January, August & Final Reports

REPORTS

Part 1 - Summary Details

Please use your TAB key to complete part 1 & 2.

CRDC Project Number: UWS2C

January Report:	☐	Due 29-Jan-01
August Report:	☐	Due 03-Aug-01
Final Report:	☒	Due within 3 months of project completion

Project Title: Oil and biological pesticide-based integrated pest management in cotton

Project Commencement Date: 01/07/2000 **Project Completion Date:**30/06/2003

Research Program: Insect Management

Part 2 – Contact Details

Administrator: Mr Gar Jones, Director of Research Services
Organisation: University of Western Sydney
Postal Address: Locked Bag 1797, Penrith South DC, NSW 1797
Ph: 02 47360463 **Fx:** 02 47360013 **E-mail:** g.jones@uws.edu.au

Principal Researcher: Assoc Prof Andrew Beattie
Organisation: Centre for Horticulture and Plant Sciences, UWS
Postal Address: Locked Bag 1797, Penrith South DC, NSW 1797
Ph: 02 45701287 **Fx:** 02 45701314 **E-mail:** a.beattie@uws.edu.au

Supervisor: Assoc Prof Robert Spooner-Hart, Director
Organisation: Centre for Horticulture and Plant Sciences, UWS
Postal Address: Locked Bag 1797, Penrith South DC, NSW 1797
Ph: 02 45701429 **Fx:** 02 45701314 **E-mail:** r.spooner-hart@uws.edu.au

Researcher 2 Dr Robert Mensah
Organisation: NSW Agiculture
Postal Address: Australian Cotton Research Institute, Myall Vale, Narrabri, NSW 2390
Ph: 02 67991525 **Fx:** 02 67991503 **E-mail:** robert.m@mv.pi.csiro.au

Signature of Research Provider Representative: _____

Part 3 – Final Report Format

The points below are to be used as a guideline when completing your final report.

1. Outline the background to the project.

For more than a century petroleum-derived spray oils have been used to kill susceptible pests, principally scales and mites, through anoxia (suffocation). This mode of action, and the use of oils as adjuvants, has severely limited their use alone as biorational products in integrated crop management (ICM) programs. Significant effects of oil deposits on arthropod behaviour, and opportunities for using products to simultaneously control a range of pests and diseases, have been overlooked. Recent research has demonstrated that the range of pests that can be controlled through behavioural effects of contemporary products is far greater than the range that can be controlled by anoxia. This research includes University of Western Sydney and NSW Agriculture studies that indicated significant potential for use of petroleum-derived spray oils (specifically horticultural and agricultural mineral oils) to control *Helicoverpa* spp. in cotton and other crops.

2. List the project objectives and the extent to which these have been achieved.

The initial aims of this project were:

- to understand how oil deposits affect the behaviour of heliothis moths and how to use this information to improve petroleum-derived spray oils for use in cotton IPM,
- to optimise application of sprays,
- to reduce the impact of sunlight on the effectiveness of biological pesticides such as the NPV Gemstar, and
- to prove the technology in large-scale field trials.

As a result of reduced funding these aims were altered and funds were used in conjunction with NSW Agriculture to determine the impact of an *n*C23 horticultural mineral oil and an *n*C24 agricultural mineral oil on *Helicoverpa* spp. populations in field trials at Auscott Narrabri. The work was successful and the results indicate significant scope for use in mineral oils in cotton IPM.

3. How has your research addressed the Corporations three outputs: Sustainability, profitability and international competitiveness, and/or people and community?

The Corporations three outputs have been addressed. UWS and NSW Agriculture research on contemporary horticultural and agricultural mineral oils has been directed at increasing the sustainability, profitability and competitiveness of a range

of crops, including cotton. These oils have a number of environmental advantages over the use of traditional pesticides:

- pests cannot develop resistance,
- they do not stimulate pest outbreaks,
- they cause little damage to beneficial insects and mites,
- their toxicity to vertebrate animals is low, and
- spray deposits are broken down within weeks by microbes, oxidation and ultraviolet light to form simple molecules that do not pose a threat to the environment.

Results reported here clearly indicate that the oils can be used cost-effectively for the control of *Helicoverpa* spp. in cotton. Other results, not reported here, indicate that the oils can be used to control *Helicoverpa* spp. and a range of other pests simultaneously.

4. Detail the methodology and justify the methodology used.

There were 5 treatments. These included prophylatic *n*C23 horticultural mineral oil (HMO) and *n*C24 agricultural mineral oil (AMO) treatments, threshold *n*C23 HMO and *n*C24 AMO treatments, and a conventional threshold-based pesticide treatment. Additional details are presented in Table 1. The focus of the oil-based treatments was on early-season control of *Helicoverpa* spp., and all involved mid to late season application of threshold-based pesticides and a Parathion/Predator spray during the Christmas/New Year holiday season. The spray application dates in all treatments was generally similar (Table 1).

