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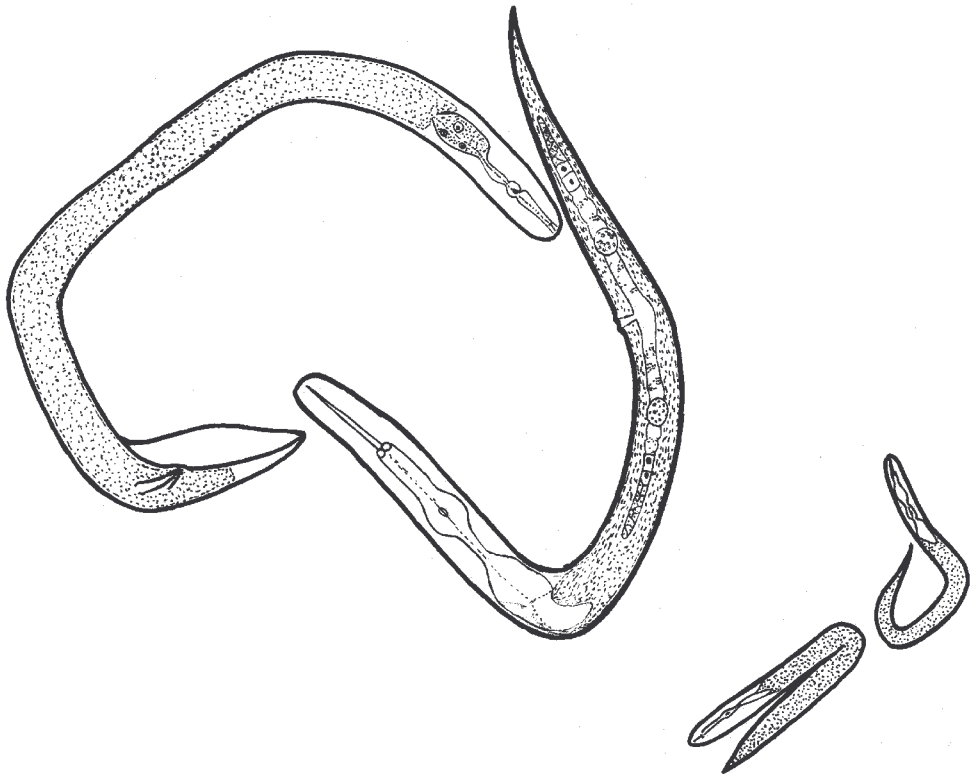
AUSTRALASIAN NEMATOLOGY NEWSLETTER



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From the Editor

In the last newsletter, I referred to the recent introduction of the new Privacy Laws. We are still not sure of our position with respect to inclusion of membership lists. We may need to ask members for their permission to have their names published in the newsletter. Thus, again there is no list in this issue. This issue will be discussed at the AGM in Geelong.

December Issue

The deadline for the December issue will be November 30th. Please have your material ready once again.

Kerrie Davies.

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From the President

The Biennial General Meeting is approaching rapidly: see the announcement elsewhere in the newsletter. The meeting will be held before a dinner held as part of the Nematology Workshop, on the Tuesday night of the APPS Conference in Geelong (note that this is not the same day as the workshop because of clashes with other events). I would like to encourage everyone to attend both the meeting and dinner, as well as the Nematology workshop. Even if not attending the Nematology workshop, come to the dinner: it is free for members. I would encourage everyone to raise any issues that they have at the meeting (good, bad or otherwise), or anything they think the AAN should be involved with, or just wish to let people know about.

I wish to flag several issues for discussion at the Meeting, all involved with the Fifth International Congress of Nematology – Brisbane 2008 (5ICN). The first is a meeting of the organizing committee for the Congress, which will be held on Monday afternoon. In previous missives I have indicated that any assistance in organizing the Congress will be most welcome, so if anyone wishes to join the committee, please let me know soon, so that information for the meeting can be sent to you.

One of the main tasks regarding 5ICN at the moment is the choice of a Professional Conference Organiser (PCO). I have received bids from 4 organizations for the role of PCO, differing considerably in price and services offered. These documents are inappropriate to circulate generally because of commercial considerations and sheer bulk, but if anyone reading this has experience in organizing a conference recently, I would encourage you to give the Committee the benefit of your experiences. (5ICN Committee Members were published in the last Newsletter.)

Another item for discussion is the status of meetings before and after 5ICN. Because of the 6 year cycle of International Congresses, the 2008 date is in a year when APPS/AAN meetings are not normally held. I have written to APPS on behalf of AAN, enquiring whether they would consider changing the date of the APPS conference to coincide with 5ICN, but have yet to receive a formal reply. If the APPS should consider it inappropriate to move their conference by a year, AAN needs to decide when to hold our meetings around 5ICN. I suggest that 3 meetings in 3 years (with APPS in 2007, 5ICN in 2008, and again with APPS in 2009) is too much, and that we consider not having a formal meeting in 2007, only an informal one. Our informal meeting in Christchurch in 2003 was, from all accounts, a successful get together, and may be a good model to follow.

The final item for discussion is the status of the AAN. Organizing an International Congress will involve financial commitments for many services, and someone will be required to make these commitments (meaning, in many cases, me and the Executive, on behalf of the AAN). At the moment, we are a special interest group under the auspices of APPS, and any 2 of the Executive (President, Secretary, Treasurer) are required to commit expenditure. However, we may need something a little more formal to allow smooth running of the Congress, and provide appropriate legal protection for the Executive in committing expenditure. Basically, the options are as follow.

1. To set up a separate legal framework for AAN as a non-profit voluntary organisation. This need not mean separating ourselves from APPS.
2. To formally operate under the APPS legal framework with the consent of APPS for the purposes of organizing APPS.

3. To set up a stand-alone entity to run the Congress. This entity would be separate from AAN, and wind up following the Congress.
4. Any other option recommended by Conference Organisers if we choose to employ one.
5. Do nothing and panic only if there are problems.

It is not that I am envisaging problems, but am merely trying to be cautious. For this reason, I do not favour the last option. (The preliminary budget indicates that under most conceivable scenarios, the Congress will either break even or generate a surplus, but only death and taxes are certainties.)

I hope these thoughts on options are useful so that people can contribute their thoughts and expertise to both the AAN and 5ICN. I look forward to seeing as many people as possible in Geelong. If you cannot make it and have something to contribute, I can raise it on your behalf.

