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**Attendance at the 4th
International
Symposium on
Environmental
Aspects of Pesticide
Microbiology, Greece,
September 2004**

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CSIRO Entomology

Project Number: VG04042

VG04042

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Conference & Travel Report

**John N Matthiessen
CSIRO Entomology, Perth**

**4th International Symposium on Environmental
Aspects of Pesticide Microbiology**

**Thessaloniki, Greece
4-9 September 2004**

&

**Visit to Department of Plant Sciences, University of Tennessee, Knoxville,
Tennessee, USA**

30 August-1 September 2004

A report for HAL Project VG04042

to:

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Summary

This document reports on attendance by John Matthiessen, CSIRO Entomology, Perth, at the 4th International Symposium on Environmental Aspects of Pesticide Microbiology, held at Thessaloniki, Greece 4-9 September, 2004, under the auspices of the Pesticide Microbiology Group of the Society of Environmental Toxicology and Chemistry, and organised by participants based at the Aristotle University of Thessaloniki. It also reports on a visit to the Plant Sciences Department, University of Tennessee, Knoxville, Tennessee, USA 30 August-1 September, 2004.

Attendance at the Symposium related to HAL-funded research on the enhanced biodegradation of metham sodium soil fumigant, while the visit to the University in Knoxville principally related to HAL-funded research on biofumigation.

A paper was presented at the Symposium. The presentation related to our findings of a crucial role of calcium in enhanced biodegradation of metham sodium, that we believe is likely to be a general phenomenon. This work is unique in that it showed that the extensive previous literature associating enhanced biodegradation with high soil pH was a correlation, not cause and effect.

A double seminar on our biofumigation and enhanced biodegradation research was presented at the University of Tennessee.

The coverage of topics at the Pesticide Microbiology Symposium related mainly to microbial degradation of pesticides in soil, with other topics on the effects of pesticides on soil microorganisms and ecotoxicology, molecular biology of the degradative processes, characterisation of the availability of pesticides in soil to degrading organisms and how to realistically measure that bioavailability, and effects of toxins from transgenic plants on degradative processes.

There was a mix of the more basic research aspects, regulatory issues and the applied agricultural and social consequences of pesticide presence in soil and the degradation processes that cause the removal of pesticides. There was a good balance of participants from the pesticides industry and academic and applied research institutes.

The diverse information presented gave a valuable insight into the very great complexity of the processes and issues involved in the use and degradation of pesticides in the environment, as well as the extreme complexity of the soil as the medium in which such processes are occurring.

The research group visited at the University of Tennessee has a diverse plant production and plant protection research and teaching program, with considerable interest in biofumigation through an integrated team. A particular reason for the visit was to commence the early stages of planning for the 2nd International Biofumigation Symposium, planned for the USA in 2006. This was a follow-up to my role on the scientific board of the successful 1st International Biofumigation Symposium in Italy in March 2004, and a desire to set early in planning a highly applied and outcome-driven theme for the next symposium.

Introduction

The 4th International Symposium on Environmental Aspects of Pesticide Microbiology held at the Aristotle University of Thessaloniki, Thessaloniki, Greece 4-9 September 2004 was a highly relevant and timely Symposium to attend in relation to results from the recently completed HAL-funded project (HG98034) on enhanced biodegradation of soil-applied pesticides.

The theme of the Symposium was ‘Pesticides, Soil Microbiology, Microbial Functions and Diversity’, a self-explanatory title that is highly relevant to the issues of the impacts of soil-applied pesticides, their microbially-mediated degradation and enhanced biodegradation, and the management of agricultural practices related to soil-applied pesticides for economic and production system sustainability.

These are important issues that are often out of sight and therefore out of mind, but as the results of HG98034 demonstrated all too clearly, Australia has the unenviable reputation of some of the most severe examples of enhanced biodegradation of soil-applied pesticides in the world – hardly a good advertisement for the ‘clean and green’ horticultural production systems we pride ourselves on. Balancing these factors is a key issue for Australian horticultural industries that use soil-applied pesticides.

