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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.

January Issue

The deadline for the January issue is December 1. 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

Nematology workshop

Mike Hodda has been doing a fantastic job of organising the troops in Canberra so that we can hold another very useful and interesting workshop at the APPS conference.

The workshop is entitled "**Nematode identification; morphological and molecular**" so there is something for everyone! You can read more details about the workshop contents elsewhere in this newsletter.

The workshop will be held on Monday 27 September from 9:30 am to 4:30 pm. The cost is $100 and will include morning tea, lunch and afternoon tea.

The venue is the Murray Upton Lecture Theatre at CSIRO Entomology, Clunies Ross Drive, Black Mountain. This is within walking distance of the hotel and university college but, if you think you'll need a lift, contact Mike Hodda on (02) 6246 4371 or Mike.Hodda@ento.csiro.au

Annual General Meeting

We've managed to slot the AGM into the APPS program on the evening of Tuesday 28 September at a nearby Malaysian restaurant. We'll start the meeting at 6:30 pm in a function room to be followed closely by the Nematology Dinner at 7:30 pm. The cost of the dinner will be included in the cost of the workshop but if you would like to come to the dinner but not the workshop or are bringing a partner, please contact Mike Hodda to help with catering. Also, contact him if you any particular dietary requirements.

The restaurant is within walking distance of the hotel and university college but, if you think you'll need a lift, contact Mike Hodda on (02) 6246 4371 or Mike.Hodda@ento.csiro.au.

If you have any business that you would like to discuss at the AGM, please let me know. Also, it is time for current AAN committee office bearers to start thinking about their successors and, for those who haven't got an AAN job, to choose from the following exciting positions!; President, Secretary, Treasurer, Newsletter Editor and Committee Member. None of the jobs is particularly arduous and it would be great for all AAN members to be part of the committee at some time.

New web site address

The AAN web site has moved from the DPI server to the State Library of Queensland server under their Community Web Publishing Project. We thank them very much for hosting our site at no cost. The new address is:

http://www.slq.qld.gov.au/cwpp/aan/

Any suggestions for improving the site are welcome at any time. However, I'll update the whole site when I put this newsletter on so that would be a great time to make changes. Let me know .....

Laboratory Guidelines

At long last, this illustrious tome has been published. All AAN members should have already received a copy. Thanks to all who devoted their time and energies to what will be a very useful reference. It is called 'Advisory Services for Nematode Pests' by Graham Stirling, Julie Nicol and Frances Reay and further copies are available from RIRDC for $15 per copy.

See you all in Canberra!!!

GENERAL MEETING AND WORKSHOP

Arrangements for the General Meeting and workshop have now been finalized. We intend to provide an exciting program for two days in sunny Canberra (at least we hope it is sunny). The hot air rising from the big house on the hill will ensure a mild and pleasant climate, so come and partake of some of the excellent nematology on offer. It is very gratifying to see the prominence given to nematology at the APPS conference with something for everyone.

MONDAY 27TH SEPTEMBER

Workshop: Nematode identification: morphological and molecular

Venue: Murray Upton Lecture Theatre, CSIRO Entomology, Clunies Ross Drive, Acton (across the road from ANU and a short walk form Rydges).

Time: 9:30 to 16:30, lunch, morning and afternoon teas provided. Lunch will be a variety of delicious sandwiches and fruit. Tea, coffee and biscuits for morning and afternoon teas.

Cost: $100

Course presenters: Dr Mike Hodda & Dr John Curran

During the morning we will focus on morphological identification of nematode species, using microscopic examination. We will present an overview of generic identification, with demonstration material of common genera encountered in Australia, and preparation of material for species identification. We will discuss and demonstrate the characters used for specific identification and demonstrate computer aided identification software being developed by CSIRO.

During the afternoon, we will present a practical guide to using molecular techniques for nematode identification, and demonstrate the use of these techniques for identification of *Pratylenchus* species.

The interactions between these two sets of techniques will also be discussed.

John Curran and I will be showing our stuff (subject to the ever-present commercial confidence), and hopefully giving a glimpse at the future of nematode identification. John is convinced that molecular will take over much of the hack work, while I remain unconvinced that that will happen for a while yet for most of the major nematode pests in Australia. In the meantime there is a long way to go even to achieve the molecular dream and morphology will have to suffice, so we might as well make it as efficient as possible.

McAlpine Lecture (Main invited lecture of the APPS)

Venue: Rydges

Time: 6:30-7:30 (followed by a reception for those registered for the main conference. For those not registered, there may be a small additional charge, but this has yet to be decided.)
Speaker: Dorothy Shaw – "Bees & Fungi"

TUESDAY 28TH SEPTEMBER

Day 1 of APPS Conference

Includes a well-subscribed session on Nematology (7 papers) in the afternoon from 3:30 and finishing at 5:30. Also poster viewing and a symposium on Plant Pathology in the Asia Pacific Region (see the full programme below).

Nematology General Meeting and Dinner

Venue: Asian Café Restaurant, West Row, Civic. (A short walk from either ANU or Rydges).

Time: from 6:30pm.

Cost: nil (subject to numbers at the workshop and the generosity of the Treasurer and President!)

We have booked the function room at this highly recommended Malaysian/Chinese Restaurant near the conference venues and accommodation for the General Meeting. The meeting will kick off at 6:30, followed by an 11 course banquet, dessert, and tea or coffee. The smell of the culinary delights to come will hopefully curtail any thoughts of extensive monologues at the meeting, and keep debate truly relevant. The President has promised that filibustering tactics will be dealt with severely, and any attempt at blackmail to delay the final item on the agenda (food) will not be tolerated. You have been warned!

WEDNESDAY 29TH SEPTEMBER

Day 2 of APPS conference

Includes sessions on trade, quarantine, resistance and the APPS dinner at Parliament House.

THURSDAY 30TH SEPTEMBER

Day 3 of APPS conference

A highlight for nematologists will be a talk by Professor Diana Wall (known to all old-time nematologists by her former name of Diana Freckman) from Colorado State University, USA on "Nematodes and soil biodiversity". There is also an informal social dinner at the new CSIRO Optus Discovery Centre in the evening.

Those wishing to stay for the entire conference should register soon to avoid late payment penalties, but those wishing to stay for only the Tuesday can pay on the day. For further details on the APPS conference please contact the local organizer, Louise Morin (02) 6246 4355 or e-mail louise.morin@ento.csiro.au.

