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Foreword

On 1 July 1995, the former Honeybee Research and Development Council became a committee of the Rural Industries Research and Development Corporation.

This publication, Honeybee Research Report 2003, provides details of honeybee research from July 2002 until June 2003 and lists projects commencing in the 2003/2004 financial year. It follows the Honeybee Research and Development Council Research Report 1980-1995 and the RIRDC Reports 1995-1997, 1998, 1999, 2000, 2001 and 2002, which were a collection of final report and progress summaries of levy funded honeybee research until June 2002.

This report provides information to help apiarists and others access research recommendations and research in progress, together with researcher contact details, in a simple, easy to read format.

This report, a new addition to RIRDC's diverse range of over 900 research publications, forms part of our Honeybee R&D program, which aims to improve the productivity and profitability of the Australian beekeeping industry

Most of our publications are available for viewing, downloading or purchasing online through our website:

- downloads at www.rirdc.gov.au/reports/Index.htm
- purchases at www.rirdc.gov.au/eshop

Alternatively, there is a RIRDC order form included on the last page of this publication.

Simon Hearn
Managing Director
Rural Industries Research and Development Corporation

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RESEARCH IN PROGRESS REPORT 2003

Project Title	Device for finding queen bees in managed beehives

RIRDC Project No.:	PFP-1A
Start Date:	1/02/2001
Finish Date:	1/02/2004
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Objectives

- To design and prove an electronic device capable of pinpointing the position of queen bees in managed beehives.

Current Progress

Unfortunately progress on this project has been slower than anticipated because of the severe illness of the principal researcher.

The other problem that was not foreseen has been the difficulty in tracking down and accessing component parts for the first phase of the project.

Before the actual queen finding device can be made, it is necessary to build a preliminary device to assertion the 'frequency dependent attenuation' of a beehive. This preliminary device is close to completion, only awaiting two components. This device is to allow us to test for a range of frequencies for the signal that will be used to bounce off the tag attached to the queen.

The project is now at a stage where we have been able to engage a technician who will be able to assemble and test the apparatus even in the absence of the principal researcher.

We expect to be able to do preliminary testing of a sample of beehives shortly and then to be able to do field testing of tagged queens during the coming spring.

RESEARCH IN PROGRESS REPORT 2003

Project Title	Drone honey bees - semen production

RIRDC Project No.: DAN-205A
Start Date: 1/7/2002
Finish Date: 31/7/2005
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Objectives

- To provide data on the effects of drone age, season (time of year), and differences between unrelated drone breeding lines on the production and quality of drone semen.

Current Progress

Field work commenced initially in July 2002 and continued until 23 October 2002 when it was postponed due to drought conditions and movement restrictions placed on apiaries due to identification of the then exotic Small Hive Beetle.

Field work recommenced in March 2003 with requeening of the 16 test hives with 4 breeding lines of young queens. With the Milestone Calendar moved forward one year, from 2002-03 to 2003-04, milestones to date have been met. The full project is expected to be completed by the original completion date of July 2005.

Project Title	Improving queen bee production

RIRDC Project No.	CSE-85A
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Objectives

To improve the profitability of commercial queen producers by improving queen performance. This will be achieved by:

- Determining whether nutritional supplements significantly improve queen and drone quality;
- Determining the factors which are responsible for causing disappearing disorder.

Background

(a) Queen and Drone Quality

Commercial queen producers feed nutrient supplements to their bee colonies in the belief that they contribute to improvements in queen and drone quality. These supplements, which usually consist of a protein base with or without added sugar, vitamins and minerals, increase production costs. However, there is no proof that the supplements are beneficial.

To address this issue three experiments were carried out in a single commercial queen-rearing yard in NSW. Prior to the commencement of each experiment bee colonies were standardised in size and re-queened with genetically similar queens. Several nutrient supplements, similar to those used by commercial queen producers, where fed to groups of queen-cell building colonies (experiment carried out in year 1), queen banks (year 2) and drone rearing colonies (year 3). Included in each experiment were an appropriate number of untreated (experimental 'control') colonies. At specific times after feeding, the supplements, groups of queens that had been reared and held in the cell-building and queen bank colonies respectively, as well as drones that had been reared in the drone rearing colonies, were captured, moved to the laboratory and tested for 'quality.' Queen 'quality' was determined by weighting the queens, counting their ovarioles and number of spermatozoa in their spermathaeca and determining whether they were infected with *Nosema*. Drone 'quality' was measured by weighing the drones and determining their numbers of spermatozoa.

(b) Disappearing Disorder

Disappearing disorder (or 'muck') is a problem affecting honey bee colonies in north-east NSW and eastern Queensland. Previous RIRDC-sponsored research had failed to find a cause.

Research Outcomes

(a) Queen and Drone Quality

- The quality of queens that were reared and held in cell-building and queen bank colonies respectively that had been fed specific nutrient supplements was no different from that of queens reared in similar colonies that had not been fed nutrient supplements.
- The feeding of nutrient supplements to drone rearing colonies produced no measurable improvement in drone quality compared to drones reared in colonies that were reared in colonies that were not fed nutrient supplements.
- A relatively high proportion of spring-reared queens were inadequately

mated (had low numbers of spermatozoa in their spermathaeca).

- Autumn-reared queens were better mated that spring-reared queens (had higher numbers of spermatozoa in their spermathaeca).
- heavier queens tended to have more ovarioles, and more spermatozoa in their spermathaeca).

(b) Disappearing Disorder

- Evidence suggested that toxic levels of metals or minerals in pollen and nectar collected by affected colonies contribute to the cause of the disorder.
- A method was identified for controlling the disorder. This involves placing pollen traps on affected colonies and feeding pollen and sugar-syrup supplements.
- The disorder was also found to be controlled by moving colonies out of affected areas.

Implications

(a) Queen and Drone Quality

- The lack of evidence from this study to support the hypothesis that supplement feeding in commercial queen rearing establishments contributes to improvements in queen and drone quality may indicate that, (a) the methods used to measure quality (which were those commonly used by other researchers) may not have been sensitive enough, (b) the benefits of feeding nutrient supplements may manifest themselves elsewhere in the life-cycle of the bee and hence elsewhere during queen or drone production (such as in 'cell-take' in cell-building colonies) or, (c) the natural variability between bee colonies may have masked possible benefits.
- The high incidences of poorly mated spring-reared queens in this study suggest there may be problems in the mating yards of commercial queen producers.

