REPORT:
FOURTH INTERNATIONAL CONGRESS OF NEMATOLOGY, TENBEL, LA GALLETAS, ARONA, TENERIFE, CANARY ISLANDS, SPAIN.

8 June 2002 – 13 June 2002

Driekie Fourie

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ACKNOWLEDGEMENTS

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- the Oil and Protein Development Trust for financial support provided to attend the congress and
- the ARC for granting permission to undertake the trip.

ITENERARY

4 June 2002	-	Johannesburg – Amsterdam (The Netherlands)
5 June 2002	-	Amsterdam – Leuven (Belgium)
6 June 2002	-	Leuven - Amsterdam
7 June 2002	-	Amsterdam – Tenerife (Canary Islands, Spain)
8 June 2002	-	Register for Fourth International Congress of Nematology (FICN)
9 June 2002	-	Attend FICN: Present two posters
10 June 2002	-	Attend FICN
11 June 2002	-	Excursion to banana plants on the island
12 June 2002	-	Attend FICN: Present one poster
13 June 2002	-	Attend FICN: Present an invited paper
14June 2002	-	Tenerife - Amsterdam
14 June 2002	-	Amsterdam - Johannesburg
15 June 2002	-	Arrive at Johannesburg International

ACRONYMS

ARC – GCI	Agricultural Research Council – Grain Crops Institute
IFNS	International Federation of Nematology Societies
FICN	Fourth International Congress of Nematology
K U Leuven	Catholic University – Leuven
SCN	Soybean cyst nematode
USA	United States of America

OVERVIEW

FOURTH INTERNATIONAL CONGRESS OF NEMATOLOGY (FICN) TENBEL, LA GALLETAS, ARONA, TENERIFE, CANARY ISLANDS, SPAIN.
7 JUNE 2002 – 13 JUNE 2002

The International Federation of Nematology Societies (IFNS) hosted the FICN in Tenerife, Canary Islands, Spain from 7 June to 13 June 2002. The goal of the IFNS is to foster world-wide awareness of nematodes and the advancement of the science of nematology.

More than 500 delegates, from all over the world, attended the congress. A total of 545 presentations, including 109 invited papers and 436 posters, have been presented covering a variety of nematological aspects. Contributions by the ARC – Grain Crops Institute included an invited oral presentation and three poster displays on migratory and sedentary plant nematodes.

Invited, oral presentations on this congress focused on topics that ranged from plant-parasitic, entomopathogenic, free-living, marine and fresh water nematodes. Although cyst and lesion nematodes received much attention, root-knot nematodes are still globally regarded as the economically most important plant-parasitic nematodes, particularly in developing agriculture. Therefore, a colloqium on the need for and focus of a second International *Meloidogyne* Project was organized and attended by delegates from Australia, Belgium, Cameroon, Cuba, England, Israel, Japan, Nigeria, Pakistan, Scotland, South Africa, the USA and the Netherlands.

Since molecular diagnostics are currently an integral part of nematology research, one of the sessions was allocated for discussion oN new trends in this particular field. One prospect is the use of micro-array technology in which thousands of different proteins can be spotted on a chip of about 1 cm^2. The presence of nematodes, among other plant pathogens, can thus be quickly detected in soil samples. The importance of and need for morphological identification was, however, emphasized throughout these discussions.

Nematode management options were the main issue of concern during the congress discussions. The imminent removal of methyl bromide stimulated a world-wide search for alternative control methods over the past few years. Progress on resistance breeding, application of organic amendments, biological control agents, chemical control and cultural control strategies were thoroughly discussed during several sessions.

Information gathered during this congress is most certainly helpful and can be applied in several nematology projects of the ARC.

RECOMMENDATIONS

1. An international congress on Nematology is held every sixth year and it is strongly recommended that a Nematologist from the ARC – GCI attend this meeting. Important contacts are made with international researchers and valuable knowledge shared during these meetings. It is also of utmost importance to evaluate own research in relation to international standards, stimulate debate and future planning.
2. Identification of molecular markers at the ARC – GCI in the South African soybean genotype LS5995 should be continued and will be the first markers associated with *M. incognita* race 2 resistance in soybean globally. This particular field of study is crucial, not only for the South African soybean industry, but also for researchers at the ARC -GCI since this information will put them in a leading position globally.
3. South American groundnut genotypes resistant to *Meloidogyne arenaria* should be obtained and evaluated for *Ditylenchus africanus* resistance. Resistance to *M. arenaria* in these genotypes was derived form a backcross-breeding programme including diploid wild *Arachis* spp. in which highly effective resistance to this parasite was discovered. Although wild *Arachis* spp. have not been evaluated to

date for resistance to *D. africanus,* Miss S Steenkamp (Nematologist : ARC – GCI) obtained sources of these genotypes for resistance evaluation purposes.