Revised Program – June 1999 – Australasian Plant Pathology Society, 12th Biennial Conference, Canberra 1999

	MONDAY 27 Sept.	TUESDAY 28 September	WEDNESDAY 29 September	THURSDAY 30 September
8:30	**Workshops Including AAN workshop** ********** **"Nematode Identification : Morphological and Molecular" at CSIRO Entomology from 9:30 am to 4:30 pm** **********	**SYMPOSIUM** **Asia/Pacific perspectives for plant pathology** *Professor Tang Wenhua,* China Agricultural University *"Progress on biological control of plant diseases"* *Dr Lee Su See* Forest Research Institute Malaysia *"Forest health in plantation forests in South East Asia"* *Dr Takane Fujimori* Japan Tobacco Inc, Japan *"New developments in plant pathology in Japan"* *Ms Ruth Liloqula* Ministry of National Development and Planning, Solomon Islands *"Plant pathology activities in the South Pacific"*	**SYMPOSIUM** **Trade, policies and exotic plant pathogens** *Dr Bill Roberts* National Offices of Animal and Plant Health, Canberra *"Incursion management of exotic plant pathogens in Australia"* *Dr Harry Evans* CABI Bioscience, UK *"Evaluating plant pathogens for the biological control of weeds: an alternative view of pest risk assessment"* *Mrs Philippa Rowland* Bureau of Rural Sciences, Canberra *"The National Strategy for Agricultural and Veterinary Chemicals: Implications for Plant Pathologists"* *Dr Jim Fortune* Grains Research & Development Corporation *"We have much to protect: keeping plant disease in perspective for the grains industry"*	**SYMPOSIUM** **Biodiversity and plant diseases** *Dr David Jones* Australian National University, Canberra *"Diversity of polygalacturonases in plant pathogens"* *Dr Everett Hansen* Oregon State University, USA *"Plant diseases in natural ecosystems"* *Professor Gustav Holz* University of Stellenbosch, South Africa *"Behaviour and infection pathways of diverse fungal pathogens on fruit"* *Professor Diana Wall* Colorado State University, USA *"Nematodes and soil biodiversity"*
10.30		**Morning tea**	**Morning tea**	**Morning tea**
11:00		**Concurrent oral sessions 1 – 4** 1. Diagnosis and detection I 2. Applied and molecular virology 3. Biological control of weeds and pathogens 4. Disease survey and new pathogens	**Concurrent oral sessions 9 – 11** 9. Plant-pathogen interactions 10. Disease resistance II 11. Biological control of pathogens	**Concurrent oral sessions 12 – 14** 12. Survival and dispersal of pathogens 13. Soil borne diseases 14. Diagnosis and detection II

	MONDAY 27 Sept.	TUESDAY 28 September	WEDNESDAY 29 September	THURSDAY 30 September
12.30		**Lunch**	**Lunch**	**Lunch**
13.30 13:45 – 14:15 14:30 – 15.00		**Poster viewing** **Concurrent poster sessions 1 & 2** 1. Forest and natural ecosystems 2. Plant-pathogen interactions **Concurrent poster sessions 3 & 4** 3. Biological control of weeds 4. Diagnosis and detection	**Poster viewing** **Concurrent poster sessions 5 & 6** 5. Quarantine issues 6. Disease management **Concurrent poster sessions 7 & 8** 7. Chemical control 8. Disease resistance	**Poster viewing** **Concurrent poster sessions 9 & 10** 9. Soil borne diseases 10. Epidemiology and modelling **Concurrent poster discussions 11 & 12** 11. Biological control of pathogens 12. Population genetics of pathogens
15.00		**Afternoon tea**	**Afternoon tea**	**Afternoon tea**
15.30	**Registration** (17:00 - 20:30) Poster placement	**Concurrent oral sessions 5 – 8** 5. Disease management 6. Disease resistance I 7. Nematology 8. Exotic pathogens threats and quarantine issues	**Presidential Lecture (15:30 – 16.30)** **General APPS Meeting (16.30 – 18.00)**	**Concurrent oral sessions 15 – 18** 15. Epidemiology and modelling 16. Forest and natural ecosystems 17. Population genetics of pathogens 18. Chemical control
18:30	**Opening & McAlpine Lecture**	**AAN General Meeting at 6:30 followed by Nematology Dinner!!!!!!**		
19:30	**Reception**	**Special discussion groups**	**Conference Dinner Parliament House**	**Informal Social Dinner CSIRO Optus Discovery Centre**

WELCOME TO NEW AAN MEMBERS

New members for the previous 12 months

Barry Conde (NT DPIF, Darwin)
Rex Pitkethley (NT DPIF, Darwin)
Deborah Carrington (Agriculture Victoria, Knoxfield)
Primo Aceret (QDPI, Mareeba)
Jenny Cobon (QDPI, Indooroopilly)
Jackie Nobbs (SARDI, Waite Campus)
Rachel Hutton (SARDI, Waite Campus)
Jason Sheedy (Leslie Research Centre, Toowoomba)

THE NEMATOLOGICAL SOCIETY OF INDIA JOINS THE IFNS

We WELCOME the NEMATOLOGICAL SOCIETY OF INDIA, with almost 400 members as the latest Society to become affiliated with the IFNS.

SITE SELECTED FOR THE FOURTH INTERNATIONAL CONGRESS OF NEMATOLOGY

The International Federation of Nematology Societies is indebted to four affiliated Nematology Societies for submitting very attractive bids to host the next Nematology Congress. The European Society of Nematology proposed Tenerife, Canary Islands; the Nematological Society of India -New Delhi; the Nematological Society of Southern Africa - Pretoria; and the Society of Nematologists - San Diego, California. We also are indebted to the ad hoc Committees and especially their "Chairpersons" who prepared these proposals; Dr. Maria Arias from the European Society of Nematologists; Dr. S. C. Dhawan - Nematological Society of India; Dr. Martie Botha - Nematological Society of Southern Africa; and Dr. Edward Platzer - Society of Nematologists.

We now have a Site for the Fourth International Nematology Congress (FICN) in 2002. The selection process for the Site was completed after extensive discussions and two ballots during more than 10 months. Because the first ballot deciding between the four proposals was very close, the selection required a second ballot to decide between the two top potential sites (Tenerife and Pretoria). Again the votes in the second ballot for Tenerife and Pretoria were very close. TENERIFE, CANARY ISLANDS was the "winner" by a thin majority. Thus, the European Society of Nematologists will be the "host" Society of the FICN.

