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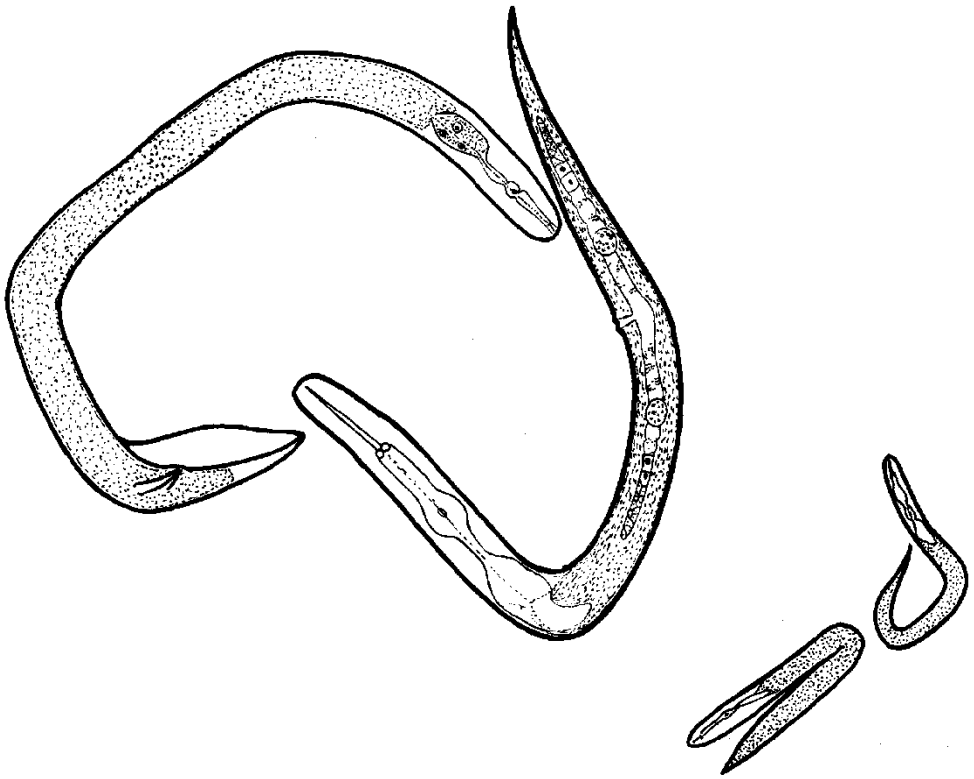
# AUSTRALASIAN NEMATOLOGY NEWSLETTER



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# From the Editor

Thank you to all those who made contributions to this newsletter.

**July Issue**

The deadline for the July issue will be the end of June. I will notify you a month in advance so please have your material ready once again.

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# Association News

## FROM THE PRESIDENT

In writing these notes, I try to make people aware of things that are happening that they may need or want to know, or else raise things that are NOT happening which people may wish to do something about.

The last article for this newsletter was about capacity in nematology in Australia. Sadly, there has been little discussion or response. Kerrie Davies and I ran another nematode workshop, which was full, so there is plenty of interest, but this does not seem to translate into the longer term support needed. Some time ago GRDC supported both a position at The University of Adelaide and a collection within ANIC, but the long-term support unfortunately proved to have a shorter term than was envisaged.

So, what do I think you need to know about what is going on related to nematology?

With the current situation regarding capability in nematology in mind, you need to note the note from Christine Horlock about notifying new organisms to various authorities (this issue). You also need to note that, despite the clarity of the concept of every country notifying each other of pests, the practical situation is much more messy.

Among the issues is whether the edict applies to ALL organisms or only those of economic significance, and who decides (among trading partners, there are disagreements about what is significant, and what is not, which are not always based on a lot of science).

There are issues with the currency and accuracy of databases of species present in a country. A recent study of vertebrates—a group much better known and studied than nematodes—found anything up to 50% of species names on databases as authoritative as the Global Biodiversity Information Facility had something wrong with them (Zermoglio *et al.* 2016). A corollary of this is: how can one tell when it is a first record?

There have also been issues with the presence of particular species in a country being inferred from an interception in produce exported from the country but at a location some distance from the original source country. In some cases, the original country was not even aware of the find.

Again, there have been issues with taxonomic disputes as to the identity of particular organisms: whether they are the same species or not.

There are issues with whether the species is the appropriate unit for biosecurity, or whether it should be the race or pathotype or something else.