(b) Disappearing Disorder

- The method devised for controlling the disorder will reduce colony losses.
- Significant resources will be needed to find the actual cause of the disorder.

Project Title	Introduction and early performance of queen bees – some factors affecting success

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Objectives

There were four principal objectives and seven small experiments carried out –

- To determine the effects of queen age at introduction on introduction and short-term survival success
- To examine variations in sperm counts between sister queen bees of the same age mated in the same mating apiary at the same time
- To examine the effects of pheromones on queen survival
- To determine any damaging effects on queen bees resulting from transport between the queen bee breeder and the honey producer's apiary

Background

A Pilot Project DAN-164A in 1997-8 identified objectives 1,2 and 4 as being possible important factors contributing to introduction and early survival success of queen bees

Research

Research was carried out over 3 seasons, 1999-2002. Sister queen bees mated in the same mating apiary at the same time and caught from their mating nucleus or from a queen bank at ages ranging between 7 and 35 days each season were – (i) examined at the CSIRO Laboratories, Entomology Dept., Canberra, for a range of physical characteristics, disease prevalence, and mandibular gland pheromone levels; (ii) same aged groups of sister queens were dispatched to two commercial honey producers and queens were introduced into established honey production colonies. The numbers of queens surviving at 7 days and at 15 weeks after introduction were recorded. Satisfactory performance by queens was evaluated at the 15 week inspection. Data was recorded on temperatures, humidities and the number of hours in transit queen bees were subjected to during transport.

Outcomes

(i) statistical and economic benefits were demonstrated for queen bees introduced into established bee colonies at between 24 and 35, about 30, days of age
(ii) average sperm counts of queen bees are low and are associated with a wide range of counts within each group of queens examined. This data suggests a major queen mating problem with drones contributing more to the problem than queens
(iii) the mandibular gland pheromone HVA was found to have a positive correlation with both increased queen survival after introduction and increased age of the queen examined
(iv) transport damage to queen bees was found to be minimal

Implications

(i) economical means of holding queen bees to an older age suitable for introduction need to be determined
(ii) overall average low sperm counts require the source of the problem, ie. queen bees or drones, to be identified
(iii) data obtained on holding queen bees in nucleus hives v. a queen bank was not satisfactory and this experiment should be repeated under increased

controlled conditions
(iv) presence of semen in queen oviducts requires determination of its importance.

Publication Introduction and early performance of queen bees – some factors affecting success, RIRDC Publication No. 03/049, May 2003

RESEARCH IN PROGRESS REPORT 2003

Project Title	A study of Gluconobacter - gluconic acid producing bacteria, symbionts of bees: development of biological control for chalkbrood

RIRDC Project No.: ANU-58A
Start Date: 1/1/2002
Finish Date: 30/4/2004
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Objectives

- To isolate and characterise from different Australian bee hives the bacteria that produce gluconic acid (identified by us as an anti-fungal agent). The results of this strategic basic research will provide specific information to carry out applied research in the future to develop biological control of chalkbrood disease.

Current Progress

This project is studying the symbiotic association of bacterial species with Australian honey bees. Only gram positive bacteria were isolated from the hypopharyngeal gland and intestinal tract of bees. These were studied by Phylogenetic analysis using 16SrRNA sequences, and three were identified to the species level by carbon source testing. These were Lactococcus plantarum, Clavibacter agropyri and Bacillus mycoides. Approximately 50% of bacterial isolates produce anti-fungal agents which inhibit bee diseases such as chalk brood. A screening of these strains has shown they produce a range of anti-fungal agents. Two of them have been shown to produce a known hydrophilic anti-fungal agent. As well one of the bacterial strains isolated produce a new hydrophilic anti-fungal agent, whose structure is yet to be identified. This bacterial strain also inhibits chalk brood. This suggests that there is selection for bacteria that can compete with fungi like chalk brood in the intestinal tract of honeybees. This may be beneficial to bees in controlling disease. This project has done the groundwork for a more intensive study in using these bee bacteria to develop biological control against important bee diseases such as chalk brood, which has currently very limited and expensive means of control.

RESEARCH IN PROGRESS REPORT 2003

Project Title	Clarification of aspects of Varroa reproduction - first stage of a possible new control method

RIRDC Project No.: CSE-87A
Start Date: 1/7/2001
Finish Date: 30/8/2003
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Objectives

- To determine the hormone profiles in the blood of pre and post-pupal stages of *Apis mellifera* and *Apis cerana* drone brood in Java, Indonesia, and in the blood of Varroa mites infesting those stages. This information will form a basis for developing a possible new method for controlling *Varroa destructor* on *Apis mellifera.*

Current Progress

Research in Asia has determined that, of more than 35 genotypes of *Varroa* mites present on different populations of *Apis cerana* (the natural host of *Varroa* mites), only 2 can reproduce on *Apis mellifera* (these are the so-called Korea and Japan haplotypes of *Varroa destructor*). All other *Varroa* genotypes are unable to reproduce on *A. mellifera* almost certainly because they cannot recognise an *A. mellifera* chemical signal that they need to initiate egg-laying. Obtaining information on this signal could lead to a new method of controlling the Japan and Korea haplotypes of *V. destructor* on *A. mellifera.* In the current project, information is being obtained on the signal by examining a situation in Java, Indonesia, where the Java haplotype of *V. jacobsoni* reproduces on the drone brood of *A. cerana* but is unable to reproduce on the drone brood of *A. mellifera.*

Colonies of both *A. cerana* and *A. mellifera* have been established in Java and methods have been developed for preserving mites and bee brood that does not interfere with the integrity of chemicals in their blood during transport to, and storage in, Canberra. Chemicals which may be worthy of further analyses are now being identified.

RESEARCH IN PROGRESS REPORT 2003

Project Title	Study of the small hive beetle (*Aethina tumida* Murray) in the USA

RIRDC Project No.: DAN-213A
Start Date: 1/2/2003
Finish Date: 31/7/2003
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Objectives

- To review the current research and management practices of academics and commercial beekeepers within the USA in relation to the beehive pest, the small hive beetle.

Current Progress

Essentially the small hive beetle from the American experience can be described as a sub-tropical pest, behaving as a scavenger and opportunist. There is no doubt that the beetle has been transported to most states within the USA, but it is encouraging that few reports of damage have been received from most areas of the country.

Beekeeping management practices have contained the problem in most cases. The adult beetle and the larval stage appear to be very tough and are capable of going into a hibernation phase when climatic conditions don't suit their development or activity.

