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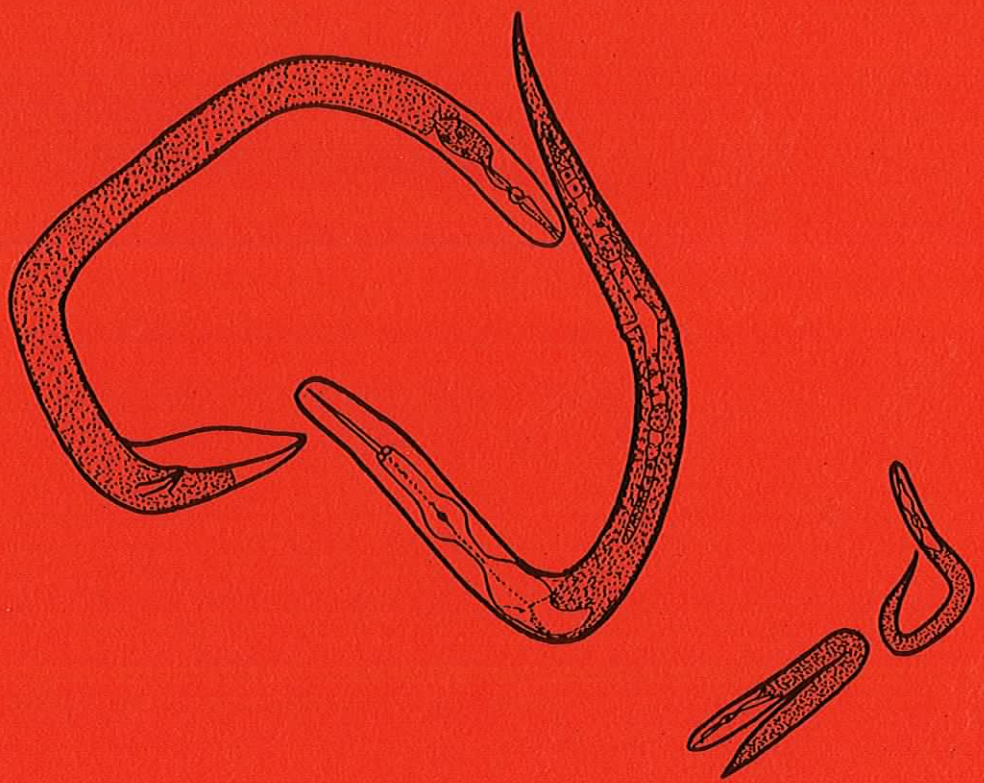
AUSTRALASIAN NEMATOLOGY NEWSLETTER



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From the Editor

Thank you to all those who made contributions to this newsletter. We have ended up with another thick volume to enjoy. Welcome to the following new members; Barry Conde, Rex Pitkethley, Deborah Carrington, Primo Aceret and Jennifer Cobon. Some members have not brought their membership subscription up to date and a further reminder will be sent in early 1999.

July Issue

The deadline for the July issue is June 20. I will notify you a month in advance so please have your material ready once again.

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Association News

FROM THE PRESIDENT

1999 Workshop

We are planning the next nematology workshop to be held in conjunction with the APPS conference in Canberra from 27 September - 1 October 1999. Mike Hodda has kindly agreed to coordinate the event and will give us further details via the Final Circular for conference and the next AAN newsletter. It will involve a half-day workshop on "Molecular diagnostics" by John Curran, together with a half day on "Nematode identification" by Mike.

AAN web site

AAN is on the Web!! QDPI is hosting the site at

http://www.dpi.qld.gov.au/nematode/aan/

The site includes information about AAN, newsletters and links to other useful sites. I have asked several other nematology sites to list ours so that it might be visited more often. The pages are not works of art! QDPI prescribes a format which prevents too much self-expression. Also, I did not want too many graphics to slow down access. Nevertheless, I am open to any suggestions about how the site could be improved. So ... have a look and let me know what you think.

Quarantine

A quarantine issue was raised at the AGM in Perth. The concern was that only seven nematode species were listed by AQIS as being of quarantine importance even though many more species are still absent from Australia. The meeting decided that AAN would prepare a list of those species which have not been recorded in Australia but which may pose a threat. Since that time, however, AQIS has changed its policy to exclude all nematode species.

Protocols for nematology laboratories

This book by Graham Stirling, Julie Nicol and Frances Reay entitled "Guidelines for the operation of advisory services for nematode pests" is available from RIRDC for $10 per copy.

Happy 1999!!

Julie Stanton, QDPI Indooroopilly.

NEW JOURNAL PUBLISHED

Recently a merger of two established journals in the field of nematological research took place. From 1st January 1999, Fundamental and Applied Nematology (published by Elsevier Science, Paris and ORSTOM) and Nematologica (published by Brill Academic Publishers in association with The European Society of Nematologists) will form a new journal.

NEMATOLOGY

International Journal of Fundamental and Applied Nematology

The scientific content of the new journal will be the responsibility of Dr Roger Cook and Dr Pierre Baujard, the two Editors-in-Chief, previously responsible for the individual journals. They will be supported by a Board of Associate Editors and Editors of recognised specialists within the subject

Nematology will be the principal journal for all areas of research on nematodes. It will also be the most important international journal. Its present strength and future standing is acknowledged by its continuing associations with the European Society of Nematologists and the French international research organisation, ORSTOM.

The formation of this new journal on nematological research offers distinct advantages:

- Easier access to important scientific papers published in the field
- More frequent publication of issues
- Rapid publication procedures "rush publication"
- Association with important, authoritative societies
- Suitable format (21 x 27 cm) for illustrations, text and tables
- 40% discount for members of the European Society of Nematology, ONTA and SON

The subscription price of Nematology will be NLG 894/US $ 511 (including Postage & Packing). This is 20% cheaper than a combined subscription to the two former journals.

For more information on this new journal Nematology you can contact:

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P.O. Box 9000
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Regional News

NEWS FROM CANBERRA
News from the ANIC Nematode collection

As usual, I open the account of news from Canberra with a report on the collection which is the basis of many of our activities here at CSIRO Entomology.

