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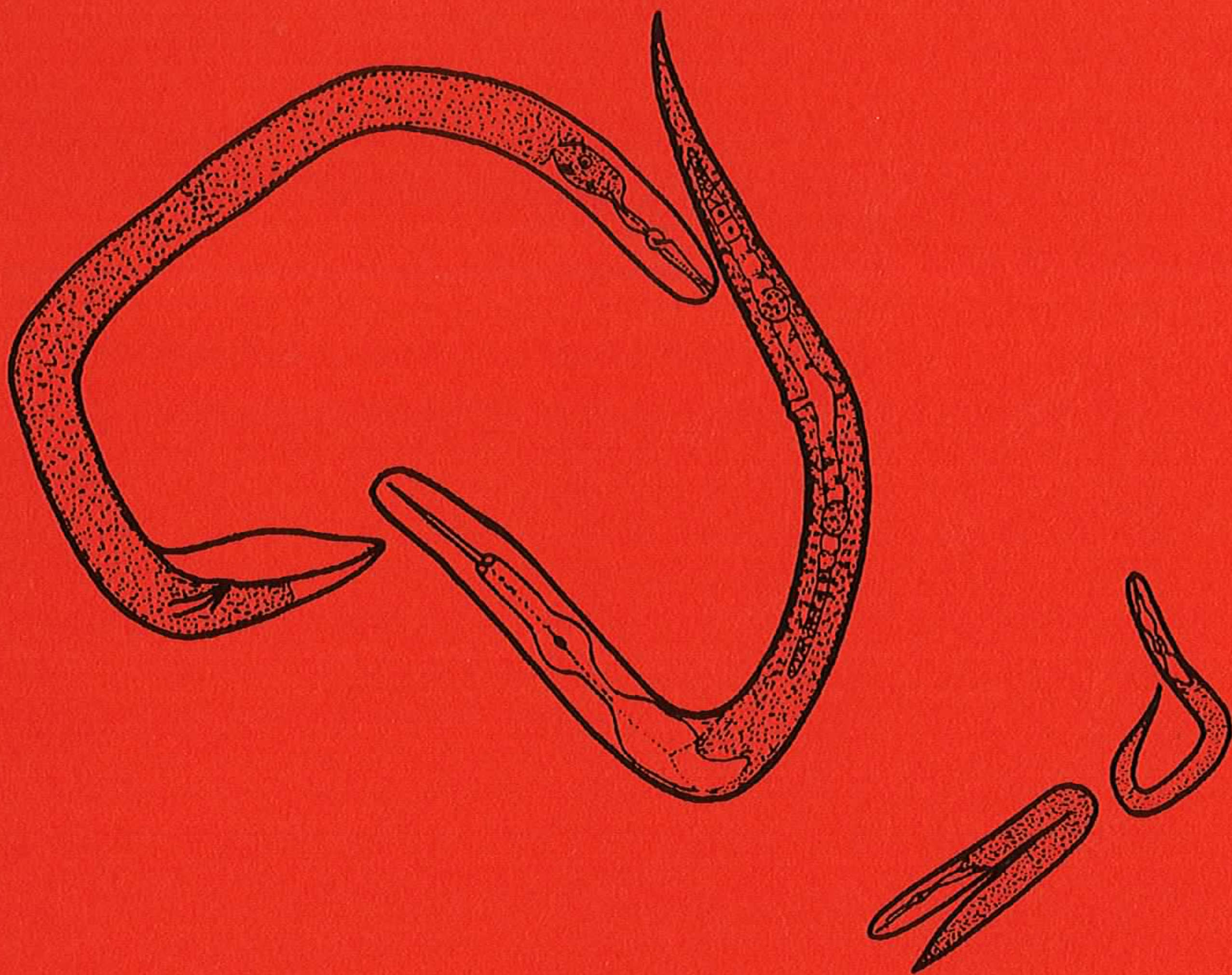
AUSTRALASIAN NEMATOLOGY NEWSLETTER



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From the Editor

The issue contains interesting news and articles from members and a current membership directory. Contributors are thanked for there efforts and we all look forward to an increased dose next issue. After the next issue it is time to hand on the editor's job, so do give some thought to your role in the Association in 1998.

July Issue

The deadline for the July issue is June 15. Please send material as it comes to hand and plan well in advance to prepare your contribution. I will be busy with the nematode workshop and APPS conference rapidly approaching, so your keen cooperation for the July issue will be appreciated.

Membership directory

A current directory of members is included in this issue. There are 5 new members since last year. On behalf of the membership, I am pleased to welcome Bob Colbran, Wendy Cooper, Grant Hollaway, Loothfar Rahman and N. Somasekhar to the Association. The contributions of the new members, along with those of the old, will undoubtedly strengthen the network of nematologists in Australasia and beyond.

If your details in the Directory are incorrect or need to be updated please send details to Nora Galway (contact details below).

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Association News

FROM THE PRESIDENT

I am pleased to hear from Nora that about half the members responded to the questionnaire about AAN membership of the International Federation of Nematologists (INFS). All responses were in favour of the proposal. Therefore, I can announce that the AAN will affiliate with the IFNS. The comments made by members will be considered when we determine our contribution to IFNS. The fees will be met from current subscriptions and will not result in an increase to members. I will keep you informed and will be able to say more in the next issue.

I hope to see most of you at the AAN meeting in Perth this year. Please make every effort to attend as your participation will result in a worthwhile meeting and a great opportunity for AAN members to interact. The WA people are putting in a good effort into this event and your support will be appreciated.

John Marshall, AAN President, Crop & Food, Lincoln

FROM THE SECRETARY

In December last year all members were asked for their votes regarding whether the AAN should join the International Federation of Nematology Societies (IFNS). Of the 73 members, 32 have responded, all in agreement that we should join. For those members who have not voted, please do so by email or fax by the 14 February. After this date, the AAN committee will respond to the IFNS. Since all of the replies so far have been in the positive, it is likely that the AAN will join the IFNS ranks under the proviso that it will cost less than $1.00 per person. Thanks to everyone who replied promptly.

During this exercise, it became apparent that many members are travelling around the country. Some people are just changing jobs and others are changing fields entirely. Please check the latest address list to ensure your details are correct and contact me if there are any errors. As the next AAN meeting is fast approaching (Perth, 28 September), an up to date list will make the transition period for the NEW secretary and NEW treasurer much smoother!

Nora Galway, AAN Secretary, CSIRO Entomology, Canberra

NEMATOLOGY WORKSHOP, PERTH 28-29 SEPTEMBER, 1997

Nematode control - genes and microbes

The workshop will focus on non-chemical approaches to the control of plant parasitic nematodes. The workshop will be divided into two sessions - genetic approaches and biological control. Each session will consist of an overview, presentations of relevant Australasian projects and a review of research directions. Dr Thierry Vrain (Agriculture Canada, British Colombia) and Dr Graham Stirling (Biological Crop Protection Pty Ltd, Queensland), internationally respected nematologists in the respective areas have been invited (subject to funding) to present overviews and chair the discussions. Support is being sought from RIRDC. All participants will be invited to offer relevant presentations on current research.

The workshop will be held at State Agricultural Biotechnology Centre, Murdoch University, on Monday, 29 September. Participants will meet in Northbridge (Perth's main restaurant precinct) on the Sunday evening for dinner and a general meeting of the association. The anticipated total cost is $75. More details can be obtained from the workshop convenors and will be provided by direct mail to members.