Beekeepers experience problems in two fields. Within the colonies the beetle is controlled in most cases and only becomes a problem to colonies weakened for other reasons. In the American context this is frequently due to Varroa mites decimating populations. Small colonies or nucleus colonies used extensively in the queen bee production industry are particularly susceptible to damage from the small hive beetle.

Maintaining strong colonies and fumigating material which originates from dead colonies prior to its reuse are the primary strategies of beekeepers in reducing the problems caused by the beetle in the apiary.

Within the honey extracting house the problem of the beetle becomes more widespread. Honey combs are normally removed from the colonies and transported to a central location for extraction. In many cases the micro climate of these sheds is ideal for beetle activity. Provided with a food source, the beetle populations can rapidly increase with the larvae causes extensive damage and loss of income through the spoilage of combs prior to extraction. To overcome this beekeepers have modified their practices and now generally extract honey combs within a day or two of their removal from a colony. The wax cappings are also an attractive food source for beetles and these are processed very quickly after the extraction process. Generally the small hive beetle has meant that many beekeepers have become more "hygienic" when it comes to the extraction process of their beekeeping business, extracting, processing and cleaning up honey plants very quickly and not relegating this job to a less important status.

Provided with a few beekeeping behavioural modifications, this pest of bee hives within the USA context seems to be under control in most circumstances.

RESEARCH IN PROGRESS REPORT 2003

Project Title	Transmission of American foulbrood (AFB) disease of honeybees through replacement of queen bees

RIRDC Project No.: DAQ-293A
Start Date: 1/11/2002
Finish Date: 30/3/2004
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Objectives

- To assess the risk of transmitting American foulbrood (AFB) disease to apiaries through use of contaminated queen bees.

Current Progress

Queens were introduced into the research hives in November 2002. Five tests over three months of preliminary sampling was conducted to ensure the hives were AFB free prior to introducing the queens.

Hives were sampled monthly for AFB by taking adult bees from the brood nest. The levels of brood and bees were visually scored and the hives weighed.

Sampling returned clear AFB results in December and January. However, the February sampling revealed AFB spores in two hives – one control and one that hadn't yet been re-queened.

Due to this disappointing outcome, the trial has been temporarily discontinued, as a valid result was not likely to be forthcoming.

Possible causes include:

- AFB in the area
- residual AFB in the combs of the hives - the bees had started to consume
- stores during January
- stored stickies placed on the hives in December

Future

It will be preferable to have absolute control of the trial hives in future to ensure the integrity of the equipment, ie no stickies etc from outside yards coming into the trial, maintain control of extracting to ensure no possible mix up of supers and /or frames hives will be started with completely new or irradiated equipment to ensure no residual spores in old combs or stored honey site will be carefully chosen to limit outside infection as far as possible.

The trial will recommenced in spring and will be monitored for 12 months.

RESEARCH IN PROGRESS REPORT 2003

Project Title	Evaluating alternative antibiotics for control of European Foulbrood disease

RIRDC Project No.: DAV-198A
Start Date: 1/7/2002
Finish Date: 15/9/2003
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Objectives

- To determine the potential of antibiotics, other than oxytetracycline hydrochloride (OTC), to control the bacterial honey bee brood disease, European Foulbrood (Melissococcus pluton) (EFB)
- To identify suitable efficacious antibiotics that quickly degrade and leave no residues in honey extracted from treated hives.

Current Progress

Conventional antibiotics:
β-lactam type antibiotics including Ampicillin (and we will examine several others); the macrolide type antibiotic - Erythromycin
Growth promoting antibiotics:
Monensin; Flavophospholipol
Peptide antibiotics:
Gramicidin; Nisin; Bacitracin

These candidates (except Flavophospholipol) have been analysed using a disk diffusion assay against several Australian strains of *Melissococcus pluton*.

Antibiotic	Amount (µg/disk)	Inhibition (mm)
Ampicillin	0.6 µg	Entire plate
Bacitracin	2.5 µg	28 mm
Erythromycin	0.6 µg	25 mm
Monensin	10 µg	5 mm*
Gramicidin	25 µg	6 mm
Nisin (2.5%)	100 µg	7 mm

*Disk diameter - 5mm

We are also testing their efficacy in a liquid media based minimum inhibitory concentration (MIC) assay. Initial testing has indicated that several on our candidates are as (or more) effective than OTC at inhibiting *M. pluton* growth *in vitro*.

Antibiotic	MIC (µg/ml)
OTC	1.25 µg/ml
Ampicillin	40 ng/ml
Gramicidin	1.25 µg/ml
Nisin (2.5%)	250 µg/ml
Bacitracin	3.0 µg/ml

Antibiotics that show high activity against *M. pluton* will have their residue lifespan tested in honey stored at several temperatures (4 °C, 25 °C and 35 °C).

Project Title:	The sensitivity of Australian honey bee bacterial pathogens to fatty acids

RIRDC Project No.: DAN-193A
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Objectives

- To determine the sensitivity of the two major bacterial honey bee pathogens in Australia, ie. *Melissococcus pluton* (the cause of European foulbrood [EFB]) and *Paenibaccillus larvae* subsp. *larvae* (the cause of American foulbrood [AFB]) to a range of fatty acids including linoleic acid.

Background

European foulbrood (EFB) is a major bacterial honey bee disease pathogen in Australia which causes significant economic loss to the beekeeping industry in Australia and around the world. In Australia the impact of EFB on the bee farming industry necessitated the introduction of hive treatment with the antibiotic oxytetracycline hydrochloride (OTC) in Australia in 1977. Alterative methods for the control of EFB are needed if problems with residues are to be eliminated. In the USA, linoleic acid has been demonstrated to inhibit the growth of the two major bacterial honey pathogens and a range of fatty acids have been demonstrated to inhibit the growth of *P. l. larvae* (AFB). It is important to determine the *in vitro* effects of fatty acids on an extensive range of Australian isolates of these honey bee pathogens if further consideration is to be given for their use in honey bee disease control in Australia.

Research

Twenty eight saturated and unsaturated fatty acids including linoleic acid were used in assays to determine their effect on *Melissococcus pluton* (EFB) and *Paenibacillus larvae* subsp. *larvae* isolates cultured from Australian honey bee colonies. A bioassay system similar to that described by Feldlaufer *et al* (1993) *Apidologie* 24: 89-94, was used to determine the sensitivity of our isolates to fatty acids.