GRDC continues to support the collection, and since the last report, we have received a diverse range of nematodes: some *Pratylenchus*, including some of the apparently undescribed species, some *Helicotylenchus*, some *Meloidogyne*, and some mermithids. For those of you who have never come across these nematodes, they are large for soil nematodes (up to about 1 cm), with most juvenile stages internal parasites of insects, and adults free-living in the soil but not feeding. The stage most commonly encountered is the infective juvenile, which, after hatching, is seeking insect hosts. Under the right conditions they can be very numerous.

For a genus which is such a major pest of wheat and many other major crops, I am continually amazed at the variety of characters of *Pratylenchus* in the specimens coming into the collection. It now seems quite likely that there are species or races or pathotypes which we have not previously identified, and that we still have quite a lot to learn about the systematics of the genus *Pratylenchus*. This brings me back to the collection, and the plea to keep sending us material. It is only through building a large collection, encompassing as much geographic, host crop and seasonal variation as possible, that we can recognize previously undiagnosed problems. It is only through collections that new threats will be identified. So please, when you are finished with your nematodes, send us some specimens. They will be looked after and really will be of great use in the future.

If you want to donate material, in whatever form (fixed or unfixed, mounted on slides or not, in pure or mixed culture), please contact me at:

CSIRO Entomology

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Other research on nematodes continues with John Curran, Robin Bedding and myself all beavering away in our particular fields. John, with Felice Driver, is studying genetic relationships of plant parasitic nematodes, with continuing development of molecular diagnostics for nematodes as a priority. SARDI and VIDA are collaborating with John in testing various molecular methods. Robin continues work on identification and mass production of nematodes for insect control. I am studying nematode pests of clover, and

supervising a PhD student from Orange Agricultural Institute (University of Sydney). I am also completing my electronic key to freshwater aquatic nematodes, sponsored by ABRS. This key will be completed shortly. Anyone who would like to try a preliminary version of this key should contact me. All feedback will be very welcome. My next major systematic project will be dorylaimids, which of course includes dagger nematodes (*Xiphinema* spp.) and Longidorids (*Longidorus* and *Paralongidorus*).

Mike Hodda

Australian National Insect Collection, CSIRO Entomology

NEWS FROM QUEENSLAND

I was given the opportunity recently to travel to Cameroon to participate in a meeting of the Nematology Working Group of PRO*MUSA*. PRO*MUSA* was developed jointly by the International Network for Improvement of Banana and Plantain (INIBAP) and the World Bank to bring together, at a global level, all the major efforts in the area of banana and plantain improvement. Briefly, the aim of the program is to develop banana and plantain cultivars which are resistant to the four most important biological constraints, viz. nematodes, viruses, Fusarium and sigatoka.

Working Groups were set up for each of these pathogens to develop collaborative projects which would hopefully eventually be funded as global projects. The Nematology Working Group was given the task of first determining its composition which is in the following table. These researchers must be working specifically on the priority research needs identified by the group, and be willing and able to participate in collaborative projects and in developing new proposals.

Region	Researcher (Organisation)
Africa	Roger Fogain (CRBP), Paul Speijer, (IITA), Mieke Daneel (ITSC), Imelda Kashaija (NARO)
Central America	Maria Araya (CORBANA)/Luis Duarte (FHIA), Emilio Fernández (INIVIT)
Latin America	Da Costa (EMBRAPA), Gladys Muñera (CORPOICA)/Carmén Trivine (INIAP)
Asia	Inge van den Bergh (VASI), Gloria Molina (Univ. Los Baños), Soori (TNAU)/Sundaraja (NRCB)
Europe	Jean-Louis Sarah (CIRAD), Dirk de Waele (KUL), Simon Gowen (Univ. Reading)
Australia	Julie Stanton (QDPI)

The Working Groups were then asked to develop potential projects which would lead to the eventual goal of resistant cultivars. Because of the wide range of nematodes, banana cultivars and climates worldwide, the Nematology group decided on a consortium approach where a large problem would be tackle by many small projects throughout the world. The first of these consortia aims to screen a large number of genotypes for resistance using similar methods so that results can be compared between regions.

Such consortia may also be used in future to study intra-species nematode biodiversity and yield loss assessments.

This type of approach to tackling major global nematode problems may be applicable to other crops. It may save duplication of effort and these larger projects are often more attractive to certain donors.

Julie Stanton, QDPI/QHI Indooroopilly.

Museum specimen collection

As a museum curator it is my job to ensure specimens in my charge are cared for in the best possible way to ensure their long term viability. There are two practices commonly used with free-living or parasitic nematodes (other than those found parasitic in vertebrates) which differ from those more usually adopted for invertebrates in museum collections.

The first I mentioned in a previous note, viz. normally invertebrates in museum collections are preserved in alcohol, but in specimens of plant/soil/free-living nematodes we see gradual deterioration when stored in alcohol - even after fixation in formalin. In these specimens lipids leach into the preserving fluid and structural integrity is slowly lost leaving the specimens flaccid. Long term storage in 3% formaldehyde prevents, or at least minimises this.

The second is the use of Cobb mounts, with specimens stored in glycerine, usually ringed with paraffin wax, and sealed. In most other invertebrates, the specimens are mounted in Canada balsam. Balsam has the clear advantage of longevity - insects in amber from the Cretaceous period (80 million years bp) are still recognisable! Glycerine mounts conversely require continual monitoring and restoration. Although some specimens remain excellent in glycerine, some do degrade and become extremely transparent - they may even virtually disappear.

I need to balance my responsibilities. The cost of continual monitoring and repeated restoration, with the concomitant risks of loss from being too late or too clumsy, must be weighed up against the additional effort needed to mount in balsam, along with any advantages that the glycerine method may have. Clearly the specimens need to be of use and just as clearly most nematologists favour the glycerine method. Why?

I have just returned from a 2 month trip to the Americas which included visits to the

nematode collections at University of California, Riverside, UC, Davis, the US Department of Agriculture collections at Beltsville as well as the marine and free living nematode collections of the Smithsonian Institution, Washington.