Mike Hodda

Nematodes in Cropping Systems: Identification and Techniques

An intensive training course on "Nematode Identification and Techniques" will be run under the joint auspices of ANIC and The Waite Institute, University of Adelaide. The course will be held in December 2005 at The Australian National University, Canberra, and co-ordinated by Dr Mike Hodda and Dr Kerrie Davies. The course will cover identification of plant, soil and insect nematodes, together with techniques for sampling, extraction, experimentation and analysis. It is aimed at professionals in plant and insect pathology, pest management, soils and other disciplines dealing with nematodes. Sufficient background will be presented to enable those with limited experience to benefit fully from more advanced aspects. Details of course content will be varied to suit the interests of the participants: please contact the co-ordinators to discuss any specific needs. Anticipated cost is $1300 (+GST) for 1 week, including all course materials. A minimum of 8 participants is required for the course to proceed.
Web site: http://www.ento.csiro.au/research/natres/nematode.htm

To register your interest or discuss specific needs please contact Dr Mike Hodda at CSIRO Entomology:

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We have run this course biennially for the last few years. However, because of changes in the level of support provided for nematology and other commitments by the co-ordinators, this may be the last course run for a few years. So if you are interested, don't wait for the next course, please consider attending this one and contact us as soon as possible.
The dates proposed are from 28th November to 2nd December 2005. This is the week before the Australian Entomological Society and Invertebrate Biodiversity Conference from which is 4th to 9th December.

AAN Nematology Workshop at 15th Biennial APPS conference

Organisation of the nematology workshop at the 15th Australasian Plant Pathology Society Conference in Lorne is well under way.

The workshop will focus on distinguishing and detecting native and exotic nematodes. Biosecurity and declaration of areas of freedom for export certification will be discussed.

Recently identified species from Australia will also be discussed and a practical session will introduce the species and their biology to participants.

It should be a highly informative workshop and a great opportunity to become familiar with issues surrounding the movement of plant material between regions, states and overseas. These issues will become increasingly important under future trade regimes.

The workshop will held on Monday 26th September 2005, at Warn Pond, Deakin University. The workshop is planned to start at 9.30am and finish at 4.00pm. There will be a bus to pick up participants from the Waterfront Campus at 9.00am and transport them to workshop. At the conclusion of the workshop, another bus will take participants to the conference registration and welcome reception.

AAN Meeting

The Biennial General Meeting of the Australasian Association of Nematologists will also be held in conjunction with the APPS conference, followed by a dinner on Tuesday 27th September. The venue is the Cat Restaurant Bar Lounge, located at 90 Little Malop Street, Geelong. The cost of dinner is included with the workshop registration, or is free for members of AAN.

If you have not registered for the conference or the nematology workshop there is still time to do so.

If you need more information regarding the workshop please contact the workshop convenors:

Lila Nambiar (lila.nambiar@dpi.vic.gov.au)
Mike Hodda (mikeh@ento.csiro.au)

Regional News

NEWS FROM SOUTH AUSTRALIA

News from SARDI

Ian Riley is now working with SARDI on a project funded by Meat and Livestock Australia to develop DNA tests for pasture soil as part of a wider MLA soil biology initiative. Although the project covers a diversity of pathogenic and beneficial organisms, the target list includes *Heterodera trifolii*, *Pratylenchus penetrans* and exploration of ways to estimate nematode community structure.

In April, Ian Riley had an opportunity to visit Siwi Indarti at UGM in Jogyakarta, Indonesia. Siwi had spent time in SA on a Crawford Fund traineeship and is now busy working on PCN. PCN has become a major problem for upland potato growers in Java, where potato crops are grown continually and economically viable rotational options are limited. Ian was in Indonesia to provide training on nematode collection and preservation as part of a Commonwealth funded workshop in collaboration with Indonesian quarantine.

Masterclass on soilborne diseases of wheat

AAN members, Julie Nicol and Ian Riley, provided nematology training at an ASTE Crawford Fund Masterclass in Zhengzhou, Henan, China in for two weeks in May. The Masterclass was held at Henan Agricultural University with the key trainers coming from Australia (and Australia via Turkey and the US), with vital support from Chinese scientists. The focus was soilborne disease of wheat and included about 20 participants from 13 wheat-growing provinces. The training was designed to be practical and interactive with field trips, laboratory and discussion sessions.

One of the main outcomes of the field work was a demonstration of the high incidence and population densities of cereal cyst nematode (CCN, species needs to be confirmed) in Henan Province. This led to five of the Australians, accompanied by local scientists, travelling to three adjacent provinces, Hebei, Shandong and Anhui, on what was to be their Sunday off, to conduct surveys for CCN. A large proportion of sites were infested. Although some attention has been given to CCN in China in the past, this exercise has stimulated renewed interest and the formation of a working group to co-ordinate future activities.

The workshop was an excellent time to further building scientific collaboration between Australia and China. Many new relationships, as colleagues and friends, were established with the Australians and amongst the Chinese scientists. Credit must be given to the tireless work of the local organising committed headed by Prof. Tan Wenhua, Drs Ma Ping and Li Honglian. Essential sponsorship came from Australian, Chinese and international organisations.

News from The University of Adelaide

Matt Rodda completed an honours project on factors affecting spatial distribution at sites in South Australia. The project built upon data being collected by John Heap and others in

GRDC-funded work on precision agriculture. Variability, the curse of nematologists, was a problem, but despite this Matt did an excellent job, and gained a first for his efforts.

The nematology group at the University is now reduced to Kerrie Davies, Zeng Qi Zhao and Elise Head. Kerrie continues to work on *Fergusobia*, with occasional forays into the world of nematodes in fig sycones (fruits). She recently obtained an ABRS grant to describe various *Schistonchus* and diplogasterids from *Ficus*, and will do another collecting trip to Cairns in July – anything to escape the southern cold. Zeng Qi is now in the final part of his Ph D work, and is busy describing new species of *Laimaphelenchus* from the bark of Australian conifers. Following a review of his project earlier this year, he was given extra funding by the Forests and Wood Products RDC to extend his survey work into pine forests in Victoria and New South Wales. This has yielded interesting information on the distribution of *Laimaphelenchus* species. Elise Head is now working part-time for SARDI Entomology, and continues to write up her Master's project on the ecology of *Fergusobia*.