Outcomes

The following fatty acids were demonstrated to have significant antibacterial activity against *P. l. larvae*: Undecanoic, lauric, capric, homo-y-linolenic, ricinoleic, linoleic, myristoleic, y-linolenic, arachidonic, linolenic, ricinelaidic, 4,7,10,13,16,19 docosahexanoic, 11,14 eicosadienoic, 13,16,19 docosatrienoic, 13,16 docosadienoic, 7,10,13,16 docosatetraenoic, myristic.
The following fatty acids were demonstrated to have significant antibacterial activity against *M. pluton*: Undecanoic, lauric, homo-y-linolenic, ricinoleic, myristoleic, ricinelaidic, 13,16,19 docosatrienoic, myristic.

Implications

This study has identified candidate fatty acids that, based on microbiological assays, could be used in the control of AFB and EFB.
The use of a fatty acid treatment would be best suited for the control of EFB. However, before fatty acids can be used in the treatment of honeybees, factors such as a carrier for the fatty acid, the stability of the fatty acid to be tested and appropriate doses must be determined.

Publications

Fatty acids – an alternative control strategy for honeybee diseases, RIRDC Publication No. 03/028, April 2003.

Project Title:	European Foulbrood – investigating control measures

RIRDC Project No.: DAV-157A
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Objectives

- To protect the apiary industry's continued access to domestic and export honey markets by reducing or eliminating industry's dependence on oxytetracycline hydrochloride (OTC) for the control of the bacterial honeybee brood disease, European Foulbrood (EFB) (*Melissococcus pluton*).
- To determine the efficacy of reduced doses of OTC for control of EFB and to determine if these measures reduce or eliminate the occurrence of OTC residues in honey.
- To identify and develop alternative, non-antibiotic measures for control of EFB by investigating, primarily, the effect of enhanced honeybee colony nutrition and changed pH of honeybee larval guts.
- To obtain a greater understanding of active and latent infections of *M. pluton* and *Paenibacillus alvei* (a common secondary invader) in honeybee larvae and to develop new Polymerase Chain Reaction (PCR) methodologies for detection of *M. pluton* as a necessary prerequisite and support of the preceding aim.

Background

In 1998, the Australian National Residue Survey detected OTC residues in lines of honey delivered by some apiarists to honey packing plants. Identification of reasons for the occurrence of OTC residues and investigation of potential alternative non-chemical strategies for control of EFB would help the Australian honey bee industry maintain market advantage through the supply of honey that had a 'clean and green' image.

Research

Field and laboratory trials investigated the occurrence of OTC residues in extracted honey and degradation of the antibiotic in stored honey. Field trials determined the ability of low doses of OTC to deliver adequate antibiotic to honey bee larvae for control EFB. The effect of enhanced protein diet, environmental factors and the role of pH on the incidence of EFB in commercially managed honey bee colonies was also studied. *M.* pluton epidemiological studies were conducted and a number of existing laboratory assays were further developed for future studies of EFB. Apiarists were surveyed to identify current industry 'best practice' for prevention and control of this disease.

Outcomes

The degradation of OTC in honey was found to be extremely slow. Residues were present in extracted honey held at ambient temperature and sampled twelve months from the date of treatment of the honey bee colonies. The potential for OTC residues to occur in honey still exists even though use patterns on labels of OTC products have changed as a result of this project. Doses of OTC that were lower than those stipulated on OTC product labels, only partially reduced the severity of EFB in moderately to heavily infected colonies. No significant reduction in the incidence of EFB occurred when a protein supplement was fed to honey bee colonies in these trials. An improved hemi-nested PCR and an assay using laboratory reared honey bee larvae were developed. The pH of honey bee larvae gut contents varied significantly between apiary locations but laboratory studies indicated that honey bee larvae have a capacity to buffer their diet. The survey

indicated that the majority of apiarists preferred to use management techniques to minimise the incidence of EFB and chose use OTC only when absolutely necessary.

Implications

The results reinforce the need for an alternative method of control for EFB to enable industry to avoid the risk of residues in honey. Further studies are also suggested to determine the effect of the feeding of protein to honey bee colonies located in environs different to those encountered by this project. The enhanced hemi-nested PCR and the honey bee laboratory larval assay developed by this project will assist the conduct of fast, relatively cheap and fully controlled experiments designed to determine the efficacy of potential alternative treatments for this serious economic honey bee brood disease.

Publications

Ben McKee, Steven Djordjevic, Russell Goodman and Michael Hornitzky (2003). The detection of *Melissococcus pluton* in honey bees (*Apis mellifera* L) and their products using a hemi-nested PCR. *Apidologie* **34**: 19-27.

Ben McKee, Russell Goodman, Christian Saywell and Graham Hepworth (*In press*). Oxytetracycline hydrochloride activity in honey bee larvae (*Apis mellifera* L.) following medication with various doses. *Apidologie*.

RESEARCH IN PROGRESS REPORT 2003

Project Title	Predicting the productivity of honeybees from the nutritional value of pollen

RIRDC Project No.:	ANU-57A
Start Date:	1/12/2001
Finish Date:	31/12/2004
Researcher:	Mr. Ian Wallis
Organisation:	Australian National University Division of Botany & Zoology CANBERRA ACT 0200
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Objectives

- To devise a rapid method for explaining the nutritional status and productivity of a colony of bees from the nutritional value of pollen they eat.

Current Progress

In the first year of this project we have been mainly developing equipment and methods for later measurements. An apiary in a secure area of campus provides hives for pollen collection as well as bees and brood for bioassays, which we conduct in a dedicated bee laboratory. We have constructed small cages for bee bioassays that enable us to measure pollen and syrup consumption and bee development. Moreover, when we supply cages of 50 bees, housed in an incubator, with pollen, water and sugar syrup, they survive for 14 days with a mortality of 1-2%. Apart from making many preliminary measurements, we have determined the sample sizes needed to demonstrate statistical differences. In one study, we showed that the hypopharyngeal glands develop faster in bees fed high-protein pollen compared with those fed low-protein pollen.

We have demonstrated that near infrared reflectance spectroscopy can accurately predict the crude protein ($r^2 = 0.99$) and individual amino acid ($r^2 = 0.6$-0.8) composition of pollen.

We are now collecting and analysing fresh pollens to build working models, but have been somewhat hampered by the drought. We have a web site on line that will be updated as our work progresses.