Everywhere I asked about the advisability of the glycerine versus the balsam method for slides of nematodes. Everywhere the answer was the same. There are some minor? advantages to glycerine (quick, easy to reverse) and Cobb mounts (light, flippable), but agreed disadvantages from risks of drying and transparency. Balsam was used by the early workers and no cogent reasons for not using it were advanced. True, it is not so quick nor is it so easily reversible, and slides are not flippable for high magnifications. Recent convention seemed the main reason for glycerine - and the fact that the slides are made for the immediate and convenient use by the researcher less concerned with long term preservation.

One sobering event occurred. I was to visit the collections at Purdue University (Indiana) which, according to the survey of parasite collections done by the American Society of Parasitologists in 1982, was the largest in the USA (nearly 200,000 specimen lots including many entomophilic nematodes). I was advised not to come as lack of finances over the years had led to an inability to keep up the monitoring and restoration, i.e. proper curation had not been possible and the collection was now virtually unusable. Perhaps this was hypersensitivity, but it highlights the vulnerability of collections to neglect. If things can go wrong they will, and any means to stave off problems must be seriously considered.

At present we are doing our best to keep up with the nematode collections at the QM, and the Queensland Department of Primary Industries is generously assisting so that we may monitor and restore regularly. Is it wise or cost effective to continue this way? I believe, as restoration is required (beginning in the second half of 1999), I should gradually transfer specimens to balsam unless I receive cogent objections. I assume this option is not now too late. In future, should I insist all taxonomic collections (as opposed to working collections) be mounted in balsam prior to accession by the museums? I would much appreciate comment. I want to know what is best, but I need to have solid argument (data) to continue along the present course.

Help me.

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NEWS FROM SOUTH AUSTRALIA

Frances Reay retired from nematology at the end of 1998. She is planning to pursue a very different, much more contemplative life. Frances recently completed a revision of some Australian species of *Ogma*, and is finalising her work with Prof Hal Heatwole (North Carolina) on Antarctic nematodes.

At the University of Adelaide, a position for Lecturer in Plant and Soil Nematology (Department of Crop Protection) was advertised, and a very strong field of candidates applied. The position is for five years in the first instance, and is jointly funded by GRDC and the University. It was offered to Dr. Ian Riley, and we look forward to welcoming him to Adelaide in January, 1999.

Ian's arrival will allow Kerrie Davies to retire and concentrate on work on *Fergusobia*.

Valerie Kempster continues work on her Ph.D. project. She has been able to show that induced systemic resistance (IRS) does occur in white clover, and that its induction leads to significant reductions in fecundity of *Heterodera trifolii*. She was successful in obtaining a travel grant from RIRDC, and presented her findings at the joint APS/ESA Conference in Las Vegas, U.S.A., in November, 1998.

Mark Potter (jointly supervised by Kerrie Davies, Tony Rathjen and Vivien Vanstone) has been awarded his Ph.D. In his project, he examined the potential of *Brassica* tissues for suppression of *Pratylenchus neglectus*. He also looked at the potential for selection to breed new strains of canola with elevated levels of glucosinolates, which break down to the isothiocynates responsible for suppression. His thesis is summarised elsewhere in this issue.

Andreas Hensel, Terry Bertozzi and Sharyn Taylor are all approaching the end of their Ph.D. projects. Andreas has been examining the interactions between *Rhabditis necromena*, bacteria and the black Portuguese millipede. Terry has been working on the biology, taxonomy and management of the flood plains staggers, which involves *Anguina*, bacteria, grasses and stock. He is now writing up 'the hard way', having moved from the nematode project to one (with Prof. Margaret Sedgely in the Department of Horticulture, Viticulture and Oenology) on viruses of almonds. Sharyn is also writing up her work with *P. neglectus*.

Thanks to a travel grant from GRDC and RIRDC, Suzanne Charwat attended the European Society of Nematologists Meeting in Dundee in August, where she presented a paper. While in Europe, she visited David Glen at Long Ashton Research Station, Bristol and Bernhard Speiser at the Institute for Organic Agriculture in Frick, Switzerland. Both David and Bernhard are part of an EC project for novel methods of slug control and involved in the research and development of *Phasmarhabditis hermaphrodita*, a commercially available nematode for biocontrol of slugs. In Europe, Suzanne learnt that nematodes for biocontrol are sold at prices which make them economic non-starters for broad-acre cropping.

Suzanne came back to Australia to complete her final field trials to assess the potential of a locally isolated rhabditid (XM13) as a biocontrol agent of helicid snails. XM13 kills adult helicid snails in soil-based laboratory bioassays. Her 1998 trials examined both adult mortality and the possible reduction of snail fecundity during breeding and oviposition in soil containing XM13. In the lab, Suzanne showed that snails on soil with low numbers of the nematode had greatly reduced fecundity (number of egg clusters/snail and number of eggs/cluster) and that newly hatched snails were very susceptible to the nematode. In the field, XM13 does not kill significant numbers of adult helicids. Unfortunately, there were much lower than expected numbers of newly hatched snails in all treatments (controls as well as plots to which XM13 was added), probably due to the natural presence of a rhabditid nematode in the field which was found attacking and killing the very young snails. This is a nematode which we had not previously seen. Thus, it seems that while inundative applications of nematodes for control of snails is likely to be too expensive for broad-acre cropping, farming methods which encourage populations of bacterial-feeding nematodes may help to reduce the numbers of young snails developing in the field.

Kerrie Davies, University of Adelaide.

NEWS FROM NEW SOUTH WALES

The Sydney based nematologists have had a great 6 months for meetings, conferences and symposia. In July, I drove over to Macquarie University to hear Alamgir Khan's talk at his department's seminar meeting. An impressive selection of biochemistry was presented and it looks like his work on the biocontrol of CCN and *Meloidogyne* by *Paecilomyces lilacinus* is coming along very well. Rita Holland, Alamgir and I had a very pleasant lunch, over which Alamgir and I discussed our travel plans for the International Symposium of Nematologists in Dundee, Scotland in August.