In June, Kerrie Davies visited Germany, and caught up with Andreas Hensel in Rossdorf, and Suzanne Charwat in Duren. Andreas did his Ph. D. at the University, and sends greetings to his Australian friends. He is now working in the pharmacological industry. Suzanne worked in Australia for more than 10 years. She is now very busy with a 14-month old son, and expects a daughter in October.

In New Zealand, Janine Paynter (nee Lloyd) has also been busy. Janine now works for the anti-tobacco lobby in Auckland, and has just produced a second beautiful baby girl.

Kerrie Davies.

NEWS FROM QUEENSLAND

News from Leslie Research Centre

Jason Sheedy left us in March this year for the Columbia Basin Agricultural Research Station, Oregon State University, Pendleton, USA to work with Dr Richard Smiley for 2 years. He is working with wheat on the root-lesion nematodes, *Pratylenchus thornei*, *P. neglectus*, cereal cyst nematode, crown rot and common root rot. We're all looking forward to his tales and photos of farming and living in a snowy country when he returns. See http://cbarc.aes.oregonstate.edu/cbarc/plantpathologyhome.php for details about what he is up to.
Just before Jason left, his Master of Agricultural Science thesis, "Resistance to root-lesion nematode (*Pratylenchus thornei*) in wild relatives of bread wheat (*Tryticum aestivum*) and Iranian landrace wheats" was accepted. The abstract is included later in this newsletter. Neil Robinson is working in Jason's position. Neil is doing a great job, and we've finally had some planting rain, so he can go ahead with the *P. thornei* wheat tolerance trials this year.

We also welcome Rujuan Huang to our group. She has replaced Rebecca Zwart on the GRDC-funded project – "molecular markers for resistances in wheat to two species of root-lesion nematodes and yellow spot". Rujuan has a degree in Plant Pathology from China and a post-graduate Honours degree from Charles Sturt University. Since graduation, she has worked in a number of positions on molecular aspects of plant pathology.

John Thompson presented results from Rebecca and Rujuan's project at the recent Australian Winter Cereals Molecular Marker Program annual meeting. Good progress is being made with the resistance genes originating from synthetic hexaploid wheats. Rebecca has also published a couple of good papers recently - Australian Journal of Agricultural Research, 2005, **56**, 345-352 and Plant Breeding, 2004, **123**, 209-212.

Ros Reen and Rujuan have had some excellent correlations between their "manual" nematode counts under the microscope from double hexaploid populations inoculated with both *P. thornei* and *P. neglectus* and results from DNA quantifications by the Root Disease Testing Service, SARDI. Work is still in progress to finalise the experiment – stay tuned for an update.

Tim Clewett conducted a great fumigation experiment with several wheat varieties last year at a *P. neglectus* field site near Goondiwindi. Unfortunately the *P. neglectus* populations were quite low at the site. So while the nematode results were interesting, their effects were overshadowed by the results that showed that arbuscular mycorrhiza fungi are important for good wheat yields, particularly in a dry year.

Kirsty Owen has had some promising first year results also at the same *P. neglectus* site with a wheat and sorghum variety trials. The 2005 wheat variety trial was planted in late May on plots with high or low populations of *P. neglectus* (established in 2004 by growing the resistant triticale cv. Abacus or the susceptible to *P. neglectus*, but resistant to *P. thornei*, wheat cv. QT8447). The 2005 sorghum trial will be repeated on high and low *P. neglectus* plots as well.

Kirsty Owen

NEWS FROM WESTERN AUSTRALIA

News from WA State Agricultural Biotechnology Centre (SABC), Murdoch University

Professor Mike Jones was invited to present the keynote lecture of the Kakitaya University conference of Trends in Plant Science, which was held at Warangal (AP), India in April. His lecture was entitled "Studies on plant parasitic nematodes - Gene expression in giant cells induced in host plant roots by *Meloidogyne javanica*", which was a one and half hour lecture covering the research on plant-nematode interactions at the Murdoch University.

In March, Zhaohui Wang visited Quessland University of Technology again, meeting with Dr. Ben Dugdale. Ben is one of the collaborators of the ARC linkage project between Mike and Prof. James Dale (A new approach to control of plant parasitic nematodes). They discussed the strategies to develop synthetic resistance to root-knot nematodes.

Dr Modika Perera has successfully completed her 2 year ARC funded linkage project jointly with Professor Mike Jones (SABC) and Dr Vivien Vanstone at Department of Agriculture WA. As a result of this pilot project a research paper has been published as a 'proof–of–concept that plant parasitic nematodes can be identified by protein profiling using MALDI-TOF mass spectrometry. Details of the publication are as follows:

Modika R. Perera, Vivien A. Vanstone and Michael G. K. Jones (2005). A novel approach to identify plant parasitic nematodes using matrix- assisted laser desorption/ ionization time-of-flight mass spectrometry. ***Rapid Communications in Mass Spectrometry*.19**: 1454-1460. On line access: http://www3.interscience.wiley.com/cgi-bin/jhome/4849.

Besides Modika's main project has also identified root-knot nematode infection in Paulownia plantations for the first time in Western Australia. A publication has been accepted in ***Australasian Plant Pathology***. Details to follow in the next newsletter.

Mike, Vivien and Modika were able to secure another ARC linkage project. The new project is entitled "Field based molecular diagnostics for identification of plant parasitic nematodes". In this project advanced techniques of proteomics and associated bioinformatics will be used to develop an end user test to identify nematodes for growers, quarantine services and biosecurity.

Kerry Ramsay is currently being employed as a Research Assistant for Zhaohui after graduated from the School of Biological Sciences and Biotechnology with a First Class Honours degree. Her major responsibility is to construct a giant cell specific cDNA library using her expertise on Laser Microdissection and Catapulting (LMC). She has accumulated root-knot nematode (*M. javanica*) infected tomato root tissue (galls at 4 dpi) through extensive tissue culture in the past couple of months, and prepared for laser microdissection by fixing and embedding these tissue into paraffin. By cutting the embedded tissue to 10µm sections, she used laser microdissection to isolate pure giant cell contents from the tissue sections. Total RNA was extracted from the LMC samples, and the mRNA was amplified by two rounds of *in vitro* transcription using T7 RNA polymerase. A subtractive strategy is being developed to produce giant cell specific cDNA library. It is hoped that a wide range of genes expressed in giant cells will be identified by sequencing the library. At the same time, she has also been developing *in situ* hybridization technique in the plant-nematology group, which is extremely useful in locating cell specific expression of candidate genes in nematode infected roots.