The workshop will be held in conjunction with the Australasian Plant Pathology Society Conference in Perth, 29 Sept - 3 Oct, 1997. Workshop participants are encouraged to stay on and provide a strong nematological presence at the conference.

Please note: As plans progress, some of the details above may be subject to change.

Workshop Convenors, Ian Riley and Rob Potter

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The Nematode Rap

You will find me everywhere
in the soil, in the sea, even in mid air
plants and animals I will kill
and you'd better watch out or I'll make you ill

Heh, it's the nematode rap!

My cavity may look like a coelom but
there are no muscles round my gut
and so I think that you will feel
that we should call it a pseudocoel

Heh, it's the nematode rap!

With regards to matters sexual
pseudogamy, amphimixis, parthenogenesis,
heterogamy I do it all
but for a real gender bender I think I might
be a protandrous hermaphrodite

Heh, it's the nematode rap!

My collagenous cuticle is annulated
my bilateral symmetry is under rated
if you look round my mouth you will see
elements of radial symmetry

Heh, it's the nematode rap!

My deirids are opposite the oesophageal bulb
with two circlets of papillae on each stomal lobe
and so that you won't think I'm silly
I have six pairs of genital papillae
Now you may think that sounds like crap

but Heh, it's the nematode rap!

David Wharton, University of Otago
(presented at an end-of-year Zoology Department review)

Regional News

NEWS FROM NEW SOUTH WALES

Sydney University and Rydalmere

Kirsty Owen has returned from South Carolina with a renewed passion for nematology. She attended the "Nematology Short Course for Professional Consultants" at Clemson University, South Carolina in December 1996 - January, 1997 with the help of a travel grant from RIRDC. Unfortunately all nematode anatomy and names have been learnt with a southern accent - awesome! Dr Stephen Lewis and Dr O. J. Dickerson still run the course and supplement the rigorous timetable with plenty of good southern hospitality and food. Kirsty's PhD is approaching its second year - with some interesting results on chemical induction of systemic resistance against *Meloidogyne* spp.

Chris Green and Rod McLeod have both retired due to the closure of BCRI, Rydalmere, but both appear to be just as busy as usual. Chris is working from home. Rod is now based at Macquarie University and is working on a project with Chris Steel from Charles-Sturt University. He is continuing his research on biofumigation for control of nematodes in vineyards.

Kirsty Owen, The University of Sydney

NEWS FROM NEW ZEALAND

Nematology in Lincoln

Things have been quiet in these parts and we continue to look at the evolution of virulence in PCN when challenged with resistant potato germplasm. *G. pallida* populations have been able to reproduce on most germplasm. We have noticed that there is a range of the multiplication between populations. The Pa3 populations have a higher multiplication while the Pa2 types are not capable of reproducing on some of the highly resistant germplasm. This begs the question of what is the difference between Pa3 and Pa2 as the pathotyping test cannot give a clear differentiation.

Root knot nematode in carrots - We have recently put in a preliminary trial using metham sodium to see if we could control violet root rot (fungal pathogen) and we will be looking at the affect of this chemical on the nematode fauna with particular emphasis on root knot nematode. With the next funding coming up we will be trying to set up a collaborative project on the population structure and ecology of temperate root knot nematodes in New Zealand.

John Marshall, AAN President, Crop & Food, Lincoln

Landcare Research, Palmerston North

Nematode ecology seems to be popular if not well funded. In the past year we have had visits from Crystal Denton (England), Brian Boag (Scotland), Andrea and Johannes Hallmann (Germany), and Dieter Sturhan (Germany). Richard Bardgett (England) is currently working with us for a month. Crystal and Richard are part of a British Council funded Higher Education Link and are contributing to a series experiments in which pulse-labelling is being used to assess the impact of nematode infection of roots on soil microbial biomass; Chris Mercer and his team from AgResearch have been contributing on the glasshouse side. While Brian Boag was principally funded by OECD to look at New Zealand terrestrial flatworms we did manage to get some work on nematode distribution and biogeography tidied up. Under another OECD award Gregor Yeates was able to spend three months with CSIRO Division of Animal Production, in Armidale. This programme involved assessing the impact of nematode-trapping fungi administered to sheep for control of gastro-intestinal nematodes on the soil nematode fauna. Some drilonematids which were recovered from the coelomic cavities of native earthworms from near Armidale are currently being described in cooperation with Sergei Spiridonov in Moscow and Rob Blackmore in Tasmania.

Gregor Yeates, Landcare Research, Palmerston North

NEWS FROM RIRDC

Rural Industries Research and Development Corporation (RIRDC) is funding four new nematology/nematology related projects from 1 July 1996.

- *Guidelines for the operation of advisory services for nematode pests*, Australasian Association of Nematologists, Dr G. Stirling, 2 years
- *Development of monitoring services for nematode pests*, CSIRO Division of Entomology, D. J. Curran, 3 years
- *Molecular diagnostics systems for soilborne plant pathogens*, CSIRO Division of Entomology, Dr J. Curran, 3 years
- *Determination of effective fumigant concentrations in different soil types for methyl bromide and other soil fumigants*, CSIRO Division of Entomology, Dr J. Desmarchelier.

The total budget for the above projects is $430,000.

Rob Brown, Program Manger, Pest, Weed and Disease Program, RIRDC

NEWS FROM SOUTH AUSTRALIA

Waite Campus, Adelaide

Nematologists at the Waite Campus have been fortunate to have several visitors during the latter part of last year.

Dr Florian Grundler from the University of Kiel visited Adelaide in August and gave a seminar entitled "Cellular and molecular responses to cyst nematodes." The detailed microtechnique and filming gave a new insight of the hostile environment nematodes encounter when entering plant roots and the various adaptations nematodes have evolved in order to circumvent plant defences.

In late November, we were visited by Drs Andrea Quadt-Hallmann and Johannes Hallmann who have both completed postdocs at the Department of Plant Pathology, Auburn University. They gave a lecture in which Andrea showed how she could detect where endophytic bacteria lodged in roots through immunological techniques, while Johannes was looking at the biocontrol of endophytes. Part of this project assessed the interaction of endophytes with nematodes, particularly root-knot nematode, and the potential to use endophytes as bio-control agents. It was found that some of the endophytic strains provided 40-50% control of root-knot nematode.

In December, the Waite Campus was also visited by molecular nematologist, Professor David Bird from the University of North Carolina and former postgraduate, Dr Kevin Williams who is currently working as a molecular biologist at the University of Kent, United Kingdom.

Also in December, Jan Gooden from SARDI spent two weeks at Rothamsted Experimental Station, UK where she trained with Dr. R. Curtis and Dr. K. Evans in techniques relating to a prototype CCN ELISA using CCN specific (Australian) monoclonal and polyclonal antibodies. These were developed at Rothamsted with funds form the South Australian Grains Industry (SAGITF). Currently, she and Dr Kathy Ophel-Keller are refining the ELISA test with a view of providing a diagnostic test for farmers.

The Waite Campus has a new honours student, Scott Paton who will be working on a project with nematologist, Dr Kerrie Davies.