We arrived in Scotland to the sound of bagpipes, and the bagpipes did not appear to stop for the next two weeks. Dundee was a terrific location for the symposia (close to distilleries, castles, the countryside where they grow the barley for the whisky and of course the terrific lecture facilities at the University of Dundee). The organisation committee worked non-stop to ensure our every question was answered and that we could pronounce "worms" properly with a thick Scottish brogue. The symposia were very friendly meetings and well balanced (almost equal time allowed for presentations and socialising). A highlight of the meetings was hearing the work of Valerie Williamson *et al.* on characterising and cloning the Mi gene for resistance in tomato. The poster sessions and talks were varied and the meeting was a terrific opportunity to see the enormous impact of nematode damage to agriculture worldwide.

After Dundee, I travelled back to Edinburgh for the largest meeting of my life - the International Congress of Plant Pathology. The congress had it all, brand new venue, royalty, security guards with a mission to protect the rest of society from the potential evils of plant pathologists, bagpipers (more!) and the most comprehensive, up-to-date

array of topics in plant pathology. The highlight of the Congress, for me, was the terrific symposia on systemic induced resistance in which the latest and most exciting research was presented. The poster sessions were so large they were held in several venues (including a sauna cleverly disguised as a marquee with eerie sloping floors) and there were strict timetables for poster check-in and departures. I met the leaders in systemic induced resistance research at my poster and had terrific discussions on all aspects of my work. Thanks must go to the International Society of Plant Pathology for helping with funding for travel and registration. Scotland was a wonderful interruption to my thesis, which is now in its final stages and should be finished soon.

Kirsty Owen, Department of Crop Sciences, University of Sydney.

NEWS FROM NEW ZEALAND

Gregor Yeates has been made a Fellow of the Royal Society of New Zealand - a rare honour for a nematologist!

The following is a report from Prof. John Barrett from the Institute of Biological Sciences, University of Wales, Aberystwyth. It describes the work we did during the 3 months or so he spent with me on study leave. I am now continuing this work in collaboration with our Biochemistry Department.

After nearly three months in Dunedin, it is now time to return to a second winter and the start of term in Wales. During the visit, David and I have been trying to characterise the thermal hysteresis protein (antifreeze protein) from an antarctic nematode *Panagrolaimus davidi*. This nematode has the unique ability to survive intracellular freezing and previous work by David had shown that they did indeed contain an antifreeze protein. After perfecting the 'splat freezing assay' and some abortive attempts at making affinity columns out of ice, we have been able to show that the nematode protein has an activity comparable to that of insect antifreeze proteins. It has a molecular weight of approximately 30kDa; it is not a glycoprotein and is active over a wide pH range. The best characterised antifreeze proteins are of course those from antarctic fish, which show a thermal hysteresis of 1 to 1.5°C. At least five different classes of antifreeze proteins occur in fish and they are all totally unrelated. This raises interesting questions about the evolution of these proteins.

One of the fish antifreeze proteins for example seems to be derived from part of the trypsinogen gene, another is related to a vertebrate lectin. So far only three invertebrate antifreeze proteins have been characterised in any detail, two from beetles and one from a moth larva. Again they fall into two totally unrelated groups, but the main interest lies in the fact that these invertebrate proteins are able to induce a much larger thermal hysteresis (up to 5°C) than the fish antifreeze proteins. The relatively small amounts of

material available from *P. davidi* makes purification of the antifreeze protein difficult, however, a start has been made and before too long we hope to have enough protein for sequencing.

I'm hoping to visit Australia in March 2000 and will be based at La Trobe University, Melbourne working with Alan Marshall. We will be applying various electron microscope (and other) techniques to the mechanisms of anhydrobiosis in nematodes. I'd like to hear from anyone who'd like to talk to me while I'm in Australia.

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NEWS FROM INDIA

News from Sugarcane Breeding Institute, Coimbatore- 641 007, India

Dr Usha K Mehta, Nematologist & Head, Division of Crop Protection, Sugarcane Breeding Institute, was awarded " Outstanding Woman Agricultural Scientist Award" of Indian Council of Agricultural Research (ICAR) in recognition of her contributions to sugarcane nematology.

Dr N. Somasekhar, Scientist (Nematology), Sugarcane Breeding Institute, was awarded "Prof. D. J. Raski Young Scientist Award" of Nematological Society of India (NSI) for his research paper on "Biorational Approaches to Nematode Management for Sustainable Sugarcane Production". This was presented at the 9th meeting of the NSI held at Gujarat Agricultural University, Anand, India.

Dr N. Somasekhar, Scientist (Nematology), Sugarcane Breeding Institute, was awarded "Smt. Snehlatha Banerjee Gold Medal" of Academy of Environmental Biology, India, for his paper entitled" Soil Biodiversity: Role in Ecosystem Processes, Sustainable Crop Production and Economic Development", published in Proceedings of Academy of Environmental Biology, Vol. 7 (1998).

Dr. N. Somasekhar, Sugarcane Breeding Institute, Coimbatore - 641 007, India

Research

EFFECTS OF RESIDUAL BANANA ORGANIC MATTER ON BURROWING NEMATODE (*RADOPHOLUS SIMILIS*) IN ESTABLISHED PLANTATIONS.

Tony Pattison, Centre for Wet Tropics Agriculture and Julie Stanton, Queensland, Horticulture Institute, Indooroopilly.

INTRODUCTION

Banana cultivation produces abundant organic matter consisting of the remains of leaves, pseudostems and bunch stalks. It is not known how best to place this residual organic matter (trash) to benefit the crop.

Nematicide labels recommend removing trash for a 30 cm radius around the base of the pseudostem to maximise efficacy of the chemicals. On the other hand, organic soil amendments have been shown to promote biological activity, including nematode parasites and predators, which helps to reduce nematode populations. The aim of this trial was to determine if the retention of trash close to the pseudostem base affected nematode damage to roots and therefore plant growth.

MATERIALS AND METHODS

The trial was established in a banana crop infested with *R. similis* on an alluvial soil near Tully in north Queensland. Plants were in double rows spaced 1.5 m apart, with plants spaced 1.5 m within rows. The distance between the centre of double rows was 6 m, resulting in approximately 1800 plants per hectare. Treatments imposed in June 1994 were placement of trash at the base of plants or placement of trash in the interrow. As trash accumulated with normal banana cultivation, it was placed according to the treatments.