And—believe it or not—there are issues with what constitutes a country. I am reliably informed that the political, geographic, legal, treaty and quarantine definitions of Australia differ. This mainly relates to territories, islands that are not territories like Macquarie Island, places like the Torres Strait, and quarantine premises. Nevertheless, because I am not aware of the full ramifications of these distinctions and don't think it is my job to be fully aware of them, what are new records is not always clear.

Out of all of this, I suppose what you should know is that you should report when you can, but also there are many reasons that the system is not perfect and there are many legitimate reasons that not everything is notified.

Quite apart from that, there is the issue of whose job it is to maintain surveillance on what has been or is presently being found in Australia. Getting back to the issue of support and capability, there have been numerous attempts to garner financial support for either making or maintaining definitive lists of the nematodes in Australia (by whichever definition). These have always come down to the scientists, diagnosticians or field staff doing it, but have never translated into long-term support for maintenance of such lists. (This is not to underestimate the excellent lists prepared by George Khair, Rod MacLeod, Jackie Nobbs and most recently myself.)

With regard to lists of what is in Australia, another thing to note is that the status and future of current databases like APPD and AFD are currently being debated by the Subcommittee on Plant Health Diagnostics (SPHD) and Plant Health Committee (PHC). I am on the subcommittee (representing CSIRO) and there are state representatives as well as CRC and PHA representatives if people have any comments that they would like considered.

Finally, another "Nematodes in Cropping Systems" workshop has come and gone. As noted by Kerrie elsewhere, this was over-subscribed and extremely enjoyable, so thoughts go ahead to the next one in approximately 2 years. The last two of these workshops have been held outside the normal venues of Adelaide and Canberra to facilitate involvement of people who would normally not be able to travel. This has worked well, but does take a considerable lead time. So a corollary of this is that if you want the show near you, let us know very soon.

Reference

Zermoglio PF, Guralnick RP, Wieczorek JR (2016) A Standardized Reference Data Set for Vertebrate Taxon Name Resolution. PLoS ONE 11(1): e0146894. doi:10.1371/journal.pone.0146894

*Mike Hodda*

# Regional News

## NEWS FROM QUEENSLAND

### University of Southern Queensland

Following on from the first half of the year, the second half of 2015 has also given me several opportunities to meet up with colleagues at various workshops and conferences. In August I attended one of the GenStat Statistical training courses which had been tailor made for the national root disease projects. It was conducted by Alison Kelly, who was as enthusiastic about statistics as ever, and therefore provided a substantial amount of useful information.

In September I travelled to Turkey. The first few days there were spent at a Statistics for plant breeding workshop which was run by Bev Gogel, from the University of Adelaide, and Chong You, from the University of Wollongong. I then spent several weeks in Eskisehir at the CIMMYT facilities. In Ankara I attended the 5$^{th}$ International Cereal Nematode Initiative Workshop and presented a review on the status of root lesion nematode research on wheat in Australia. It was great to be a part of such an international conference and to catch up with my European colleagues. The included excursion to Cappadocia was a highlight as was the hospitality from my Turkish colleagues.

The Nematodes in Cropping Systems Identification and Techniques Course held here in Toowoomba in December was an ideal finish to a busy year. It was great to be able to learn about the most relevant PPN affecting Australian agriculture from the extremely knowledgeable Kerrie Davies and Mike Hodda.
*Lea Meagher*