When the IFNS was organized in 1996, a primary goal for the Federation was to provide continuity and planning of future International Nematology Congresses. For this reason, the responsibility for the development of the Scientific Program of the Congress rests with the Council of the IFNS. Thus, the IFNS Congress Scientific Program Committee chaired by Dr. Thierry Vrain will commence planning the scientific program of the

FICN. This Committee will be working closely with Dr. Maria Arias, President Elect, European Society of Nematologists and her Local Arrangements Committee in developing the overall program for the 2002 Congress. Dr. Vrain and Dr. Martie Botha, Chair of the IFNS Finance Committee, also are exploring various options for raising funds for this Congress and other activities of our Federation. Undoubtedly, Dr. Vrain, Dr. Arias, Dr. Botha, and all related committees will need support as well as input from you, your IFNS Councillor(s), and your Society's Officers and members as the plans for this Congress and other projects such as an IFNS Web Page develop.

Please feel free to offer suggestions on the activities of the IFNS and for the upcoming 2002 Congress. Your ideas and inputs for Symposia Topics, Workshops and other facets for the FICN will be appreciated. This may be done through your IFNS Councillor or by contacting other IFNS Committee Chairpersons or either of us (Vrain or Barker) directly. We look forward to working with you to prepare the 2002 Congress.

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Regional News

NEWS FROM QUEENSLAND

Retraction and apology

In Regional News (ANN 10 (1) Jan 1999 I included the words "i.e. proper curation had not been possible and the collection was now virtually unusable". I used hyperbole inappropriately. This was an unfortunate choice of words and I apologise for their use and for any hurt they may have caused or misinformation generated. Despite financial constraints the collection has been professionally maintained: and on reflection I should have found a better way of expressing my view that without adequate funding it is increasingly difficult to provide the full range of uses and services which is desirable for any collection.

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NEWS FROM SOUTH AUSTRALIA

SARDI

Dr Jackie Nobbs was appointed as Nematode Taxonomist at SARDI, Field Crops Pathology Unit in February 1999. She is currently working on a part-time basis on funds provided by GRDC, HRDC, SRDC, SARDI and AQIS and will be developing a CD ROM of Plant Parasitic Nematodes of Australia. She will be updating "Plant-parasitic nematodes of Australia" and will be contacting people regarding new records of nematodes or hosts (so be prepared!!). Jackie is also available for diagnostic work.

Rachel Hutton is another new face at SARDI. She began work in August 1998 on a GRDC and SAGITF (South Australian Grains Industry Trust Fund) project to assess the pathology component of medic decline in South Australia. Rachel has already shown both *Rhizoctonia* and *Pratylenchus* cause root and shoot reduction in pot trials. Symptoms observed in pots when these pathogens occur in combination were the same as those observed in affected field specimens.

In other news, we have been successful in securing a visit by Professor Diana Wall (formerly Freckman) to the APPS Conference in Canberra. She will also be visiting Adelaide following the conference.

The University of Adelaide

Grains Research and Development Corporation has provided a Visiting Fellowship Award for Dr Wim Wouts to visit agricultural research institutions in SA and WA. Wim will be visiting for two months (Sept-Oct) to review the taxonomy of root lesion and burrowing nematodes in Mediterranean climate zones of southern Australia. His visit will also have a much appreciated training role. The visit is also supported by AgWA and SARDI. Wim will also attend the Canberra meeting providing opportunity for nematologists from other states to talk with him during his visit.

Grape and Wine Research and Development Corporation has provided support for a PhD student to work on plant parasitic nematodes in viticulture. The project is to be conducted within the CRC for Viticulture and in collaboration with Greg Walker, Alan McKay and Kathy-Ophel Keller, SARDI. We will be advertising within a couple of months, so get in touch if you are interested.

Andreas Hensel has completed his project on *Rhabditis necromena* and the black Portuguese millipede. He has returned to Germany to present his PhD thesis and prepare for his *viva* at the University of Berlin.

Robin Giblin-Davis (Department of Entomology and Nematology, University of Florida) recently spent a fortnight in SA with Kerrie Davies and Gary Taylor working on *Fergusonia/Fergusobia* galls in *Eucalyptus*. It was a very busy trip for Robin, who gave three seminars and made several extended field trips all within the two weeks. Kerrie and Gary will travel to Brisbane for July to work on *Melaleuca* galls with Robin and Mathew Purcell at the USDA Biocontrol Laboratory at CSIRO Entomology, Indooroopilly.

Astrid Schmitz, Rheinische Friedrich-Wilhelms-Universitat Bonn, Germany will be visiting for six months from mid October to undertake her diploma research project in nematology. The project being planned is an investigation of some aspects of the biology of *Anguina australis* and its interaction with bacterial and fungal associates of *Anguina* spp. Her contribution will be valuable as *A. australis* shows unique biology worthy of investigation in its own right and is also a non-target organism that would need to be screened for secondary impact in further research on exotic non-toxicogenic bacteria for biocontrol of annual ryegrass toxicity (ARGT).

The nematology discussion group at the Waite campus had an interesting range of speakers and topics in the first semester, *viz.* John Lewis, SARDI (Cereal cyst nematode resistance screening), Robin Giblin-Davis, University of Florida (Nematode phoresis), Vivien Vanstone, University of Adelaide (*Pratylenchus neglectus*: hosts and impact) and V. Gutpa, CRC Soil and Land Management (Free-living nematodes and nutrient cycling). If any members are visiting Adelaide, let us know in advance so you don't miss out on coming along or better still being a speaker.

Sharyn Taylor (SARDI) and Ian Riley (The University of Adelaide)

NEWS FROM NEW ZEALAND

Gregor Yeates (Landcare Research) is involved in a new 3 year, Marsden funded programme which includes looking at nematode diversity and feeding group abundance in epiphyte 'islands'. David Wardle (also Landcare Research) is the principal investigator. Landcare had a visit from Brian Boag earlier this year. Gregor and Brian have a wee project on the ecological implications of the developmental stages of nematodes. Brian returned to Scotland with specimens of the NZ flatworms which are devastating earthworm populations in the UK.

David Wharton (Zoology Dept., Univ. Otago) is heading for the UK in July as part of his study leave. He'll be working with Rolo Perry at Rothamsted Experimental Station trying to do electrical recordings from nematodes recovering from anhydrobiosis. He'll also be visiting the British Antarctic Survey in Cambridge, the University of Wales at Aberystwyth and the University of Bristol.

With Chris Mercer (AgResearch Grasslands), a Massey University PhD student, Pyone Pyone Kyi from Myanmar, has started a nematode sampling programme in pasture at the AgResearch Grasslands site at Palmerston North. Monthly soil samples will give a pattern of clover cyst nematode development in white clover. Later experiments will quantify the effects of fungal pathogens infecting the nematode cysts.

