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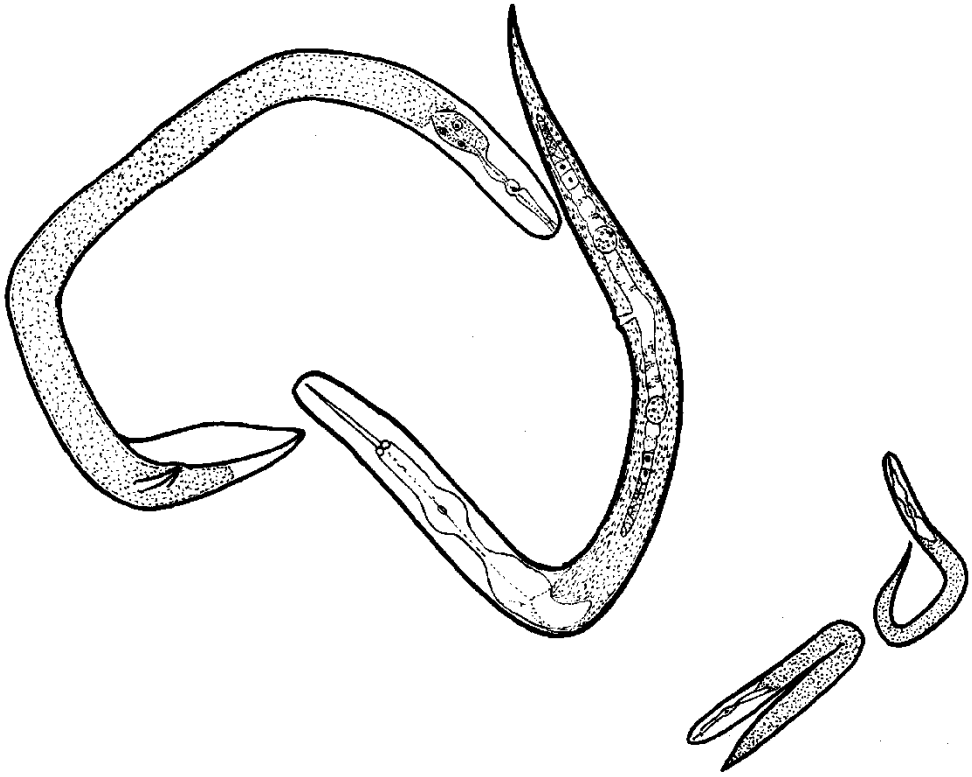
AUSTRALASIAN NEMATOLOGY NEWSLETTER



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From the Editor

Thank you to those of you who made contributions to this newsletter. This issue is delayed, as I have been working overseas.

I look forward to more contributions in June. Please give me something to edit.

July Issue

The deadline for the July issue will be mid June 2012. I will notify you a month in advance so please have your material ready then.

Kerrie Davies

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Association News

FROM THE PRESIDENT

There is not much to report specifically from international nematology this issue.

The International Federation of Nematology Societies (IFNS) continues to hold discussions regarding formalising their structure and becoming an officially incorporated body, based in one of the traditional centres of nematology (Beltsville, Rothamsted, Wageningen or Gent). Issues currently being decided include who will pay the considerable legal costs involved (in the order of several thousand US dollars or Euros), then who will be responsible for the annual costs and reporting required. Don't hold your breath for a resolution.

In the meantime planning is continuing for the 6-yearly international meeting in South Africa, but there is nothing really to report on that either.

The European Society of Nematologists (ESN) is hosting their biennial meeting in Turkey in September this year, and have called for applications for travel bursaries. These are only open to members of ESN, and there are few of these in Australasia (I know because I am the area representative). ESN meetings are usually very friendly affairs, and I can recommend them as including a wide range of nematological topics from a wide geographic area.

In a similar vein, the Society of Nematologists is hosting their annual meeting in Georgia, USA in August. They, too, have student bursaries for members.

The next major nematology meeting in Australia is the Soil Borne Disease Symposium in Perth in September.

Not to be outdone by our fellow nematology societies, we have student travel awards available for any of these meetings, or indeed any others. If there are student members of AAN who would like to attend either of these meetings, then I can recommend the Australian Nematology Support Fund. We have an ultra-simple application procedure: just write to one of the office holders listed at the start of the newsletter, telling us where you want to go, how much money you need, and, briefly, why we should support your trip. One of the aims of AAN is to foster communication, and this includes the rest of the world. We recognise that we are a long and expensive way from most of the other nematologists in the world, and so this is one way that we can foster communication. I encourage applications.