Both Julie Nicol (University of Adelaide) and Maria Scurrah (SARDI) were fortunate to secure travel funds to attend the Third International Nematology Congress at Guadeloupe in July, 1996. A small contingency from the AAN was also present including John Marshall, Julie Stanton, John Curran and Nora Galway. Over 500 nematologists attended, representing the three largest international nematological societies; ONTA, SON and ESN. Julie presented a poster from her PhD entitled "Field yield reductions caused by the root lesion nematode, *Pratylenchus thornei* on wheat in South Australia," which was awarded runner-up in the competition for the best paper presented by a postgraduate student. Maria Scurrah presented a paper entitled "Resistance and tolerance to stem nematode in oats, peas, and faba beans in South Australia," at the *Ditylenchus* workshop.

The conference covered a large spectrum of topics. From the Australian perspective, interesting topics included: a workshop on cereal cyst nematode, a symposium on resistance and the evolution of resistance genes and virulent genes in nematodes, a symposium on genetic engineering with emphasis on sedentary nematodes, *Globodera* and *Meloidogyne*, and discussions on taxonomy and the future of it. Tools for teaching nematology were also discussed, with the University of California at Davis, in particular making the undergraduate nematology teaching lectures accessible on the World Wide Web (accessed by http://ucdnema.uc.davis.edu). If anyone is interested in reading the abstracts, please contact either Maria or Julie.

The conference was action packed, not only with the number of concurrent sessions and papers, but also with the appearance of CYCLONE BERTHA, where the welcoming reception was cancelled and everybody was ordered to stay in their rooms as the electricity flickered. The cyclone, however, veered of the Island at the last minute. The next morning a small earthquake shook the conference centre. Julie Nicol had the pleasure of sharing a room with Maria, and was awoken in the early hours of the morning by a startled Maria, who was quite adamant the earth had moved for her! Also of note was Julie Stanton's demonstration of how an Aussie can have a good time at the banquet dinner by dancing in the pool with clothes on!

John Marshall never adjusted to local time and went through the entire conference a day ahead resulting in him arriving at the airport a full 24 hours earlier than scheduled.

Both Maria and Julie had the opportunity to visit the University of California, Riverside and Davis campuses, and to meet with the Nematology Departments at both. Most of the research at both of these campuses is focussing on population dynamics modelling and the identification and utilisation of resistance genes for both traditional breeding programs but also for genetic engineering applications. Dr Howard Ferris and co-nematologist Rob Venette (UC Davis) are involved in a project to assess the population dynamics and ecology of both plant parasitic nematodes and also free living nematodes, involved in nutrient recycling. One of their important discoveries is that that by keeping non-pathogenic free living nematode populations high, they were able to record a significant yield response, especially in their organically grown plots. The yield increase was due, on the one hand, to an increase in the breakdown of organic material in soil by free living nematodes who also play a significant role in mineralising nitrogen, and, on the other, to the finding that high populations of free living nematodes compete with plant pathogenic nematodes and suppress their numbers. Plant pathogens in the conventional tomato/wheat rotations were: root lesion nematode, *P. thornei*, and root knot nematode, *M. incognita*. Both were suppressed in plots where high numbers of free living nematodes.

The principal nematode researched in California is *Meloidogyne* (root-knot nematode). Dr Phil Roberts and co-researchers (UC Riverside) have established a highly effective laboratory screening method for root-knot nematode with tomato which may have some application to work with root lesion nematode and cereal cyst nematode. This involves growing and inoculating plants in flat plastic bags under controlled conditions with a limited amount of soil and nutrient and screening for the presence of galls. The method used is comparable with that used for CCN and root lesion nematodes in Australia, but appears to be less labour intensive and relatively time and cost effective. In addition, work by Dr Valerie Williamson and her research group (UC Davis) has used molecular biology techniques to clone the Mi gene which confers resistance to root-knot nematode. This gene was originally found in wild tomatoes and has the potential with genetic engineering to be transferred to other crops.

Julie has been working on a project with the Grape and Wine research Development Corporation to write a review of the Current Status and Future Research Directions for Grapevine Nematology in Australia. Part of this project involved attending the Conference, visiting related researchers in California, France (INRA at Rennes, Colmar and Montpellier) and South Africa (University of Stellenbosch, NIETVOORBIJ Institute for Viticulture and Oenology, INFRUITEC and UNIFRUCO). In France, much of the work in this field has been focused at producing transgenic grapevines with possible resistance to *Xiphinema index*, the vector of the grape fan leaf virus, which is a threat to both European and Californian viticultural industries. In California most of the research is focussed on the development of new rootstocks with broad based resistance to a range of nematode species, in particular to root-knot nematode. In South Africa, very little current work is being done in this field. However, in the past assessments on the resistance of rootstocks against both citrus and root-knot nematodes have been made. Currently a large review paper is being prepared by Robyn van Heeswijck (Senior Lecturer Viticulture, University of Adelaide), Julie Nicol (University of Adelaide) and Graham Stirling (Bio Crop Protection, Queensland).

Graham Stirling, Julie Nicol are currently involved in preparing a publication on "Guidelines for the operation of an advisory service for nematode pests" funded by RIRDC. Frances Reay is also involved with preparation of taxonomic diagrams. This publication is aimed to assist commercial diagnostic laboratories to sample, accurately identify and provide information for nematode management.

Frances Reay, with Prof. Heatwole, has also been busy continuing her project on terrestrial nematodes from Antarctica, funded by the North Carolina State University (Raleigh) to be completed by the end of the year. Invertebrates, including mainly rotifers, tardigrades and nematodes have been extracted from samples of soil, gravel or moss beds. Some samples are from offshore islands, but the majority are from the eastern mainland Antarctica. Nematodes are mainly free living, the most commonly found genera being *Plectus*, *Eudorylaimus* and *Scottnema*. Work on some species of *Ogma* (Criconematidae) has been submitted for publication. This includes a proposal to transfer all species of *Pateracephalanema* to *Ogma*, description of some new Australian species, and a list of species of *Ogma* recorded in Australia.

Alan McKay and the diagnostics lab made a major contribution to the lifting of a temporary ban on the export of Australian oaten hay to Japan. The ban was imposed when a shipment, with unusually heavy contamination of toxic ryegrass, caused the death of dairy calves in Japan. Now samples from all hay have to be tested and found to be free of the ARGT bacterium before export to Japan. All other South Aussie nematologists are busy pottering away and can be counted (for the want of a better word) on providing an update in the next AAN newsletter.

Julie Nicol, University of Adelaide, Department of Horticulture, Viticulture and Oenology and Maria Scurrah, South Australian Research and Development Institute

NEWS FROM QUEENSLAND

Nematology in the private sector

Recently I opted for a career change, resigning my DPI nematology position to join my wife (Marcelle) in our own business, Biological Crop Protection Pty Ltd. However, the move hasn't been as drastic as it might appear because we are leasing space within the nematology section of DPI. Thus I hope to maintain a close relationship with nematologists in Queensland and elsewhere.

As freelance researchers, we intend to specialise in soil-borne disease problems and will be involved initially in the following projects.

- HRDC project to help the Queensland pineapple industry cope with the withdrawal of EDB.
- RIRDC project to develop a nematode monitoring service for the Bundaberg vegetable industry.
- HRDC project on alternatives to methyl bromide for the tomato and capsicum industry in Bundaberg.

We also intend to provide diagnostic and advisory services in areas such as nematology, soil-borne fungal pathogens, soil microbiology, biological control and integrated pest management.

For those wishing to make contact, our new details are listed in the membership directory at the end of this issue.

