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Honeybee Research Report 2002

Research completed and in progress for the Honeybee R & D Program

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

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 800 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.

Peter Core
Managing Director
Rural Industries Research and Development Corporation

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COMMUNICATION AND EXTENSION

Continuing projects

RESEARCH IN PROGRESS REPORT 2002

Project Title	Improving queen bee production

RIRDC Project No.:	CSE-85A
Start Date:	01/07/99
Finish Date:	31/07/02
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Objectives

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

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

Current Progress

Effects of nutrient supplements on queen banks

In the autumn of 2001 tests were carried out to determine whether nutrient supplements fed to queen banks affected the quality of the queens banked in them. Two hundred sister-queens in small cages were banked in groups of 20 in one of 10 standardized queen banks. Groups of 2 banks were then fed one of the following supplements on a continuous basis for 2 months: (a) no supplement (control), (b) soya-flour based supplement, (c) commercially available pollen patty, (d) vitamins in 60% sucrose solution and (e) 60% sucrose solution. After 2 months the banked queens were tested for: (1) weight, (2) number of ovarioles, (3) diameter of spermathecae, (4) number of spermatozoa in spermathecae, and (5) nosema levels.

There was no significant differences in the quality of the queens kept in the banks that were fed the different supplements. Tests in the spring of 2002 will focus of the effects of feeding nutrient supplements to drone-rearing colonies.

Disappearing Disorder

During the 2000/01 season, brood, pollen and nectar samples were collected from colonies affected with disappearing disorder at a single apiary in Queensland. Tests on these samples showed some evidence that elevated levels of iron may have contributed to the cause of the disorder. Results from tests conducted on colonies affected with the disorder at Gladstone during the 2001/02 season are still being finalised.

RESEARCH IN PROGRESS REPORT 2002

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

RIRDC Project No.:	DAN-182A
Start Date:	01/09/99
Finish Date:	31/07/02
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Objectives

1. To determine whether the age of the queen bee at introduction influences introduction success.
2. To identify factors affecting sperm counts of sister queen bees mated under the same mating conditions and to investigate relationships between low spem counts and queen failure following introduction.
3. To examine the effects of temperature and humidity during transport of queen bees on their introduction success.
4. A comparison of sperm counts between sister bees mated in a commercial queen bee breeder's apiary and between those mated in a commercial honey producer's queen bee breeder's apiary.
5. Development of a method for preserving adult drones which would allow accurate sperm counts to be carried out on those drones.
6. To determine differences in (i) introduction and short term survival rates, and (ii) the number of sperm in the spermatheca, between queen bees held in (i) mating nuclei, and (ii) queen banks, from 17 days of age until 24 and 31 days of age before being introduced into commercial honey hives.
7. To examine the effects of temperature and humidity during transport of queen bees on their introduction success.

Current Progress

Points 1, 2, 3, 4, 6 and 7 have been completed, Point 5 was not able to be achieved successfully and an alternative method has been found. The final report for DAN 182A is being prepared.

Point 1: Increased age of the queen at introduction improved introduction success, 21-28 days old was the most suitable age for introduction. One mandibular gland pheromone showed a positive correlation with both queen age and introduction success.

Point 2: Based on physical measurements of ovariole numbers, spermatheca diameter and queen weight, all queens used in the project were of a high standard when compared with USA and NZ data. Sperm counts for queens caught at all ages, but particularly at 7 and 14 days of age, were generally below the acceptable levels of 3 million sperm for survival >12 months, and 4.5 million sperm considered suitable for a commercially reared queen based on USA data.

Point 3, Point 7: No relationship found, to date, between temperature and humidity data queens were subjected to during transport and queen survival and performance.

Point 4: No significant difference was found between sister queens mated in a queen breeder`s or a honey producer`s mating apiary.

Point 5: A satisfactory method for preserving adult drones to allow examination at a later date was not achieved. A process where freshly caught

drones can be examined to provide the required data has been determined.
Point 6: The queen banking project has been completed and data is being analysed. Compared to data from the 2 previous years, sperm counts were higher but still averaged below 4.5 million/queen. Queen survival rates were also higher with queens caught at 24 and 31 days old higher than 17 day old. Banking reduced survival for 24 d.o. queens but not for 31 d.o. queens.