There were 4 replicates of each treatment. Each replicate was 16 rows wide and 1000 m long (approximately 1.6 ha). Both oils were applied at 2% v/v. Sprays were applied with a groundrig and care was taken to optimise coverage. From 4 to 12 December the oil sprays were applied in 33% bands at 80 L/ha. From 15 to 23 December they were applied in 50% bands at 100 L ha, and from 29 December to 17 January in 100% bands at 120-150 L/ha. The conventional pesticides were applied at 60-100L/ha. Application of conventional pesticides in all treatments was based on predator to pest thresholds.

Assessments (eggs and larvae) on each sampling date were based on 4, 1-m lengths of row within each replicate. On each occasion, assessments in the prophylatic treatments were undertaken just before the application of sprays and thereafter every 7 days. Counts in the threshold treatments were undertaken in the same way as the prophylactic sprays. Yield was determined by mechanical harvesting of treatment and control plots. The results were analysed using SPSS® for Windows™ Version 10. (SPSS 2000).

Table 1. Narrabri field treatments for control of *Helicoverpa* spp. in 2000-2001.

Prophylactic pre-closure oil then threshold-based pesticides		Threshold pre-closure oil then pesticides or threshold-based pesticides		
Date	**Oil & pesticides**	**Date**	**Oil & pesticides**	**Pesticides**
4 December	HMO/AMO	6 December	HMO/AMO	0.9 L Costar
12 December	HMO/AMO	12 December	HMO/AMO	0.2 L Tracer
23 December	HMO/AMO	22 December	HMO/AMO	0.2 L Tracer/0.3 L Abamectin/0.25 L Confidor
29 December*	1.4 L Parathion/ 5.0 L Predator	29 December	Parathion/Predator	2.1 L Endosulfan/0.3 L Abamectin
5 January	HMO/AMO	11 January	HMO/AMO	0.085 L Karate/0.4 L Pbo/ 0.25 L Folimat
17 January	HMO/AMO/NPV	17 January	HMO/AMO/NPV	0.085 L Karate/0.4 L Pbo/2.0 L Amitraz/1.4 L Parathion
22 January	0.8 L Talstar/ 0.4 L Pbo			
3 February	0.085 L Karate/ 0.4 L Pbo/ 0.4 L Amitraz	3 February	Karate/Pbo/Amitraz	0.085 L Karate/0.4 L Pbo/ 0.4 L Amitraz
14 February	5.0 L Predator	14 February	Predator	5.0 L Predator
22 February	5.0 L Predator	22 February	Predator	5.0 L Predator
5 March	1.2 L Larvin/1.4 L Parathion			

5. Detail results including the statistical analysis of results.

The preliminary results are presented in Figure 1. Initial analysis of pre-spray counts from 10 assessments between 12 December and 22 January (inclusive) indicated significant differences between treatments. Egg counts in the oil-based treatments were significantly lower than in the threshold-based pesticide treatment. The *n*C23 HMO prophylatic treatment performed better than the 2 threshold-based oil treatments. There were no differences between the *n*C24 AMO prophylatic and threshold treatments, or between the *n*C23 HMO and *n*C24 AMO threshold treatments. For small larvae, and medium/large larvae, there were no significant differences between the 4 oil treatments but numbers in the oil treatments were significantly lower than in the threshold-based pesticide treatment.

For yield, there were no significant differences between the 4 oil treatments and no significant differences between the 2 prophylatic oil treatments and the threshold-based pesticide treatment. However, yields in the 2 threshold-based oil treatments were significantly lower than the yield in the pesticide treatment.

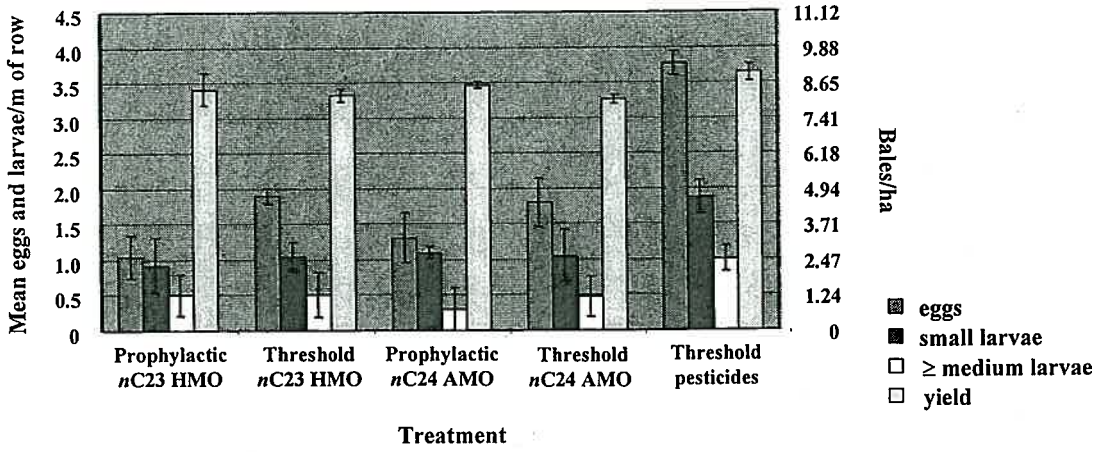

Figure 1. Impact of horticultural and agricultural mineral oil, and conventional pesticide treatments on *Helicoverpa* spp. and cotton yields at Narrabri in 2000-2001.