Jiangyong Zeng has finished his one-year Visiting Scholar project, and returned to China in May. He has been working with Zhaohui on a project on screening potential root-specific transcription factors (TFs) from *Arabidopsis thaliana*. This work is based on a list of 35 TF genes identified by real-time RT-PCR and microarray, whose expression levels are much higher in root tissue compared to other tissue. With gene specific primers for each individual TF genes designed by Jiangyong and Zhaohui, expression of these genes was investigated in root, leaf, flower and stem tissues of *A. thaliana*. Out of these 35 genes, only two are root-specific, because transcripts of these two genes were not detected in tissue rather than root by RT-PCR. To confirm this result, promoter region (~1.5kb upstream of the transcription starting codon) of these two genes were cloned from *A. thaliana* genomic DNA, and fused to a GUS reporter gene in a binary vector. Plant transformation will be carried out soon to confirm root specificity.

Mike Jones, Zhaohui Wang, Modika Perera, Kerry Ramsay, Jiangyong Zeng

News from Department of Agriculture WA (DAWA)

PCN Project Commences

Sarah Collins joined DAWA Nematology in June as a Technical Officer to work on the 3-year project "PCN Area Freedom for WA: Evaluation of the current status of Potato Cyst Nematode (*Globodera rostochiensis*)". This work is funded by HAL, the Potato Growers' Association of WA and DAWA.

There are strong indications that WA is already free of PCN as it has not been detected since 1989, following the successful eradication of an isolated infestation near Perth. Subsequent quarantine, testing and monitoring protocols have remained in place since this time. After 16 years of freedom from this pest, extensive and intensive sampling will now be undertaken in all potato production regions to confirm the PCN-free status of the State.

We are confident that PCN was eradicated from the 6 sites of original infestation (near Munster, 20km south of the Perth metropolitan area). These sites have been sampled regularly with no detections of PCN, but will be re-sampled intensively in the first phase of the project. Several of these properties have recently undergone development for housing, with strict supervision of soil and machinery movements by WAQIS.

The second phase will involve sampling all potato growing properties within the 5km quarantine zone, followed by 50% of remaining properties in the Perth region. Finally, 25% of all remaining WA potato growing properties will be sampled, including seed production areas.

Some 2,000ha of potatoes are grown annually in WA, producing 10,000 tonnes of seed potatoes and 87,000 tonnes for domestic consumption, processing and export. New markets have been identified in the Middle East and in South East Asia. Area Freedom status will benefit marketing of seed potatoes to Indonesia, Sri Lanka, Thailand and Mauritius.

Sarah will be working closely with DAWA Horticulture, Quarantine Plant Pathology, Surveillance, Pest Risk Analysis and Plant Health, as well as AQIS and WAQIS staff.

John Marshall (New Zealand Institute for Crop & Food Research, Christchurch) is collaborating on this project, and will provide invaluable advice and assistance with sampling protocols, including PCR methods for detection of PCN. John will be joining us in Perth during July and August.

Cereal Cyst Nematode

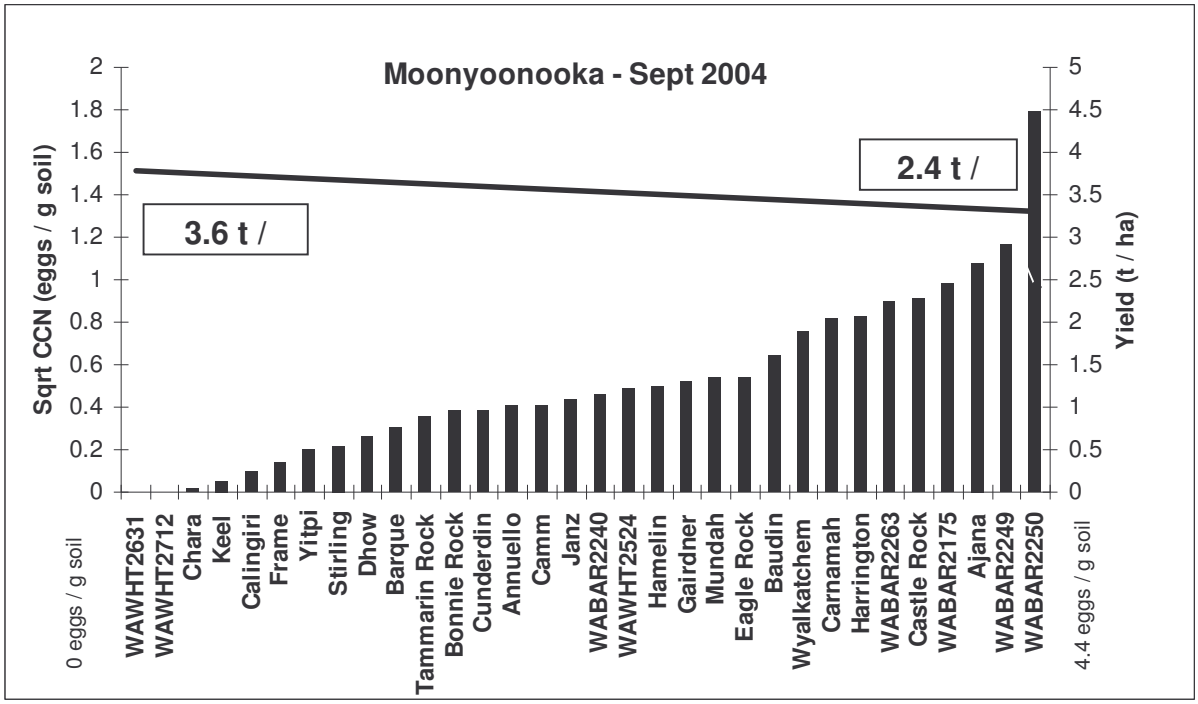
Over summer, soil was collected by Anne Smith (DAWA Geraldton) from three sites in the Northern Agricultural Region that had severe CCN infestations during the 2004 cropping season. Anne washed and sieved several hundred kilograms of soil to collect organic matter. Packages of organic matter were duly despatched to Perth, cysts picked for various purposes, and the bulk of the material then sent to Milanka Matic and John Lewis (SARDI Nematology). Material was also collected from a site in the Central Region where CCN had damaged a crop in 2004.

Milanka has established hatcheries for the WA CCN, and we are pleased to report that her expert nursery care has produced juveniles that will be used as inocula for tube tests at SARDI. Comparative tests will be performed to establish that resistance in wheat conferred by *Cre1*, *Cre3* or *Cre8* is just as relevant in WA as it is in SA and Victoria. Hopefully, this information will assist in persuading WA cereal breeders to take action against CCN, and perhaps make use of the screening service already established at SARDI.