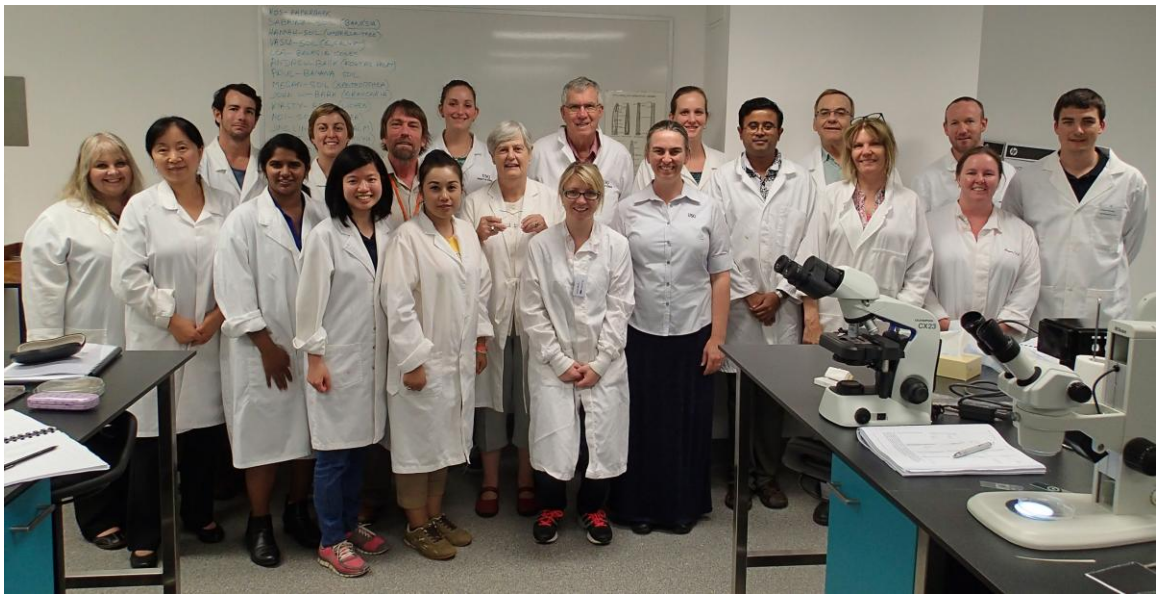
## NEWS FROM SOUTH AUSTRALIA

### The University of Adelaide

In late July, I flew to Michigan to attend the SoN meeting in Lansing. I presented a paper on *Fergusobia* as part of a symposium on using model systems to study evolution of insect parasitism by nematodes. It was a fascinating meeting, and an eye-opener to realise how many groups are seriously working on potential biological control methods, and how these could be incorporated into integrated pest management systems. As always, it was great to catch up with colleagues and friends. I was very grateful for the financial support provided by SoN, and also for the support and encouragement of Weimin Ye (North Carolina Dept. of Agriculture and Consumer Services).

'Fred' Bartholomaeus and I made a short trip to NSW in August, collecting figs in Newcastle and Sydney and spending a couple of days at The University of Western Sydney with Professor James Cook. We thoroughly enjoyed our time at Hawkesbury, but alas the fig nematodes were few and far between.

In early December, Mike Hodda and I presented (I think) our 10th Short Course on Plant and Soil Nematodes in Cropping Systems, this time at the University of Southern Queensland, Toowoomba. Special thanks to Jason Sheedy and John Thompson for suggesting we hold a course in Toowoomba, and to the lab. staff at USQ who provided us with brilliant support and encouragement. We had so many 'takers' for this course that we asked Sunil Singh to come to help, which he did – flying in from Samoa. Mike and I were delighted with the level of participation in discussions during the course, and with the enthusiasm and diverse interests of the group attending. By the end of the week (assuming my voice would have held out), I was ready to keep going for at least another week – which says a lot, and thanks to everyone who attended and made it such an enjoyable course.



*Kerrie Davies*

**SARDI**

During the November bushfires at Pinery, SARDI had 4 trials burnt before they were harvested. This means we lost tolerance data for our cereal and faba bean trials for *Pratylenchus neglectus* which were part of the GRDC funded National Nematology Project. However, we were still able to collect soil samples so hopefully will be able to generate resistance data. The two other trials burnt were only in the setup year. We were able to recover our weather station, still fairly intact, from the site and have sent it back to the manufacturer to recover the data. We are interested to see if the soil temperature spiked due to the fire. We sampled 15 National Variety Trials (NVT) sites in 2015 to analyse the resistance of canola, chickpea, lentil, pea, faba bean and oats to *P. neglectus* and *P. thornei*.