Graham Stirling, Biological Crop Protection Pty Ltd., Moggill

NEWS FROM VICTORIA

Victorian Institute for Dryland Agriculture, Horsham

I'm Grant Hollaway, and have recently joined the nematology team at VIDA. I am working on the Victorian component of the Southern Region Field Crops Nematology project, a 5 year GRDC funded project. It is a collaborative project, between VIDA, SARDI and the University of Adelaide, which will conduct research into root lesion nematodes (RLN) and stem nematodes as outlined in the previous Australasian Nematology Newsletter (page 5, July 1996).

My component of the work is predominantly with *Pratylenchus thornei* and some work with *P. neglectus*. We are conducting field trials with the range of field crops grown in the Wimmera and Mallee to assess them for resistance and tolerance to RLN. We are also breeding wheat with resistance to *P. thornei*. So far my involvement in the world of nematology has involved digging holes and having my face welded to the microscope doing lots of counting. I have spent time at SARDI with Sharyn Taylor who has taught me how to identify *Pratylenchus* and some of the other nematodes.

Before this project I spent 4 years as a bacteriologist at VIDA, working on the epidemiology and control of bacterial blight of field peas. I am hoping that *Pratylenchus* are less temperamental in the field, but I doubt this will be the case.

In addition to the *Pratylenchus* work at VIDA Russell Eastwood is continuing his work on development of CCN resistant wheats using a gene from the wild species of wheat, *Triticum tauschii*. Russell completed his PhD in 1995 with a thesis titled 'Genetics of resistance to *Heterodera avenae* in *Triticum tauschii* and its transfer to bread wheat'. He is also working on the application of molecular biology to plant breeding.

Grant Holloway, Victorian Institute for Dryland Agriculture, Horsham

NEWS FROM WESTERN AUSTRALIA

Agriculture Western Australia

There have been significant changes at Agriculture WA. We are told that these are only a taste of much more to come. As from July, I have been shifted to the role of quarantine plant pathologist. Fortunately, I still maintain supervisory input to some nematology work within the agency. Dr George Yan (RO) and Mr Paul Murphy (TO) have shifted from other functions within the agency to the project on biological control of annual ryegrass toxicity.

The field evaluation of inoculants and methods for commercial-scale establishment of the biocontrol agent, *Dilophospora*, gave encouraging results in 1996. The work showed that bulk inoculum can be produced more quickly and with less handling than was expected. These improvements should greatly reduce the eventual costs to farmers. Establishment and spread, in cropped paddocks by broadcasting inoculum following crop emergence, were also better than anticipated or had been achieved in pasture paddocks. It now appears that provided *Anguina funesta* and host populations are moderate to high (situations likely to cause ARGT), *Dilophospora*, can be readily established and will spread over moderate distances within the year of application.

Preliminary examination of the effect of root lesion nematode populations on wheat production in the Esperance Mallee in 1996 provided some interesting results. The level of infestation in the roots was quite high at four of five sites. Temik gave about a ten-fold reduction in nematode numbers. Significant yield response to Temik application were recorded at two sites.

Ian Riley, Agriculture Western Australia, South Perth, WA

Research

ROOT LESION NEMATODE 1996: TOLERANCE, RESISTANCE AND MANAGEMENT STRATEGIES

Sharyn Taylor, SARDI, Waite Campus, Vivien Vanstone, University of Adelaide, Waite Campus and Andrew Ware, PISA, Minnipa Research Centre

Tolerance and yield loss were determined in field trials by comparing yields in untreated plots with plots treated with nematicide. Resistance to *Pratylenchus neglectus* was determined in field trials by assessing numbers of nematodes in soil from all plots at sowing and immediately prior to harvest. As the nematicide also acts as an insecticide, all pulse and medic varieties at field sites were sprayed with insecticide during the season to eliminate any effects of insect damage. Data are presented as either nematodes per 200 grams of soil or per gram of soil.

Cereal tolerance/yield loss

A trial was established at Sandilands on Yorke Peninsula (YP) to determine tolerance and resistance of wheat, barley, oat and triticale varieties to *P. neglectus*. Field pea, faba bean, chickpea, vetch, canola and medic varieties were also included in this trial and will be discussed in the following section. Although initial nematode numbers at the Sandilands site were low (average of one *P. neglectus* per gram of soil at sowing) a yield loss of 13-17% was observed in the most intolerant wheat varieties Machete, 11/9 and Beulah. Buckley, Franklin, Carrolup, Wallaroo, Ouyen and Yallaroi were moderately intolerant with a yield loss of 9-11%. The most tolerant cereal varieties were Excalibur, Muir, Spear, Trident, Galleon, Chebec, Yanac, Frame, Bettong and Krichauff (Table 1).

In addition to the Sandilands site, two smaller cereal tolerance trials were sown on Upper Eyre Peninsula (EP) by Andrew Ware. One site (Condada) had pure *P. neglectus* (average of three *P. neglectus* per gram of soil at sowing) and a second site (Minnipa) had high levels of *P. thornei* (average of four *P. thornei* per gram of soil at sowing). The most intolerant varieties at the Condada *P. neglectus* site were Echidna and Machete with losses of 25% and 21%, respectively. The most tolerant varieties were Excalibur, Krichauff and Schooner (Table 2). Similar rankings were obtained from the Sandilands site, although some exceptions did occur, with Tahara and Echidna having higher yield loss on Eyre Peninsula. Sites and seasonal conditions will affect magnitude of yield loss caused by nematodes.

The most intolerant variety at the *P. thornei* site was Stiletto with a loss of 14%. Barunga Excalibur, Frame and Krichauff were moderately intolerant. Echidna, Tahara, Potoroo, Chebec and Schooner appeared most tolerant (Table 2). Although Machete appeared tolerant in this trial, previous research has indicated this variety is intolerant to *P. thornei*. These rankings were different to those obtained for *P. neglectus*, indicating the variation in tolerance response to the nematode species.

Pulse, oilseed and medic tolerance/yield loss

Some varieties of canola were intolerant, with visual responses observed early in the season, and yield losses of 28% in Karoo and 10% in Rainbow. Narendra, Oscar, the breeders' lines BLN800 and BLN900 and Hyola 42 were more tolerant (Table 3).

Although pulses were sprayed for Heliothis, a heavy infestation still occurred and yield losses may have been over-estimated especially for faba beans, chickpeas, peas and vetch. The yields of chickpeas were very low at this site, because of contamination with regenerating medic. For these reasons all pulses require further investigation.

Table 1. Yield loss in cereal varieties caused by *P. neglectus*, Sandilands, Yorke Peninsula, 1996 (pre-sowing 1 nematode/g soil).

Crop	Variety	Untreated yield (t/ha)	Yield loss (%)	Crop	Variety	Untreated yield (t/ha)	Yield loss (%)
Wheat	Machete	3.1	17	Triticale	Tahara	3.4	6
Wheat	11/9	3.5	14	Oat	Euro	3.6	5
Wheat	Beulah	3.4	13	Wheat	Janz	3.8	4
Wheat	Buckley	4.1	11	Triticale	Abacus	3.4	4
Barley	Franklin	3.8	11	Oat	Potoroo	4.1	4
Oat	Carrolup	3.2	11	Wheat	Excalibur	3.8	3
Oat	Wallaroo	2.6	10	Triticale	Muir	3.2	3
Wheat	Ouyen	3.6	9	Wheat	Spear	4.2	2
Durum	Yallaroi	3.2	9	Wheat	Trident	3.6	0
Barley	Schooner	3.4	8	Barley	Galleon	3.8	0
Oat	Echidna	3.6	7	Barley	Chebec	3.6	0
Oat	Bandicoot	2.5	7	Wheat	Yanac	3.2	0
Wheat	Bowie	3.6	7	Wheat	Frame	3.9	0
Wheat	Barunga	2.9	7	Oat	Bettong	3.4	0
Wheat	Tatiara	3.5	6	Wheat	Krichauff	4.1	0

Table 2. Yield loss caused by *P. neglectus* (pre-sowing 3 nematodes/g soil) and *P. thornei* (pre-sowing 4 nematodes/g soil), Upper Eyre Peninsula, 1996.