4. Dry bean genotypes Aporé and Pot-51 exhibit resistance to *M. javanica* in Brazil. These genotypes should be obtained and evaluated for resistance to South African populations of *M. javanica*. To date no South African dry bean genotypes and / or breeding lines could be identified with resistance to both *M. javanica* and *M. incognita* race 2. Inclusion of the above-mentioned resistant material in the dry bean-breeding programme can contribute to minimise losses due to root-knot nematode infestation, both commercially and in small-scale farming systems. This research will ensure a pro-active approach to root-knot nematode control in the South African dry bean industry.
5. The quest for alternative root-knot nematode control strategies in South Africa should be continued, with strong emphasis on host plant resistance and resistance breeding including marker-assisted selection (MAS) where possible.

REPORT ON THE FICN

1. Purpose of the visit

- To attend the 2002 International Congress of Nematology at Tenerife, Canary Islands, Spain.
- To present an invited paper and three posters.
- To facilitate personal contact between researchers with the aim of future co-operation.
- To evaluate own research in relation to international standards and stimulate debate and future planning.
- To create a forum for the exchange of information.
- To represent South African nematologists during a colloquium on the need for a second, global International *Meloidogyne* Project.
- To attend the public defense of a PhD-student at the Catholic University of Leuven, Belgium.

2. Contributions by ARC – Grain Crops Institute

i) One invited, oral presentation during the session on resistance breeding against non-sedentary nematodes.

Topic:

Quest for resistance to the peanut pod nematode

Authors:

A. H. Mc Donald, <u>H. Fourie</u> * & S Steenkamp

Date: 13 June 2002 (11h10am)

ii) Three poster presentations during sessions on:

- Detection and diagnostics
- Resistance breeding and
- Integrated managament, respectively.

a) *Poster 1:* Advances in applied nematode research in South Africa after introduction of the SCAR-PCR technique for nematode identification.

Authors:

H. Fourie, C. Zijlstra, A.H. Mc Donald & G.A. Venter

b) *Poster 2:* Evaluation of soybean genotypes for host suitability to *Meloidogyne incognita* race 2: an *in vivo* study.

Authors:

H. Fourie, A.H. Mc Donald, D. De Waele & A.J. De Lange.

c) *Poster 3:* The challenge towards integrated control of root-knot nematodes for developing agriculture in South Africa.

Authors:

H. Fourie, M.J. Schoeman, M.B. Mtshali, C.M. Leswifi, H.F. Riekert & A.H. Mc Donald.

3. Important contacts made at the congress.

Dr Vivian Blok: Molecular Scientist, Scottish Crop Research Institute, Invergowrie, Dundee, DD2 5DA, Scotland, UK. vblok@scri.sari.ac.uk

Dr Derrik Brown: Nematologist, Scottish Crop Research Institute, Dundee, DD2 5DA, Scotland, UK. jhuebschen.sfla-nw@agrainfo.rpl.de

Dr Roger Cook: Nematologist, Institute of Grassland and Environmental Research, Aberystwyth, Ceredigion, SY23 3EB, Wales, UK. roger.cook@bbsrc.ac.uk

Dr Danny Coyne: Nematologist, IITA - Ibadam, Nigeria, c/o Lambourn $ Co., Carolyn House, 26 Dingwall Road, Croydon, CR9 3EE, UK. d.coyne@cgiar.org

Dr Dave Crump: Nematologist, BioNem Ltd, 46 Chaul End Road, Caddington, Bedfordshire, LUI 4AS, UK. rump@bionem.freeserve.co.uk

Prof Dirk De Waele: Nematologist, Laboratory of Tropical Crop Improvement, Kasteelpark Arenberg 13, 3001 Leuven, Belgium. Dirk.Dewaele@agr.kuleuven.ac.be