Also to be encouraged are new members of AAN. Anyone with any interest in nematodes should be encouraged to join. It is cheap ($15 per year), you get to hear about what is going on, and you become eligible for the support fund if you are a student.

On a completely different tack, on 23 December 2011, a listing of the number of valid nematode species was published. Combined with the (not quite complete) checklist of nematodes recorded from Australia sponsored by ABRS and the Atlas of Living Australia, this presents an interesting picture of our knowledge of nematodes in Australia. Kiwis,

sorry for the Australocentric view, but these projects have been funded for Australia only: lists of the NZ fauna were compiled some time ago, and we are only just catching up.

Worldwide, there were nearly 25 000 valid species of nematodes, including marine, freshwater, terrestrial, free-living, invertebrate associated, and vertebrate parasitic (the helminths). The total nematodes known from Australia will be somewhere about 3 000. However, the interesting part for me as a taxonomist is that most of the 3 000 known from Australia are not in the 25 000 valid species for the world because they are only known to genus. That is, they are identified only to genus, or less. Plant parasites were about 15% of the total, with similar numbers of marine, freshwater, free-living and slightly more helminths, but fewer invertebrate parasites.

Mike Hodda

Regional News

NEWS FROM SOUTH AUSTRALIA

The University of Adelaide

Kerrie Davies presented a lecture and a practical class on classical diagnostic methods for plant nematodes to students in the Masters course in Plant Health and Biosecurity offered by The University of Adelaide.

In September, Kerrie travelled to Canberra with entomologist colleague Dr Gary Taylor, to attend a 2 day workshop on the *Fergusobia/Fergusonina* mutualism. This was held at the Black Mountain laboratories of the former Division of Entomology, and was organised by Drs Leigh Nelson and David Yeates. It was a very stimulating couple of days of discussions and planning for future collaborations.

In late November, Kerrie and Mike Hodda (CSIRO Ecosystems Sciences) ran their eighth short course in plant and soil Nematology at the Waite Campus of The University of Adelaide. With 18 participants, from Australia, Nigeria, Indonesia and New Zealand, it was the biggest such course they have taught. Two of the participants, from Nigeria and Indonesia, were funded by the Crawford Foundation. Dr Nuchanart Tangchitsomkid from Thailand also attended. She assisted with teaching, and described the innovative non-destructive method she has developed using sonication to drive nematodes out of roots of aquatic plants. If the technique works as well with plants growing in soil, it will lead to a whole new suite of methods for sampling and extraction of plant parasitic nematodes.

Kerrie and 'Fred' Bartholomaeus have been preparing descriptions of new species of *Schistonchus* nematodes.

Kerrie Davies

NEWS FROM QUEENSLAND

Lesley Research Station

A new project on Wheat Genetic Control for Root-lesion nematodes funded by Grains Research and Development Corporation (GRDC) is now underway. Neil Robinson and Jing Lin join the team of John Thompson, Jason Sheedy, Ros Reen,Tim Clewett and Stephen Neate on this project. Neil returns to our group following 6 years in wheat breeding and computer modelling. Jing has been with our group for 3 years now and also has a background in wheat breeding at Wagga Wagga, New South Wales. The ultimate aim of the 5-year project will be to (a) produce wheat lines that are adapted to the Australian environment particularly the northern region and have tolerance and resistance to both *Pratylenchus thornei* and *P. neglectus* to be used as parents by Australian wheat

breeding companies; (b) in collaboration with Australian Wheat and Barley Molecular Marker Program, obtain phenotypic data for the development of molecular markers to genes for resistance and tolerance to *P. thornei* and *P. neglectus* for use by breeding companies, (c) continue to survey the northern region for the spread of root-lesion nematodes and (d) increase industry awareness of the need to grow resistant wheat varieties to solve problems with root-lesion nematodes.

Neil Robinson attended the plant and soil Nematode Identification Course in late November at The University of Adelaide.

The root-lesion nematode component of the wheat National Variety Trials (NVT) has had a successful year with 126 lines and released varieties being tested for tolerance at our *Pratylenchus thornei* and *P. neglectus* field sites. In addition, 156 lines are being tested in glasshouse experiments for resistance to both nematode species. Steven Gould has been working on the NVT project and in his spare time finished off his B. Chem. Sc. (Central Queensland University) with a research project looking at the impact of pre-planting urea application and burning stubble on population densities of *P. thornei* and non-parasitic nematodes. The combination of burning and urea application caused a 30% decrease in populations of *P. thornei* (over 0–30 cm). Steven has now been awarded his degree and received a distinction for his research project.