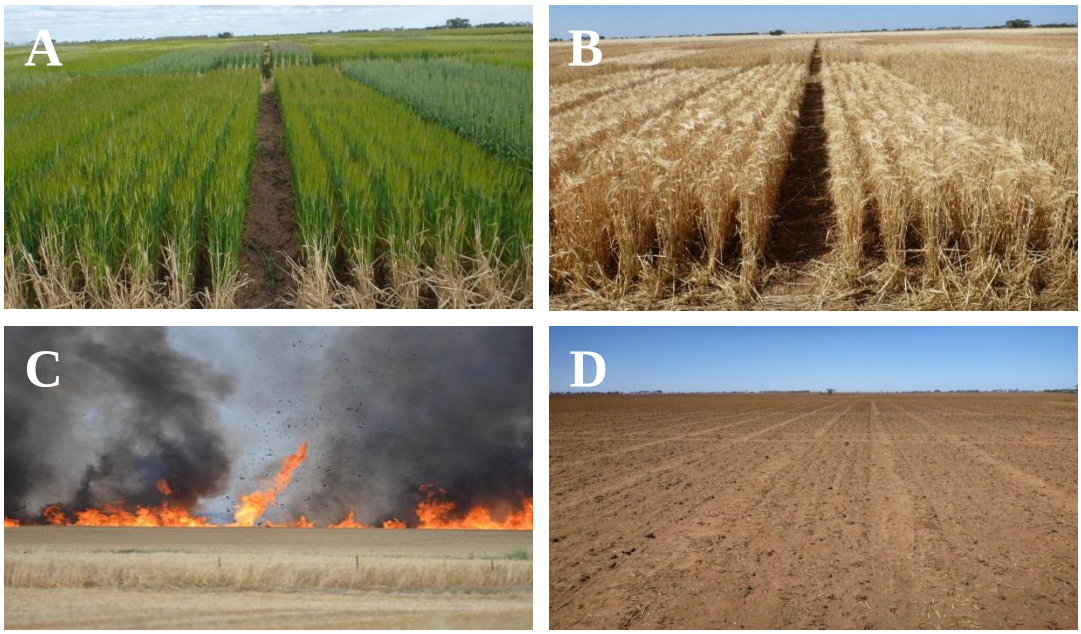



**Figure 1.** *P. neglectus* tolerance and resistance trial at Pinery 2015. (A) September (B) October (C) November fires (D) Post fire.

Previous SARDI trials had shown that the Syngenta fungicide, Uniform, provided yield benefits in soils with high Rhizoctonia when applied as a liquid band above and below the seed. However, a significant negative effect of *P. neglectus* on the fungicide yield responses was noted. With SAGIT funding, in 2015 a trial was run in the SA Mallee to further investigate if *P. neglectus* affects the yield responses of Uniform. The site at Wilkawatt had high Rhizoctonia levels and quite severe bare patching. A fungicide and *P. neglectus* interaction was observed in wheat where at low *P. neglectus* densities the split application of Uniform increased yields by 0.24 t/ha but at moderate *P. neglectus* densities no fungicide yield response was observed. There was no significant effect of *P. neglectus* density on yield response to the fungicide in barley. Subject to funding, we hope to run a similar trial in 2016.

*Katherine Linsell*

## NEWS FROM VICTORIA

### Horsham

During 2015, there were 35 field trials sown in the Wimmera and Mallee investigating root lesion (*Pratylenchus neglectus* and *P. thornei*) and cereal cyst nematode. Trials included investigating yield losses caused by root lesion nematodes for cereals, canola, chickpeas, lentils and field peas and cereal cyst nematodes for cereals. Resistance to root lesion nematodes trials for beans (faba and broad), lentils, chickpeas and cereals and cereal cyst nematode for cereals were completed. Unfortunately the year was very dry with rain events at unwanted times with strong winds following rain events. This resulted in very low yields in a number of trials and we are still

assessing which trials will provide useful data trials and how many two-year trials will progress to the second year.

Although it was a dry year in Victoria, Grant and Josh had the opportunity to travel visiting trials in other states where there was rain. Both Grant and Josh completed a statistics course in Queensland and visited the field trials in Toowoomba. Josh also participated in a field tour of Western Australian field trials with other pathology staff from around Australia. A nematology course conducted by Mike Hodda and Kerrie Davies was held in Toowoomba in December, which Joshua also attended.

In Western Australia, Joshua presented at the APPS conference on the economic impact of nematodes in Western Victoria. Root lesion nematodes occur in almost every paddock in Western Victoria with yield losses highly variable between seasons. These results are consistent with the samples seen through our CropSafe program, which identifies diseases agronomists cannot distinguish or want confirmation on. Most cereal samples received through the CropSafe program during 2015 showed root lesion nematode damage at some levels, but in only 10% of samples was it considered the predominant cause of the symptoms observed.

During October, Grant and Joshua were involved in two days of agronomist training at Horsham, with all relevant crop types and most field crop diseases covered both practically and theoretically at the workshops. Grant also presented at the PreDicta B Soil-borne diseases training workshop in Bendigo.