This report gives an overview of the scope and content of the Symposium. A copy of the program, my presentation and the abstract are included. The conference proceedings are to be published as a special edition of the peer-reviewed journal Pest Management Science and the manuscript of a detailed scientific paper was submitted at the Symposium for this purpose.

This report also includes a section on a brief visit to the Plant Sciences Department of the University of Tennessee, Knoxville, Tennessee. The visit was aimed at establishing personal contact with Carl Sams, Austin Distinguished Professor in that department to discuss biofumigation research and to engage in planning for the 2nd International Biofumigation Symposium, which is planned for 2006 in the USA.

Travel itinerary

Conference travel by: John Matthiessen, CSIRO Entomology, Perth

26-27 August 2004:	Travel Australia – Tennessee, USA
30 August-1 September 2004:	Visit University of Tennessee, Knoxville
2-3 September July 2000:	Travel Tennessee-Greece
4-9 September 2004:	Pesticide Microbiology Symposium, Thessaloniki
13-15 September 2004:	Travel Greece-Australia

Pesticide Microbiology Symposium

A copy of the Symposium program is appended, as is the abstract of the presented paper and the oral presentation in handout format. A printout of the seminar in handout format is also appended.

The number of delegates attending the Symposium was around 70.

The format of the Symposium was of invited and contributed papers and poster sessions. I presented a paper giving details of the latter part of our work during HAL Project HG98034 that revealed the crucial role of calcium interacting with high soil pH to greatly increase the risk of onset of enhanced biodegradation of metham sodium, particularly in sandy soil. I made the point that the data on the effects of soil type were preliminary and limited in scope to a simple comparison between two soils, and that more work needs to be done to clarify that issue.

In keeping with the microbiological basis of the Symposium, emphasis in my presentation was placed on the important role of calcium in the formation of the spore coat that characterises the highly environmentally resistant *Bacillus* and actinomycetes bacteria that cause the extreme enhanced biodegradation of metham sodium that we have observed in sandy soils in Australia.

A detailed research paper was submitted to be included in the special issue of the high-ranking international scientific journal Pest Management Science. This is still subject to peer review, so is not appended to this report.

Some various aspects of particular relevance to various theoretical and applied aspects of enhanced biodegradation covered during the Symposium were:

- An overview of the history and formation of the Pesticide Microbiology Group which has played a major role in defining appropriate methods for testing the side-effects of pesticides on soil microflora and agreeing on meaningful tests suitable for registration requirements. Given the variability of soils and difficulties in studying biota and their functions, it is critically important that good methods for measurement and evaluation are widely agreed and adhered to. This talk then went into details of recommendations and guidelines that have been established to evaluate pesticide effects, and how it has remained dynamic and has evolved to embrace impacts of genetically modified organisms.
- The concept of bioavailability, and how best to measure it. Chemical analysis of soil may not adequately represent what amount of pesticide is able to be reached by soil microbes. This is a very complex topic that serves to illustrate both the complexity and often the sheer power of soil microbes in metabolising or being affected by pesticides.
- The pointing out that the degradation of pesticides in soil can happen in various ways – biodegradation, where the compound is a substrate ('food') for the microbes; co-metabolism, where the pesticide is transformed, but is not an energy source (the rate of transformation doesn't increase with time or addition of more pesticide); addition reactions where the pesticide is transformed by addition of functional groups by

various means; and environment-related reactions through effects of such pH, redox potential and catalysts such as some metal ions.