Currently, there is only one commercial WA cereal variety (Doolup barley) known to be resistant to CCN. Where appropriate, growers are currently advised to grow SA cultivars (such as Frame or Yitpi wheat, or Barque barley) if CCN is an issue. The alternative is to NOT grow cereal, which is not a popular recommendation. However, a field trial near Geraldton in 2004 indicated that there may be some hope.

We have no reason to believe at this stage that WA and SA CCN are “different”. Nematode taxonomist Jackie Nobbs (SARDI Nematology) has investigated some of our cysts, and reports

nothing unusual. Furthermore, WA CCN is detected by the PreDicta-B™ test, using probes that were developed in SA.



Modika Perera (Plant Biotechnology Research Group, WA State Agricultural Biotechnology Centre, Murdoch University) will be generating protein-profiles for CCN from different WA locations. Cysts have also been sent to Janet Rowe (Rothamsted) for inclusion in a comparative study of CCN species from Europe and the UK.

The mission to educate growers and agronomists in the recognition and management of CCN continues. To this end (and to address issues stipulated by GRDC), we have commenced three 2-year field trials to demonstrate the practical benefits of rotations for management of CCN. Trials at three locations have been sown with cultivars of wheat, barley, oat, lupin, faba bean and field pea to manipulate CCN levels. In 2006, plots will be over-sown with resistant/tolerant and susceptible/intolerant wheat. "Sacrificial" intolerant oat has been included in 2005, which should provide a dramatic demonstration of the damage caused by CCN. Levels of CCN prior to sowing at the three sites were, respectively, 17, 41 and 74 eggs per gram soil.

Pratylenchus penetrans

In 2003, *P. penetrans* was identified in cereals at Narrogin and in field pea at Mt Barker. *P. penetrans* is rarely reported from Australian cereal cropping rotations. However, significant damage was observed to the roots of wheat and oat at Narrogin in 2003, where *P. penetrans* levels in October were, respectively, 11.5 and 21.3/g dry soil. Identification of *P. penetrans* in cropping areas has implications for the use of rotational crops in the management of RLN in WA.

Samples submitted to *AGWEST* Plant Laboratories for diagnostic purposes have since revealed high levels of *P. penetrans* (up to 36,000/g dry root) in wheat and oat at additional locations (from Moora 150km north of Perth, to Mt Barker 340km south-east of Perth). Significantly, high levels of *P. penetrans* occur in the absence of other *Pratylenchus* species.

Hosts of *P. penetrans* have now been assessed in the glasshouse using naturally infested field soil from Narrogin. Ten replicate plants each of 5 barley, 4 canola, 2 triticale, 4 oat, 4 field pea, 3 faba bean, 4 durum, 5 wheat, 5 lupin and 4 chickpea cultivars were grown singly in 750g pots. After 11 weeks, nematodes were extracted from roots and counted. *P. penetrans* multiplication rates were determined.

Field pea is resistant to *P. neglectus*, but susceptible to *P. penetrans* (Table 1). In the glasshouse, all crops were susceptible to *P. penetrans* (Table 2). For faba bean, wheat, lupin and chickpea differences between nematode multiplication rates of the cultivars were significant.

Crops resistant to *P. neglectus* (field pea, lupin, faba bean) are susceptible to *P. penetrans*, emphasising the need for growers to know not only the level but also the identity of RLN species present when devising rotational management strategies.

Cultivar	**Multiplication Rate**	
	P. neglectus	***P. penetrans***
Cooke	0.32	1.4
Parafield	0.13	1.6
Dunwa	0.15	2.0
Kaspa	0.28	2.4
Snowpeak	1.02	2.5
Helena	0.49	3.5
Dundale	0.55	4.1
Sturt	0.07	7.0
Mean	0.38	3.1
LSD 5%	ns	3.3

Table 1: Multiplication in the field of *Pratylenchus neglectus* (6.1 RLN/g dry soil at sowing) and *P. penetrans* (1.7 RLN/g dry soil at sowing) on field pea.

Crop	**Multiplication Rate**
Barley	2.5
Canola	2.9
Triticale	3.2
Oat	4.0
Field Pea	5.4
Faba Bean	6.0
Durum	6.1
Wheat	6.5
Lupin	7.1
Chickpea	13.3
LSD 5%	2.1

Table 2. Multiplication of *Pratylenchus penetrans* on crops grown in pots of infested field soil.

Assessment of crop species and cultivars as hosts to *P. penetrans* will be repeated in the glasshouse using inocula produced in carrot culture. Cultures have been established from several cereal cropping locations, as well as from horticultural areas.

Pratylenchus "teres"

Taxonomists Mike Hodda (CSIRO Canberra) and Jackie Nobbs (SARDI Nematology) have often expressed doubts regarding identity of the nematode recognised in WA as *P. "teres"*. Mike has now carefully examined additional specimens, and is in the process of putting *P. "teres"* to rest.

Mike concludes that taxonomic differences between *P. "teres"* and other *Pratylenchus* species are sufficient to differentiate this WA nematode as a new species. Sequence data produced by Di Hartley (CSIRO Canberra) confirm Mike's taxonomic findings.

Stay posted for a new name, and publication of the description. Jackie will be working on a description of the male of this species, which she has identified from at least one WA location.

Mike is also preparing a paper describing variation within and between populations of WA *Pratylenchus*. This study has included about 500 specimens, as well as sequence data from Di Hartley.

Since 2003, *AGWEST* Plant Laboratories has identified *P. "teres"* from submissions of barley, oat, wheat and canola. This nematode is sometimes associated with *P. neglectus*, and less frequently with *P. penetrans* or *P. zeae*. Levels extracted from roots are often in the order of 1,000 – 6,000/g dry root, but can be as high as 70,000 – 130,000/g dry root.

Pratylenchus zeae

Over the last 7 years, *P. zeae* has often been detected by *AGWEST* Plant Laboratories in wheat, barley and oat roots submitted for diagnostic purposes. This RLN is usually found in association with *P. neglectus*, *P. "teres"* and/or *P. thornei*. When alone, *P. zeae* levels are generally low (usually only several 100/g dry root, occasionally up to 10,000/g dry root). However, high numbers of *P. zeae* alone were detected recently in a sample of Rhodes grass from Kununurra. Nematodes have been sent to Jackie Nobbs (SARDI Nematology) for species confirmation, prior to attempting to establish this nematode in carrot culture.