6. Discuss the results, and include an analysis of research outcomes compared with objectives.

The results showed that oil deposits, as anticipated, reduce oviposition by *Helicoverpa* spp. Significant differences between the *n*C23 and *n*C24 oils were not detected. Future research may indicate that this was due to the impact of emulsifier type and concentration on the quantity of oil deposited rather than the median number of carbon atoms in the oils. There were some inconsistencies in the results. For example, yield in the conventional pesticide treatment was higher than we would have expected given the numbers of *Helicoverpa* eggs and larvae recorded and the absence of any noticeable phytotoxicity in the oil treatments. Also, the variation between the prophylatic and threshold oil treatments was greater than expected given the general similarity of spray application dates.

7. Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. Where possible include a statement of the costs and potential benefits to the Australian cotton industry and future research needs.

The results indicate that contemporary high-quality petroleum-derived spray oils will have a role in future cotton IPM programs. The results add to earlier results of Dr Robert Mensah's and provide a sound platform for research over the next 2-3 years. This research should lead to sound opportunities for using products for the simultaneous control of *Helicoverpa*, aphids, thrips, mites, whiteflies, green mirid, apple dimpling bug and other pests. Use of the products should also significantly

enhance natural enemy activity, lower production costs for conventional cotton, and enhance resistance management in both conventional and transgenic cotton.

The estimated costs of the HMO/AMO-based programs were $415/ha for the prophylatic program and $285/ha for the threshold program (the difference due to the additional pesticide sprays applied in the prophylatic treatment). The estimated cost of the conventional pesticide program was $533/ha. The estimated cost of sprays applied from 4 December to 17 January in the HMO/AMO treatments was $122/ha compared to $ 342/ha for the conventional pesticide treatment.

8. **Describe the project technology (eg. commercially significant developments, patents applied for or granted licenses etc).**

   There were not significant commercial developments or improvements of oil spray technology.

9. **Provide a technical summary of any other information developed as part of the research project. Include discoveries in methodology, equipment design, etc.**

   Not applicable.

10. **Detail a plan for the activities or other steps that may be taken;**

    (a) **to further develop or to exploit the project technology.** Development of the technology is being pursued in current research funded by CRDC (**Evaluation of mineral oils for cotton IPM**), and through 2 UWS-funded PhDs on cotton and pulses. The PhD students are focusing on the impact of oil deposits on *Helicoverpa* spp.

    (b) for the future presentation and dissemination of the project outcomes. Technology transfer is being actively addressed. Dr Beattie addressed the Cotton Consultants Seminars at Goondawindi in August and recently addressed 3 meetings in the Narrabri-Moree region. The presentations dealt with the chemistry of petroleum-derived spray oils, the history of their use, their modes of action and the impact of deposits on a range of pests - including *Helicoverpa armigera*. The importance of oil quality was stressed and so to was the need to develop the technology cautiously before it is adopted by the industry.

11. List the publications arising from the research project.

No publications have been formally published.

12. Are changes to the Intellectual Property register required?

No.

Part 4 – Final Report Plain English Summary

Provide a half to one page Plain English Summary of your research that is not commercial in confidence, and that can be published on the World Wide Web.

Five treatments were compared in a large-scale field experiment at Narrabri. The treatments were prophylatic (preventative) *n*C23 horticultural mineral oil (HMO) and *n*C24 agricultural mineral oil (AMO) treatments, threshold *n*C23 HMO and *n*C24 AMO treatments, and conventional threshold-based pesticides. The focus of the oil-based treatments was on early-season control of *Helicoverpa* spp., and all involved mid to late season application of threshold-based pesticides and a Parathion/Predator spray during the Christmas/New Year holiday season.

The results showed that oil deposits, as anticipated, reduce egg laying by *Helicoverpa* spp. Significant differences between the *n*C23 and *n*C24 oils were not detected. Future research may indicate that this was due to the impact of emulsifier type and concentration on the quantity of oil deposited rather than oil properties. There were some inconsistencies in the results. For example, yield in the conventional pesticide treatment was higher than we would have expected given the numbers of *Helicoverpa* eggs and larvae recorded and the absence of any noticeable phytotoxicity in the oil treatments. Also, the variation between the prophylatic and threshold oil treatments was greater than expected given the general similarity of spray application dates.

The results indicate that contemporary high-quality petroleum-derived spray oils will have a role in future cotton IPM programs. The results add to earlier work by Dr Robert Mensah and provide a sound platform for research over the next 2-3 years. This research should lead to sound opportunities for using products for the simultaneous control of *Helicoverpa*, aphids, thrips, mites, whiteflies, green mirid, apple dimpling bug and other pests. Use of the products should also significantly enhance natural enemy activity, lower production costs for conventional cotton, and enhance resistance management in both conventional and transgenic cotton.

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Part 5 – January Supervisor Report (Scholarships Only)

The Scholarship Recipient's Supervisor is to provide a brief statement on the Recipient's progress and achievements during the relevant year and whether the Recipient is fulfilling the requirements of the postgraduate or undergraduate course in which the Recipient is enrolled.