*Joshua Fanning and Grant Hollaway*

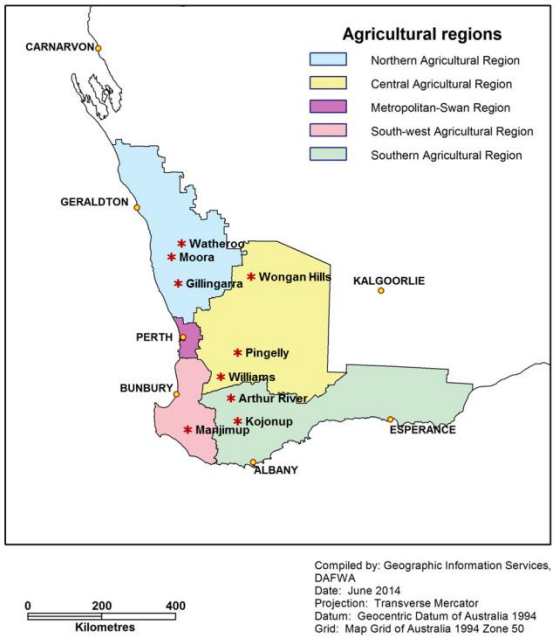
## NEWS FROM WESTERN AUSTRALIA

### Department of Agriculture and Food, WA

The Australasian Plant Pathology Society (APPS) biannual conference was held in Western Australia (WA) in September 2015. Our DAFWA Plant Pathology group decided to put on a short tour to show off our ‘wares’ while our colleagues were in town. We conducted a field tour 10-12$^{th}$ September and it proved to be great fun as well as informative!

It was a very mixed crowd aboard the bus with fellow researchers, colleagues and potential collaborators from CSIRO, DPI Victoria (now DEDJTR), SARDI, University of Southern Queensland, Murdoch University and DAFWA. This included nematologists, a modeller, molecular biologists, biometricians, plant pathologists, and our technical staff.

Tour participants ready to board the bus for Day 3 (still smiling!). (L to R) Sarah Collins, Clayton Forknall, Daniel Huberli, Carla Wilkinson, John Thompson, Louise Thatcher, Johnathan Anderson, Farhana Begum, Karyn Reeves, Helen Hunter, Ros Reen, Lingling Gao, Josh Fanning, Katherine Linsell, Rhonda Foley, Kirsty Owen, Lucy DeBrincat, Pip Payne, Kawsar Salam.




Locations of site visits in the Northern, Central, South-west and Southern Agricultural Regions of Western Australia during DAFWA's 2015 Plant Pathology pre-conference tour (modified from Raper *et al.* 2014).

The busy schedule took us over 1300km in 3 days and incorporated site visits across four agricultural regions in WA. Growers from Moora and Pingelly who collaborate with us took the time to come and discuss broad-acre cropping, RLN and other disease issues while we poked around in their paddocks.

David Cameron, Farmanco Consultant, also took the lead for half a day and showed us paddocks that had suffered severe impacts from RLN, *Radopholus* and *Rhizoctonia*. We visited DAFWA Plant Pathology experimental trial sites for RLN's (*P. quasitereoides*, *P. neglectus* and *P. penetrans*), *Rhizoctonia*, yellow spot, barley yellow dwarf virus, crown rot, apple breeding …the list goes on! We also stopped off at DAFWA's regional research stations (RSU's) in Wongan Hills and Manjimup for a tour and discussion with RSU managers Steve Cosh and Ian Guthridge, and Shari Dougall who services current regional trials in the northern and central agricultural regions.

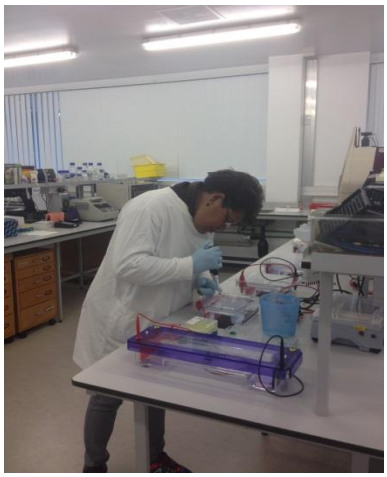
The tour was a real success in bringing together growers, consultants, DAFWA plant pathology experts, biometricians, RSU management and technicians to showcase WA crop protection research for our interstate colleagues.

# Training Programme for Identification of Plant Parasitic Nematodes; supported by the Pacific Horticultural & Agricultural Market Access Program August and November 2015

A training programme for work on plant parasitic nematodes was specifically designed for trainees from Fiji, funded by the Pacific Horticultural & Agricultural Market Access Program. The training was run by Dr Zeng Zhao, Nematologist, Landcare Research. The programme was planned for 15 days which included 10 days for training in Auckland, and 5 days for training in Fiji.