Dr L.J.M.F. den Nijs: Nematologist, Plant Protection Services, 15 Geerjesweg, 9102, 6700 HC Wageningen, the Netherlands. L.j.m.f.den.nijs@pd.agro.nl

Dr Mireille Fargette: Nematologist, Centre de Biologie et de Gestion des Populations, CBGP, CS 30016, Montferrier-sur-Lez Cedex, France. Mireille. Fargette@mpl.ird.fr

Mrs Farroteh Fatemy: Nematologist, Nematology Department, Plant Pests and Diseases Research Institute, P.O. Box 1454-19395, Teheran, Iran. fatemi@tavana.net

Dr Roger Fogain: Nematologist, Centre Africain de Recherche sur bananiers et Plantains, BP 832, Douala, Cameroon. Rfogain7@yahoo.fr

Dr Sue Hockland: Nematologist, Invertebrate Identification Team, Plant Health Group, Central Science Laboratory, Sand Hutton, York, Y041 1LZ, UK. s.hockland@csl.gov.uk

Dr Roy Neilson: Nematologist, Plant & Pathogen Co-evolution Programme, Scottish Crop Research Institute, Dundee, DD2 5DA, Scotland, UK. roy.neilson@scri.sari.ac.uk

Prof. James Starr: Nematologist, Dept. of Plant Pathology & Microbiology, Texas A & M University, College Station, TX 77843, USA. starr@ppserver.tamu.edu

Dr Carolien Zijlstra: Molecular Scientist, Plant Research International, P.O.Box 16, 6700 AA, Wageningen, The Netherlands. C.zijlstra@plant.wag-ur.nl

Proof of follow-up contact, made with Dr Vivian Blok, Dr Roy Neilson and Mrs Farroteh Fatemy during the FICN, is included as Appendixes 3, 4 and 5, respectively.

4. Report on the congress

4.1. General introduction

The congress was attended by more than 500 delegates from across the world. A total of 545 presentations have been presented including topics on molecular diagnostics, resistance breeding, alternative nematode control strategies, application of organic amendments, biological control agents, chemical control, cultural control and nematode management in resource-poor agriculture. The congress programme and selected abstracts are included as Appendices 1 and 2, respectively. A copy of the congress book is available at Mrs H. Fourie (ARC – GCI) or online at www.brill.nl, for further references. Invited oral presentations will be published in Nematology during 2002/2003. In this report emphasis will be placed on topics presented and discussed during the symposium, which is of concern for nematologists of the ARC – GCI.

4.2. Molecular diagnostics

Identification of pathogenic nematodes at species level is increasingly dependant on the use of molecular tools. Morphological differences may be absent or difficult to observe. Accurate and reliable identification of nematodes are fundamental requirements before research programmes or proper management strategies can be implemented, particularly where quarantine organisms are concerned (Zijlstra, 2000).

Several invited papers and poster presentations referred to the use of molecular identification techniques for nematode diagnostics. Thus far, PCR-based diagnostics offer the best possibilities for precision, reliability, sensitivity and quantification. For example, the use of ribosomal DNA has been widely exploited to distinguish between various plant-parasitic species, to investigate intraspecific variation and to examine evolutionary relationships. Further refinements to use rDNA to quantify and determine the relative proportions in mixtures of species for use in risk assessments have already been achieved. Mitochondrial DNA-size polymorphisms have also been used to distinguish between many of the economically important root-knot nematode species, but for many genera this molecular target remains unexplored or may be problematic. Where the "conventional" targets have lacked sufficient variability to distinguish closely related species, randomly amplified polymorphisms from fingerprinting patterns have been exploited. Challenges remain, however. Incorporating diagnostics into management programmes to more effectively deploy resistance, pesticide use or crop rotation will require improvement of simplicity, reproducibility and probability of these diagnostics to encourage their uptake.

A more advanced technique to detect the presence of nematodes and other soil-related plant pathogens in soil samples is currently being exploited. The multiplicity of detection assays available for a specific pathogen leads to a lack of consistency among the various testing agencies and hampers standardisation. Micro-array technology, however, in which thousands of different proteins can be spotted on little more than 1 cm^2, enables the detection of many different target molecules in the same sample with increased specificity. Therefore, micro-arrays can meet the demand for fast, specific, efficient, cost-effective, user-friendly and reliable multiplex detection methods for different organisms. Recent data to detect plant pathogens in this multiplex setting look promising.