RESEARCH IN PROGRESS REPORT 2003

Project Title	Production of a publication on honeybee nutrition in Australia - 'Fat bees/skinny bees'

RIRDC Project No.: DAN-186A
Start Date: 1/1/2000
Finish Date: 30/10/2003
Researcher: Mr. Doug Somerville
Organisation: NSW Department of Agriculture
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Objectives

- To produce an extension publication on honey bee nutrition, incorporating research findings from past RIRDC projects, literature searches and anecdotal examples of applications in the Australian context in a format that will be readily understood and adopted by beekeepers.

Current Progress

A total of 28 interviews have taken place documenting sugar feeding and protein supplementary feeding practises of commercial beekeepers, package bee producers and queen bee breeders.

These case studies include:
NSW - Warren Jones, Daryl Knight, Greg Mulder, Keiren Sunderland, Warren Taylor, Stan Hughston, Rosemary Doherty and Keith McIlvride.
VIC - Ray Phillips, Ken Gell, Ian Oakley, Kevin and Glen Emmins and Craig Scott.
TAS – Ken Jones, Col Parker, Julian Wolfehagen, Bill Oosting, Headley Hoskinson, Shirley and Ian Stevens.
SA – Graham Wagenfeller, John Fuss, Geoff Smith and Lee Duffield.
WA - Ron Jasper, Rod Pavy, Peter Detchion, Colin Fleay and John Davies.

In brief; supplementary feeding honey bees is not a regular event on mainland Australia. Sugar syrup feeding in Tasmania is an annual event each spring and is an essential management strategy to build colony strength prior to the primary honey flow from December to March. Many beekeepers on the mainland see the possibilities of providing protein supplements but consistent use of such strategies is not evident. The mainland beekeepers may well benefit in increased profitability by the strategic use of sugar syrup adopting Tasmanian practises. There is some evidence in 2003 of this happening due to the very poor seasons brought on by wide spread drought, few reliable nectar sources and very high wholesale honey prices. The economics have shifted to such an extent that the cost of supplementary feeding is seen by many beekeepers as a means of lifting the profitability of their enterprise when nectar sources are limited (similar to the Tasmanian experience).

The knowledge and understanding of the use of protein supplements is still poor. The availability of key ingredients for various accepted recipes have caused a number of beekeepers concern. Soya flour, yeasts etc, are produced by some manufacturers but the availability and variation between batches changes on a seasonal basis.

Most beekeepers who are supplementary feeding protein in the form of patties are aware that they could do better in relation to recipe ingredients meeting honey bee nutritional requirements.

RESEARCH IN PROGRESS REPORT 2003

Project Title	An Australian survey of pollens for their fatty acid composition

RIRDC Project No.: DAW-100A
Start Date: 1/5/2001
Finish Date: 31/7/2005
Researcher: Mr. Robert Manning
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Objectives

- Identify fatty acids of pollens from twenty major honey and pollen producing plant species from each State of Australia.
- Categorise the importance of each species and compare fatty acid profiles from previous studies.
- Determine the effects of long term cold storage on the fatty acids of pollens.

Current Progress

The projects' objective is to obtain pollen from 20 major honey and pollen species from each of the 6 States of Australia which equates to finally analysing 480 samples. So far 79 species (338 samples) have been analysed. Most samples (79%) have been collected from WA and NSW (due to researchers being based there; and a large number of samples were already collected from NSW during a previous project. A number of NSW species are found in adjoining States of Queensland and Victoria). Drought and extensive wildfires have had a significant impact on pollen collections.

Conferences in Griffith NSW (30th May- 1st June); Bendigo Victoria (13-14th June) and Murray Bridge South Australia (24-25th June) were attended and a paper at each was given on data collected so far. Attendance at Queensland and Tasmania State conferences in June 2003 has been conveyed to respective Associations. It is envisaged that pollen collection should be extended to December 2004 and the final report rescheduled to June 2005.

No significant additional information to that reported to State conferences is available from analyses to date.

RESEARCH IN PROGRESS REPORT 2003

Project Title	Eucalypt regrowth thinning trails to optimise leatherwood honey production

RIRDC Project No.: FTA-1A
Start Date: 21/01/1999
Finish Date: 30/06/2003
Researcher: Frieda Heese
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Project Objectives

- To demonstrate that non-commercial thinning of eucalypt regrowth will enhance leatherwood regrowth at no extra cost.
- To establish a set of prescriptions for the timing and intensity of Eucalypt regrowth thinning.
- To communicate main findings to the beekeeping and forestry industries.

Current Progress

The measurement of flowering had to be conducted approximately two weeks earlier then previous years as local beekeepers reported earlier flowering then normal. Flowering in both coupes appear sporadic some trees that flowered last year did not flower this year and where as some trees flowered that previously hadn't flowered. This year as in previous years, seed formation was measured, this year when the site was visited three weeks later it was noted that some flowers in the experimental plots that had dropped petals where not setting seed.

Growth measurements taken this year show no significant increase between thinned plots and control coupes. Although some individual trees to show significant growth in the 12 months since last measured.

RESEARCH IN PROGRESS REPORT 2003

Project Title	The effect of logging on nectar production in NSW forests

RIRDC Project No.: SFN-2A
Start Date: 30/8/2002
Finish Date: 31/5/2005
Researcher: Dr. Brad Law
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Objectives

- To quantify the impact of logging on nectar production in two eucalypt species (Spotted Gum and Grey Ironbark) by measuring nectar production in different tree sizes in forest under different stages of regeneration from logging.
- A better understanding of nectar production in logged forests, when widely communicated, will allow an integration of apiculture with forest management and thus promote sustainability and accessibility.

Current Progress

South Coast State Forest regional staff have been contacted about the initiation of the eucalypt nectar study in their region. To assist with the selection of appropriate sites, GIS data layers of forest types and disturbance history have been collated, inspected and maps prepared. These provide delineation of the forest types of interest (Spotted Gum and Grey Ironbark) and guidance on the logging history of different State Forest compartments. The maps have been used in preliminary site visits to south coast NSW. The presence of floral budding on Spotted Gum was noted at a number of sites indicating the possibility of flowering for this species in 2003. However, budding was not extensive, which means heavy flowering is not expected this year. Indeed it was apparent that final selection of sites would not be possible until flowering actually begins. Bushfires in 2001 and 2002 have reduced the amount of forest available for study in some categories, especially mature forest, which is not widespread in accessible areas. The 2002 drought is also expected to reduce the level of flowering in and June.

Project Title	Floral resource database for the South Australian apiary industry

RIRDC Project No.: DEH-1A
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Objectives

- To identify the major floral resources used by South Australian apiarists and document the locations used by beekeepers when exploiting different floral resources and to compile these data in a suitable electronic form.