Fijian trainee Ms Unaisi Turaganivalu from the Ministry of Primary Industries, Department of Agriculture, Koronivia Research Station (KRS), completed the plant parasitic nematode identification training programme with Dr Zeng Qi Zhao of Landcare Research, Auckland. The training was conducted at Auckland from 10 to 21 August and Suva from 23 to 28 November 2015. During these periods, Ms Unaisi Turaganivalu successfully achieved the following objectives: 1) foliage nematode symptom recognition, 2) plant parasitic nematode dissection and extraction, 3) nematode specimen preparation and identification, 4) nematode specimen illustration (line drawing and micro-photography), 5) nematode specimen characterising and measuring, and 6) molecular taxonomy (single nematode DNA extraction, PCR, sequencing and GenBank BLAST search).

Ms Unaisi Turaganivalu (Ministry of Primary Industries, Department of Agriculture, Koronivia Research Station, Fiji) visited Landcare Research, Tamaki Campus, Auckland in Auhust 2015, and Zeng Qi Zhao visited Suva in November 2015.



In Auckland, Unaisi was taught how to draw, measure and photograph nematode specimens. She learnt the main distinguishing characteristics of *Radopholus similis* and its closely related species.

She was also taught the basic molecular techniques used in nematode taxonomy (pictured left). In the Landcare Research EcoGene laboratory, she practiced DNA extraction using a single nematode, PCR preparation, gel imaging and preparing PCR products for sequencing. She also performed DNA sequence analysis and did BLAST searches in GenBank.

The nematode training class at Koronivia Research Station, Ministry of Primary Industries, Department of Agriculture, Fiji is pictured below.

In Fiji in November, a training program was conducted at Koronivia Research Station (KRS)**.** Five ginger growers at Veikoba and Muanaweni were visited. Soil and ginger rhizome samples were collected. The Whitehead & Hemming (1965) method for soil nematode extraction was practised, and the Southey (1986) maceration method was used for ginger rhizome extraction. After leaving samples for 48 hrs on the extraction tray, nematodes were harvested, heat killed, preserved and temporary specimens for identification were prepared.

Lectures were presented to Unaisi, two staff from Biosecurity Fiji and more than ten students from the University of the South Pacific at the KRS. General knowledge of nematology was taught and nematode extraction, collection of individuals and making 'permanent' nematode slides were practised in the laboratory.

Unaisi refreshed her nematode culturing skills. Three isolates of *R. similis* were inoculated onto carrots.

Ways to build up Fiji's nematode database and collection were discussed with Unaisi. An excel datasheet for the Fiji nematode collection was implemented and 20 nematode permanent slides were registered.

*Zeng Qi Zhao*

Landcare Research, Auckland NZ

# Progress in development of Nematode Resistant Sugarcane varieties in Australia via introgression breeding

Root knot (*Meloidogyne* spp, predominantly *M. javanica*) and root lesion (*Pratylenchus zeae*) are the two most important nematode pathogens of sugarcane in Australia. Root knot nematodes are restricted to sandy soils, produce gall on root tips, and limit root elongation (Figure 1). This nematode is also an important pathogen of a range of other crops such as tomato, capsicum, potato and soybean. Root lesion nematode occurs in all soil types. It produces lesions in the cortical tissue and destroys fine roots. Collectively these two nematodes cost the Australian sugar industry in excess of $80 million annually (Blair & Stirling 2007). Nematicides are of limited value because they are highly toxic, hard to apply and give unreliable control. Crop rotation with non-host crops is only successful for a limited time due to the perennial nature of the sugarcane crop (Stirling 2006). Improving soil organic matter, beneficial organisms and soil physical structure can partially alleviate damage but require major changes in sugarcane cropping systems. Almost all of the commercial varieties are highly susceptible to both types of nematodes.

A collaborative introgression breeding program in 2002 between Australia and China crossed commercial sugarcane with the wild relatives, *Saccharum spontaneum. S. robustum* and *Erianthus* spp., to introduce new genes to the Australian sugarcane germplasm population (Foreman *et al.* 2007). Preliminary testing on some progenies in Australia suggested that the wild species possessed nematode resistance (Stirling *et al.* 2011).

Figure 1 – Symptoms of root knot (left) and lesion (right) nematodes in sugarcane roots

The objectives of the current research are to: (i) obtain a step-wise improvement in yield through control of nematodes and other soil borne diseases by using introgression families, (ii) identify new sources of resistance in wild germplasm and the introgression families, (iii) use

resistant clones as parents to introduce the resistance genes into the SRA/CSIRO breeding program, and (iv) assess resistant hybrids as potential commercial cultivars.