Chris Mercer found large numbers of nematodes in 13 of 14 samples from farms in the Northland "Clover 300" survey confirming other data that nematodes are a problem for clover in Northland. The findings were discussed at the Massey University Dairy Farmer's conference in Whangarei in May.

Research

ROOT LESION NEMATODE (*PRATYLENCHUS NEGLECTUS*) SOUTH AUSTRALIAN CEREAL TRIAL OBSERVATIONS 1998

Vivien Vanstone and Michelle Russ, Department of Plant Science, University of Adelaide, Waite Campus

Multiplication of *P. neglectus* on cereals was assessed from multi-site, replicated SARDI Field Crop Evaluation trials: 26 wheat entries at four sites, 18 barley entries at two sites, eight triticale/rye entries at one site and 13 oat entries at one site. These trials were sampled to: confirm results obtained over previous sites and seasons; assess new varieties for reaction to *P. neglectus;* and to assess advanced breeders' lines.

Initial nematode numbers were determined from trials in June, within three weeks of sowing. Trials were divided into 16 blocks, and 12 soil samples (4cm diameter to 10cm depth) were taken from each block in a zig-zag pattern and bulked. To determine final nematode population, 12 soil samples (4cm diameter to 10cm depth) were taken in October/November from each individual plot and bulked. Nematodes were extracted from 200g sub-samples on a mister over four days. By comparing initial (*Pi*) with final *(Pf) P. neglectus* numbers/g dry soil, the nematode multiplication rate *(Pf/Pi)* over the season was calculated.

Over all sites, the nematodes multiplied on all cereals over the 1998 season ($Pf/Pi > 1$). However, a number of varieties were rated as MS or MR (see Table) when data were considered in relative terms. Although less susceptible, Excalibur, Worrakatta and Krichauff (MS-MR) still multiplied the nematodes about 5 times, but these wheat varieties were more resistant than Janz, Frame or Machete (VS-S) which multiplied *P. neglectus* 18 - 31 times. The VS, S and MS varieties will therefore lead to significantly higher nematode numbers in the soil compared to the MR and MS-MR varieties. This is an important factor when considering the impact these nematodes could have on the crop planted in the following season, particularly if this crop is intolerant and therefore likely to suffer yield loss.

The 1998 season was very conducive to multiplication of *P. neglectus.* Differing seasonal and regional conditions influence nematode multiplication and crop growth, and therefore assessment of resistance and tolerance. However, relative variety rankings were consistent with previous field results (1995 - 1997), increasing our confidence in results for entries not previously tested. Furthermore, "related" material generally behaved similarly in the extent to which the nematodes multiplied.

Wheat

Wheat is the cereal most susceptible to *P. neglectus*. Machete (intolerant and S) yielded 27% less than Worrakatta (moderately tolerant and MS-MR), and had 66% more *P. neglectus* than Worrakatta. Machete multiplied the nematodes 31 times, and Worrakatta only 6. Excalibur, Worrakatta and Krichauff have consistently been the least susceptible wheat varieties for *P. neglectus*.

Machete, Frame and Janz were VS-S, multiplying *P. neglectus* 18 - 31 times over the season. Although rated S, Frame has some tolerance, making it one of the few wheat varieties in which tolerance and resistance to *P. neglectus* do not concur. Carnamah, Silverstar, Westonia, Spear and Goldmark were susceptible, with multiplication rates of 12 –14. Brookton was MS, and multiplied the nematodes 3 times.

The line W196112 (201/21) from the Waite Wheat Breeding Program stands out among the wheats tested as having the lowest susceptibility to *P. neglecus*. Multiplication rate was only 3, compared to 5 - 6 for Excalibur, Worrakatta and Krichauff (which have been used as the low standards for *P. neglectus* multiplication). The line 201/21 also has a low level of CCN resistance, and is being used as a parent in the breeding program.

W196080 (59/1) is in the process of being released, and W196115 (3/10) is being considered for release. Both are Frame-type wheats but showed lower multiplication rates than Frame (8 compared to 24), which probably reflects selection for grain yield under high *P. neglectus* populations.

Results for durum wheat have been variable over the years. Although MS-MR in some seasons, durums seem reasonably intolerant to *P. neglectus*.

Barley

On average, barley was more resistant than wheat, as we have shown in previous years. Barque and Sloop (multiplying *P. neglectus* 7 times) were slightly more susceptible than other barley varieties, but no more so than the MS wheats like Brookton. Skiff was one of the more resistant barleys tested. The malting barley SA93013, with a multiplication rate of 11, was more susceptible than other barleys tested.

Triticale/Rye

Triticale/rye were quite resistant to *P. neglectus*, with all lines/varieties tested having nematode multiplication rates of < 5. Triticale/rye have consistently proven to be the most resistant cereals available for *P. neglectus*.

Oats

Oats was sampled from one site only, so more data are required from additional sites/seasons. However, those tested in 1998 were MS-MR to R, with multiplication rates of 1 - 4, similar to the triticale/rye and least susceptible barleys.

Yield Loss

Correlation analyses of mean variety *Pf or Pf/Pi* compared to mean variety grain yield showed significant, negative relationships between *P. neglectus* and yield, suggesting the nematodes played a role in reducing grain yields at these sites in 1998. Yield loss

was calculated from the regression of final nematode population against grain yield. *Pi* was not significantly related to yield.

For wheat, yield loss calculated for intolerant varieties (eg. Machete, Janz, Spear, Carnamah, Brookton) was 7 - 16%. No yield loss was recorded for Krichauff, Worrakatta, Frame or 201/21. The negative relationship between *Pf* and yield ($r = -0.704$, $P < 0.001$) or between *Pf/Pi* and yield ($r = -0.638$, $P < 0.001$) was highly significant. This relationship, however, was weaker for the other cereals. For barley, *Pf* was negatively related to yield ($r = -0.518$, $P < 0.05$), and for oats there was a negative relationship between yield and both *Pf and Pf/Pi* ($r = -0.844$, $P < 0.001$ and $r = -0.695$, $P < 0.01$, respectively).