Treatments were arranged in a completely randomised block design, with each treatment replicated three times. Each plot consisted of two double rows with 60 plants in each row. Soil and roots were collected by sampling 5 plants in each double row (10 plants per plot). A soil block 25 x 25 x 25 cm was removed next to the bunching pseudostem. All functional banana roots were removed from the soil block.

Root disease index was determined by slicing the roots lengthwise and rating the amount of cortex occupied by lesions (Broadley 1979) (where 0 = no visible lesions; 1 = 1-25 % of root cortex occupied by lesions; 3 = 26-50 % of root cortex occupied by lesions; 5 = 51-75 % of root cortex occupied by lesions; 7 = 76-100 % of root cortex occupied by lesions). Nematodes were extracted from roots in a misting cabinet (Hooper, 1986) over seven days.

Organic matter on the soil surface was quantified in ten 0.1 m^2 quadrats from each plot. The organic matter was dried at 70°C for 7 days and weighed.

In March 1995, twenty 10-mm-diameter soil cores were collected in each plot at depths of 0-5, 5-10, 10-20 and 20-30 cm. Soil and trash samples taken at this time were bulked for each plot and subsamples used for nutrient analysis

RESULTS

Dry matter accumulated more rapidly at the base of pseudostems when trash was placed at the base rather than in the interrow. In December 1994, there was 23 t organic matter/ha around pseudostems (Figure 1). Trash placement was found not to affect plant growth. Nematode populations similarly had no effect on plant growth.

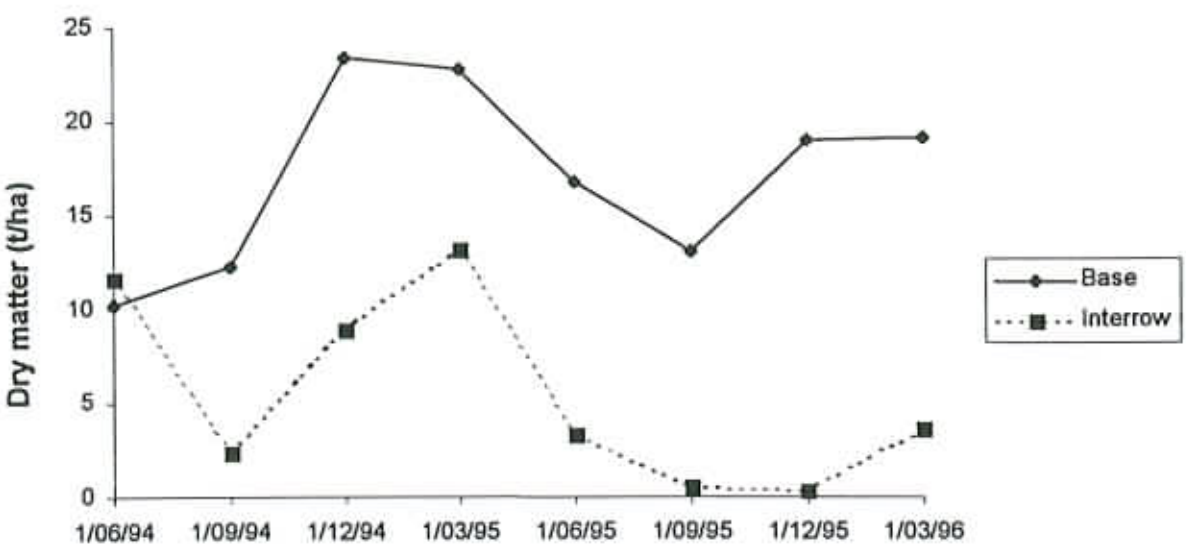

Figure 1. Accumulation of organic matter at the base of banana plants where trash is placed at the base of plants or in the interrow.

In March 1995, there was a significant increase in the disease index when trash was kept at the base of plants (Figure 2). The disease index increased in both treatments throughout the trial at 0.3-0.4/month. Trash placement did not affect numbers of nematodes in roots (Figure 3).

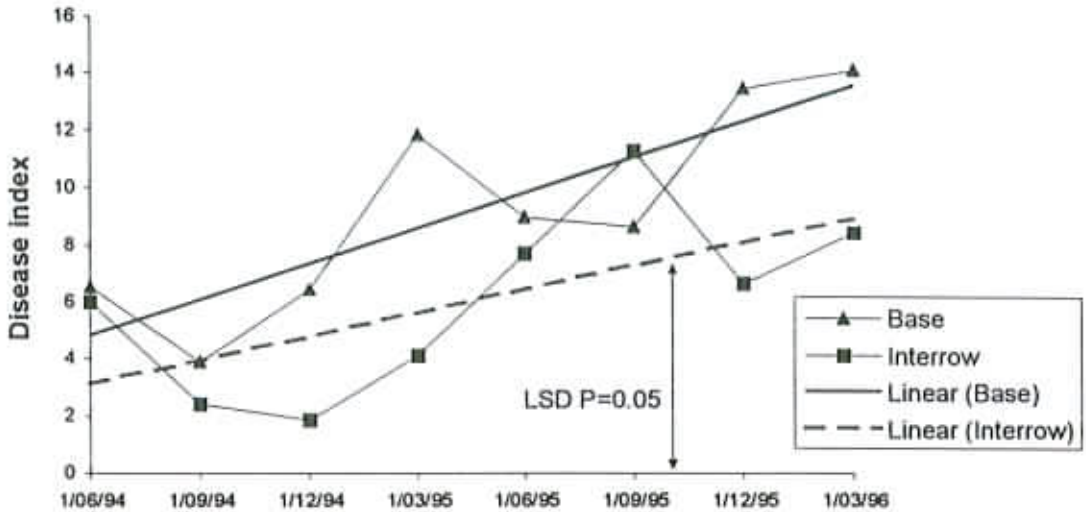

Figure 2. Increased disease index ratings of banana roots where trash is kept at the base of bananas relative to trash placement in the interrow, over a two year period.