Radopholus

One glasshouse test to investigate ability of field crops (5 barley, 4 canola, 2 triticale, 4 oat, 4 field pea, 3 faba bean, 4 durum, 5 wheat, 5 lupin and 4 chickpea cultivars) to host Burrowing Nematode (probably *R. nativus*) is nearing completion. A second test is planned to assess a population containing males (probably NOT *R. nativus*; this species is being investigated by Jackie). We are currently using naturally infested field soil, as attempts to establish *Radopholus* in carrot culture have been less than successful.

Protein-profiling

Modika Perera (Plant Biotechnology Research Group, WA State Agricultural Biotechnology Centre, Murdoch University) has completed the initial phase of an ARC/DAWA funded project to identify nematode species using Matrix-Assisted Laser Desorption/Ionisation Time-of-Flight Mass Spectrometry (MALDI-TOFMS). In the proof-of-concept phase, diagnostic protein-profiles have been generated for *Anguina tritici*, *A. funesta* and *Meloidogyne* species.

Reproducible, good quality, species-specific profiles can be generated using this technique, which shows promise to enable rapid identification of plant-parasitic nematodes.

Results have been recently published: Perera, Vanstone and Jones (2005) A novel approach to identify plant parasitic nematodes using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry *Rapid Communications in Mass Spectrometry* **19**:1454-1460.

Modika is now testing *Pratylenchus* from carrot cultures that have been verified taxonomically by Jackie Nobbs. This involves comparison of *P. neglectus* from different locations, and comparison between *P. neglectus*, *P. thornei* and *P. penetrans*. CCN from 4 locations in WA will be tested in the future, as will *Radopholus* species if and when cultures become available. *Ditylenchus* have been obtained from SARDI, and Modika will attempt to differentiate between the oat and lucerne races of this nematode.

Modika's work will provide additional information on differences within and between nematode species to add to the taxonomic work of Mike Hodda and Jackie Nobbs, and to the sequence data generated by Di Hartley.

APPS Conference 2005

Nematological offerings to the APPS Conference to be held at Geelong in September:

***Pratylenchus penetrans* in Western Australian field crops**
VA Vanstone, SJ Kelly, HF Hunter and MC Gilchrist

***Radopholus* – scourge of the West**
VA Vanstone, J Nobbs, SJ Kelly, HF Hunter and MC Gilchrist

***Hidden enemies of crop plants: Developing a novel method to identify plant parasitic nematodes**
MR Perera, VA Vanstone and MGK Jones

***Nematodes in Western Australian vineyards**
F Lamberti, VA Vanstone and N Lantzke

***Potato cyst nematode – the Western Australian experience**
VA Vanstone, A Taylor and SJ Collins

New Project and a Might-Have-Been

GRDC have approved funding for a further two years from July 2005. The new project, "Rotations to reduce impact of nematodes in Western cereal cropping systems", is essentially a continuation of our current work. GRDC have now requested that we undertake field trials to demonstrate to growers the practical benefits of rotations for nematode management. Two 3-year *P. neglectus* trials are already in their final year, a further two 2-year *P. neglectus* trials have been established, as have three 2-year CCN trials.

Although GRDC are not keen for us to work with nematodes other than *P. neglectus* and CCN, we will surreptiously continue to investigate additional *Pratylenchus* species and *Radopholus* in glasshouse trials.

Issues to be addressed will include:

*Comparative host ranges for *P. neglectus*, *P. teres*, *P. penetrans* and *Radopholus*

*Comparative testing of WA and SA *P. neglectus*
*Comparison between WA *P. neglectus* from different locations
*Host range for *Radopholus* and comparison of species
*Comparative testing at SARDI of WA and SA CCN populations.

The RIRDC proposal to "Identify risks to Western Australian cropping from endemic parasitic nematodes" was not funded, although a full proposal was invited. This would have allowed retired New Zealand Taxonomist Wim Wouts to work with us one day per week for 2 years. This work was considered "*not of national significance"*, despite objectives to:

*Identify risks to established WA broadacre cropping from endemic plant-parasitic nematodes
*Improve capacity to identify and address impact to cropping from endemic nematodes nationally
*Address the information gap on the diversity and identity of endemic plant-parasitic nematodes in WA
*Pre-emptive identification of risks, and improved capacity to address emerging risks nationally

Would have been nice, but oh well!

Vivien Vanstone

Research

RESISTANCE TO ROOT-LESION NEMATODE (*PRATYLENCHUS THORNEI*) IN WILD RELATIVES OF BREAD WHEAT (*TRITICUM AESTIVUM*) AND IRANIAN LANDRACE WHEATS

Jason Sheedy

2004 Thesis Abstract, Master of Agricultural Science, University of Queensland

Common or bread wheat (*Triticum aestivum*, **BBA^{u}A^{u}DD**) is an allohexaploid comprised of three genetically related genomes (**A**, **B** and **D**) that originated as a hybrid of emmer wheat (*Triticum turgidum*, **BBA^{u}A^u**) and *Aegilops tauschii* (**DD**) (Mukai *et al*., 1993). Wheat is the primary grain consumed by humans around the globe (Ekboir, 2002) and is by far the largest grain industry in Australia (Anon., 2001b), representing a value of five billion dollars at the farm gate (Rathmall *et al*., 2001).

Pratylenchus thornei is a migratory root-endoparasitic nematode that feeds and reproduces in the cortex of wheat. Yield can be reduced by as much as 70% in intolerant wheat cultivars. Although wheat is its preferred host, it attacks a range of crops including chickpea (*Cicer arietinum*) and mungbean (*Vigna radiata*).

P. thornei is widely distributed both internationally and in Australia. It causes substantial damage in southern Queensland and northern New South Wales and is also a problem in Victoria, South Australia and has recently been identified in Western Australia (Riley and Kelly, 2002). The estimated annual value of Australian wheat production lost from *P. thornei* is $36M (Brennan and Murray 1998).

The existence of a large reservoir of useful genes in the wild relatives of wheat is apparent from the adaptation of the various wild forms to different environments. Among the desirable characteristics that can be found in the wild relatives of *T. aestivum* are improved quality and quantity of grain protein, and increased resistance to plant pathogens, drought, lodging and salt tolerance (Feldman and Sears 1981).