Average yield loss calculated for intolerant barley (eg. Arapiles, Namoi, Franklin) was 13% and for intolerant oats (eg. Bandicoot, Numbat, Euro) 24%. However, influence of genotype and environment on yield of barley and oats seems greater than for wheat, casting some doubt on the validity of these analyses of the association between *P. neglectus* and yield for these cereals. Furthermore, the range in resistance reactions is much narrower for oats and barley than for wheat *(Pf/Pi* for wheat 3 - 31, compared to 3 - 11 for barley and only 1 - 4 for oats). The wheat entries tested represent less genetically diverse material that is also better adapted to South Australian growing conditions. High yield losses (> 20%) were calculated for poorly adapted and therefore inherently low yielding barleys (eg. Franklin, Arapiles, Namoi) compared to high yielding, well adapted barleys (eg. Barque) with losses calculated at < 10%.

Triticale/rye is quite resistant and moderately tolerant to *P. neglectus*, so there was no relationship between *Pf or Pf/Pi* and grain yield.

For wheat, assessment of tolerance and extent of calculated yield loss were consistent with previous trial results (Vanstone *et al.* 1998), and magnitude of yield loss was similar to results obtained from trials using nematicide (Taylor *et al.* 1999).

Acknowledgements
This work forms part of a collaborative GRDC project between the University of Adelaide, SARDI (Sharyn Taylor) and Agriculture Victoria (Grant Hollaway). SARDI Field Crop Evaluation allowed us to sample their trials, and provided yield data. Collection of soil samples was coordinated by Caroline Versteeg, Kylie Fitzgerald and Wendy Payne.

References

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SP Taylor, VA Vanstone, A.H Ware, AC McKay, D Szot and MH Russ 1999 - Measuring yield loss in cereal; caused by root lesion nematodes *(Pratylenchus neglectus and P. thornei)* with and without nematicide. *Australian Journal of Agricultural Research 50:* 617-622.

	P.neglectus Multiplication Rate (Pf/Pi)	*Resistance/ Susceptibility Rating **	*Pf/g dry soil*
WHEAT (26 entries x 4 reps x 4 sites)			
Machete	31	VS	18.3
Frame	24	S	11.4
Janz	18	S	10.3
Carnamah	14	S	13.1
Silverstar	13	S	14.0
Westonia	13	S	11.1
Spear	12	S	8.5
Goldmark	12	S	10.0
WI97119 (13/4)	11	S	10.0
RAC875	10	S	9.1
Rosella	9	MS	9.4
RAC873	9	MS	9.8
RAC655	9	MS	7.4
RAC868	8	MS	12.0
WI97097 (59/3)	8	MS	9.5
Bookton	8	MS	10.2
Tamaroi (durum)	8	MS	5.9
WI96080 (59/1)	8	MS	9.9
WI96115 (3/10)	8	MS	7.5
VI184	6	MS-MR	8.7
Yallaroi (durum)	6	MS-MR	7.3
Worrakatta	6	MS-MR	6.2
RH911996 (durum)	5	MS-MR	5.7
Ecalibur	5	MS-MR	4.4
Krichauff	5	MS-MR	6.0
WI96112 (201/21)	3	MR	4.2
BARLEY (18 entries x 4 reps x 2 sites)			
SA9013	11	S	2.1
Barque	7	MS	1.5
Sloop	7	MS	2.9
VB9613	7	MS	1.9
Gairdner	6	MS-MR	2.1
Chebec	5	MS-MR	2.9
Fitzgerald	5	MS-MR	1.5
Galleon	4	MS-MR	1.5
Schooner	4	MS-MR	1.9
VB9524	4	MS-MR	1.7
Franklin	4	MS-MR	2.0
Mundah	4	MS-MR	2.2
WI3102	4	MS-MR	1.5
Arapiles	4	MS-MR	2.2
WI2976	4	MS-MR	1.6
WA0563	3	MR	1.7
Namoi	3	MR	1.8
Skiff	3	MR	1.2
TRITICALE/RYE (8 entries x 4 reps x 1 site)			
Treat	4	MS-MR	1.5
TX93-19-1	4	MS-MR	0.6
Credit	4	MS-MR	1.1
TX93-19-2	3	MR	1.5
Bevy rye	2	MR-R	0.7
Tahara	2	MR-R	0.9
Muir	2	MR-R	0.7
Abacus	2	MR-R	0.9

	P.neglectus Multiplication Rate (Pf/Pi)	*Resistance/ Susceptibility Rating **	*Pf/g dry soil*
OATS (13 entries x 3 reps x 1 site)			
SV88123-11-17	4	MS-MR	8.5
SV89070-18	4	MS-MR	6.2
WA2014 (Needilup)	4	MS-MR	6.8
Echidna	3	MR	7.9
Bandicoot	3	MR	3.3
Numbat	3	MR	6.8
Quoll	2	MR	3.9
Hotham	2	MR-R	4.3
SV87073-10-14	2	MR-R	3.4
Euro	2	MR-R	2.9
Mortlock	2	MR-R	2.9
Potoroo	1	R	2.9
SV90109-49	1	R	4.1

***VS – very susceptible; S – susceptible; MS – moderately susceptible; MR – moderately resistant; R – resistant**

WEEDS AS HOSTS OF ROOT LESION NEMATODE (*PRATYLENCHUS NEGLECTUS AND P. THORNEI*)

Vivien Vanstone and Michelle Russ, Department of Plant Science, University of Adelaide, Waite Campus

Root lesion nematodes have a very wide host range, infecting all cereals as well as the crops grown in rotation with cereals (pulses, pastures and oilseeds). *P. neglectus and P. thornei* are found throughout the dryland cropping areas of South Australia. *P. neglectus* is the more common species in South Australia, contributing to yield losses for intolerant wheat varieties in the order of 15%.

As part of our studies into effect of management practices on *Pratylenchus* populations, the role of grass weeds as hosts of *P. neglectus and P. thornei* was investigated.

Seed of grasses (barley grass, brome grass, silver grass, ryegrass and wild oats) was obtained from throughout the cropping regions of South Australia, including some samples from western Victoria. Numerous samples of each grass species were assessed, as these weeds can be quite genetically variable.

Methods

Seeds were placed in Petri dishes on moist filter paper. After several days at ~5°C, plates were incubated at 20 – 25°C until seeds had germinated.

Plants were grown singly in 600ml plastic cups (without drainage holes) containing pasteurised sandy loam field soil. Cups were placed in the glasshouse in controlled temperature waterbaths to maintain soil temperature at 20°C.

Once seedlings had emerged (~4 days), each plant was inoculated with 1000 nematodes extracted from carrot cultures. Ten replicates of each weed sample were grown, plus susceptible (Machete wheat) and moderately resistant (Abacus triticale) cereals for comparison. Plants were watered with distilled water as and when required.