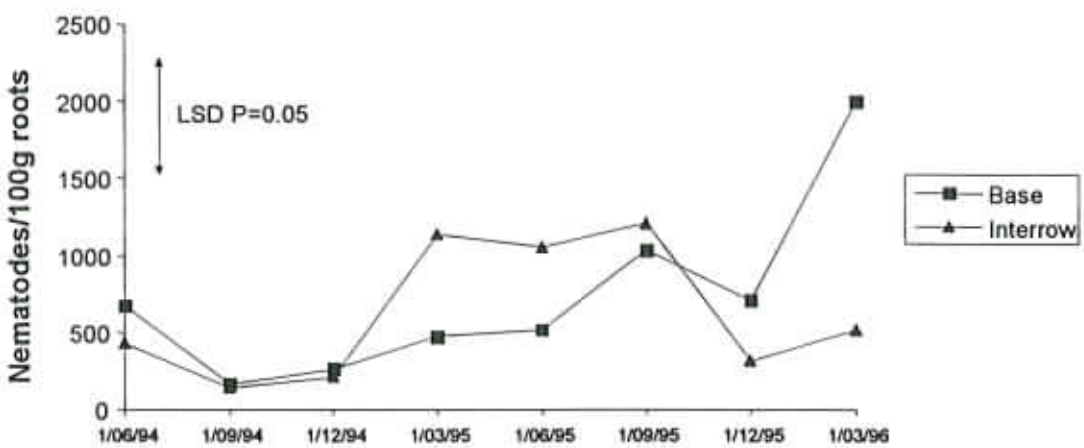

Figure 3. Changes in populations of burrowing nematode recovered from banana roots where trash is retained around the base of plants or removed to the interrow over a two year period.

The nutrient content of organic matter sampled at the base of banana plants was unaffected by trash placement (Table 1). The concentration of all soil nutrients measured decreased with increasing soil depth (Table 2). Soil nutrients were unaffected by trash

placement with the exception of organic carbon (Figure 4) and calcium (Figure 5) in the top 5 cm of soil when the trash was retained at the base of plants.

Table 1. Concentration of nutrients in organic matter retained around the base of banana pseudostems.

	Nitrogen	Phosphorus	Potassium
% of dry matter	1.54	0.32	1.88
kg/ha	351	7.3	428
kg/ha/year	199	23	660

Table 2. Decreasing concentration of nutrients with increased soil depths in a banana crop.

Depth (cm)	Organic carbon (%)		NO_3 nitrogen (mg/kg)		Potassium (m.e./100g)		Calcium (m.e./100g)		Magnesium (m.e./100g)	
0-5	1.62	a	27.3	a	1.20	a	4.55	a	6.16	a
5-10	1.56	a	19.0	b	0.87	b	3.62	b	3.43	b
10-20	1.45	b	14.9	bc	0.58	c	2.79	c	2.37	c
20-30	1.42	b	10.8	c	0.39	d	2.70	c	2.10	c

Means followed by the same letter are not statistically different ($P<0.05$).

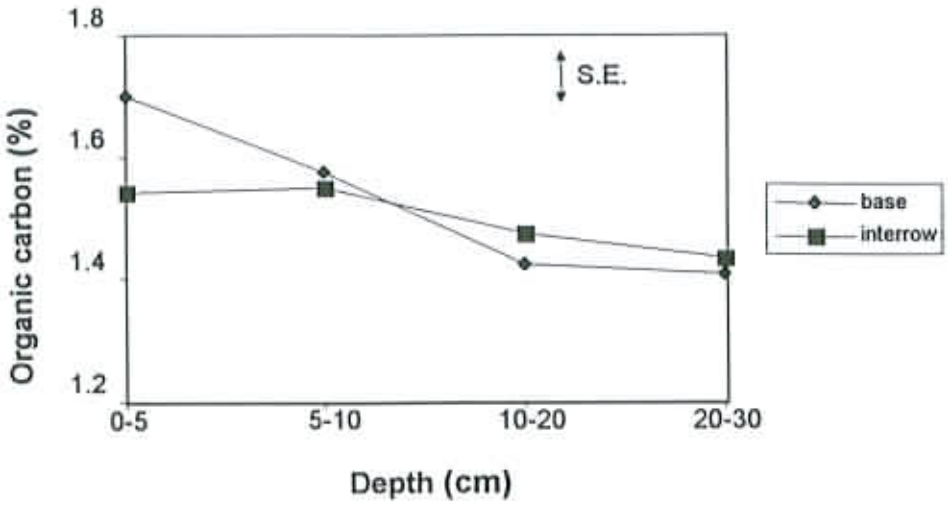

Figure 4. Increased organic carbon in the top 5 cm of the soil profile where trash is retained at the base of banana plants compared to other soil depths.

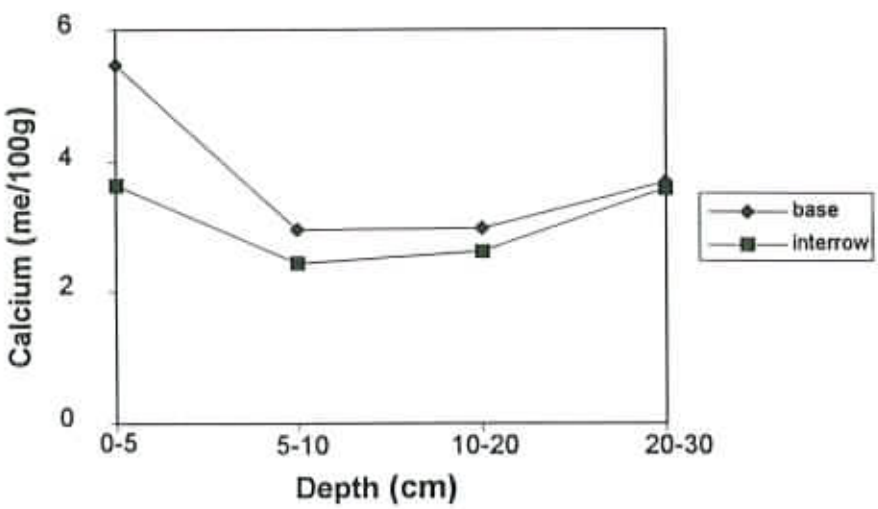

Figure 5. Increased calcium in the top 5 cm of the soil profile where trash is retained at the base of banana plants compared to other soil depths.