Current situation at ARC - GCI

The author and a molecular scientist, Dr C. Zijlstra, from Plant Research International, The Netherlands, have been able to identify *M. chitwoodi* and *M. fallax* by PCR-based technology. These results were displayed at the congress during a poster session on 9 & 10 June 2002. While the identification of *M. fallax* is a new record for South Africa, the geographical distribution of M. *chtiwoodi* was expanded from three to five known localities locally. Both these species are declared as quarantine organisms in Europe. A paper on this topic has also been published during 2001 in the internationally approved journal, Nematology. This collaborative study is a result of personal contact by Dr A.H. Mc Donald and Mr H.F. Riekert during their attendance of the Third International Nematology Congress in 1996 at Guadeloupe Antilles, French West Indies.

4.3. Resistance breeding

Host plant resistance is one of the cornerstones upon which integrated pest management is based. Nematode resistant genotypes can be one of the most useful, economical and effective means of managing nematodes in both the commercial and developing agricultural sector (Starr, 2002). However, breeding for durable resistance to plant-parasitic nematodes is a challenging task since various factors, i.e. high temperatures, variability in the nematode population etc., increases the risk for resistance breaking.

Evident throughout the presentations concerning resistance breeding were the use of marker assisted selection (MAS), which is currently commonly used in various crops to verify resistance against plant-parasitic nematodes, in particular root-knot nematodes.

Various invited papers and posters dealt with this topic and included a wide variety of crops.

4.3.3.1. Soybean - soybean cyst nematode (SCN)

Breeding programmes aimed at resistance to the SCN were developed in the USA soon after its discovery in 1954. Resistant sources to this parasite include genotypes Peking, Bell, PI188.788, PI90.763, PI209.332 and PI437.654 which are most successful in reducing SCN numbers in the USA.

Current status in South Africa

Although this parasite has not yet been discovered on soybean in South Africa, the possibility of it being present in samples is closely monitored during each growing season.

4.3.2. Soybean – *M. javanica*

M. javanica causes significant yield loss to soybean, particularly in Brazil. Genotype PI595099 proved to exhibit resistance to this parasite. Progress in selection for nematode resistant lines was accelerated by the use of molecular markers associated with resistance. Four QTL's showed significant association with the resistance trait and the presence of at least one gene responsible for this resistance, were identified.

Current status in South Africa

In South Africa, three molecular markers associated with resistance to *M. javanica* were identified at the ARC – GCI in soybean lines obtained from a cross between Gazelle (resistant) and Prima (susceptible). Application of these markers supplies an easy, quick and cost-effective way to screen soybean germplasm for resistance to *M. javanica*. Shortcomings with regard to the application of the marker however exist, since the genetic pool of genotypes from which the markers were derived, differs from that of other genotypes.

4.3.3. Soybean – *M. incognita*

In contrast with root-knot nematodes being a major parasite of soybean in the southern parts of the USA, *M. incognita* is currently an emerging threat to crop production in southern Illinois, USA. The potential impact of this parasite to soybean germplasm in northern latitudes is unknown. Reports on resistance screening to this parasite indicated that reproduction of *M. incognita* was lowest on Pioneer 9481, Pioneer 9492, Gateway 493 AND LS 94-3207. These genotypes will be included in breeding programmes during the next few years to refine this trait in commercially available genotypes potentially grown in Illinois.

Current status in South Africa

Evaluation of commercial South African soybean genotypes for resistance to *M. incognita* race 2 is in an advanced stage. Genotype LS5995 was identified as a resistance source to this species from greenhouse, microplot and field data. Crosses between the latter and Prima2000 (susceptible) were conducted and resulted in 26 F1 soybean plants. Identification of molecular markers will commence during January 2003. The USA line, D82-3298, which is also resistant to *M. incognita*, was included in the above-mentioned trials. This information has been displayed during a poster session at the congress on 9 June 2002.