After eight weeks, soil was washed from the roots under running tapwater, and nematodes extracted by misting over four days. Nematode multiplication rates over the eight week period were calculated.

Results

Minimum, maximum and average multiplication rate of *P. neglectus and P. thornei* on a collection of grass weeds grown for eight weeks at 20°C. (*n* is the number of samples tested for each weed species; minima, maxima and averages refer to the range in mean values within each species; means of 10 replicates for each sample).

			P. neglectus multiplication rate		
		n	*Minimum*	*Maximum*	*Average*
Barley grass	***Hordeum* spp.**	34	0.3	1.7	0.9
Brome grass	***Bromus* spp.**	15	0.5	1.5	1.0
Silver grass	***Vulpia* spp.**	7	0.8	1.8	1.3
Ryegrass	***Lolium* spp.**	19	0.3	1.0	0.6
Wild oats	***Avena* spp.**	10	3.1	10.9	5.8
Abacus	***Triticale***				2.0
Machete	***Wheat***				7.2
			***P.thornei* multiplication rate**		
		n	*Minimum*	*Maximum*	*Average*
Barley grass	***Hordeum* spp.**	7	1.1	3.0	1.9
Brome grass	***Bromus* spp.**	5	0.6	1.7	1.3
Silver grass	***Vulpia* spp.**	4	0.2	0.6	0.4
Ryegrass	***Lolium* spp.**	8	0.2	0.7	0.4
Wild oats	***Avena* spp.**	3	0.4	1.8	1.0
Abacus	***Triticale***				2.6
Machete	***Wheat***				4.1

P. neglectus

All wild oats samples tested were very susceptible to *P. neglectus.* Wild oats can be classed as a very good host, allowing the nematodes to multiply.

Barley grass, brome grass and silver grass were moderately resistant/resistant. These are poor hosts, allowing only slight increase in *P. neglectus* population, and the nematodes did not multiply on all of the samples tested.

Ryegrass samples were all resistant to *P. neglectus.*

P.thornei

Wild oats and brome grass were moderately resistant/resistant to *P. thornei,* and therefore poor hosts, allowing slight increase in nematode population on only some of the samples tested.

Barley grass was moderately susceptible, and a good host, with increase in nematode numbers recorded for all samples.

Ryegrass and silver grass were resistant and not a host to *P. thornei.*

Conclusions and Recommendations

- Some grass weeds may host *P. neglectus* and/or *P. thornei,* therefore increasing populations of these nematodes in the soil.
- Control of grasses in fallows and pastures may be important in controlling *Pratylenchus.*
- For *P. neglectus,* control of wild oats should be of concern to cereal growers, particularly if susceptible and/or intolerant varieties are included in the rotation. Control of barley grass may be important in management of *P. thornei.*
- Ryegrass was the only weed tested that showed resistance to both *P. neglectus and P. thornei.*
- Differences between grasses in hosting of *P. neglectus and P. thornei* emphasise the need for growers to identify *Pratylenchus* species present when devising management strategies. This also applies to crops, as species/varieties can differ in reaction to *P. neglectus* compared to *P. thornei.*
- There was no indication that samples of a grass species from different areas varied in ability to host the nematodes.
- Weeds able to host the nematodes need to be controlled in the crop for rotations to be effective. Even though pea, for example, is resistant to *P. neglectus* and to *P. thornei,* nematode numbers might increase if wild oat or barley grass are not controlled in the crop. The benefit of the resistant crop would therefore not be fully realised. Wild oats can multiply *P. neglectus* as much as if a highly susceptible wheat variety were grown.
- About 20 species of broad leaf weeds are currently being tested to determine hosting status for *P. neglectus* and *P. thornei.*

Acknowledgements

Thanks to the many farmers, advisors, agronomists, researchers and others who collected seed from around South Australia and western Victoria. Sharyn Taylor and Danuta Szot (SARDI) supplied cultures of *P. thornei* that were used to prepare inoculum. This work forms part of a collaborative GRDC project between the University of Adelaide, SARDI (Sharyn Taylor) and Agriculture Victoria (Grant Hollaway).

EVALUATION OF NON-TOXIGENIC, NEMATODE-VECTORED *CLAVIBACTER* SPP. FOR POTENTIAL BIOCONTROL OF *CLAVIBACTER TOXICUS*, THE BACTERIUM RESPONSIBLE FOR ANNUAL RYEGRASS TOXICITY

IAN T. RILEY (The University of Adelaide) and GEORGE YAN (Agriculture Western Australia)

Introduction

Clavibacter toxicus produces corynetoxins in annual ryegrass (*Lolium rigidum*) and is responsible for the livestock poisoning know as annual ryegrass toxicity (ARGT). Other related bacterial species (Table 1), like *C. toxicus,* also colonise poaceous hosts using nematode vectors (*Anguina* spp., seed gall nematodes) but do not produce toxin. Some strains of these faster-growing, non-toxigenic species will adhere to *Anguina funesta*, the vector in ryegrass. It is postulated that these species could colonise ryegrass to displace *C. toxicus* and offer potential for novel biocontrol.

Table 1. Non-toxigenic, *Anguina*-vectored bacteria

Bacterium	Host	Origin
"Corynebacterium agropyri"	Wheat grass	USA
Clavibacter iranicus	Wheat	Iran
Clavibacter rathayi	Cocksfoot	UK, NZ
Clavibacter tritici	Wheat, barely	Egypt, India, Iraq

Materials and methods

Container-grown ryegrass was inoculated with *A. funesta* galls and *C. toxicus*-colonised galls at sowing. The treatments, suspensions of one of 17 non-toxigenic strains (6 reps and 18 uninoculated controls), were sprayed on the soil surface three times at fortnightly intervals from a month after sowing. The experiment was repeated in two seasons in an approved quarantine facility. At maturity, nematode and bacterially colonised galls were counted in individual seedheads and whole pots. Toxicity of galls was assayed by a bacterial inhibition and isolates from galls were identified serologically.

Results

Eight strains gave a proportion of non-toxic galls (Table 2); three *"C. agropyri"* strains (20-100%), two *C. rathayi* strains (6-30%) and three *C. tritici* strains (10-55%). Inoculation with some strains also reduced overall gall levels in the 1997 experiment. Re-isolates from non-toxic galls were confirmed to be the species applied and *C. toxicus* from toxic galls.

Conclusions

The work has demonstrated that:

- non-toxigenic *Clavibacter* spp. can colonise ryegrass with *Anguina funesta* as a vector, and
- some strains could potentially displace *C. toxicus*, thereby reducing the risk of ARGT to livestock.

