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NSW AGRICULTURE

AGRICULTURAL RESEARCH STATION, NARRABRI

FINAL REPORT ON OVERSEAS TRAVEL

I would like to submit the following final report on overseas travel to the British Society of Chemical Industry 'Resistance 91' Symposium held at Rothamsted, UK in July 1991.

Neil W. Forrester
Special Entomologist.
9th August, 1991.

1. Supervisor of Research, Narrabri.
2. Regional Director of Research, NEHM, Tamworth.
3. Regional Director of Agriculture, NEHM, Gunnedah.

Copies also sent directly to:

Director of Entomology, BCRI, Rydalmere.
Director, Overseas Project Section, Orange.
Principal Officer (External Funding), Orange.

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COTTON RESEARCH COUNCIL
FINAL REPORT ON OVERSEAS TRAVEL 1990/91

1. **Project** : DAN 58C (Attendance at British Society of Chemical Industry `Resistance 91' International Symposium).

2. **Organisation** : NSW Agriculture

Officer : Mr N.W. Forrester
Special Entomologist
Agricultural Research Station, Narrabri.

Project Supervisors : Dr W.K. Mason, Regional Director of Research
Agricultural Research Centre, Tamworth. NSW.

Dr V. Edge, Director of Entomology,
Biological & Chemical Research Institute,
Rydalmere. NSW.

3. **Itinerary** :

26 – 28 June	Narrabri – Paris
28 June – 14 July	Visit agrochemical research institutes in France (Roussel Uclaf, Rhone–Poulenc), Italy (Endura Spa), Switzerland (Ciba–Geigy, Sandoz) & Germany (Bayer, Hoechst).
15 – 17 July	BSCI Conference, Rothamsted, UK.
18 July	IOPERM Meeting, Fernhurst, UK.
19 – 23 July	Visit agrochemical research institutes in UK (ICI, Wellcome) & Reading University.
24 – 26 July	London – Narrabri.

4. **Final Report** : The main aim of this trip was to accept an invitation from the British Society of Chemical Industry to deliver a paper at their `Resistance 91' international symposium. While in Europe, the opportunity was taken to review the latest developments in the agrochemical industry's R & D programmes, including both biological and conventional chemistry innovations.
More detailed notes are given in an Appendix.

5. **Financial Summary:**

Allocation		$4,867
Expenses incurred		
Sustenance	2,193.61	
Airfares/Internal Transport	3,192.74	
Travel Insurance	100.00	
Others (Exchange Commissions, Departure Tax, Taxis, Medical Costs, Visa, Incidentals, etc.)	108.75	
	5,595.10	
Balance of Allocation		$0.00

APPENDIX

Roussel Uclaf (Gambetta Office, Paris)

Met with

Jean Pierre Mollon	–	International Marketing Manager, Crop Protection.
Pierre Pastre	–	Director, Research Centre for Applied Biology, Marseilles.
Serge Smolikowski	–	Senior Development Manager, Americas,
Louis Roa	–	International Development Manager, Plant Protection.
Manuel Guillaumont	–	Project Manager, International Crop Protection Activity.
Eric Tesson	–	Marketing Manager, Asia/Pacific
Claude Le Rumeur	–	Overseas Technical Manager

Also met with

Jean Cauquil	–	Director, Institut de Recherches du Coton et des Textiles Exotiques, Montpellier.

Key points from discussion :–

- Hoechst is a major shareholder, also Rhone–Poulenc (20%).
- major producer of pyrethroids (deltamethrin accounts for 35% of worldwide pyrethroid use).
- world pyrethroid market is still increasing (mainly due to use on new crops).
- cotton pyrethroid market reached a plateau in 1989.
- Australia is the lowest percentage pyrethroid cotton market in the world.
- Roussel have reached a marketing and research agreement with Ecogen, USA (manufactures of *Bacillus thuringiensis*). They are funding research into strains and formulations and have the rights to develop Ecogen products in Australia.
- Le Rumeur suggested some field evidence from Pakistan that early Larvin use can flare mites/whitefly. This has been passed onto Lewis Wilson who hopes to investigate this potential problem next season.
- Le Rumeur also suggested that buprofezin may have mite activity. This compound has the potential for early season mirid control as well, so it should be researched further.