Between 2011 and 2014 approximately 300 lines from different introgression and core families were screened for resistance to *M. javanica* and *P. zeae*. The initial nematode population used to inoculate the test clones (Pi) and the final population recovered after 12 weeks (Pf) were used to determine the multiplication factor (Pf/Pi), which is a measure of resistance levels of clones. Susceptible cultivars, Q135 and Q208[A], were used as standards.

Basic wild species *E. arundinaceus* and *S. spontaneum* were highly resistant to root knot nematodes (Figure 2). The average levels of resistance tended to decrease with successive backcrosses between the wild species and commercial sugarcane (Figure 2). Similar trends were observed for the root lesion nematodes (data are not provided). A number of lines from backcross (BC) 1, BC2, and BC3 showed high level of resistance to both types of nematodes (Table 1). No nematode resistance were observed in *S. robustum* species.

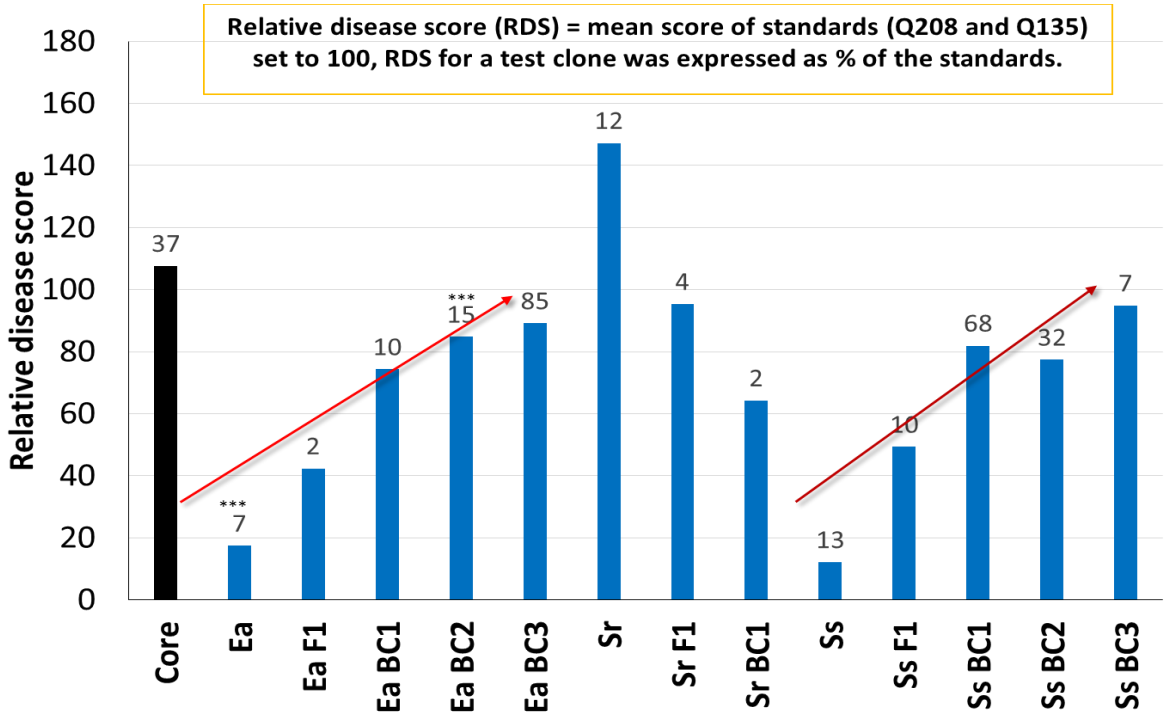



**Figure 2.** Mean disease scores for root knot nematodes from 2012 to 2014. Core = variety/lines from core breeding program, Ea = *Erianthus arundinaceous*, Sr = *Saccharum robustum*, Ss = S. *spontaneum*, F1 = F1 population, BC1, BC2 and BC3 = Backcross 1, 2 and 3. Numbers above the top of the column represent number of clones in each crossing type.