Further studies may be needed before field-testing is approved.

Table 2. Effect of inoculation of ryegrass with non-toxigenic, *Anguina*-vectored bacteria on nematode gall production (*Anguina funesta*), bacterial colonisation of galls and toxin production

Bacterium	Strain	1996				1997			
		Total galls	Bacterial galls	Per cent bacterial	Per cent non-toxic	Total galls	Bacterial galls	Per cent bacterial	Per cent non-toxic
"C. agropyri"	**CS35**	**592**	**273**	**46**	**20**	**592***	**62**	**11**	**100**
	CS105	816	302	37	0	1513	13	01	-
	CS106	**403**	**180**	**45**	**91**	**666***	**67**	**10**	**90**
	CS107	**349**	**122**	**35**	**41**	**537***	**176**	**33***	**39**
C. iranicus	CS13	642	356	56	0	1537	4	0	-
C. rathayi	CS5	952	459	48	30	1185	1*	0*	-
	CS7	664	232	35	0	1287	2*	0*	-
	CS18	442	159	36	6	1124	6	1	-
	CS26	613	193	31	0	1530	3	0*	-
C. tritici	CS4	734	278	38	0	1131	9	1	-
	CS11	686	346	50	0	1434	4	0	-
	CS12	536	246	46	0	1006	3	0	-
	CS16	514	168	33	25	1088	28	3	-
	CS21	**494**	**179**	**36**	**10**	**954***	**55**	**6**	**33**
	CS22	616	163	26	0	1399	1*	0*	-
	CS101	**745**	**182**	**24**	**54**	**814***	**9**	**1**	**19**
	CS103	436	119	27	0	1408	7	1	-
Control		686	256	37	0	1399	28	2	-

Strains in bold produced non-toxic bacterial galls indicating biocontrol potential. *Data statistically different from control ($P<0.05$). Galls counts analysed transformed ($\log(x+1)$) and presented back transformed. Per cent bacterial galls logit transformed for analysis. - indicates toxin not assayed.

NEMATODE MONITORING CAN BE USEFUL AS A MANAGEMENT TOOL

Graham Stirling,Biological Crop Protection Pty. Ltd.

Nematicides and soil fumigants are widely used in horticulture, but de-registration of some of the most effective products and concerns about costs and off-target effects are causing growers to seriously consider whether a nematicide should be applied. Nematode monitoring provides objective data about nematodes and can be used to help growers make management decisions. This article outlines the monitoring system that is currently used in the Queensland pineapple industry.

Background information

For the last 30 years, almost every field planted to pineapples in Queensland was fumigated with EDB. However, it has now been withdrawn from the market and growers only have access to chemicals that are more expensive or less effective than EDB.

Despite the fact that EDB was universally used, previous research has shown that the importance of nematodes varies from field to field. In some fields, nematodes increase to damaging levels and control is only obtained by regularly applying nematicides, while in other fields, nematodes do not cause major problems. Monitoring provides a means of identifying fields that are most at risk from nematodes, as it does not make sense to use the same nematode control measures in all situations.

Monitoring involves regularly collecting a soil sample from a field and sending it to a laboratory for nematode analysis. Results will indicate whether nematode numbers are sufficient to justify nematicide treatment. If few nematodes are found, chemical costs can be reduced because nematicides are not applied unnecessarily. If higher numbers are present, it is often possible to minimise yield losses by applying a nematicide before severe damage occurs.

Nematode monitoring involves more than collecting an occasional sample from a field. Fields are sampled about once a year, and a bank of information is gradually built up for that field. With time, this historical data becomes more and more valuable, as it eventually enables results to be interpreted with more precision. Thus management decisions can be made with more confidence once fields have been monitored for several years.

Protocol for collecting samples

1. Aim to collect four samples from a field during each crop cycle. The best times to sample are prior to planting, about 12 months after planting, at plant crop harvest and about ratoon crop harvest.

2. Select a field of 0.5-1 ha in size that is relatively uniform with regard to soil type, aspect, cropping history etc. Define the area with a block name or number, so that the same area can be identified in future.

3. Use a sampling tube about 2 cm in diameter. Walk over the area and collect 50 random cores of soil from the root zone (i.e. 0-25 cm depth). Carefully mix the soil in a bucket and retain a 500 ml sample for analysis. It will take about 20 minutes to collect a sample.

4. Ensure that the sample is kept cool prior to submission to the laboratory (i.e. keep samples in an insulated container and do not leave them in a vehicle parked in the sun). Do not refrigerate samples.

5. Pack samples in a Postpack box or other similar container and forward to:
   Biological Crop Protection Pty Ltd
   3601 Moggill Road
   Moggill Qld 4070

6. Forward the following information with the samples:

Pre-plant samples

Site or block name
Date previous crop ploughed out
Situation during intercycle (e.g. bare fallow, weeds or crop)
Anticipated planting date

Samples from a growing crop

Site or block name
Date planted
Nematicides applied before and after planting

Interpretation of nematode counts

Nematode management decisions should not be made on the basis of nematode counts alone. Data on root health and records obtained previously from a field (e.g. nematode monitoring data, notes on responses to nematicides, observations of symptoms caused by nematodes) should also be taken into consideration. The following is therefore only a general guide on how to interpret results of nematode analyses.

Samples taken prior to planting

1. After a traditional bare fallow intercycle period of more than 3 months, nematode populations should have declined to low levels due to starvation. Root-knot nematodes should not therefore be detected and populations of lesion nematode should be very low. The presence of either nematode at planting suggests that either the fallow has not been long enough or that host plants (e.g. volunteer pineapples, weeds or a crop) have provided a food source and allowed nematodes to survive. If any nematodes are detected immediately prior to planting, a pre-plant nematicide should be considered and nematode populations should be checked again when the crop is 9-12 months old.

2. Nematodes often cause problems when virgin soil or fields that have previously been under pasture or another crop are planted with pineapple. A low or nil count in these circumstances should be interpreted with caution, as nematodes are sometimes present at depth and may migrate to the root zone after pineapples are planted.

3. A count of zero means that the nematode population is below the level of detection. However, this does not necessarily mean that nematodes should be ignored. For example, if samples were handled roughly or packed incorrectly, if they were exposed to excessive heat or the soil was very wet or very dry, or if previous experience suggests that nematodes should have been detected in a field, it is possible that nematodes may have died while being transported to the laboratory.