Roussel Uclaf (Romainville Research Labs, Paris)

Met with

Jean Pierre Demoute	–	Director of Chemical Research
Jean–Marc Girodeau	–	Research Chemist

A very useful discussion took place concerning the possibility of designing resistance breaking pyrethroids and synergists. Roussel are still interested in pyrethroid chemistry and are willing to pursue the matter further. As an aside, Demoute suggested they had found neem oil to be slightly phytotoxic.

Rhone Poulenc (Lyon)

Met with

Jean–Noel Bridon	–	Worldwide Product Manager, Crop Protection
Pierre Loubiere	–	Marketing Manager, Asia/Pacific, Middle East
Daniel Caron	–	Worldwide Project Manager, Crop Protection

Key points from discussion :–

- Rhone–Poulenc invest 7% sales back into R & D
- account for 9% of world agrochemical sales (Ciba–Geigy 11%, ICI 10%, Bayer 9%)
- hold numerous patents and doing further research on water soluble packaging (could be useful for *Bt* use in dryland cotton)
- Larvin mostly used on cotton (82% in 1989). Newer markets being developed (cotton 71% in 1990) eg. baits for slugs. Baits could be useful for cricket/beetle control in establishing crops.
- No reports of resistance to Larvin yet (although some suggestions of problems in USA on *Heliothis virescens*).
- Rhone Poulenc have a large programme on genetic engineering of cotton and rapeseed. At the moment, effort is being directed into engineering herbicide resistance (bromoxynil) into rapeseed. I saw advanced , high yielding lines of successfully engineered rapeseed in limited scale field trials. The cotton work is in collaboration with Calgene, USA.

Endura Spa (Bologna)

Met with

Giovanni Carini	–	Commercial Manager
Saturno Marchetti	–	Managing Director
Antonio Tozzi	–	President
Riccardo Balzarotti	–	Technical Manager

Key points from discussion :–

- Endura is the largest producer of Pbo (greater than 70% of worldwide production)
- Endura are keen to continue supplying Pbo into the Australian cotton market and are quite understanding and supportive of the recommendation to limit use to one spray only.
- Shortage of Pbo from natural sources is a potential problem. Endura have made the commitment to develop a synthetic analogue of Pbo. Some early analogues/formulations have already been tested in Australia. This work will continue with more advanced analogues/formulations.
- Endura have shown Pbo synergism with resistance to some other groups (eg. chitin inhibitors) and with some other compounds (eg. abamectin).

Ciba Geigy (Basle)

Met with

Gert-Henri Ernst	–	Resistance Management Support
Franz Buholzer	–	Entomologist
Steve Robinson	–	Worldwide Product Manager
Joe Fischer	–	Application Technology Specialist

Most discussion centred on the need to reduce the odour drift problem with profenofos. A detailed discussion was held on the problems of volatility of active ingredient versus odour producing contaminants. The problem of secondary volatilisation some time after spraying was also raised as an important source of odour. Ciba chemists had undertaken an analysis of headspace volatiles and found a range of odour producing compounds. They will be evaluating a number of possible solutions to the problem:-

1) recrystallisation of active
2) addition of perfumes (must be of similar persistence and vapour pressure)
3) microencapsulated formulations
4) odour scavengers

Ciba-Geigy will liaise with their Australian colleagues to assess the possibility of air sampling trials following profenofos applications next summer.

Sandoz (Basle)

Met with

John Atkin	–	International Product Manager
Kurt Nabholz	–	Product Manager
Ulrich Gisi	–	Head Plant Pathology Research (Resistance expert)

Key points from discussion :-

- Sandoz have a major research effort in biologicals (especially *Bt* and viruses)
- Most discussion centred around the pricing structure of *Bt* in Australia. Sandoz suggested that the price of Dipel in Australia (A$1.16 / billion international units) is similar to the USA (A$1.03). It was impressed upon Sandoz that the high price of *Bt* was the biggest constraint preventing the wider adoption of this biological insecticide. They intend to enter the Australian market next season. The extra competition could reduce the retail price of *Bt* to around A$12-14/litre (currently A$17.50/litre). The removal of the 15% import duty could reduce this by a further $1.50-$1.70 per litre.
- Dipel ES does not work on early season *Spodoptera exigua* (lesser armyworm) which is an early season pest in Australia.