Background

There has been no detailed survey that has identified the key floral resources used by the beekeeping industry in South Australia. Such information is important for regional planning particularly with respect to protecting floral assets and maintaining access for beekeepers to these assets.

Research

The primary method of collecting data was by a questionnaire that was distributed to 216 beekeepers that had registered at least 40 hives in South Australia. Each beekeeper was asked to answer a series of questions about their beekeeping operations. These included providing details of the locations that they used for their bees, the times of the year that these sites were used, the numbers of hives placed at each site and the main floral resources that were being used at each site. The initial response to the questionnaire was poor (<30%) and additional data were collected by interviewing individual beekeepers willing to be included. Beekeepers were also asked to identify potential threats or changes to the floral resources that they used.

Outcomes

Based on the responses of 103 beekeepers, at least 118 plant species were identified as providing important floral resources to beekeepers in South Australia. 69 of these were native species (mainly various eucalypts), 27 were introduced plants (many were agricultural weeds) and 22 were crop plants. The most important and widespread resources were Salvation Jane (*Echium plantagineum*) and South Australian Blue Gum (*Eucalyptus leucoxylon*) being recorded as important resources at 26 and 25% of the 750 or so locations listed by South Australian beekeepers. Other widespread key plants included lucerne (14%), *Eucalyptus diversifolia* (14%), and *Eucalyptus camaldulensis* (14%). Of the plants listed as being important to beekeepers, most of the crop and introduced plant species were reliable produces from one year to the next. Many of the native plants, particularly various eucalypts did not flower or provide reliable resources every year. The major factors listed as reducing resource availability for the industry were dieback of eucalypts, grazing of understorey, more frequent dry conditions in recent years, reduction of agricultural weeds associated with a shift from grazing to cropping. Shifts in the types of crops and to more intensive agriculture were also issues. Vegetation clearance was an issue but not in the last ten years. Examination of individual beekeepers' production records supported some of these changes in resource use and some native species such as Pink or Hill Gum *Eucalyptus fasciculosa* which were significant components of honey production from the 1960s-1980s were now minor contributors, suggesting widespread decline for some native plant species.

Implications

More detailed assessments and monitoring of the health and vigour of many of

the key floral resources used by beekeepers in South Australia, particularly Pink Gum *Eucalyptus fasciculosa,* is warranted to better track changes in resource availability and to better quantify temporal aspects of flowering intensity. Since approximately half of South Australia's registered beekeepers did not contribute to this survey some caution is required before assuming that the above surveys have captured all of the key resources used by South Australian apiarists.

Project Title:	Economic evaluation of honeybee pollination services

RIRDC Project No.: CIE-15A
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Objectives

- The study was tasked with estimating the contribution of honeybee pollination to the Australian economy.

Background

A study undertaken in 1989 by Gill estimated the contribution of honeybee pollination to Australian agriculture was between $0.6 and $1.2 billion. This study looked at the 'morning after' losses of a complete loss of honeybee pollination for 27 crops for which data was available at that time.

Research

This study updated and improved on Gill's methodology by including 35 crops and allowing for the adjustments that would occur in the import and export markets to such a shock. The downstream impacts on the processing distribution and retailing industries are also assessed as is the potential loss of jobs. A multiplier approach is used to assess what the flow-on impact of such a major loss of agricultural production would be for the Australian economy. The study highlighted some problems with the methodology that attributes the total value of production to just one of the essential inputs. To assess the impact over the adjustment period we utilised the models to assess the impact with different capacities of farmers to adjust out of the honeybee pollination dependent crops. As expected the costs are highest where farmers have few other opportunities and must suffer a considerable decline in income before adjusting.

Outcomes

The estimates replicating Gill's methodology for 35 crops was a value of $2.1 billion in 1999-2000. Allowing for import and export adjustment this value was reduced to $1.7 billion. The downstream impacts of this were an additional loss of $1.6 billion and a loss of 9 500 jobs. Flowing from this would be a temporary loss of an additional $2 billion and 11 000 jobs. Allowing for adjustment over time, the costs range from $1.2 billion a year if farmers suffer a 25 per cent fall in income before they adjust, to $100 million a year if farmers adjust if income falls by more than 5 per cent.

Implications

Exotic incursions if honeybee diseases is the most likely cause of a sudden decline in honeybee populations and hence pollination services. Under such circumstances is likely that a market for pollination services would develop rapidly in the heavily honeybee dependent industries, lowering the impact largely to production losses while honeybee producers expand supply to meet the demand for pollination services. This study did not aim to estimate the potential size of the market for paid pollination services, nor the price these services would attract. It can be argued that the value of this market is a more accurate way to estimate the value of honeybee pollination services than the approach followed in this study. However, the paper demonstrates that a loss of the honeybee would see a major restructuring of agriculture in Australia, and to the extent that the value of an essential ingredient should be attributed the value of the whole, honeybee pollination services make a major contribution to Australian agriculture.

Publication

Valuing honeybee pollination, RIRDC Publication No. 03/077, May 2003

RESEARCH IN PROGRESS REPORT 2003

Project Title	High power ultrasound for candied liquid honey liquefaction and controlled creamed honey crystallisation

RIRDC Project No.: UQ-101A
Start Date: 1/10/2002
Finish Date: 31/05/2005
Researcher: Dr. Bruce R D'Arcy
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Objectives

- To reduce the amount of expensive heating and loss in quality during liquefaction of candied honey by developing an alternate, cost-effective ultrasound based method for the partial or complete liquefaction of candied honey by 2005, with a view to ultrasound having direct application for beekeeper control of honey crystallisation, or for liquefying candied honey prior to decanting in a honey packing plant.
- To better control the texture of creamed honey spread by developing an ultrasound based method that enhances the nucleation rate and produces uniform crystal growth in a creamed honey system by 2005, with a view to it being used by beekeepers and honey processors for producing consistent and high quality creamed honey.

Current Progress

A preliminary study of the effect of high-power ultrasound on candied honey was undertaken during 2002. Differential scanning calorimetry can be used to determine the glucose monohydrate crystal content in honey. The findings of this study suggest that sonication amplitude plays an important role in glucose crystal reduction. Higher amplitudes can be used to reduce the time required for crystal liquefaction. Candied yapunyah honey when treated with ultrasonic waves of amplitude of 25% (lowest setting) for 60 s was completely liquefied, with a moderate temperature rise of 41 °C. This preliminary study has shown the potential for ultrasonic liquefaction of candied honey. However, the temperature to which the honey is heated by the sonication must also be taken into consideration so as to minimise any effects on honey quality such as increases in HMF levels. Mr Tikiri Bandara Jayampathi Rajapakse has been appointed (28-01-03) to undertake the research as the major part of his PhD studies. A significant review of the literature related to the use of high power ultrasound in food science, with particular emphasis on foods containing sugar, is being undertaken at present to expand the already accumulated literature material.