- Issues related to point-source pesticide contamination, whereby spills and leakage from fill-up areas can often be major sources of contamination, and the development of 'biobeds' as a means of degrading spilled pesticide within a confined area to prevent broader-scale contamination.
- The very large spatial variability in the biodegradation of pesticides that can occur both laterally and with depth across fields, some of the factors that are related to this, and what it means for pest management and avoidance of enhanced biodegradation.
- The design of studies using litter-bags to determine the effect of plant protection products on functional endpoints, notably organic matter breakdown, in soil.
- Increasingly, studies are being undertaken to determine the effect of Bt toxins arising from genetically modified plants on the breakdown of herbicides to which the plants are also tolerant or resistant. It is early in this work, but already there is emphasis on establishing suitable, consistent and valid methods to fully evaluate the ecological risk of genetically modified crops.
- The importance of physical interactions of the pesticide with the soil (sorption – desorption reactions) in altering the bioavailability of the compound and hence its microbially-mediated degradation. Sorption-desorption reactions commonly exhibit hysteresis, which further complicates the issue.
- Many other detailed aspects of the environmental fate of pesticides as they are affected by soil microbes were addressed, most of which illustrated the great complexity of the reactions and interactions that can occur in such a variable and diverse living system as soil.

Visit to Department of Plant Sciences, University of Tennessee, Knoxville, Tennessee, USA

The Department of Plant Sciences at the University of Tennessee has research and extension programs that cover the areas of weed science, ornamental horticulture, turfgrass management, and the production of vegetables, fruit, cotton, cereals, grains and forage.

My contact there was Dr Carl Sams, Austin Distinguished Professor. His research interests and expertise include: Fruit and vegetable crop physiology, effects of abiotic stress on disease resistance, yield and quality of fruit and vegetable crops, biofumigation and hydroponic production systems and mineral nutrition of plants in relation to post harvest quality.

The Department of Plant Sciences has recently acquired excellently equipped new laboratories. Prof. Sams is working hard at building an inter-disciplinary team to conduct his broad-ranging research program. He was particularly interested in the methods we have developed for maximising release of isothiocyanates from brassicaceous biofumigants and measuring those isothiocyanates in soil. Up to now his team has included pathologists but not a chemist, whereas we have had the reverse situation with the recently concluded biofumigation (VX00013) and enhanced biodegradation (HG98034) projects. He intends to

adopt our methods to measure isothiocyanates in soil simultaneously with evaluation of pathogen impacts in upcoming field trials.

A major reason for visiting Prof. Sams was to engage in some early planning for the 2nd to be held in the USA in 2006. I was a member of the Scientific Board for the 1st International Biofumigation Symposium held in Florence, Italy in March 2004, and continue in a committee role preparatory for the next symposium. Unfortunately, Prof. Sams was unable to attend the first symposium owing to other pressing commitments, so it was not possible to include his inputs in early discussions. My objective was to encompass contrasting climate areas in the US for the symposium to broaden its scope, and to focus on practical applications in different horticultural industry situations.

I now have good agreement from the US colleagues in Idaho and Tennessee to adopt this approach. I am working hard on trying to move sharply beyond laboratory studies to real world situations. The plan is to centre on the broad-scale potato production regions of the temperate north-western US and the more intensive production regions of the sub-tropical south east. This travel project, on an economical round-the-world fare was an immensely useful opportunity to act very soon after the first symposium to exert influence to set a solid direction and approach for the next symposium while it was still fresh in participant's minds.

I was invited to present a seminar on our research on biofumigation and enhanced biodegradation. This was very well attended by many research and teaching staff and students from different departments within the University's College of Agricultural Sciences and Natural Resources, staff from the University and students. I estimate that the attendance at 50-60 people. Despite the somewhat long presentation because of including two significant (but related) topics in the one talk, there was a very good question and discussion session at its conclusion, and numerous congratulatory comments on the content and style of presentation.

A significant outcome of this presentation was to be approached by staff member Prof. Robert Trigiano, an editor of Critical Reviews in Plant Sciences, who wished to recommend to the Chief Editor that I be formally invited to prepare a review article around biofumigation and enhanced biodegradation for this journal. Critical Reviews in Plant Sciences only takes reviews by invitation. I have subsequently been contacted by Chief Editor Prof. Dennis Gray with a formal invitation, and have accepted. John Kirkegaard of CSIRO Plant Industry, my collaborator on the biofumigation research, will co-author the review with me. This is good recognition of the significance on the world stage of the quality and impact of Australian work in these fields.