Bayer (Koln)

Met with

Wolgang Leicht	–	Basic Research Insecticides
M. Elbert	–	Head, Institute for Pest Animals
Ali Merabet	–	Technical Director, Agrochemicals
Don Nicoll	–	Business Group, Plant Protection

Key points from discussion :–

- Bayer have just released a new systemic aphicide called imidacloprid. This is from a new chemical group with no cross resistance from any established resistances. This should be quite a useful compound for resistance management of aphids. However, it is quite residual (30–60 days control) as a seed treatment, so it could cause mite flare problems if used in this way in Australia. This potential problem could be overcome by fine tuning of application rates.
- odour producing problems with sulprofos were discussed. Bayer had done less work than Ciba–Geigy in this area and were concentrating only on masking agents such as perfumes. Detailed discussions of the problem took place with Bayer formulation chemists, resulting in a better understanding of the problem by all parties.
- Bayer are exploring some interesting initiatives to short cut the laborious primary screen procedures.
- pyrethroid synergists were discussed and some potential compounds will be sent to Australia for testing.

Hoechst (Frankfurt)

Met with

Rob Michel	–	Technical Director
Hubert Stier	–	Marketing Manager
& others		

Key points from discussion :–

- main outlets for endosulfan are cotton 50%, tomatoes 19%, cereals 15% (surprisingly as a seed dressing for stem fly), fruit 5%, coffee 5%, others 6%.
- Hoechst are the biggest producers of endosulfan technical (61%), followed by India (31%), Israel (5%) and Korea (3%).
- discussed endosulfan resistance and endosulfan/pyrethroid mixtures.
- Hoechst indicated some interest in mixtures of the chitin inhibitor (chlorfluazuron) with both pyrethroids and endosulfan.
- during discussion of general resistance problems with *Heliothis* spp. throughout the world, it was suggested that problems seemed to be less where cotton was grown in mixed cropping with sugar cane eg. in Brazil, Colombia and Thailand. This same point was noted by a number of other people during the trip and should be investigated further. The sugar cane could be acting as a source of a natural enemies without generating any significant cotton pests. This could be useful for possible future cotton production systems in tropical Australia.

BSCI `Resistance 91' Symposium (Rothamsted, UK)

An invited paper on the Management of Insecticide Resistance in *Heliothis armigera* was delivered (see attached).

Key points from selected papers :–

Rubin (Israel)
- **Qualitative and quantitative methods for identifying and monitoring herbicide resistant weeds.**
- displayed a simple diagnostic test kit to detect triazine resistant weeds.

Leonard (UK)
- **IRAC Fruit Crops Working Group's Spider Mite Resistance Management Strategy.**
- grouped miticides according to potential cross resistance patterns.

Roush (USA)
- **Evolution and management of resistance in the Colorado potato beetle, *Leptinotarsa decemlineata*.**
- suggested synergistic interaction between endosulfan and oxamyl.
- interesting adoption of propane flame throwers for early season control of beetles in seedling potatoes.
- discussed the use of trap crops and genetically engineered transgenic potato varieties.

Denholm *et al.* (UK)
- **Simulation and analysis of resistance buildup in the whitefly, *Bemisia tabaci*.**
- demonstrated `field control simulators' for investigating the impact of management practices on resistance in whitefly.

Leroux (France)
- **Negative cross-resistance in fungicides : from the laboratory to the field.**
- negative cross resistance can vary between enantiomers (can be positive in one, negative in the other).

Marrone (USA)
- **Insect resistance to biotechnology products : an overview of research and possible management strategies.**
- *Bt* has low development costs (about $3 million) compared to conventional insecticides.
- *Heliothis virescens* is cross resistant to all strains of *Bt*.
- suggests resistance problems will develop with uncontrolled use of transgenic cottons. Privately suggests single protein continuously producing transgenic cottons should be restricted in use to a maximum of about 20% of the total cotton area.

Ferre *et al.* (Spain)

- **Genetic and biochemical basis of resistance to a *Bacillus thuringiensis* toxin in a population of diamondback moth (*Plutella xylostella*).**
- demonstrated resistance to *Bt* in a field strain of diamondback moth from the Phillipines.
- resistance mechanism involved target site insensitivity to the toxic crystal protein.
- resistance was recessive and possibly sex linked.