John Thompson *et al.* recently published a paper in Australasian Plant Pathology on their work seeking resistance to root-lesion nematodes in chickpea from wild *Cicer* spp. (Thompson J.P., Reen R.A., Clewett T.C., Sheedy T.G., Kelly A.M., Goggel B.J., Knights E.J. (2011) Hybridisation of Australian chickpea cultivars with wild *Cicer* sp. increases resistance to root-lesion nematodes (*Pratylenchus thornei* and *P. neglectus*). *Australasian Plant Pathology* 40: 601–611).

Our "Test your farm for nematodes" service received samples from 158 fields in the northern grain region in 2011 – 85% of paddocks contained *Pratylenchus* spp. (49% with *P. thornei* alone, 29% with *P. thornei* and *P. neglectus* together and 6% with *P. neglectus* alone). *Merlinius brevidens* was identified in 82% of paddocks tested.

Kirsty Owen, Tim Clewett and John Thompson were a little distracted from their nematode work in looking at zoosporic parasites in roots of cereals in a survey of northern grain region soils (in the GRDC-funded Northern Integrated Disease Management project). The protozoan *Polymyxa graminis* which vectors soil-borne viruses overseas was found in a cereal crop in Australia for the first time (Thompson J.P., Clewett T.G., Jennings R.E., Sheedy J.G., Owen K.J., Persley D.M. (2011) Detection of *Polymyxa graminis* in a barley crop in Australia. *Australasian Plant Pathology* 40, 66–75). Research from the USA (Langdon *et al* 1961; Schlehuber *et al*. 1965) suggested that yield loss in winter cereals was associated with root infection by the zoosporic fungus *Olpidium* sp. and the stunt nematode *Merlinius brevidens*, so other experiments will look at the interaction of these organisms (and any other interesting beasts we find in our survey). We will be planting a summer crop rotation trial at our *P. thornei* field site in December 2011 with cultivars of soybean, mungbean, maize, sunflower and grain sorghum followed by wheat in winter 2013.

We have all had a busy year speaking about our work at GRDC Update meetings in the northern region for winter and summer crops, and at several well attended field days. Look out for a DVD in the January 2012 issue of Ground Cover that features our group's research on root-lesion nematodes.

Nikki Seymour, Graham Stirling, Jady Li and James McLean are making good progress on the GRDC-funded project on biological suppression of root-lesion nematodes which started last year. In the first year, general suppressiveness has been confirmed in several northern

grain-growing soils. The research team is also surveying soils to identify and isolate the parasites and predators of nematodes and to determine whether other fungi that colonise the plant roots might be involved in nematode suppression in northern grain-growing soils. The parasitic bacteria *Pasteuria* sp. in root-lesion nematode populations was found in Queensland and northern New South Wales, and a glasshouse experiment has been set-up to determine if they could have a role in reducing *P. thornei* numbers in soil. The possibility that these bacteria could act as a biocontrol agent is also being explored. To investigate the relationship between organic carbon inputs and biological suppressiveness of the soils, a field trial with varying rates of organic amendments was established on a nearby research station this year. This trial will run for several years and culminate in a test crop of wheat to determine the treatment effects on crop productivity.

Kirsty Owen

Biological Crop Protection Pty Ltd

Kerrie is always imploring us to write something for the newsletter, but her requests never seem to reach the top of my 'to do' list. Since my last contribution was in January 2009, this is a brief update on what I've been doing, and what I'm currently up to.

Current projects

- In a national project funded by HAL on managing nematodes in vegetable crops, my main role is to determine whether losses from root-knot nematode can be reduced by integrating minimum tillage, crop rotation and organic amendments into the vegetable farming system. I am also helping Jenny Cobon determine the impact of planting date on the damage threshold for *M. javanica* on potatoes. Jenny and I are also examining claims made by a seed company that there is a 'fumigation effect' when certain forage sorghum cultivars are incorporated into soil. My other contribution is to help Frank Hay establish a web-based extension manual for vegetable growers.
- A project jointly funded by GRDC and SRDC aims to better integrate sugarcane and grain production in the southern section of the Queensland cane industry. My interest is in soil management practices that will increase suppressiveness to *Pratylenchus* and *Meloidogyne*. I have shown that the soil immediately beneath the trash blanket is sometimes highly suppressive to plant-parasitic nematodes, and have just established a microplot experiment that will hopefully tell me whether the carbon inputs required to sustain the suppressive biota are coming from root exudates, crop residues, or both.
- A GRDC project involving Nikki Seymour and Jady Li in Toowoomba builds on my recent work on suppressiveness to *Pratylenchus thornei* in northern cereal-growing soils. In the first year of the project, we have been isolating natural enemies of nematodes from these soils. Interestingly, *Pasteuria thornei*, a bacterial parasite of *Pratylenchus*, is reasonably common and the next step is to determine its impact on nematode populations.
- A related GRDC project on free-living nematodes in cereal soils is led by Kathy Ophel-Keller in Adelaide. Ultimately, the aim of this work is to develop DNA tests for omnivorous and predatory nematodes, as they may be useful indicators of soil health. Currently, Marcelle and I are doing manual nematode community analyses

