

Publications: (Additional recent publications have been in different research areas).

Iqbal, S., Fosu-Nyarko, J., & Jones, M.G.K. (2020) Attempt to silence genes of the RNAi Pathways of the Root-Knot Nematode, *Meloidogyne incognita* results in diverse responses including increase and no change in expression of some genes. *Frontiers in Plant Science*, 11: 328

Begum, F., Jones, M.G.K., & Fosu-Nyarko, J. (2020) Assessment of the pest status of *Pratylenchus curvicauda* and ultrastructural changes in roots of infected wheat and barley. *Plant Pathology*, 2020, 69(8): 1574–1588

Current major grants:

- Confederation of Grain Growers Organisations (COGGO) $200K – frost tolerance in wheat
- AgrifuturesAustralia $600k – developing reduced saponin Quinoa lines for Australia
- Commonwealth Government PASE program $579K - training small exporters to understand market requirements for genome-edited produce.

Mike Jones

Member Profile

NEW NEMATOLOGIST AT THE AUSTRALIAN NATIONAL INSECT COLLECTION, CSIRO

Dr Daniel C. Huston

Greetings to the Australasian Association of Nematologists, I'm Dan Huston and I am very pleased to be joining the AAN. I'm originally from Texas, and although I tend to say I'm from south of Austin, as that's where I spent my early university years, I mostly grew up out east, in the piney woods. The natural world has always been my primary interest. Until I turned teen and needed to look cool, I was that kid with the dinosaur and bug t-shirts, and I spent a lot of my time looking for and catching bugs, frogs and the like. I tried to turn this passion into a career and started my undergrad in Wildlife Biology at Texas State University, in San Marcos, Texas. My undergrad training focused a lot on wildlife management (and far too much on whitetail deer), but I did end up choosing parasitology as an elective and loved it. I loved it so much that I asked my professor, Dr David Huffman, if I could do some undergraduate research in his lab – this was all around about 2010, and looking back, that is probably what kicked off my career.

Dr Huffman put me right on a project dissecting out the gills of a bunch of pickled fish he had lying around. The fish collection included a bunch of threatened and endangered species from around the limestone aquifer fed spring systems throughout West Texas, and they were left-over from a diet study. Huffman had me looking for trematode parasites on the gills of these fish, as an invasive trematode parasite had been reported about a decade prior. I found them, and I found that their distribution had increased. We took this info directly to the United States Fish and Wildlife Service (USFWS), as they had been involved in research into these invasive trematodes in the past. The USFWS threw us an emergency research grant and hired me on to complete a more extensive survey for these trematodes, and ultimately they decided to hire me into an internship and put me through a Master's degree, which I completed in 2014. After my MSc, I started looking out for PhD programs and ultimately left my position in the USFWS, landing at the University of Queensland in Brisbane Australia, working under Dr Tom Cribb.

During my PhD I cut my teeth as a proper helminthologist with research focussed on the taxonomy, systematics, and life cycles of trematode parasites of marine fishes. It was pretty much a dream project – I spent time in the field spearfishing up on the Great Barrier Reef and digging through fish guts. I also got lots of opportunity to travel and collected all around Australia, as well as in South Africa and French Polynesia. I've described about 15 species new to science now, mostly trematodes, but also a rhabdocoel flatworm from the intestine of a sipunculan worm and I am presently working up a new species of Acanthocephalan. I use an integrative approach, using molecular gene-sequences for barcoding and phylogenetic analyses, along with traditional morphological analyses. After finishing my PhD in 2019, I completed a short Endeavour postdoctoral fellowship at the University of Tasmania under Prof. Barbara Nowak, with a focus on parasites in marine aquaculture. In October of 2020, I joined the Nematode Biosecurity team as a postdoctoral fellow under Dr Mike Hodda at CSIRO's Australian National Insect Collection (ANIC). My current project is on plant-parasitic nematodes of the genus *Heterodera*, with aims to build the ANIC's reference collection, improve molecular coverage, perform revisionary taxonomy, and update national diagnostic protocols for pest species in the lineage. Plant parasitic nematodes are a new direction for me, but I am finding their diversity and ecology incredibly interesting. I am working hard towards gaining rapid competency in plant-parasitic nematode taxonomy, so keep an eye out for my contributions, coming soon.