	P. thornei (Minnipa)		*P. neglectus* (Condada)	
Variety	Untreated yield (t/ha)	Yield loss (%)	Untreated yield (t/ha)	Yield loss (%)
Echidna	1.5	0	1.1	25
Machete	1.2	1	1.1	21
Janz	1.3	5	1.2	17
Tahara	1.3	0	1.3	14
Stiletto	1.2	14	1.5	11
Chebec	1.2	0	1.3	11
BT Schomburgk	1.3	2	1.3	10
Euro	1.5	5	1.4	9
Potoroo	1.7	0	1.5	7
Frame	1.3	8	1.5	6
Barunga	1.2	9	1.3	5
Excalibur	1.4	9	1.5	5
Krichauff	1.3	7	1.6	4
Schooner	1.5	0	1.6	1

Table 3. Yield loss in pulse, oilseed and medic varieties caused by *P. neglectus*, Sandilands, Yorke Peninsula, 1996 (pre-sowing 1 nematode/g soil).

Crop	Variety	Untreated yield (t/ha)	Yield loss (%)	Crop	Variety	Untreated yield (t/ha)	Yield loss (%)
Chickpea	Amethyst	0.3	43	Canola	Oscar	1.7	6
Chickpea	Tyson	0.7	37	Chickpea	Kaniva	1.0	5
Faba bean	Ascot	2.2	28	Canola	BLN800	1.5	5
Canola	Karoo	1.1	27	Canola	BLN900	1.7	5
Vetch	Languedoc	1.7	17	Pea	Early Dun	2.5	3
Pea	Bluey	1.4	16	Pea	Alma	2.5	2
Chickpea	Desavic	0.8	14	Pea	Glenroy	1.8	0
Canola	Rainbow	1.4	10	Chickpea	Dooen	0.6	0
Pea	Laura	1.8	10	Canola	Hyola 42	1.7	0
Faba bean	Fiord	2.8	9	Pea	Bonzer	2.0	0
Canola	Dunkeld	1.5	8	Pea	Dundale	2.4	0
Vetch	Blanchefleur	1.5	7	Vetch	Popany	1.1	0
Canola	Narendra	1.5	7	Faba bean	Icarus	1.7	0

Cereal resistance

Nine wheat varieties were sampled in September/October from SARDI Field Crop Evaluation Secondary and Waite Wheat Breeding trials. Four sites were assessed for *P. neglectus* and one for *P. thornei*. Rankings at these sites were similar to those obtained for the Sandilands and Condada sites (Figure 3a). Excalibur, 11/9, Krichauff and RAC655 contained significantly fewer nematodes than Spear or Machete: 64% fewer *P. neglectus* (Figure 1a) and 58% fewer *P. thornei* (Figure 1b). *P. thornei* numbers were much higher than those for *P. neglectus*.

Figure 1a. Multiplication of *P. neglectus* on wheat (data from 5 reps at four sites: Streaky Bay, Minnipa, Kalanbi, Walker Flat). LSD 5% = 4.7

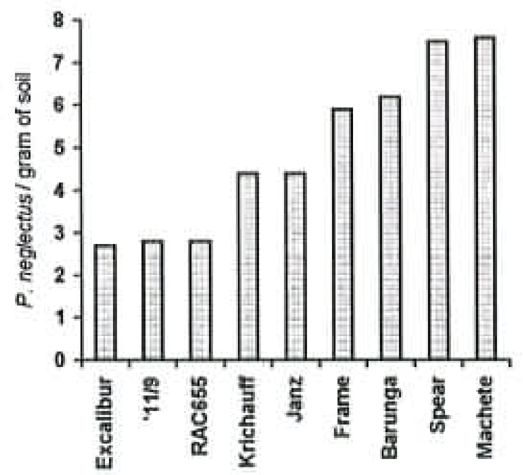
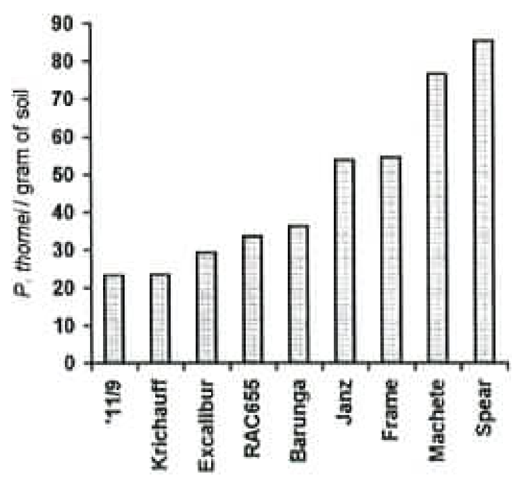
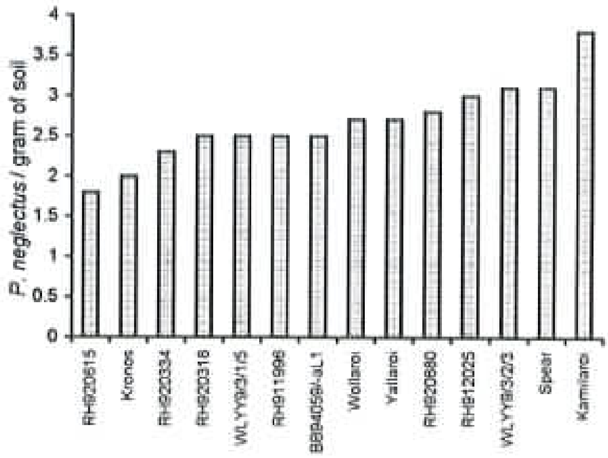


Figure 1b. Multiplication of *P. thornei* on wheat (data for 5 reps at one site: Nunjikompita). LSD 5% = 36.1



Durum varieties and lines from trials established by Brenton Brooks (Waite Wheat Breeding) were assessed for *P. neglectus* at three sites (Walker Flat, Roseworthy, Minnipa) in September/ October, and values compared with Spear. Durums were similar to Spear, although Kamilaroi contained significantly more nematodes (Figure 2). All varieties hosted similar numbers of nematodes, although further testing is required.

Figure 2. Multiplication of *P. neglectus* on durum wheat (4 reps at 3 sites). LSD5% = 1.9



At the Sandilands site, initial *P. neglectus* numbers were low. Most varieties showed relatively low rates of nematode multiplication and many appeared to reduce *P. neglectus* numbers from the initial level of one nematode per gram of soil. In general the wheat varieties were the most susceptible, followed by oat and barley varieties. Excalibur and Krichauff wheat and Abacus, Muir and Tahara triticale were the most resistant varieties tested. Rankings from the Condada site were very similar but final nematode levels were much higher (Figure 3a). These rankings support previous research by Vanstone. Samples from the *P. thornei* site are still to be assessed.