4.3.4. Groundnut – *M. arenaria*

M. arenaria is a major pest of groundnut in the USA. Groundnut genotypes resistant to this species were released in the USA only after 12 to 15 years of intensive research and breeding efforts. Resistance sources to *M. arenaria* originated from wild *Arachis* spp., endemic to the Amazone valley in South America. Genotypes COAN and NemaTAM, resistant to this parasite, are currently available for commercial cultivation in the USA. These genotypes, as well as several other breeding lines will be supplied to Mrs Sonia Steenkamp (Nematologist: ARC – GCI) by Prof James Starr for evaluation against the peanut pod nematode as well as the local root-knot nematode species.

The use of a restriction fragment length polymorphysm (RFLP) marker linked to resistance to *M. arenaria* is also a common practise to evaluate USA groundnut breeding lines for resistance to the peanut root-knot nematode.

Current status in South Africa

South Africa is in an unique position with regard to the occurrence of the peanut pod nematode, *Ditylenchus africanus* on groundnut. This endoparasitic, migratory nematode has not been reported to date on groundnut in any other country of the world (De Waele et al., 1989). This parasite is amongst other factors, one of the reasons why a decline in groundnut production has been experienced locally since 1982 (Swanevelder, 1997).

Although the local genotype Kwarts exhibits tolerance to this parasite when low *D. africanus* population levels occur, no other local groundnut genotype has resistance to this pathogen. Various foreign genotypes were also evaluated since 1987 in *in vitro*, greenhouse, micro plot and field trials. No resistance sources have been identified in these material too. As mentioned above, foreign groundnut germplasm from the USA and India will be obtained for evaluation against *D. africanus* and *Meloidogyne* species. If resistance is identified in these material, breeding efforts will commence to transfer the resistance trait into popular, commercial genotypes. An oral paper, titled: "Quest for resistance to the peanut pod nematode" was presented by the author during the resistance breeding session against non-sedentary nematodes on 13 June 2002. Presentation of this data, compiled by the author, Dr A H Mc Donald and Miss S Steenkamp, evoked a lively discussion during the discussion session. A valuable contact was also made with Prof James Starr (Texas A & M University), the nematologist involved with resistance breeding of groundnut against *Meloidogyne arenaria*.

4.3.5. Dry bean and cowpea – *M. javanica*

Dry bean is cultivated both as an important protein-rich crop in commercial and developing agriculture world-wide. Two Brazilian dry bean genotypes, Aporé and Pot-51, were recently identified as resistant to *M. javanica*, while all available Brazilian cowpea genotypes permitted abundant reproduction of this pathogen.

Current status in South Africa

To date, no local dry bean material has been identified with resistance to either *M. javanica* or *M. incognita* race 2. The above-mentioned resistance sources from Brazil will be obtained and evaluated against the South African populations of these two root-knot nematode species.

Two local cowpea breeding lines were identified by nematologists of the ARC – GCI, with resistance to *M. javanica.* The evaluation of these cowpea lines within a crop rotation system for developing farmers will receive attention during the following two years.

4.3.6. Alternative nematode control strategies

4.3.6.1. Organic amendments

Organic amendments enhance natural biological control through the production of toxic substances during decomposition and by alterations in soil microbial ecology (Bridge, 1996).

Although success were reported during the congress with regard to the use of organic amendments under certain conditions, the use of nematicides and other control strategies (i.e. solarisation) in combination with these amendments rendered the best results by far.

The incorporation of canola seed meals and milkweed seed meal proved to reduce the impact of *M. chitwoodi* on potato in the Pacific North West of the USA by 50 – 80%. These amendments, however, failed to control other root-knot nematode species and indicated that local environmental conditions is a key factor in the efficacy of these amendments.

In Brazil, carrot quality was 80% higher in treatments including chicken manure, solarisation and carbofuran (40kg/ha before planting), compared to the untreated control. Soil temperatures of 77 °C were experienced where chicken manure were incorporated, compared to soil temperatures of 75 °C in solarised plots. In Puerto Rico, the application of poultry litter reduced *M. incognita* numbers on pumpkin while plant development and yield were improved.

The application of goat manure at different dosages on 6-year old guava trees in Venezuela resulted in no significant differences in *M. incognita* numbers ten months after treatments on a three monthly basis. Branching, number of flower buds and amount of fruits were, however, higher in trees treated with goat manure. In Israel, results from a tomato trial treated with cattle manure suggested that high nitrogen concentrations, particularly N-NH4 contributed to nematode suppression.