on cereal soils from across Australia, and we are also helping Katherine Linsell (who is based in Adelaide) learn to work with the main free-living nematode groups that occur in cereal soils. Hopefully we will both be able to retire gracefully in a couple of years, with the SARDI team replacing our expertise with a DNA test.

- In the diagnostic service we provide for the Australian turf industry, we receive many samples infested with sting nematode. The identity of this nematode, which is widespread in the Sydney-Newcastle area and around Perth, has always caused confusion, as two belonolaimids have been described from turf in Australia (*Ibipora lolii* from Newcastle and *Morulaimus gigas* from WA), while a third species (*Belonolaimus longicaudatus*) is a major problem on turfgrass in the south east USA. A second issue of interest is whether we are dealing with a native or an introduced nematode. Although we have no funding for this work, I have been collaborating with Robin Giblin-Davis and colleagues in Florida and their DNA analyses are helping us sort out these issues. The next step is to publish our results.
- Since David Guest at the University of Sydney is keen to ensure that his plant pathology students learn something about nematodes, I have been giving a nematology lecture and running a practical session in Sydney for the last few years. That effort is finally bearing fruit. This year we have a student from New Guinea (Gloria Tenga) who is doing a Masters degree on the impact of various rotation crops on *Meloidogyne*. Also, one of the technical staff in Sydney (Carolina Cuenca Cardozo) is maintaining cultures of *Pratylenchus*, *Radopholus* and *Meloidogyne*, and so nematodes are available to undergraduates who may wish to take on a nematology project.
- My book entitled 'Biological Control of Plant-Parasitic Nematodes' (published by CABI in 1991) is now badly out of date, so I have just begun the task of revising it. Given the enormous amount of work published in the last 20 years on soil health, suppressive soils, rhizosphere biology, parasites and predators of nematodes and many other areas relevant to biological control, I sometimes wonder whether I can do the topic justice, and whether I will ever complete the revision. However, I have made a start, and hopefully will have the energy to complete the job.

The good thing about my current projects is that two young people with strong backgrounds in nematology (Jady Li and Katherine Linsell) are working with me on the GRDC-funded projects. They are already making good progress, and hopefully they will continue to enjoy working with nematodes and become the vanguard of the next generation of Australian nematologists.

Recent publications

Stirling G.R., Turuganivalu U, Stirling A.M., Lomavatu M.F. and Smith M.K. (2009) Rhizome rot of ginger (*Zingiber officinale*) caused by *Pythium myriotylum* in Fiji and Australia. *Australasian Plant Pathology* 38: 453-460.

Hayward A.C, Fegan N., Fegan M and Stirling G.R. (2009). *Stenotrophomonas* and *Lysobacter*: ubiquitous plant-associated *gamma*-protobacteria of developing significance in applied microbiology. *Journal of Applied Microbiology* 108: 756-770.

Stirling G.R., Halpin N.V., Dougall A. and Bell M. J. (2010) Status of winter cereals, other rotation crops and common weeds as hosts of lesion nematode (*Pratylenchus zeae*). *Proceedings of the Australian Society of Sugarcane Technologists* 32: 62-70.

Stirling, G.R., Halpin, N.V., Bell, M.J. and Moody P.W. (2010) Impact of tillage and residues from rotation crops on the nematode community in soil and surface mulch during the following sugarcane crop. *Proceedings of the Australian Society of Sugarcane Technologists* 32: 152-168 (Also, *International Sugar Journal* 113: 56-64).

Stirling, G.R., Moody, P.W. and Stirling A.M. (2010) The impact of an improved sugarcane farming system on chemical, biochemical and biological properties associated with soil health. *Applied Soil Ecology* 46: 470-477.