RESEARCH IN PROGRESS REPORT 2003

Project Title	Antioxidants as health and nutritional components of Australian floral honeys

RIRDC Project No.: UQ-102A
Start Date: 2/09/2002
Finish Date: 30/11/2003
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Objectives

- To increase knowledge of the health and nutritional values of Australian honey by determining the identity and levels of antioxidant flavonoids and other polyphenols in straightline samples of two species-specific floral types of Australian honey, with a view to such data being used to promote increased use of honey by consumers and the food industry.

Current Progress

Separation of the flavonoids and phenolic acids from the sugars in honey was done using a established published method involving the use of Amberlite XAD-2 resin and column chromatography. HPLC (with diode array detection) and LC-MS have been used to identify and quantify the extracted phenolic compounds. Significant method development and recovery studies on flavonoid and phenolic acid standards were done in 2002, with the procedure now optimised for flavonoids. A preliminary study of straightline samples of yapunyah and spotted gum honeys has shown that the following phenolic compounds are components of Australian yapunyah and spotted gum honey:

- the ***flavonoids***, myricetin, tricetin, quercetin, luteolin, kaempferol, and chrysin
- the ***phenolic acids***, caffeic acid, *p*-coumaric acid, ferulic acid, and ellagic acid.

Quantification of these compounds using authentic standards, and HPLC and LC-MS is proceeding at present. Further straightline samples of other floral types of honey from Western Australia and Tasmania are presently being sourced from beekeepers for future analysis.

Project Title:	Honeybee industry survey

RIRDC Project No.: ABA-15A
Researcher: Veronica Boero Rodriguez, Cid Riley, Walter Shafron and Ray Lindsay
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Objectives

- To assist benchmarking to improve the honeybee industry performance and provide information to target industry efforts to improve productivity and profitability. To enable calculation of the economic value of the industry and the resources used by the industry. To assist the development of industry policy and planning, providing a factual basis for the further development of the honeybee industry.

Background

The honeybee industry is an important Australian industry. In common with many other industries, the honeybee industry faces a number of challenges. These include access to native flora and competition in both export and domestic markets. The industry needs to maintain its competitiveness and comparative advantage as a supplier of high quality honey. However, only limited information is available on the industry. In particular, little information is available on the physical, financial and socioeconomic characteristics of honey producing businesses.

Research

The Australian Bureau of Agricultural and Resource Economics (ABARE) conducted a survey of honeybee businesses. The specific information sought included: physical characteristics of honey producing business, receipts, costs, financial performance, investment, debt, capital and resources used by beekeepers. The Australian honeybee industry survey was designed and the sample selected on a framework based on lists from each state's regulatory body. This framework includes beekeepers in each state classified by number of hives as a measure of size. Estimates in this report cover registered beekeepers with 50 hives or more, accounting for 85 per cent of the total number of registered hives.

Outcomes

Australia has around 9600 registered beekeepers, but the majority of honey is produced by a relatively small number of honeybee businesses. Around sixty per cent of total honey production is estimated to be produced by the 3 per cent of businesses that operate more than 500 hives. Only 16 per cent of Australian honey production is produced by businesses with 250 hives or less.
Over 60 per cent of beekeepers used public land for honey production in the last five years. The proportion of large honeybee businesses using public land was 90 per cent, but only 53 per cent of small businesses used public land. The survey results lead to an estimate of total Australian honey production in 2000-01 of approximately 27 800 tonnes. In addition, the total gross value of the honeybee industry in 2000-01 is estimated to have been around $63 million.

Implications

Overall, Australian honey production is highly concentrated among larger honeybee businesses. Issues that impact on these larger producers have greatest impact on the industries short term performance.

Publication

Honeybee Industry Survey, RIRDC Publication No. R03/039, May 2003

Project Title	Commercial beekeeping in Australia

RIRDC Project No.	FSB-1A
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Objectives

- To produce a report on Commercial Beekeeping in Australia that describes the physical and cultural environment in which beekeeping is undertaken and describes production methods commonly employed by Australian beekeepers, as a reference for those contemplating a career in beekeeping and for students of Australian primary production.

Background

Between March 1990 and March 1996 RIRDC produced a series of reports on commercial beekeeping. One report was prepared for each State in the Commonwealth. Since 1990, when the series began, "best practice" in beekeeping has changed in several significant respects. The original six State reports never achieved the circulation and attention that they deserved and failed to fulfil their intended role.

Research

The six existing publications were reviewed and additional information needs determined. Industry leaders throughout Australia were consulted to obtain required information, mostly by phone and Email. Writing progressed in tandem with information gathering.

Outcomes

The 94 page manuscript is intended to be published in 2003 and will be more readily accessible than the original six State reports. It is envisaged that the publication will be sold throughout Australia, both as hard copy and on CD Rom.

Implications

For the first time, an easy to read, factual account of commercial beekeeping in Australia at the beginning of the third millennium will be available to readers in Australia and overseas. The ingenuity and inventiveness of Australian beekeepers in devising methods of production and patterns of management that permits successful commercial beekeeping under Australia's unique conditions of climate and of flora is documented.

Publication

Commercial Beekeeping in Australia, RIRDC Publication No. 03/037, May 2003

New Projects –2003/2004

The following projects have been approved by RIRDC for commencement in the 2003/2004 year:

Title	Researcher	Phone
Biological control of chalkbrood by anti-fungal bacterial symbionts of bees (HBE03-01)	Dr. Murali Nayudu	(02) 6125 3643
The sensitivity of Paenibacillus larvae isolates (AFB) to oxytetracycline (HBE03-02)	Dr. Michael Hornitzky	(02) 4640 6311
Nutrition field trial to maximise colony population (HBE03-03)	Mr. Doug Somerville	(02) 4828 6619
Development of two genetic markers for hygienic behaviour of honeybees (HBE03-04)	Dr. Ben Oldroyd	(02) 9351 7501
Floral resource database for Tasmania (HBE03-07)	Dr. Simon Pigot	(03) 6233 8357
Determination of pollen content of canola (*Brassica napus*) honey (HBE03-11)	Dr. Michael Hornitzky	(02) 4640 6311
Using temperature manipulation to control small hive beetle (HBE03-14)	Dr. Garry Levot	(02) 4640 6376
Insecticidal control of small hive beetle (HBE03-15)	Dr. Garry Levot	(02) 4640 6376
Investigate small hive beetle traps (HBE03-16)	Mr. Bruce White	(02) 4577 0627