Grass tops of *Brachiaria brizantha*. *B decumbens*, *Panicum maximum* cv. Guiné and *Andropogon gayanus* cv.Planaltina were mixed into soil where indicator tomato seedlings were planted 30 days later. No effect was evident with regard to a reduction in *M. incognita* and *H. glycines* numbers.

Although the use of organic amendments is seldom able to reduce root-knot nematode numbers significantly, these treatments usually improve soil fertility and minimise the loss of nutrients and pesticides. Plots amended with organic materials also have a higher capacity for water retention and an increased amount of organic matter. The use of organic amendments also improves the activity of micro-organisms associated with the rhisospere of crops (Bridge, 1996).

This approach may be utilised to contribute to reduce the dependence on synthetic pesticides and to mitigate the environmental contamination produced by the intensive use of chemicals. Results provided throughout the congress, however, indicated that nematicides still proved to reduce nematode numbers most successfully in the short term.

4.3.6.2. Biological control

Concern and restriction on nematicidal use prompted the exploitation of biological control as an alternative nematode control strategy during the past few years (Stirling, 1991). The effect of various biological control agents against plant-parasitic nematodes were presented and discussed during the congress.

According to research results the nematicidal activity of methanol extracts from brown algae from the Red Sea proved to cause more than 90% mortality to *Meloidogyne* spp. egg-masses in an *in vitro* experiment.

The fungus, *Monacrosporium* spp. originating from Brazil, was able to capture between 81.3 and 100% of *Rotylenchulus reniformes* spp. in an *in vitro* experiment. Various other fungi, namely *Verticilium chlamydosporium*, *Trichoderma harzianum*, *Paecilomyces lilacinus* and *Cylindrocarpon destructans* are also investigated, especially for their various modes of action i.e., direct parasitism on second stage juvenile

(J2) and eggs and metabolits produced by these fungi affecting the J2 viability and egg hatching.

With regard to the bacterium, *Pasteuria penetrans*, evidence exists that the greatest parasitism occurred when *Meloidogyne* spp. genetically close to those from which the bacteria populations were originally isolated were exposed to *Pasteuria* isolates. Another study on this bacterium revealed that a negative correlation existed between the amounts of *P. penetrans* present and a high soil clay content. Lighter textured soils allowed higher attachment of *P. penetrans* to juveniles of *M. javanica* than heavier soils.

The bacterium, *Corynebacterium paurometabolum* strain C-924 originating from Cuba, is also a potential biological agent that is currently under investigation for nematode control. This bacterium concurrently produces hydrogen sulphur and chitinases in sufficient amounts to impede egg hatching and kill juveniles of plant-parasitic nematodes.

Current status in South Africa

Biocontrol agents currently dominating the market in South Africa in terms of management of nematode populations, include the fungus *Paecilomyces lilacinus* and the bacterium sp., *Bacillus*. Although these agents are marketed aggressively, their efficacy under harsh South African conditions remains inadequate to control particularly root-knot nematodes successfully.

4.3.6.3. Chemical control

Since environmental and human health concerns resulted in increased restrictions on the use of nematicides during the past few years (Starr, 2002), chemical nematode control received little attention during the congress.

It was apparent, however, that nematicide treatments (included in trials to compare alternative treatments to) generally resulted in significant reduction of nematodes and improved crop quality or yield. The latter trend was also evident when nematicides were combined with alternative nematode control measures, i.e. *P. lilacinus* combined with cadusafos on citrus in South Africa.

It was evident throughout the congress that the frantic search for substitutes for the highly effective soil fumigant, methylbromide, which will be withdrawn from the market in the near future. Fenamiphos will also be phased out in North America during 2007. Although promising compounds for future development as methylbromide substitutes were proposed (i.e. inorganic azides, propylene oxide, methyl iodide etc.), the main difficulty in finding these substances resides in the need to develop economically viable soil treatments that are safe, environmentally acceptable and effective. These treatments must not only be effective against plant-parasitic nematodes, but also against weeds and other soil-borne pathogens and pests.

Another problem faced by the nematicide industry, is that the market niche for any newly developed nematicide is limited relative to the market for herbicides or insecticides (Starr, 2002). While many researchers are searching for replacements for methylbromide, developing a new formulation or improving on an old one is just the beginning of the process. According to information disseminated during the congress, this process can take up to four years and can cost in excess of US $12 million. It is thus unlikely that new nematicides based on current available chemistry will be developed in the near future, with nematicides likely to play a diminishing role in crop protection in future.