Research Report

3D IMAGING OF CCN-INFECTED ROOTS WITH CONFOCAL MICROSCOPY AND LASER ABLATION TOMOGRAPHY

Diane Mather
University of Adelaide

To overcome some of the limitations of 2D micrographs for the analysis of nematode-infected plant tissue, we have applied confocal laser microscopy and laser-ablation tomography to wheat and barley root tissue infected with cereal cyst nematodes (CCN, *Heterodera avenae*).

At the stages that we are interested in, the juvenile nematodes and their syncytial feeding sites are too deep within the roots (near and in the vascular cylinder) to be seen from the outside with confocal microscopy. Adelaide PhD student Kara Levin overcame this limitation with (1) thick sectioning (up to 150 µm), (2) clearing agents, (3) scanning from both sides of each section and (4) building 3D models. This gave clear 3D views of nematodes and their feeding sites (Levin et al. 2020). It also revealed a surprising response in root xylem vessels (Fig. 1). In uninoculated controls, the xylem vessels were (as expected) narrow tubes consisting of uniformly cylindrical elements (Fig. 1A). In infected plants, xylem vessels were much 'messier', with numerous irregular 'bubble-like' elements (Fig. 1B). This surprising discovery raises new questions about how and when this response is induced and about downstream effects on the parasite and its host.

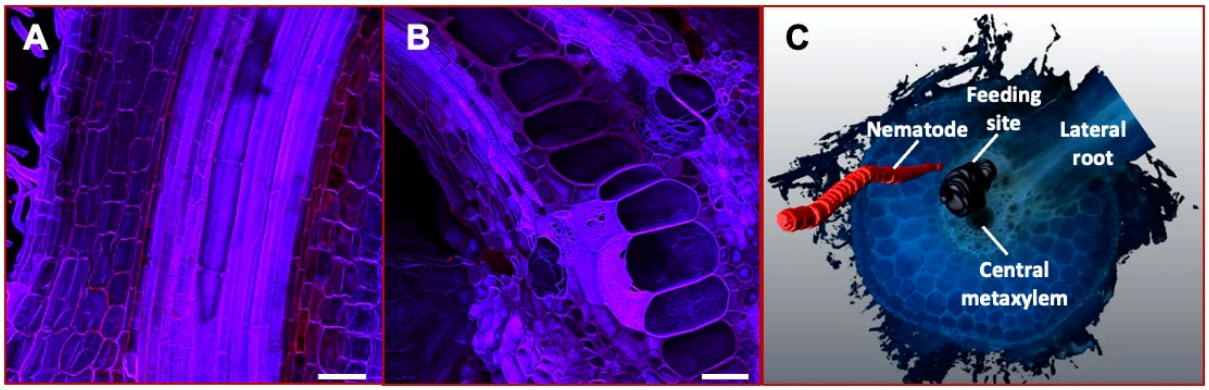

Figure 1. Maximum projected confocal images of longitudinal sections of (**A**) a non-inoculated seminal wheat root showing a typical tubular central metaxylem vessel and (B) a CCN-inoculated seminal wheat root showing distortion of the central metaxylem, as reported by Levin et al. (2020). Blue: calcofluor white. Red: propidium iodide. Scale bars 50 µm. (**C**) Screenshot from Supplementary Video S6 of Strock et al. (2019) showing part of a model of a CCN-infected segment of a barley seminal root scanned using laser ablation tomography.