Thompson and Haak (1997) have identified *P. thornei* resistance in accessions of *Ae. tauschii*, the **D** genome donor of wheat. The first aim of this thesis was to test the **AA** and **BBAA** progenitors of wheat to determine if resistance to *P. thornei* is present on these genomes. The second aim was to identify improved and/or novel sources of resistance to *P. thornei* in the wild relatives of wheat and Iranian landrace wheats for use in wheat breeding programs.

To achieve the first aim, 148 wild wheat accessions were tested for resistance to *P. thornei*. These were obtained from Kansas State University via the Australian Winter Cereals Collection in Tamworth. This group of wild relatives included *Aegilops speltoides* (2n = 14, **SS** genome), *Triticum urartu* (2n = 14, **A^{u}A^u** genome), *T.*

monococcum (2n = 14, $\mathbf{A^mA^m}$ genome), *T. timopheevii* (2n = 28, $\mathbf{GGA^uA^u}$ genomes) and *T. turgidium* (2n = 28, $\mathbf{BBA^uA^u}$ genomes).

The second objective was to identify resistance to *P. thornei* in Iranian landrace wheats (*T. aestivum*, 2n = 42, $\mathbf{BBA^uA^uDD}$ genomes) from CIMMYT. Information from CIMMYT indicated that no "western" wheat cultivars contain Iranian wheats in their pedigree. Therefore these wheats represent potentially novel sources of resistance to many pathogens including *P. thornei*.

Of the 148 wild wheat accessions tested, 26 (19%) (eight *Ae. speltoides*, nine *T. urartu*, eight *T. monococcum* and one *T. turgidum* ssp. *dicoccoides*) proved to be more resistant than the current best source of resistance, GS50a.

Since resistant accessions were found among both *T. urartu* and *T. monococcum* I have confirmed that there are one or more resistance genes on the **A** genome. A number of resistant accessions were also found among the *Ae. speltoides* accessions. Although *Ae. speltoides* is an **S** genome diploid, it is thought to be the **B** genome donor of modern bread or common wheat and therefore it is reasonable to hypothesise that resistance genes found on the **S** genome could be introduced into the **B** genome of domestic wheat. Thompson and Haak (1997) have also identified *P. thornei* resistant accessions of the **D** genome donor to wheat, *Ae. tauschii*. Theoretically resistance genes could be introduced into all three genomes (**A**, **B** and **D**) of domestic bread wheat and pyramided to produce a higher level of resistance.

Of the 274 Iranian landrace accessions tested for resistance to *P. thornei*, 82 were found to be partially resistant over two years of testing. Of the 82 superior accessions, four accessions (AUS28470, AUS28321, AUS28302 and AUS28433) consistently produced fewer *P. thornei* than GS50a.
These Iranian hexaploid landrace wheats appear to be a very valuable untapped genetic pool of multiple *P. thornei* resistance genes. They also possess a number of other genes to combat other biotic and abiotic stresses. The four elite Iranian landrace accessions identified should be the primary accessions introduced into a breeding program to breed for *P. thornei* resistance. The very significant advantage of the landrace wheats examined in this thesis is that as hexaploid wheats they are able to be immediately introduced into any wheat breeding program and crossed with its elite germplasm without requiring any specialised procedures or equipment.

Book Review

Nematode Behaviour edited by Randy Gaugler and Anwar Bilgrami.
2004. CABI Publishing, Wallingford, UK.

Overall Comments
In their introduction to the book, Gaugler and Bilgrami define 'nematode behaviour' as "a set of activities and responses translated by the nervous system in response to internal and external stimuli". They discuss the difficulties of classifying particular nematode behaviours, given the lack of well-defined criteria, and suggest that there are two basic types of behaviour – operational (voluntary) and consequential (influenced by stimuli). The former includes 'what nematodes do', e.g., movement, egg laying, nictation, swarming, orientation, penetration. Behaviour by consequence, they argue, is extremely varied since nematodes are "governed by endogenous activities and sensory stimuli of physical and chemical natures". Thus, this book includes chapters that review muscular, neurological and physiological mechanisms that 'trigger' the nervous system and lead to "displays that constitute behaviours". The book goes far beyond consideration of nematode responses to abiotic and biotic stimuli. While it is not surprising to find a review of nematode behavioural adaptations to diverse ecological conditions in a book of this nature, the presence of a chapter titled 'Population Dynamics' is a surprise. (The authors of this chapter actually focus on non-uniform distribution behaviour of nematodes). Gaugler and Bilgrami suggest that the new tool of functional genomics will boost behavioural studies, and that nematodes (or *C. elegans*?) will become a new model for studies of animal behaviour. They also hope that behavioural studies will cut across the divide between the sub-disciplines of animal and plant nematology etc., and act as a unifying focus. There are repeated pleas for work on nematodes other than *C. elegans,* to enable comparisons and generalisations about nematode behaviour to be made. The book is generally stimulating, up-to-date, and will provide a good resource for those searching for research projects.

Chapter by chapter
Chapter 1. Ecological and Behavioural Adaptations; *Gregor Yeates*
Yeates reviews the primary factors (food, water and temperature) determining habitats occupied by nematodes, and to which they have adaptations. He proposes a new system of classification of nematodes, based on their behaviour with respect to water. Nematodes that occupy permanently water-saturated habitats are described as *interstitial;* and those (including many plant parasitic forms) that use meniscus forces for efficient locomotion are referred to as *pellicole* nematodes. Biological adaptations such as the number of juvenile stages and the occurrence of cysts in some some species are considered. Yeates highlights a need for more work on how the rates of population increases are related the distribution of food resources in space and time.

Chapter 2. Locomotion Behaviour; *A. H. Jay Burr & A. Forest Robinson*
Locomotion is covered in relation to mechanisms, in turn related to structure of nematodes, shown to lead to a wide range of movement behaviours. This chapter has a very comprehensive and up to-date literature list (at the time of writing). It attempts to draw together work on structure of the hydroskeleton, musculature, cuticle, transmission of forces and the motor-neuron system, largely examined separately; and to relate them to locomotion. Further investigative approaches that could be taken, particularly with regard to the nematode hydroskeleton, are suggested.