Outcomes

The overseas travel reported here was extremely valuable in maintaining my expertise gaining broader insights into the many complex issues related to the environmental fate of pesticides applied to soil, and seeing how it is a major issue that occupies the minds of researchers in the agrochemical companies. It was also very valuable in maintaining international contacts previously made with world-class researchers in the field of pesticide fate, developing new contacts and relationships, and gaining better understanding of the significant issues related to use of pesticides in other parts of the world. Many of these aspects are intangible, but they are diffused into the local industry and research realm in reports such as this, commentary at various forums, and general interaction with industry.

The travel was also an valuable and timely opportunity to strongly influence the planning for the next International Biofumigation Symposium very early in its gestation to ensure direction towards a highly practical applied focus. I believe that this is needed to keep driving the concept forward on this track that the Australian research has been so influential in setting.

The primary reason for the travel, attendance at the 4th International Symposium on Environmental Aspects of Pesticide Microbiology, was an excellent opportunity to present our unique and scientifically exciting findings on the importance of a calcium and soil pH interdependence in significantly raising the risk of onset of enhanced biodegradation of soil-applied pesticides, particularly it would seem in sandy soil. My presentation elicited much interest and many questions and positive comments.

It very evidently caused a significant amount of re-evaluation of the previously single-channel focus on the mechanism being solely a consequence of raised soil pH. Several of the other researchers present had published quite extensively on the correlation of greater risk of enhanced biodegradation and elevated soil pH. While there was some discussion about the possible mechanism of the effect we observed, such as the relative importance of physico-chemical and biotic factors and the interactions of those with soil type, there was no faulting of the research methodology or interpretation.

It was particularly gratifying to be able to present what was recognised as a significant basic science research result at a key international meeting coming from what was, in world terms, a very small one-off research project that was sponsored by the Australian horticultural industries.

The not so gratifying aspect of this research project is of course the finding that Australia has some of the world's worst examples of enhanced biodegradation of soil-applied pesticides. In the face of this information, it is hard to see that Australian farmers differ in their general approach to use of soil-applied pesticides than their counterparts in equivalently-advanced countries, despite rhetoric about 'clean and green' production in this country. It is also quite predictable that growers in the highly risk-prone areas will face similar issues of enhanced biodegradation of other soil-applied pesticides that have recently come onto the Australian market, such as 1,3-dichloropropene and possibly chloropicrin, unless they implement preventative practices.

I feel that we need to be aware of falling into traps in the unwise use of such materials that some producers overseas have. Learning from their mistakes and using our locally-derived knowledge, that we have demonstrated through the presentation made at this Symposium is based on world-class science, to implement preventative practices is the best way to go as enhanced biodegradation cannot be cured once induced.

Opportunities to attend such meetings overseas, and visit other research institutions, offer intangible and non-immediate outcomes for industry, but I trust that this report offers sufficient to demonstrate that those intangibles can contribute to real benefits over time.

Acknowledgments

I am grateful to HAL and the Vegetable Industry Advisory Committee for providing the funding to enable attendance at the Pesticide Microbiology Symposium and the visit to the University of Tennessee.

John N Matthiessen

24 September 2004

Appendices

Appendix 1: Copy of the program of the 4th International Symposium on Environmental Aspects of Pesticide Microbiology.

Appendix 2: Copy of the abstract of my paper to the Symposium.

Appendix 3: Printout of my oral presentation at the Symposium.

Appendix 4: Printout of my seminar at the University of Tennessee.

Appendix 1

Copy of the program of the 4th International Symposium on Environmental Aspects of Pesticide Microbiology.

Appendix 2

Copy of the abstract of my paper to the Symposium.

Appendix 3

Printout of my oral presentation at the Symposium.

Appendix 4

Printout of my seminar at the University of Tennessee.