Stirling G.R. (2010) Minimum tillage and residue retention enhance suppression of *Pratylenchus* and other plant-parasitic nematodes in both grain and sugarcane farming systems. In '*The Rovira Rhizosphere Symposium: Celebrating 50 years of rhizosphere research*' (V.V.S.R. Gupta, M. Ryder and J. Radcliff (eds.), pp. 66-71. The Crawford Fund.

Stirling G.R., Halpin N.V. and Bell M.J. (2011) A surface mulch of crop residues enhances suppressiveness to plant-parasitic nematodes in sugarcane soils. *Nematropica* 41: 109-121.

Stirling G.R. (2011) Suppressive biological factors influence populations of root lesion nematode (*Pratylenchus thornei*) on wheat in vertosols from the northern grain-growing region of Australia. *Australasian Plant Pathology* 40: 416-429.

Stirling G. R., Cox, M.C. and Ogden-Brown, J. (2011) Resistance to plant-parasitic nematodes (*Pratylenchus zeae* and *Meloidogyne javanica*) in *Erianthus* and crosses between *Erianthus* and sugarcane. *Proceedings of the Australian Society of Sugarcane Technologists* 33 (CD ROM)

Smith M.L., Smith J.P., and Stirling G.R. (2011) Integration of minimum tillage, crop rotation and organic amendments into a ginger farming system: impacts on yield and soilborne disease. *Soil & Tillage Research* 114: 108-116.

Stirling G.R., Smith M.K., Smith J.P., Stirling A.M. and Hamill S.D. (2012) Organic inputs, tillage and rotation practices influence soil health and suppressiveness to soilborne pests and pathogens of ginger. *Australasian Plant Pathology* 41: 99-112.

Turaganivalu U., Stirling G.R.and Smith M.K. (2012) Current status of burrowing nematode (*Radopholus similis*) on ginger in Fiji. *Australasian Plant Disease Notes* (submitted).

Stirling G.R., Rames E., Stirling A.M. and Hamill S. (2012) Factors associated with the suppressiveness of sugarcane soils to plant-parasitic nematodes. *Journal of Nematology* (submitted).

It would be nice to have time to play more golf

Graham Stirling

Thesis Abstract

COLD-TEMPERATURE ADAPTATION IN NEMATODES FROM THE VICTORIA LAND COAST, ANTARCTICA

Mélianie R. Raymond

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The invertebrates that inhabit Antarctica's terrestrial ice-free areas are a unique resource for the study of adaptations to extreme conditions and illustrate the limits to which physiology can be stretched by evolution to allow life to continue.

Perhaps the most exciting result of the study of these adaptations in the Antarctic's terrestrial fauna was the discovery in 1995 of the survival of extensive intracellular freezing in the nematode *Panagrolaimus davidi*. Intracellular ice formation is generally considered fatal, and as the first and, so far, unique example of this adaptation in a multicellular organism, it has remained contentious. Understanding this adaptation could have important applications for cryopreservation, but research has currently been limited to this one species and based on a laboratory culture that have been isolated from its environment for over 20 years. There has been little research into the thermal tolerances of other Antarctic nematode species.

This thesis explores three broad research themes in order to contribute to the understanding of adaptation in Antarctic nematodes generally, and the survival of intracellular freezing specifically.

Firstly, to place their adaptations in an environmental context, the distribution of the nematode species found in two ice-free areas, around Cape Hallett in Northern Victoria Land and Gondwana station in Terra Nova Bay, is described and factors underlying their distribution patterns are investigated using regression models. Four nematode species were found: *Panagrolaimus davidi, Scottnema lindsayae, Plectus murrayi* and *Eudorylaimus antarcticus*. Their distribution patterns are correlated to both broad-scale habitat descriptors and to soil geochemistry, revealing species-specific differences in distribution patterns that are broadly consistent with other studies of these species in soils from the Dry Valleys and penguin rookeries on Ross Island. The importance of soil conductivity (as a measure of salinity) in predicting the distribution patterns of all four species supports the hypothesis that salinity plays a primary role in determining invertebrate distribution in the terrestrial Antarctic. The current environmental challenges faced by these Antarctic nematodes in their habitats are then described, providing context for laboratory investigations of their adaptations.