DISCUSSION

Placement of banana trash had no effect on burrowing nematode. This is consistent with previous studies. McSorley and Gallagher (1994) suggested that the management of crop residues had little consistent effect on nematodes and should be based on agronomic benefits rather than for nematode management.

Nematode populations and nematode damage evident on banana roots increased as the trial progressed. However, plant growth was not affected suggesting that nematode populations in the trial had not reached a damaging level. Plant tolerance to nematodes can be improved with the addition of organic matter even if nematode densities are not reduced (McSorley and Gallagher, 1995). In this study, there was no evidence of improved plant tolerance to burrowing nematode when banana trash was retained at the base of plants, possibly because the nematode infestation was not damaging.

By retaining banana trash on the soil surface close to the base of pseudostems, organic matter can be as high as 25 t/ha. The nutrients returned to the soil in this study as part of the organic matter are similar to the results obtained by Lahav and Turner (1989). Nutrients in banana trash are released slowly and their availability depends on the decomposition of the organic matter.

When trash is retained at the base of the plant, increased organic carbon in the top 5 cm of soil may improve soil structure. It may also increase the cation exchange capacity of the soil which would explain the increased calcium in the top 5 cm of soil.

The agronomic benefits of banana trash retention require a more thorough and long-term study as the benefits of organic matter to crop growth depend on the type of organic matter and the duration of its use (McSorley and Gallagher, 1994). It may be necessary to supplement banana trash with amendments to fully utilise any nutritional or improved soil biological effects which improve the growth of banana plants.

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ROOT KNOT NEMATODE, A SERIOUS PROBLEM OF VEGETABLES IN THE TOP END OF THE NORTHERN TERRITORY

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Root knot nematode is a significant disease of vegetables in the Northern Territory. With the increase in the Asian population in Darwin, snake beans, bitter melon, luffa and other Asian vegetables have been grown to meet the needs of this market. As a consequence, there have been increasing and severe problems of root knot disease on snake beans and other vegetable crops since 1988.

Two root knot nematode species have been identified from the Top End (area from Darwin to Katherine) of the NT, *Meloidogyne incognita* (Kofold & White) Chitwood and *M. javanica* (Treub) Chitwood. One of the most widely grown and severely affected crops has been snake bean, *Vigna unguiculata* (L.) Walp. ssp. *sesquipedalis* (L.) Verdc. Some other Asian vegetables affected by root knot nematode are okra, *Abelmoschus esculentus* L., bitter melon, *Momordica charantia* L., angled luffa, *Luffa acutangula* (L.) Roxb., smooth luffa, *L. cylindrica* (L.) M. Roemer and sweet basil, *Ocimum basilicum* L.. At this stage it is not known which of the two species of *Meloidogyne* affects these crops. Usually the first crop on new soil is not affected. However when crops are grown on the same land the next season, they are often devastated by the nematode. Some Asian growers grow crops on new land each season to avoid the root knot nematode problem.

In the early 1980's, rockmelons dominated the vegetable horticulture industry in the Top End. A cultivation procedure was developed by Horticulture, DPIF. It involved growing a green manure crop of forage sorghum (Pacific Seeds male sterile, "Sudax-ST6") or pearl millet and discing it into the soil to improve the soil organic matter and structure before planting the crop. The crops were planted under black plastic mulch, using fertigation through bi-wall irrigation system. Although commercial rockmelons are very susceptible to both species of *Meloidogyne*, the melons had no root knot problems during this time.

Since the late 1980's, Vietnamese and other Asian growers in the Darwin rural area have not grown green manure crops because they wished to grow vegetables all year round, and saw green manure crops as a non-productive crop. Many of their crops have been severely affected by root knot nematode, causing them large losses.

In recent times, ginger growers in Australia and overseas claimed that applications of sawdust and chicken manure to improve crop nutrition had a side benefit of controlling root knot nematodes. This claim has been confirmed by nematologists. Earlier research with pineapples in Hawaii before World War II demonstrated that applications of plant waste gave very good control of the root knot problem in the pineapples. However, with the emphasis on chemical control after the war, the importance of this Hawaiian research was lost for some time. It was only in the last ten to fifteen years, when there has been a

trend to use less chemicals in agriculture, that the use of mulches and green manure crops has come to the fore.

In Darwin, the growing of bulky green manure crops of Sudax sorghum and discing in to improve the soil organic matter and structure had an unintentional side benefit of effective control of root knot nematode in the rockmelon crops. The inability of Sudax sorghum to host root knot nematodes and its ability to smother weeds that are alternative hosts are two reasons for the effect. The act of breaking down the plant organic matter may also be important, as a fungal microflora that is antagonistic to nematodes appears to develop. The procedure of growing a bulky green manure crop over the wet season and incorporating into the soil by discing is now being recommended to growers of Asian vegetables as a means not only of controlling root knot nematode, but of also of improving their soil.

A NEW WEAPON TO COMBAT ANNUAL RYEGRASS TOXICITY (ARGT)

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Annual ryegrass toxicity (ARGT) is the poisoning of livestock from toxin contained in bacterially-infected annual ryegrass. The toxin is produced by the bacterium *Clavibacter toxicus*, which is carried into the ryegrass by a seed-gall nematode, *Anguina funesta*.

Much of the present ARGT management has focused on the control of ryegrass. Control reliant on herbicides is resulting in marked reduction in pasture productivity, is associated with a rapid increase in herbicide resistance and is often ineffective. Projects funded by GRDC and IWS have demonstrated that the naturally occurring fungus, *Dilophospora alopecuri* provides a useful level of control of ARGT without the need of controlling ryegrass. The fungal inoculum is now available to farmers for on-farm application.

The fungus reduces the risk of ARGT by hindering the movement of nematodes. Once inside the ryegrass, the fungus colonises the host and competes with the nematode and the bacterium. The effect of the twist fungus will be accumulative over the years. Results from field and pot experiments have shown that the fungus is capable of reducing the bacterial gall level by up to 100% and nematode gall levels by 50-70%, depending on the rate of application and conditions.