Publications

A Quality Survey of Australian Honeys R01/044 (2001, 44pgs)	$16
Australian Liquid Honey R99/145 (1999, 83pgs)	$21
Beekeeping & Access to Public Land R97/026 (1997 59 pgs)	$16
Beekeepers Use of Honey & Pollen Flora Resources in Victoria R01/050 (2001, 104pgs)	$21
Breeding hygienic disease resistant bees R02/048 (2002, 35pgs)	$16
CD - Honeybee Research Reports on CD (version 2) CD03/001	$26
CD - Pollination Manual 2000 CD00/001	$26
Commercial Beekeeping in Australia R03/037 (2003; 91pgs)	$21
Controlling American Foulbrood R01/048 (2001,14pgs)	$16
European Foulbrood R99/020 (1999, 23pgs)	$16
Fatty Acids - An Alternative Control Strategy for Honeybee diseases R03/028 (2003, 19pgs)	$16
Floral Resource Database for the NSW Apiary Industry R99/174 (1999, 154pgs)	$21
Honeybee Disease Barrier Management Systems R01/052 (2001, 23pgs)	$16
Honeybee Industry Survey R03/039 (2003)	$21
Hot Wax Dipping of Beehive Components R01/051 (2001, 28pgs)	$16
Impact of Commercial Honeybees on Flora & Fauna R99/015 (1999, 31pgs)	$16
Introduction and Early Performance of Queen Bees R03/049 (2003; 45pgs)	$16
Literature Review of Chalkbrood-a Fungal Disease R01/150 (2001, 20pgs)	$16
Natural Resource Database for the QLD Apiary Industry R99/043 (1999, 68pgs)	$16
Nosema Disease in Honeybees-Genetic Variation & Control R01/046 (2001, 36pgs)	$16
Nutritional Value of Bee Collected Pollens R01/047 (2001, 166pgs)	$21
Pollen Analysis of Eucalypts in Western Australia R01/053 (2001, 63pgs)	$16
Strategic Planning & Action Meeting for Honeybee Nutrition R98/128 (1998, 22pgs)	$16
Study of the Small Hive Beetle in the USA	$21
Short Report 10 - Bulk Honey Containers	Free
Techniques for the detection of adulterated honey R02/047 (2002,16pgs)	$16
The Use of Honeybees as a Transfer Vector for Control of Core Rot in Apples R02/046 (2002,54pgs)	$16
Treating American Foulbrood R98/144 (1998, 12pgs)	$16
Valuing Honeybee Pollination R03/077 (2003)	$16

Non-RIRDC Publications and Videos

The following publications and videos have been jointly funded by RIRDC but are not available from RIRDC. Ordering details as indicated.

Beekeeping in the NSW State Forest Districts

by NSW Agriculture, $5 each, phone (02) 4823 0616 to order

A series of reports which include information on beekeeping activities and honey and pollen flora of importance to beekeeping within each state forest district of New South Wales. Each report is approximately 20-26 pages.

Current reports in the series are:

- Queanbeyan/Badja State Forest Management Area – Apiary Management Potential (1995)
- Central Murray Valley Forestry Area – Apiary Management Survey (1995)
- Forbes Forestry District – Apiary Management Survey Results (1996)
- Beekeeping in the Bulahdelah State Forests (1997)
- Beekeeping in the Kempsey State Forests (1997)
- Beekeeping in the Narrandera State Forests (1997)
- Beekeeping in the Taree State Forests (1997)
- Beekeeping in the Tumut-Tumbarumba State Forests (1997)
- Beekeeping in the Wauchope State Forests (1997)
- Beekeeping in the Glen Innes State Forests (1997)
- Beekeeping in the Mildura Forestry Management Area (1997)
- Beekeeping in the Inverell State Forests (1997)
- Eden-Bombala Forestry District - Study of Beekeeping Usage and Importance (1997)
- Beekeeping in the Dubbo State Forests (1998)
- Beekeeping in the Urbenville State Forests (1998)
- Beekeeping in the Morisset State Forests (1998)
- Beekeeping in the Bathurst/Oberon State Forests (1998)
- Beekeeping in the Grafton State Forests (1998)
- Beekeeping in the Urunga State Forests (1998)
- Beekeeping in the Casino State Forests (1998)
- Beekeeping in the Gloucester/Walcha State Forests (1998)
- Beekeeping in the Dorrigo State Forests (1998)

Chalkbrood Disease of Bees

by NSW Agriculture, $25 (includes postage), phone (02) 6391 3433 or 1800 028 374 to order

Enables beekeepers to identify the symptoms of Chalkbrood, outlines measures to take to reduce the impact of this disease and outlines the epidemiology of this disease and how to correctly examine hives to detect Chalkbrood. 10 minutes

Bee Parasites Exotic to Australia

by NSW Agriculture, $30 (incudes postage), phone 02) 6391 3433 or 1800 028 374 to order

Enables beekeepers to identify external exotic parasites (varroa, trachael mites and tropilaelaps) and exotic bees (Asian, giant and dwarf honeybees) and be able to contact the right authorities should they see them in Australia. Includes biology of the parasites, how to inspect hives, how they spread and control measures should they enter Australia. Also covers how to legally import honeybees with approval from AQIS. 20 minutes

Endemic Bee Diseases (VDO5) 1992

by NSW Agriculture, $30 (includes postage), phone (02) 6391 3433 or 1800 028 374 to order

Enables beekeepers to identify endemic bee diseases (American Foulbrood, European Foulbrood, Sac Brood, Wax Moths, Braula Coeca (Tasmania only)) and other brood disorders. Enables beekeepers to identify the symptoms of the disease and pests, outlines measures to take to reduce the impact of this disease and outlines the epidemiology of the diseases and pests. How to correctly examine hives to detect problems. 49 minutes

Package Bee Production in Australia

by NSW Agriculture, $30 (includes postage), phone (02) 6391 3433 or 1800 028 374 to order

Enables beekeepers to follow a step-by-step guide on how to produce, handle and care for package bees, how to prepare package bees for shipment to overseas destinations. Inspection and certification requirements to overseas countries who buy package bees and Queen bees from Australia. 27 minutes

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