Pulse, oilseed and medic resistance

Most pulse, oilseed and medic varieties showed low rates of nematode multiplication at the Sandilands site. Chickpea and canola varieties were the most susceptible: Desavic supported the highest nematode population, which was equivalent to the highest multiplication in the cereals (Buckley). Of the canola varieties, Hyola 42 had the lowest yield loss (Table 3) but was the most susceptible (Figure 3b) indicating that it is very tolerant. Canola plots will be re-sampled at the start of the 1997 season to determine if nematode levels have decreased over summer as a result of possible biofumigation action of canola roots and stubble break down. Vetch, pea and faba bean varieties were more resistant. With the exception of the medics, these field data support pot tests by Vanstone, indicating that canola, chickpea and vetch are more susceptible than pea or faba bean. Numbers obtained from medics at this site were lower than indicated from previous data, so further field tests are required.

Rotations and management

Rotation trials at Lameroo and Pinnaroo (established by Trent Potter, SARDI, Struan) were assessed for *P. neglectus*. Chebec barley and Janz wheat were sampled following a range of rotational crops. Cereal grown after faba bean, pea or peaola (poorer hosts to *P. neglectus*) was infected with 49% fewer nematodes than cereal after medic, chickpea or vetch (which are better hosts). The previous crop had more effect on nematode numbers in the wheat than in the barley, probably as Janz is more susceptible than Chebec (Figure 3a). Final samples from two rotation/tillage trials and two tillage/fertiliser trials on EP are yet to be assessed.

In a *P. thornei* trial and a *P. neglectus* trial on EP, the application of high rates of phosphorus (50kg P/ha) to Machete significantly reduced the magnitude of yield loss caused by the nematodes. At the *P. thornei* site, very high levels of nematodes (pre-sowing 33/gram of soil) caused a yield loss of 33%, which was reduced to 14% (significant at 5% level) with the

Figure 3a. Multiplication of *P. neglectus* on cereals, Sandilands (YP) and Upper Eyre Peninsula, 1996. (Sandilands mean of 2 replicates, Eyre Peninsula mean of 6 replicates).

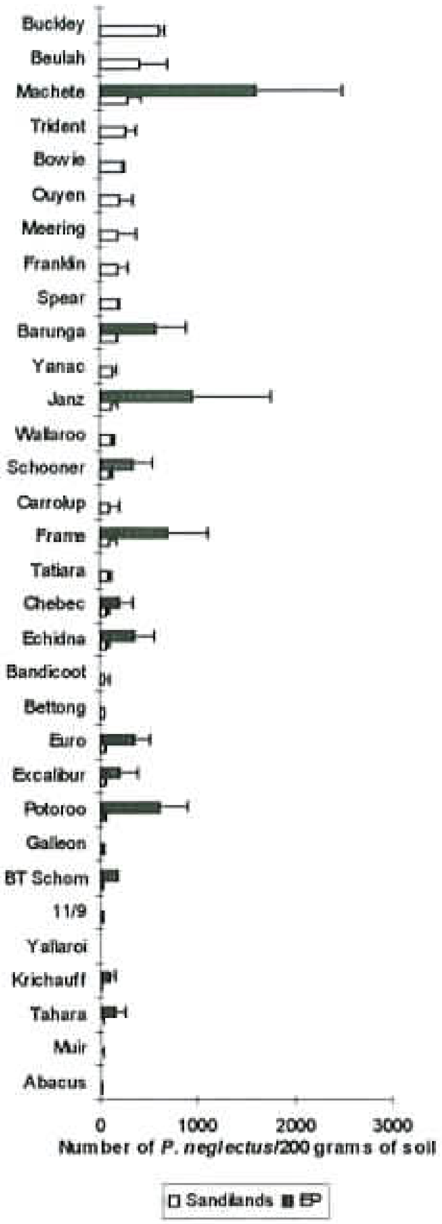
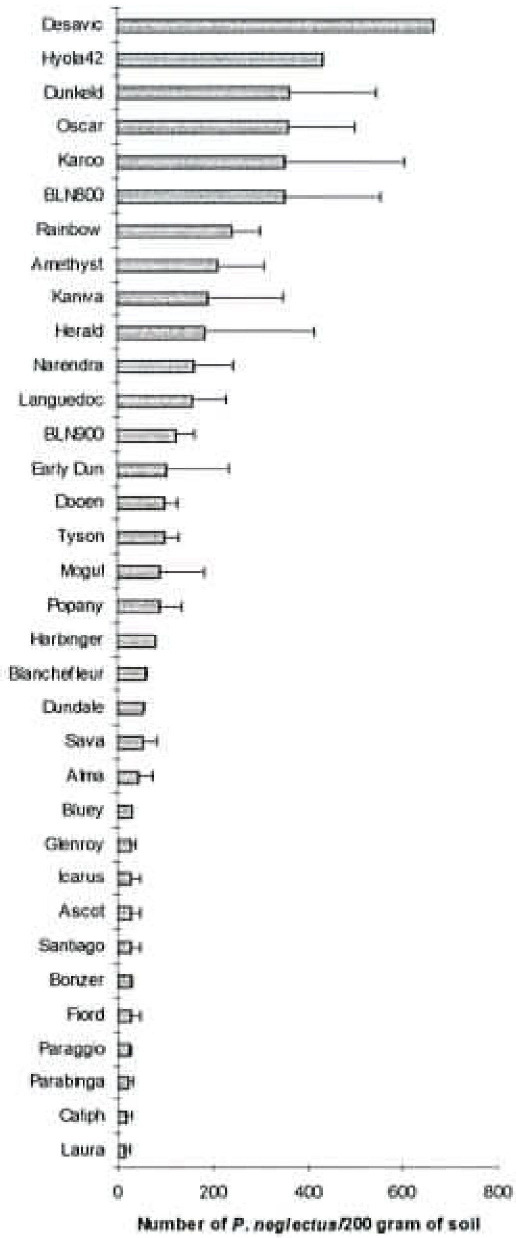


Figure 3b. Multiplication of *P. neglectus* on pulses, oilseeds and medics, Sandilands, 1996. (Mean of 2 replicates; data for Desavic and Hyola 42 based on one replicate only).



application of high phosphorus. *P. neglectus* (pre-sowing 1/gram of soil) caused a 12% yield loss which was reduced to 6% (significant at 5% level) with the application of high phosphorus.

Conclusions

- Krichauff, Excalibur and triticales are consistently both more tolerant and more resistant to *P. neglectus* than other cereals in field trials.
- 11/9 appears to be more resistant to *P. neglectus*, although may be relatively intolerant.
- Franklin is more susceptible and more intolerant to *P. neglectus* than other barley varieties.

- Frame, Galleon and Chebec appear tolerant to *P. neglectus* and are recommended where CCN is a problem.
- Desavic chickpea and canola varieties appear more susceptible to *P. neglectus* (although further information on the potential of canola as a biofumigant is required).
- For *P. neglectus*, Karoo was the most intolerant canola and Hyola 42 was the most tolerant.
- Faba bean and pea varieties are more resistant to *P. neglectus* than other crops.

Acknowledgments

This work is supported financially by the Grains Research and Development Corporation. Trials on EP were established, managed and sampled by Andrew Ware and staff at Minnipa Research Centre. Allan Mayfield managed and harvested the trial at Sandilands. The Waite Wheat Breeding Unit assisted with cereal trials, and some samples were assessed from SARDI Field Crop Evaluation trials on EP. Finally, we sincerely thank the many farmers who make land available for field trials.