**Table 1.** Some selected lines originated from introgression breeding showing nematode resistance

(Numbers in column indicate Pf/Pi values, * significantly different (P<0.05) from the rest using LSD. Numbers in parentheses are the number of times tested for nematode resistance)

| Clone | Clone-Type | Lesion nematode | Root knot nematode |
|---|---|---|---|
| IJ76-388 | Ea | 6.5 (3) | 4.2 (2) |
| KQ08-1011 | Ea BC3 | 21.0 (2) | 4.3 (2) |
| KQ08-1012 | Ea BC3 | 14.5 (2) | 7.0 (2) |
| KQ08-1047 | Ea BC3 | 12.2 (3) | 6.8 (1) |
| KQ08-1231 | Ea BC3 | 10.5 (2) | 13.2 (1) |
| KQ08-1347 | Ea BC3 | 13.3 (3) | 13.5 (2) |
| KQ08-1348 | Ea BC3 | 24.3 (2) | 4.3 (3) |
| KQ08-1359 | Ea BC3 | 11.8 (3) | 9.1 (2) |
| KQ08-6014 | Ea BC3 | 12.6 (3) | 7.5 (3) |
| KQB09-20141 | Ss BC1 | 11.0 (2) | 0.5 (1) |
| KQB09-30117 | Ss BC2 | 11.9 (2) | 4.3 (1) |
| MQB88-10825 | Ss BC1 | 21.2 (2) | 0.8 (1) |
| QBYC06-30376 | Ea BC2 | 10.3 (4) | 7.6 (3) |
| QBYN05-20563 | Ss BC1 | 12.0 (4) | 2.6 (3) |
| Q135 | Commercial Standard | 31.3 (4)* | 26.8 (2)* |

The crosses with wild species from China offer new sources of resistance to nematodes. The introgression clones will increase the genetic diversity of germplasm which will assist in protecting the sugar industry against new threats. This is a long-term research which requires backcrossing to increase sugar content, and screening to select clones which retain the good traits of the wild cane. We are closely working with the SRA and CSIRO molecular research groups to speed up selecting clones with good traits by molecular markers and chromosome staining with *in situ* hybridisation.

**References**

Blair BL, Stirling GR (2007) The role of plant-parasitic nematodes in reducing yield of sugarcane in fine-textured soils in Queensland, Australia. Aust J Exp Ag 47: 620-634.

Foreman J, Jackson P, Aitken K, Jingchuan Li, Wang Liping, Fu Cheng, Fan Yuanhong, Deng Haihua, Hu Fengduo, Croft B (2007) Introduction and evaluation of clones derived from Chinese *Saccharum spontaneum* and *Erianthus* spp. Proc Aust Soc Sugar Cane Technol 29: 242–250.

Stirling GR, Cox MC, Ogden-Brown J (2011) Resistance to plant-parasitic nematodes (*Pratylenchus zeae* and *Meloidogyne javanica*) in *Erianthus* and crosses between *Erianthus* and sugarcane. Proc Aust Soc Sugar Cane Technol 33, accessed on 15/01/2015 at https://www.assct.com.au/media/pdfs/Ag%2036%20Stirling%20et%20al.pdf

Stirling GR (2006) Susceptibility of sugarcane varieties to two species of root-knot nematode (*Meloidogyne javanica* and *M. incognita*) and implications for crops grown in rotation with sugarcane. Proc. Aust. Soc. Sugar Cane Technol. 28, accessed on 23/12/2015 at http://www.assct.com.au/media/pdfs/2006-Ag7-Stirling.pdf

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# Reporting the Discovery of New Organisms and Plant Pathogens

Remember that your plant pest research and diagnostic activities can have significant implications for our plant biosecurity. In Australia, biosecurity measures are based on the presence of a 'pathogen' rather than presence of 'disease'. By law, the detection of a new plant pest or pathogen must be reported and there are penalties for not doing so. New Zealand also has similar rules.

If you identify a microorganism that may be a plant pest or pathogen, which has not previously been reported from Australia or New Zealand, you must report it immediately to the appropriate authorities. In Australia this is through the Exotic Plant Pest Hotline 1800 084 881 – this number will automatically connect you to the state department for agriculture or relevant biosecurity organisation in the state or territory that you are calling from. In New Zealand, call the Pest and Disease Hotline 0800 80 99 66.

**You must not publish your research findings without having first notified the relevant authorities.** The Australian and New Zealand Governments have international reporting obligations in regards to each country's plant health status. Publication of new pathogens (or pests) without prior notification to these authorities puts our reputation for honesty and transparency at risk, and may lead to the loss of significant market access (export trade).

For more information on reporting plant diseases and pests please go to the following websites:

Australia
http://www.agriculture.gov.au/pests-diseases-weeds/report

New Zealand
http://www.mpi.govt.nz/protection-and-response/reporting-pests-and-diseases/

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