The fungus is found in parts of WA, SA and Vic. In WA, the fungus is most commonly found in the southern part of the state. The current distribution of the fungus in WA is believed to be a function of original introduction, possibly with *Holcus lanatus*. In the field, the fungus relies mainly on surface water flow and farm machinery for dispersal and spreads relatively slowly.

Use of the fungal inoculum will greatly accelerate the spread of the fungus outside its current range. To facilitate the establishment of the fungus, we are recommending that paddocks selected for treatment (1) have a history of ARGT, (2) have moderate to high

density of ryegrass, (3) are likely to be in pasture in the following year. Our results have shown that spread of the fungus during the year of application is best with cropped paddocks. Harvesting and other activities will further spread the fungus around the paddock and farm. Hence, crop paddocks are better for local dispersal of the fungus. Paddocks that will be in pasture in the year after inoculation would assist the build-up of the twist fungus as it relies on the presence of a reasonable level of ryegrass.

The promotion, production and distribution of the fungal inoculum are currently funded by GRDC. The three year project starts from 1998 and aims to supply the inoculum to farmers to inoculate 10% of the ARGT-affected paddocks. We are now taking orders for the 1999 supply. If you are aware of anybody who is interested in the twist fungus, please advice them to contact G Yan on 08 9368 3935 or 08 9367 2625 (fax).

Review

BIOCHEMICAL STUDIES OF TISSUE GLUCOSINOLATES FOR IMPROVEMENT OF CANOLA (*BRASSICA NAPUS*) AS A DISEASE BREAK WITHIN THE SOUTHERN AUSTRALIAN CEREAL ROTATION

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Thesis Summary

The inclusion of canola (*Brassica napus*) in the southern Australian cereal cropping rotation has led to much discussion regarding the qualities of the crop as a 'disease break'. Canola has been reported to 'clean up' the soil, reducing populations of pests and pathogens and therefore providing a healthier soil environment for subsequent crops. However, while many growers and agronomists agree that the crop can be used as a disease control tool, the effect is not reliable, often exacerbating soil disease problems, due primarily to the apparent susceptibility of canola to a range of pests and pathogens.

Field studies reported within this thesis showed that canola (*Brassica napus*) led to at least comparable reductions in soil levels of the root lesion nematode (*Pratylenchus* spp.) as other rotation crops grown in parallel. *Brassica* crops were observed to be particularly effective when green manured (incorporated into the soil), suggesting the release of nematicidal agents as tissue broke down in the soil. However, the disease break effect of the crop was limited by its susceptibility to infestation by the nematode. Efforts to improve the disease break effectiveness of the crop against *Pratylenchus* spp. must therefore consider both the susceptibility of the plants and the nematicidal potency of the tissues as they degrade in the soil.

Degrading leaf tissues were observed to be more potent against *P. neglectus* than root tissues. However, HPLC studies revealed no relationship between the nematicidal potency of *Brassica* leaves and the glucosinolates within them, suggesting that an alternative allelopathic system was active within these tissues. As leaf tissues are not incorporated into the soil within the cropping system under study, further scrutiny of these tissues was considered beyond the scope of this thesis.

A close association was observed between the levels of glucosinolates within the roots and the nematicidal potency of these tissues. Further study revealed that a single glucosinolate, 2-phenylethyl (2-PE), was entirely responsible for the nematicidal qualities of the root tissue, despite the presence of comparable levels of other glucosinolates, such as 2-propenyl, within some tissues. *In vitro* studies of purified 2-PE isothiocyanate confirmed the nematicidal properties of the molecule. Studies also revealed that root levels of 2-PE glucosinolates were closely associated with the susceptibility of *Brassica*

roots to *P. neglectus*. Plants containing above a critical level of 2-PE glucosinolate were both more resistant to *P. neglectus*.

The mean 2-PE glucosinolate levels in the most commonly grown canola variety of the southern Australian cereal region, Dunkeld, were below the observed critical level, perhaps explaining the unpredictable nature of the crop as a disease break. However, considerable variation was observed in the levels of 2-PE glucosinolate within its roots, suggesting the potential to increase the mean levels beyond the threshold. Self pollination studies of Dunkeld plants revealed that the variation in 2-PE glucosinolate levels was heritable, with S_1 and S_2 populations maintaining the parental phenotype. S_2 progeny of a segregating selection exhibited a 'high' : 'low' 2-PE glucosinolate phenotype in approximately a 3:1 ratio, suggesting single gene inheritance following Mendelian principles. 'High' 2-PE glucosinolate S_2 sub-populations were significantly less susceptible to *P. neglectus* than 'low' 2-PE glucosinolate counterparts.

These same self pollination studies revealed a varied distribution pattern for total glucosinolate levels, suggesting a second heritable character which may have been linked to total seed glucosinolate levels. However, these findings were not further pursued within this thesis, and served only to stress the need to select for % 2-PE glucosinolate levels to minimise the risk of impacting on seed glucosinolate levels and thus quality.

It is likely that 'high' 2-PE glucosinolate sub-populations could be developed from many of the current canola varieties. Such sub-populations should maintain the agronomic characters of the parent line, occupying the same rotational niche as the original varieties. However, being less susceptible and more nematicidal, these lines should perform reliably as disease breaks against *P. neglectus* within the cereal rotation.

More detailed information may be found in the following publications:

Potter, Davies & Rathjen 1998 - Suppressive impact of glucosinolate in *Brassica* vegetative tissues on root lesion nematode (*Pratylenchus neglectus*). *Journal of Chemical Ecology* **24**:67 - 80.

Potter, Davies, Kirkegaard & Rathjen 1999 - Improved resistance to root lesion nematode (*Pratylenchus neglectus*) in canola (*Brassica napus*) containing elevated root levels of 2-phenylethyl glucosinolate. *Journal of Nematology* (in press).

Potter,Davies & Rathjen 1999 - Breeding to increase the disease break strength of canola (*Brassica napus*). The inheritance of 2-phenylethyl glucosinolate in the root. *Plant Breeding* (in press).

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