SUMMARIES OF PROJECT REPORTS

Graham Stirling, DPI, Indooroopilly

During the last six months I have written final reports of four projects that were completed this year. The following summaries have been extracted from those reports and may be of interest to AAN members.

HRDC project VG216/VG501 *Development of sustainable strategies for managing root-knot nematodes.*

A survey of planting material used by the Queensland ginger industry showed that 13 out of 17 seed samples were infested with root-knot nematode. Generally, less than 20% of the seed pieces in a sample were infested, but in four samples, levels of infestation were 25%, 30%, 54% and 86%. Observations in a field where both nematode-free and nematode infested ginger was used suggested that nematodes multiplied more quickly and caused more damage where infested seed had been planted. Data collected during this project confirmed that hot water treatment (48°C for 20 minutes) eradicated nematodes from seed. Nematode-free seed was also produced by growing ginger in a layer of sawdust mulch and discarding the portion of the rhizome that was in contact with soil.

Field experiments were established on a well-structured clay loam soil to investigate the potential of crop rotation and organic amendments for controlling root-knot nematode. In an experiment in which early harvest ginger was grown for three successive years, root-knot nematode populations remained low and caused no damage in the first crop, which followed two years of green panic (*Panicum maximum*). Nematode damage was observed in the second and third crop, but the severity of symptoms on rhizomes was reduced by amendments containing poultry manure and/or sawdust. However, the best control was achieved with a nematicide program involving pre-plant fumigation with EDB and post-plant sprays of fenamiphos. When late harvest ginger was grown in rotation with a green manure crop, populations of root-knot nematode were lower following forage sorghum (*Sorghum bicolor* x *sudanense*) cv. Jumbo than following lablab (*Dolichos lablab*) cv. Highworth. Nematode damage was never severe in the ginger/forage sorghum rotation and several poultry manure and sawdust treatments reduced nematode populations and nematode damage to the same extent as nematicides.

These results suggest that non-chemical control of root-knot nematode can be achieved with clean planting material, crop rotation and the use of large quantities of organic matter (eg. at least 150 m^3/ha/annum of sawdust and poultry manure). However, nematode populations increase to high densities when successive ginger crops are grown and in this situation, nematicides are needed to achieve satisfactory control.

HRDC project FR217/FR504 *Management of nematodes on pineapples.*

Root-knot nematode (*Meloidogyne javanica*) can cause serious crop losses in pineapple and nematicides are used throughout the Queensland pineapple industry as an insurance against losses. However, nematodes do not cause damage in all fields, which suggests that it may be possible to use nematode population assessments to predict the need for nematicides. This project aimed to establish the sampling procedures required to obtain good estimates of nematode population density, to provide data on economic thresholds for root-knot nematode on pineapple and to examine the feasibility of establishing a nematode monitoring service for the pineapple industry.

The variability in nematode distribution was studied by collecting 120 individual cores on a 5m x 5m grid from two pineapple fields. Nematodes in each sample were counted. Analyses of data showed that the ratio of the variance to the mean was much greater than one, indicating a clumped rather than random nematode distribution. Distributions for most nematode species did not differ significantly from a negative binomial. Because populations were highly clumped, the number of cores required for a reasonable estimate of nematode density was relatively high. For example, to obtain a precision (standard error to mean ratio) of 0.3 for root-knot nematode, 41 and 72 cores were needed from each of the fields. This indicates that to obtain a reliable indication of the nematode status of a particular field, samples must consist of a composite of at least 50 cores.

The relationship between nematode population densities and yield was studied in field trials on sandy loam and clay loam soils. A range of nematode population densities was established by multiplying root-knot nematodes on tomato in the glasshouse and inoculating them into soil prior to planting. Data collected 9-15 months after planting showed that the initial differences in nematode density had been maintained. Yields in the plant crop were similar, regardless of nematode population density but fewer than 10 nematodes/200ml soil at 12-15 months reduced ratoon crop yields by about 10%. Severe losses in the ratoon crop (ie. more than 25% reduction in yields) were observed when population densities at 12 months were greater than about 50 nematodes/200ml soil.

To determine whether useful information on nematode populations in pineapple fields could be obtained by taking a limited number of samples during the crop cycle, 20 fields were sampled at four critical times in each crop: prior to planting; 10-15 months after planting; plant crop harvest; and at the end of the ratoon crop. Sampling continued for three years and in 18 of the 20 fields, the data proved useful as a management tool. However, in one field, a developing nematode problem was not detected because of an uneven distribution of nematodes within the field. In another field, responses to nematicides were obtained in a field where treatment was not recommended, suggesting that the preliminary damage threshold used in this pilot study (20 nematodes/200ml soil at 12 months) was too high. Alternatively, the nematicide may have provided temporary suppression of white grubs, which were also feeding on roots in this field.

Results from this project have been used to revise economic thresholds for root-knot nematode on pineapple. This information, together with data on responses to nematicides in soils with a range of nematode densities has been used to develop a prototype of an expert system which will help technical personnel interpret the results of nematode analyses. This computer-based program has the potential to improve the value of any nematode monitoring service that is developed for the pineapple industry, but its utility is yet to be confirmed under field conditions.

During the development of the expert system, it was apparent that the knowledge base that was used to construct it was inadequate, particularly with regard to data on the effects of the physical and biological environment on nematode populations and damage. Soil texture and pests and pathogens such as white grubs and *Phytophthora* are some of the important factors which interact with nematodes and these interactions will have to be better understood if the expert system is to be improved.

HRDC project VG324; Crop Care bionematicide project. *Development of commercial formulations containing nematophagous fungi for biological control of root-knot nematode.*

This collaborative project between Queensland Department of Primary Industries and Crop Care Australasia Pty Ltd had the following objectives:

- select Australian isolates of nematophagous fungi with potential for development as biological control agents against root-knot nematodes (*Meloidogyne* spp.)
- develop methods of mass producing these isolates by liquid fermentation in commercially acceptable media.
- formulate the fungal biomass produced in a fermenter into a granular product with good handling characteristics and long-term viability in storage.
- test the efficacy of formulated biological products in controlling root-knot nematode on tomato.
- develop improved methods of monitoring nematophagous fungi following their introduction to soil.

Isolates of both egg-parasitic and nematode-trapping fungi were screened for activity against root-knot nematodes. Some isolates of both *Verticillium chlamydosporium* and *Paecilomyces lilacinus* showed consistent parasitic activity against eggs in screening tests. Because of concern about the health risks possibly associated with the latter fungus, *V. chlamydosporium* isolate LS53 was chosen for further study. In screening tests with the nematode-trapping fungi, two isolates were identified that warranted further attention: *Arthrobotrys dactyloides* A4 and a fungus initially identified as *Dactylella candida* but later found to be a new species. When later studies showed that *A. dactyloides* consistently out-performed *D. candida*, work was concentrated on the former species.

Studies using shake culture and a fermenter showed that both *V. chlamydosporium* and *A. dactyloides* could be mass produced in quantities that suggested it was feasible to use them as biological control agents. The fungi grew readily in media containing commercially available, low-cost ingredients such as cotton seed meal, soybean meal, glucose and corn steep powder. Biomass of *V. chlamydosporium* consisted of mycelium and conidia and contained no chlamydospores, while biomass of *A. dactyloides* consisted largely of mycelium.