Chapter 3. Orientation Behaviour; *Ekaterina Riga*
Much of the work on orientation behaviour of nematodes has used *C. elegans*, and Riga points to the need for comparative studies on nematodes from varying habitats. While chemoreceptors, mechanoreceptors, photoreceptors, electric and magnetic field receptors have been studied, more work is needed on their function. Much remains to be investigated of the physiology and mechanics of the various receptors, (eg. in chemoperception, aggregation). While the effects of sex pheromones are known, in all but a few species of nematodes information is lacking on the composition and site of production of such pheromones. The mechanisms of mechanoreception and photoreception are poorly understood. Thermo-orientation, seen as an important aspect of nematode behaviour with implications for the activity of entomopathogenic nematodes, is indicated as a potentially important field of study. Riga suggests that understanding nematode orientation is of importance to the potential for disruption of the nematode life cycles in management strategies.

Chapter 4. Feeding Behaviour; *Anwar Bilgrami & Randy Gaugler*
This chapter looks at patterns of feeding types and mechanisms, muscular movements, food and feeding, host recognition, penetration, predation, ingestion, and defaecation. It stresses that nematode diversity in food and feeding habits occurs even though nematodes have structural and functional similarities. Thus, feeding and ingestion by the animal parasite *Trichuris trichuris* (whipworm) actually resembles that of *Meloidogyne*, with predigestion and induction of host cell modifications!

Chapter 5. Reproductive Behaviour: *Robin Huettel*
Huettel begins with a historical view, pointing to the role that studies of nematode reproduction have played in such discoveries as meiosis, mitosis, recombination, sex determination etc. This role continues, with the use of *C. elegans* in molecular and genetic studies. There are good descriptions of amphimictic and parthogenetic (both meiotic and mitotic) reproduction and pseudogamy. The uniqueness of the movement of nematode sperm, sperm competition and its evolutionary significance, and the role of sperm proteins are all covered well. On the macro level, studies on mate location are traced from its initial observation to molecular studies to elucidate the mechanisms involved. While much of this work was with *C. elegans*, investigations of the mating behaviour of several different species of nematodes are included. Huettel claims that further knowledge of this behaviour may lead to disruptive strategies for the control of pest nematodes.

Chapter 6. Ageing and Developmental Behaviour; *E E Lewis & E E Perez*
As you would expect, much of the work reviewed in this chapter deals with *C. elegans,* but many other nematodes, including plant parasites and entomopathogens, are considered. Lewis and Perez point out that most of the *C elegans* research used strains

originally isolated over 40 years ago, and maintained since in laboratory cultures, that may be genetically very different from the wild type. This is a problem common to all nematologists using laboratory cultures of nematodes, including 'Prat people'. The section on sensory responses and learning is particularly interesting. Nematodes are capable of forms of learning, and Lewis and Perez observe that 'learning is inextricable linked to ageing because it takes time to learn; thus a nematode must age if it is to learn'. The chapter also contains sections on dormancy and cryptobiosis and dauers. Behavioural characters can be used to predict lifespan and used to choose longevity mutants in *C. elegans.* Understanding of such characters from parasitic nematode populations in the field could be used in studying variation in natural populations.

Chapter 7. Osmoregulatory and Excretory Behaviour; *Denis Wright*
The nematode excretory system is both secretory (osmo-regulation) and excretory (excretion of nitrogenous wastes). Wright considers both these mechanisms in explaining changes in nematode behaviour, and suggests that studies on membrane channels, transporters and pumps may lead to development of novel anthelmintics.

Chapter 8. Physiological and Biochemical Basis of Behaviour; *Roland Perry &Aaron Maule*
Perry and Maule review the nervous system and its sensory physiology, neurotransmitters and neuromodulators, and motor function and somatic musculature. They also look at specialized muscular systems such as the pharynx and the 'ovijector' (vagina). The role of hormones and enzymes on behaviour, e.g., in moulting, feeding and dauer formation, is also considered.

Chapter 9. Molecular Basis for Behaviour; *Maureen Barr & Jinghua Hu*
This chapter concentrates on reviewing the literature on the molecular basis of *C. elegans* behaviour, and gives a useful introduction to the emerging areas of functional genomics and proteomics. Most of the work in this area has been done with the *elegans* model, but it is disappointing that the authors make few references to other nematodes.

Chapter 10. Biotic Interactions; *Patricia Timper & Ken Davies*
This covers both beneficial (enabling transport to other environments) and antagonistic interactions. It includes parasitism, mutualism (eg. entomopathogenic nematodes) and commensalism (phoresy). There are detailed descriptions of different types of phoresy – facultative, obligate and necromeny. Antagonistic behaviour includes predation and parasitism; with good definitions of predators, parasites, commensals etc. Areas highlighted as needing further research include: interactions between microbials and parasitic nematodes at the individual and population levels, with a view to microbial use in biocontrol; the genetics of the interactions between nematode hosts and their microbial parasites; and antibiosis from bacteria, other nematodes or plants and tritrophic interactions.

Chapter 11. Abiotic Factors. *Mary Barbercheck & Larry Duncan*
Standard factors affecting nematode behaviour, such as temperature, gravity, visible light, electrical charge, oxygen, CO2 and pH, are considered. The chapter includes effects of exposure to microwaves and UV radiation, and of water potential.

Chapter 12. Population Dynamics: *Brian Boag & Gregor Yeates*
At first sight, this is the most controversial chapter in the book. Population dynamics

and behaviour? But, of course, they are linked – because nematodes move, i.e., they can migrate, and as we all know they have patchy distributions. The role of migration in nematode distribution is unclear, because tiny nematodes by themselves move only small distances. Boag and Yeates could have mentioned behaviours relating to phoresy in this context. They concentrate on factors affecting horizontal and vertical distribution of nematodes, and discuss daily and seasonal variations in distribution of free-living infective juveniles of animal parasites, that could be an adaptation to host-finding.

Chapter 13 Survival Strategies *David Wharton*
Wharton broadens the definition of behaviour to include capacity adaptation (ability to grow and reproduce under extreme conditions), synchronisation of life cycle to host; and resistance adaptation. He reviews adaptative behaviour to temperature and pH extremes, stress, starvation and immune reactions and to the life cycle of the host in parasitic nematodes. The subjects of dormancy and diapause are well covered, as are responses to extremes of heat and cold and desiccation in a variety of nematode species.

In conclusion….
This volume is dedicated, most appropriately, to the memory of Neil Croll, whose 1970 book "The Behaviour of Nematodes" could be said to have 'kick-started' the work described in this new book. "Nematode Behaviour" is a long overdue, and welcome, addition to the literature on nematodes. When shall we see a new Goodey?

Kerrie Davies
Val Kempster.