Samples taken at 12 months or at plant crop harvest

1. The following table is a guide to the likely hazard from root-knot nematode.

	Samples taken at about 12 months		**Samples at PCH**
Root-knot nematodes/200 ml soil	**Hazard to plant crop**	**Hazard to ratoon crop**	**Hazard to ratoon crop**
0-5	Very low	Low	Very low
6-20	Low	Moderate	Low
21-100	Moderate	High	Moderate
101-300	High	Very high	High
>300	Very high	Very high	Very high

Samples at ratoon crop harvest

1. Nematode counts at about ratoon crop harvest can be used to indicate the likely hazard from nematodes in the next crop. However, samples at plant crop harvest are even more useful. Root-knot nematode populations of 0-20, 21-100 and >100 at any stage in the current crop suggest a low, moderate and high hazard to the next crop.

Importance of nematodes other than root-knot nematode

1. Root-knot nematode (*Meloidogyne javanica*) is the major nematode pest of pineapples in Queensland. Lesion nematode (*Pratylenchus brachyurus*) and reniform nematode (*Rotylenchulus reniformis*) can sometimes be important, but their economic thresholds are not well defined. If either of these nematodes are present at population densities greater than 100 nematodes/200 ml soil, they probably cause some crop loss.

2. Spiral, stubby root and ring nematodes are often present on pineapple, but they are not economically important.

Observations on root health

Root disease problems in pineapple are rarely caused by a single factor. Thus nematode monitoring is of limited value as a management tool without data on other components of the root disease complex. The best way to gain an overall picture of the root system is to monitor root health every time a field is sampled for nematodes.

Some information on root health can be obtained by making casual observations of roots, but there are advantages in assessing root health and recording the data in a formal manner. A monitoring system has therefore been developed in which five plants are selected at random from a field and each plant is rated for various parameters using a 1-5 scale. Recording books are available from Golden Circle Ltd. which contain data sheets on which ratings can be recorded. The rating system being used throughout the industry is as follows:

ROOT HEALTH RATINGS

Crop health: 1=v. poor, 2=poor, 3=moderate, 4=good, 5=excellent.
Soil compaction: 1= no compaction, 5= severe compaction.
Root depth: 1=0-5cm, 2=6-10cm, 3=11-15cm, 4=16-20cm, 5=>20cm.
Root volume: 1=<1L, 2=1-2L, 3=3-5L, 4=6-10L, 5=>10L.

The next five parameters are based on a % of roots:

1=<5% (i.e. <1 in 20 of the roots).
2=6-33% (i.e. up to one-third of the roots).
3=34-67% (i.e. one to two-thirds of the roots).
4=67-95% (i.e. > two-thirds of the roots).
5=all or most of the roots.

Fine feeder roots: % of primary root length with fine feeder roots.
New roots: % of the primary roots that are new.
Galled roots: % of primary roots with terminal galls.
Rotted roots: % of primary roots that are rotted.
Branched roots: % primary roots with terminal branches.

The occurrence of root pests is noted as follows:

White grubs: No. of white grubs under plant.
Symphylids: + = present, - = absent.

Although some growers will feel that a formal rating scheme is unnecessary, there are advantages in using such a scheme:

1. The process of observing roots provides an holistic view of the root system, while the ratings are useful as a management tool. The aim should be to achieve high ratings for root depth, root volume, fine feeder roots and new roots, and low ratings for galling, rotting and branching.

2. Root health data provides a useful record of changes in root health over the life of the crop.

3. During the process of completing a root health assessment, any major problems due to nematodes, *Phytophthora*, white grubs or symphylids will be diagnosed.

4. Root gall ratings allow growers to relate nematode counts from a laboratory to actual damage in the field. Such comparisons serve as a check on the results received from a laboratory, and enable the grower to gain confidence that the laboratory is providing meaningful results.

Using monitoring as a management tool

Once a root health rating has been completed and a nematode count is available, it should be possible to decide whether nematodes are affecting the current crop or are likely to cause problems in future. The best person to interpret such data is a pineapple agronomist who understands root diseases and is familiar with the field from which the data were obtained. Technical staff from Golden Circle Ltd. can provide such a service for company shareholders.

Quality control

It is important to note that all nematode densities mentioned in this paper refer to numbers of nematodes/200 mL soil after correction for extraction efficiency. If growers have samples processed by laboratories other than Biological Crop Protection, they should ensure that the laboratory has adequate quality control procedures and that their counts are corrected for extraction efficiency. Details regarding these issues can be found in the following publication:

Stirling, G. R.. Nicol, J. and Reay, F. (1999). *Advisory services for nematode pests - Operational guidelines.* RIRDC Publication No. 99/41, Rural Industries Research and Development Corporation, Canberra, 111 pp.

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Diagnostic nematology in horticultural crops
Entomophagous nematodes

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Molecular taxonomy of plant-parasitic nematodes (*Pratylenchus* spp.)

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Diagnosis and taxonomy of plant parasitic nematodes

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Host-parasite interactions
Sedentary nematodes
Plant physiology and molecular biology

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Nematode problems on turf

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Biological control
Rotation crops resistant to root knot nematode
Organic matter to control root knot nematode

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Potato cyst nematode
Pasture nematodes
Horticulture

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Systematics and ecology of free-living nematodes
Taxonomy

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Breeding for cereal cyst nematode resistance and tolerance in wheat
Root lesion nematode tolerance breeding
Pratylenchus sp.

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Meloidogyne javanica and *Heterodera avenae* interactions with *Paecilomyces lilacinus*

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Pratylenchus

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General interest
Cyst nematodes
Population dynamics and modelling

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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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Biological control of nematode
Radopholus similis

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Cereal cyst nematode – control and resistance

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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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General diagnosis
Research trial assessment
Research on cover crops
Biofumigation in viticulture

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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
Pasture nematology in New Zealand
Quarantine issues

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Wheat nematology

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Nematode quantification and diagnosis for research trials

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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 nematode and burrowing nematode

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Root knot and cyst nematodes
Giant cell gene expression
Engineered resistance

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Economic impact of nematodes on grapevine
Root knot and root lesion nematodes in grapevine
Diagnosis and non chemical control

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Taxonomy of plant and soil nematodes
Antarctic soil nematodes

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Anguina/*Clavibacter* associations

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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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Pratylenchus thornei.

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Sugarcane nematodes
Biological Control
Resistance mechanisms and
screening ecology

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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.
Cereals
Grain legumes
Annual legumes

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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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Environmental physiology of cold tolerance and anhydrobiosis
Nematode ultrastructure

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Development and production of bionematicides

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Ecology
Taxonomy