Rothamsted Experimental Station

Met with

Ian Denholm	}	
Alan Devonshire	}	Entomologists/Biochemists/Toxicologists
Andrew Farnham	}	
Bhupinder Khambay	–	Research Chemist

Key points from discussion :–

- Alan Devonshire is expanding his work on the biochemistry of resistance in aphids to the cotton aphid, *Aphis gossypii.*
- Andrew Farnham demonstrated the equipment for rearing whitefly and the fibre optic tool developed for observing whitefly on leaves without disturbance.
- Bhupinder Khambay expressed keen interest in synthesising potential `resistance breaking pyrethroids'. He wishes to formalise an agreement for screening of these Rothamsted compounds on pyrethroid resistant *Heliothis armigera* at Narrabri.

IOPERM Meeting (Fernhurst)

The members of the International Organisation for Pesticide Resistance Management who were present at the Rothamsted Symposium, were invited to attend this meeting. Those present included the Executive and various Working Group members and chairmen. Funding issues were discussed, particularly in relation to preparing projects for submission at the proposed 1992 Washington Congress. Communication among IOPERM members was clearly a problem and the Executive undertook to resolve this. The Cotton Working Group initiative in India was discussed and final plans for the October 1991 Workshop formulated.

ICI (Haslemere)

Met with

John Cole	}	Environmental Toxicologists
Richard Brown	}	
Keith Alcock	}	Basic insecticide research
Bob Perron	}	

& various Marketing & Business Managers for different geographical regions

Key points from discussion :-

- ICI has been pursuing the rotation approach to Insecticide Resistance Management but has been generally unsuccessful (outside of Australia) in the market place and were losing to the simpler premix approach of its competitors (eg. pyrethroid/organophosphate mixtures). These were being pushed strongly elsewhere in the world (eg. Pakistan, China, India) but not in Australia.
- some interesting new chemistry innovations being pursued.
- the results of the environmental impact study on chlorfluazuron (Helix) were discussed.

University of Reading

Met with

Alan McCaffery	-	Entomologist
Colin Walker	-	Biochemist
Richard Gladwell	-	Insect Physiologist

Key points from discussion :-

- pyrethroid resistance mechanisms in *Heliothis virescens* from the USA seemed to parallel those of *H. armigera* from Australia, India and Asia.
- resistance breaking pyrethroids also working on pyrethroid resistant *H. virescens* from the USA.
- Alan McCaffery is working on diagnostic kits for the various resistance mechanisms.
- discussions were held with Alan McCaffery (member of the Editorial Board of the Bulletin of Entomological Research) on the possibility of publishing my thesis on the Management of Insecticide Resistance in *Heliothis armigera* in Australia, as a supplement to or as an entire article within their journal.

Wellcome (Berkhamsted)

Met with

George Cayley	-	Research Director
Jane Cayley	-	Virologist
Steve Irving	-	Insect Physiologist
Steve Moss	-	Entomologist
& various formulation chemists		

Key points from discussion :-

- discussed possibility of stabilising piperonyl butoxide (Pbo) formulations. Suggested instability is due to oxidation in the presence of light not due to the high ph of the cotton leaf surface as formulations are stable in the ph range 3-10.

- microencapsulation does not always improve photostability.
- they are trying a mixture of stabilised and free Pbo to obtain both an initial rapid action along with sustained residual control. It is not yet known whether this stabilised Pbo (TF 2435) works by contact or stomach action or both. The residual activity of this mixture will be tested next season in Australia. Initial laboratory results are encouraging.
- Wellcome have just announced their success in genetically engineering the scorpion venom gene into a virus and they have just applied for permission to trial it in the field.
- Pbo synergises azinphosmethyl resistance in Colorado potato beetle.
- Pbo/fenvalerate used to control pyrethroid resistant pear pysIla in Washington State in 87/88. Replaced soon after by cyfluthrin which soon failed.
- Pbo synergises a number of compounds in soybean looper in the USA.
- Pbo synergises propargite (Comite) on citrus red mite (*Panonychus citri*) on oranges in California.