When biomass of *V. chlamydosporium* was mixed with a carrier (kaolin and finely ground vermiculite) and a binder (gum arabic), granulated and dried to a moisture content of less than 2%, a biologically active granular product suitable for application to soil was produced. The granules were 100% viable and retained their viability on storage in vacuum sealed plastic bags at 25°C for 18 months. Similar formulations containing *A. dactyloides* showed poor viability and a solid phase incubation step following granulation and prior to drying was necessary to achieve satisfactory formulations.

Experiments in the glasshouse showed that when formulations of *V. chlamydosporium* were added to soil, population densities of the fungus were increased and 30-70% of the first generation egg masses produced by *Meloidogyne* were parasitised. However, in the field, *V. chlamydosporium* parasitised few eggs early in the season and did not reduce galling or nematode populations at harvest. Formulations containing *A. dactyloides* were more effective. In soil microcosms, numbers of *Meloidogyne* juveniles were generally reduced by more than 80% and in ten successive glasshouse experiments, the number of galls induced by the nematode on tomato was reduced by 57-96%. In seven field experiments, granules applied at 220-440 kg/ha reduced the number of nematodes invading roots early in the season by about 80%.

Molecular studies of *A. dactyloides* have shown that isolate A4 has unique regions of DNA which make it possible to differentiate it from other isolates of the same species. Work on these unique regions of the genome is continuing, with the aim of designing PCR primers which will distinguish isolate A4 from other isolates of the same species and *A. dactyloides* from other species of nematode-trapping fungi. This work should lead to the development of isolate-specific molecular techniques which could be used to monitor the fungus following its introduction into soil.

Although this project did not achieve its ultimate aim of producing a biological product that could be promoted as an alternative to organophosphate and carbamate nematicides, considerable progress was made. When used at application rates of less than 500 kg/ha, formulations of *A. dactyloides* showed greater activity than has been achieved with any other biological control product for nematodes. Since the formulations used in this study were relatively crude and other recent studies with alginate formulations have shown that more active products can be made, there is considerable potential to improve biological activity and/or decrease application rates. Since this study showed that tomato is relatively tolerant of nematode damage under the crop management systems used in Queensland, it is likely that the production levels now achieved with nematicides will eventually be achievable using biological control.

HRDC project HG301/HG602; RIRDC project DAQ-152A. *Nematode control with organic amendments and rotation crops.*

Root-knot nematodes (*Meloidogyne* spp) are a major problem on many horticultural and vegetable crops and many growers routinely apply nematicides as an insurance against crop losses. Since these chemical control strategies are now at risk because of concerns about the health and environmental risks posed by nematicides, this project investigated the potential of using crop rotation and organic amendments for nematode control.

Approximately 240 accessions of 73 crops were screened for resistance to *Meloidogyne javanica, M. incognita* (races 1 and 2), *M. arenaria* (race 2) and *M. hapla*, the four most common root-knot nematode species in Australia. In the first stage of the screening process two replicates of each accession were inoculated with three nematode species and the level of reproduction was measured by counting the number of eggs produced after about 8 weeks. The most resistant material was then re-examined in well-replicated experiments containing all five nematodes. The results indicated that almost half the crops tested contained accessions that were resistant to at least one species of *Meloidogyne*. Accessions of most crops exhibited a similar level of resistance to all *Meloidogyne* spp., but there were important exceptions. For example, *Capsicum* was only susceptible to *M. incognita*. In some crops (eg. *Setaria, Avena, Sorghum* and *Zea)*, some accessions were resistant and others susceptible, while in other crops, all accessions were either resistant (eg. *Arachis, Brachiaria, Chloris* and *Panicum)* or susceptible (eg. *Phaseolus, Vicia* and *Vigna)*.

Results of field experiments clearly showed the value of crop rotation as a management tool for root-knot nematodes. Zucchini was not heavily galled when it was planted following relatively resistant crops such as forage sorghum, pinto peanut and watermelon but heavy losses from nematodes were experienced following susceptible crops such as maize and sweetcorn.

Previous research has shown that suppression to nematodes can be induced by stimulating microbial activity through the addition of organic materials to soil. This study aimed to determine whether measurements of soil microbial status could be used to predict antagonistic effects on nematodes. A range of organically amended and non-amended soils from home gardens, organic farms and field experiments were bioassayed for suppressiveness to root-knot nematode, while their biological status was also determined by measuring % organic carbon, microbial biomass and microbial activity. The results showed that some soils were suppressive to nematodes and that there was a significant relationship between the microbial activity of soil and suppressiveness. These results therefore suggest that it might eventually be possible to measure specific soil parameters and determine whether a soil is biologically active enough to provide some control of nematodes.

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Root lesion nematode tolerance breeding
Pratylenchus sp.

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Host parasite relations of endoparasites (root-knot and cyst-nematodes); Molecular approaches to understanding and control -emphasis on plant response

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Entomopathogenic nematodes
Plant-parasitic nematodes

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Cereal cyst nematode - control and Resistance

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Entomophilic nematodes

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Advice/sales and application of nematicides

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General plant nematology
Biocontrol

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Biology and management of nematodes in temperate crops
Molecular biology of nematodes

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Nematode counting and diagnosis for research trials

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Annual ryegrass toxicity

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Diagnosis, information systems, control strategies

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Resistance in white clover to *M. hapla* and *H. trifolii*
Resistance in clover hybrids
Effect of grass endophytes on nematodes

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PCN
Nematodes of horticultural crops

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PhD Research
Hoplolaimus columbus on cotton-USA
Quarantine issues
Pasture Nematology in New Zealand

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Significance of *P. thornei* on wheat productivity in South Australia

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Interaction of grapevines and *Meloidogyne* spp

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General interest in nematology and biological control

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Pratylenchus thornei in wheat
Nematodes of bananas and tropical fruits

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Root Knot and cyst Nematodes
Giant cell gene expression
Engineered resistance

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Taxonomy of plant parasitic nematodes
nematode distribution in native vegetation
Taxonomy of Dorylaimidia

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Anguina and associated microbes
Biological control of annual ryegrass toxicity

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Chemical control, taxonomy, biological control, host ranges and nematode disease complexes

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Pratylenchus neglectus - does it damage wheat?
Ditylenchus dipsaci - resistance in oats, beans, peas, lucerne
Ex-interest: PCN - races and breeding

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Molecular diagnosis of *Meloidogyne*
Non chemical control of *Meloidogyne* and *Radopholus similis*

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General plant nematology
Biological control

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Pratylenchus spp.
Meloidogyne spp.
CCN

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Pratylenchus spp.
Cereals
Grain legumes
Annual legumes

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Dr John P. **Thompson**
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Pratylenchus thornei and *Merlinius breviden*
Identification of nematodes
Control methods, especially through resistance breeding

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Biological, chemical and cultural control of nematodes

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Pratylenchus neglectus ,biology control, crop rotations
Cereals and legumes

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Nematode problems in horticultural crops
Biocontrol - root knot
Chemical control

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Plant nematology, especially in horticulture
Control
Interactions
Diagnostic services and extension
Ecology
Pasture Pathology

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Pasture nematology; biocontrol; bionomics; managerial control; plant improvements

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Biological control, rotation crops resistant to root knot nematode, organic matter to control root knot nematode

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Environmental physiology of cold tolerance and anhydrobiosis
Nematode ultrastructure

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Development and production of bionematicides

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Ecology
Taxonomy