In parallel, we established a collaboration with Jonathan Lynch's lab at Penn State University to use laser ablation tomography (LAT). Adelaide PhD student Bart Van Gansbeke prepared CCN-infected samples of barley roots. Penn State PhD student Christopher Strock scanned these samples with LAT and generated 3D models (Fig. 1C) and videos (Strock et al. 2019). While this technology does not provide as much detail as confocal microscopy, it does not require any sectioning and it gives very clear views of the relative positions of nematodes and their feeding sites within roots.

As our main interest is in understanding host plant resistance, we applied both methods to compare responses between susceptible and resistant host plants (Levin et al. 2021). We found that in a susceptible line of wheat, CCN feeding sites were consistently directly adjacent to xylem vessels (Fig. 2A), often with direct connections through xylem cell walls and sometimes completely overtaking the xylem vessel. In contrast, in a resistant sister line that carries the *Cre8* resistance allele, feeding sites were rarely adjacent to xylem vessels and never connected with them (Fig. 2B) We also saw differences in the severity of xylem modification, differences in lignification of plant cell walls and differences in the retention of remnant cell walls within feeding sites.

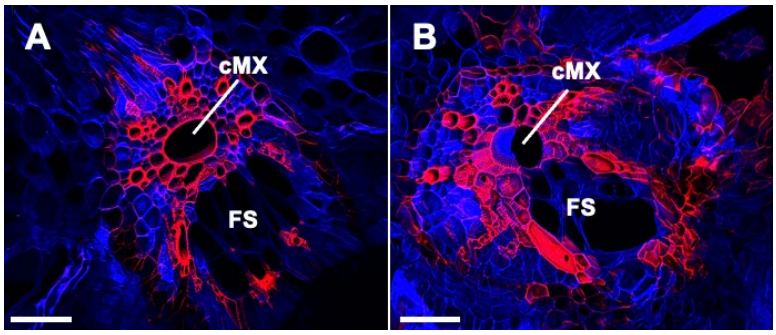

Figure 2. Maximum projected confocal images of basic-fuchsin-stained transverse sections of CCN-infected seminal roots of (**A**) resistant (*+Cre8*) and (**B**) susceptible *(-Cre8*) wheat plants. cMX: central metaxylem. FS: feeding site. Red: basic fuchsin (indicating lignin). Blue: calcofluor white. Scale bars 100 µm.

With these new approaches, we can continue to investigate mechanisms of host plant resistance and the formation and role of nematode-induced xylem modification. We're also starting to explore alternative imaging technologies, including some that may be suitable for imaging living roots and nematodes. Anyone interested in collaborating in this area can contact me at diane.mather@adelaide.edu.au.

Acknowledgements:

I acknowledge the contributions of all of the authors of the three publications listed below, and I especially thank Kara Levin, Bart Van Gansbeke and Chris Strock (all of whom have now completed their PhDs) for their innovation and perseverance in establishing new ways to investigate how plant parasitic nematodes affect host plant tissues. I thank Kerrie Davies for advice and encouragement and the Grains Research and Development Corporation for financial support.

References

Levin KA, Tucker MR, Strock CF, Lynch JP & Mather DE (2021) Three-dimensional imaging reveals that positions of cyst nematode feeding sites relative to xylem vessels differ between susceptible and resistant wheat. *Plant Cell Reports* https://doi.org/10.1007/s00299-020-02641-w

Levin K A, Tucker MR, Bird DM & Mather DE (2020) Infection by cyst nematodes induces rapid remodelling of developing xylem vessels in wheat roots. *Scientific Reports,* 10: 9025.

Strock CF, Schneider HM, Galindo-Castañeda T, Hall BT, Van Gansbeke B, Mather DE, Roth MG, Chilvers MI, Guo X, Brown K & Lynch JP (2019) Laser ablation tomography for visualization of root colonization by edaphic organisms. *Journal of Experimental Botany,* 70: 5327-5342.

Nematology Conferences

THE 60TH ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS

Date: 12-15th September 2021
Venue: Gulf State Park, Alabama
Website: https://nematologists.org/Annual-SON-Meeting

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/