Secondly, the survival strategies employed by these nematodes are investigated. For *P. davidi* the survival of intracellular freezing was found to be strongly correlated with its nutritional status, explaining some of the variation in survival rates reported in previous

studies. *Plectus murrayi* was also found to survive intracellular ice formation, providing a second example of an organism able to employ this survival strategy. The appearance of internal ice differed markedly between these two nematode species and that in a temperate species, *Panagrellus redivivus*, suggesting that adaptations enabling the survival of intracellular freezing involve the control of internal ice. Further evidence was also provided for the use of a cryoprotective dehydration survival strategy in response to slow freezing rates in these Antarctic nematodes.

Thirdly, to provide a historical context for their adaptations, and in order to distinguish between the Antarctic species and show their relation to nematode species worldwide, genetic techniques and phylogenetic analyses were employed. Genetic sequencing of the 18S and D3 expansion ribosomal RNA regions and comparisons with published phylogenies for the phylum Nematoda revealed that the Antarctic species do not form a discrete Antarctic clade, but rather are spread over the phylum. This supports current hypotheses of endemism and a long Antarctic history for these species. However, the laboratory culture of *P. davidi* (referred to now as *P. sp. nov.*) was found to be a distinct species from the wild populations of *P. davidi* that were sequenced in this study. The surprising lack of sequence divergence between *P. sp. nov.* and some Californian *Panagrolaimus* species brings its origin into question, and suggests that it may represent a relatively recent invasive species to the Ross Sea Region. This finding calls for further research to address the possibility that it is the first example of a successful animal invasion of Continental Antarctica and to investigate the origins of its remarkable adaptations to freezing.

Obituary

BRIAN KERRY

(1948-2011)

Brian Kerry gained his BSc at the School of Agriculture of Nottingham University, attended Imperial College for a year and completed PhD studies at Reading University. He followed his university education by a career devoted to agricultural research. He made close friends in farming and the farming advisory services as well as in academia.

As a direct consequence of his PhD thesis work on the population biology of the cereal cyst nematode, he began his research career with a study of the factors involved in the phenomenon of cereal cyst nematode decline under cereal monoculture. His work generated deep understanding of the systems involved and led to studies of the possible use of biological organisms for the control of economically important plant-parasitic nematodes.

He also worked in other areas of plant nematology, always with the aim of improving nematode management in crop production. His research provided the data and information required for the publication of more than 100 research papers and the inspiration for a much quoted book.

In 1981 Brian was seconded for six months to CSIRO in Australia as a Senior Research Officer; and made many friends here. He developed wide-ranging links with fellow nematologists around the world, including Australia. One of Brian's key characteristics was the ease with which he got on with everyone, from students to peers.

Brian was appointed head of the newly formed Entomology and Nematology Department at Rothamsted in 1987. He oversaw the amalgamation of what had been two separate and successful departments, and managed a new department of 90 scientific staff, including 28 PhD students, with an annual budget of about £3.3 million. Brian was head of this department until 2000 and, in 1998, took on the additional responsibilities of a position as Associate Director of Rothamsted, a position he held until his official retirement in 2010.

Brian's responsibilities were not confined to the research programmes at Rothamsted. With Roger Cook he organised a workshop at Rothamsted for the Association of Applied Biologists (AAB) dealing with developments in nematicides as a tool for the management of plant-parasitic nematodes. Brian eventually became President of the AAB in 2004. The ultimate example of his work outside the research programme must be the work he did for the Rothamsted Research Redevelopment Project, in which he oversaw the £35 million capital development plan that resulted in construction of the showpiece Centenary Building. He made a huge success of everything he tackled.

His last major project was the nematology capacity building initiative in east and southern Africa funded by the Gatsby Foundation. Together with UK partners, nematologists from Kenya, Malawi, Tanzania, Uganda and Zimbabwe joined forces to form the Nematology Initiative for East and Southern Africa (NIESA). Nematology laboratories were equipped, in-country training courses on a variety of topics organised, MSc and PhD scholarships provided and scientific outputs disseminated at a number of international conferences.

In his younger days, Brian was a hockey-player and a long-distance runner. He relaxed from all his hard work by indulging his life-long hobby of bird watching, which he was able to pursue in all continents.

In 2008, he was awarded an MBE. He was also a Fellow of the Society of Nematologists (1993) and was given special awards by the Cuban Ministry of Agriculture and Environment (2003) and by the Organization of Nematologists of Tropical America (2011).

Brian's outgoing, cheerful personality made him friends wherever he went. Everyone who knew him developed great respect for him. He is survived by his wife Maxine, his daughter Anna, his brother and his mother.

Ken Evans, Rosa Manzanilla-Lopez and David Hunt

(adapted, with permission, from *Nematology*)