Current status in South Africa

Commercial South African farmers are mainly dependant on nematicides to reduce plant-parasitic nematode numbers significantly in the short term. Although several biological control agents are currently aggressively marketed in the local agricultural sector, little or no substantiated proof exists of their efficacy, particularly on annual crops cultivated under harsh conditions. Another serious drawback for the nematicide industry in South Africa is the current, illegal abuse of highly toxic nematicides. To my opinion nematicides will always play an essential role in crop protection since no other investigated control strategy is able to replace nematicides on various crops. Nematicides must, however, be used sensibly and responsibly together with host plant resistance, crop rotation and other management practices.

4.3.6.3. Other alternative control strategies

Other non-chemical nematode control measures reported to be generally applied in developing agriculture include biofumigation, cover crops, trap crops, hot water treatment, crop rotation, flooding and soil solarisation.

5. Nematode control in developing agriculture

Although global yield losses to plant-parasitic nematodes are estimated between 5% - 7% annually, yield losses of more than 70% can occur in developing agriculture when extremely high nematode population densities are encountered (Barker & Koenning, 1998).

Ample evidence was provided during oral and poster sessions at the congress that nematodes play a major role in quality and yield reduction of numerous crops grown by subsistence farmers across the world.

According to several oral presentations on nematode management in subsistence farming in Africa, Mexico, the Carribean, Bangladesh, Nepal and Pakistan, nematode populations can be reduced by implementation of low-cost nematode management strategies. These include solarisation, surface burning, host plant resistance, crop rotation, flooding, green manure and organic amendments. Although these practices provide some success in reducing nematode numbers, nematode problems remain severe since nematicides are too expensive and toxic for use by these farmers.

Current situation in South Africa

A survey, conducted by the ARC – GCI over the past two years in resource-poor areas of South Africa, indicated that root-knot nematodes are a major concern with regard to crop quality and yield losses. Several on-farm and micro plot trials were conducted to establish the effect of low-cost, alternative control measures on root-knot nematode populations. Several of these treatments and a particular crop rotation sequence proved to be successful in reducing root-knot nematode numbers. These results were presented during a poster session on 12 June 2002 at the congress. The integration of these treatments is, however, the bottom line to ensure sustainable food production and will receive attention during the following growing seasons. Also important is that every producer cultivate his / her crops under a set of unique conditions. Therefore, no general recipe exists for the management root-knot nematodes since developing farmers in South African are faced with different environmental conditions, soil types, crop rotation sequences, etc. Extreme caution must therefore be practiced to tailor-make nematode control strategies for any given set of conditions.

Although the latter also applies to commercial farmers in South Africa, use of nematicides facilitates complex nematode control process in this sector. Needless to mention that resource-poor farmers do not have the financial resources or the infrastructure to apply nematicides and that the high toxicity levels of these products make it difficult for them to apply.

6. **Attendance of public defense: PhD-student , KU Leuven, Belgium.**

Since permission was granted to attend the congress only at a late stage to the author, spare time according to the available flight schedules at that time was optimally utilized.

The author managed to attend the public defense of a PhD-student, Mrs Annemie Elsen at the K U Leuven on 5 June 2002. Approximately 80 persons, including the jury, researchers and students, attended the defense, which lasted for two hours. The topic of this study was: "Study of the interaction between arbuscular mycorrhizal fungi (AMF) and plant-parasitic nematodes in *Musa* spp."

The final conclusions of this study included the following:

- the presence of AMF has no additional effect on nematode reproduction when nematode reproduction is already very low (due to the reproductive fitness of the nematode population and / or the resistant host plant response of the tested genotype)
- the implementation of early michorrhizal inoculation at nursery level can represent a biotechnological alternative rarely considered for the management of migratory endoparasitic nematodes when plants are transplanted to infested soil.
- Application of AMF reduces the negative effect of Al-toxicity (abiotic stress) and of fungi (*Cylindrocladium spatthiphylli* & *Fusarium oxysporum* f.s. *cubense*) after transplant into the field.

Information on this topic is included as Appendix 6.

7. Literature cited

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