RESEARCH IN PROGRESS REPORT 2002

Project Title	Device for finding queen bees in managed beehives

RIRDC Project No.:	PFP-1A
Start Date:	01/02/01
Finish Date:	28/02/03
Researcher:	Mr. Alan Roberts
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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

The aim of the project is to attach a small device on a honey bee queen that will allow a scanning tool to pinpoint her position in the hive. This would allow faster finding of those queens (which have not been superseded) during requeening. It will also enable a quick check to be undertaken (from outside the hive) to ascertain whether the original queen is still in attendance. A benefit for both commercial beekeepers and researchers.

The project has not advanced as quickly as anticipated for two unexpected reasons. The principal researcher has a serious illness which has slowed progress considerably.

There has also been reluctance, by some electronic component manufacturers, to supply their products in the small quantities required for research. All components for a preliminary test have now been obtained.

Both researchers attended the "Austronics 2001" trade show and workshops to view latest components and electronic assembly techniques.

It is envisioned that assembly and preliminary testing will take place by the end of May, and then wider testing during the spring of 2002 under a range of hive conditions.

RESEARCH IN PROGRESS REPORT 2002

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:	01/01/02
Finish Date:	30/04/04
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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

Bacterial species such as Bacillus have been frequently isolated from European honeybee (*Apis mellifera*) collected from a variety of regions in other parts of the world. The nature of this bee-bacterial relationship is poorly understood. Hydrogen peroxide has been identified as a strong anti-microbial agent. More recently gluconic acid has been shown to be a powerful anti-fungal agent. The relative contribution of these two different sources to the hydrogen peroxide and gluconic acid present in honey is unknown.

The aim of this project is to study the nature of Australian gluconic acid production of bacteria that associate with honeybees. At the start of this project we have shown by isolation that a diverse range of bacterial species associate with Australian honey bees. Many of these are acid producing strains, and several may be producing the anti-fungal agent gluconic acid. Over 50% of the bacterial strains isolated from honeybees inhibit chalkbrood. This suggests that there is selection for bacteria that can compete in the intestinal tract of honeybees with fungi like chalkbrood.

In conclusion the results so far strongly suggest there is a potential to utilise these Australian bee bacteria to obtain a biological control for chalk brood.

RESEARCH IN PROGRESS REPORT 2002

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

RIRDC Project No.:	CSE-87A
Start Date:	01/07/01
Finish Date:	30/08/03
Researcher:	Dr. Denis Anderson
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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

This project aims to gain a better understanding of why the Java genotype of *Varroa jacobsoni* can reproduce on drone brood of its native *Apis cerana* in Java but not on the drone brood of *Apis mellifera*. Understanding the underlying mechanisms could lead to novel ways of controlling those *Varroa* genotypes that can reproduce on *A. mellifera*.

Clearances and permits have been obtained for moving bee and mite material from Indonesia to Australia. Colonies of *A. cerana* and *A. mellifera* have been established at Paung Panjang and Bogor and these will be used to source all bee and mite material throughout the course of the project.

In the initial stages, tests are being conducted to determine the best method for extracting hormones from the samples collected in Java. Hence, blood samples were collected from prepupal and early pupal stages of *A. cerana* and *A. mellifera* in Java from 1-5 October and again from the 1-4 April 2002. The October samples were placed in liquid nitrogen prior to being shipped, while the April samples were placed in methanol. Dr M. Lacey at CSIRO Entomology is currently extracting hormones from these samples.

RESEARCH IN PROGRESS REPORT 2002

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

RIRDC Project No.:	DAN-193A
Start Date:	01/08/01
Finish Date:	31/07/02
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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.

Current Progress

The activity of 28 fatty acids was tested against 13 *Paenibacillus larvae* subsp. *larvae* isolates from NSW, South Australia, Tasmania, Western Australia, Queensland, Northern Territory, New Zealand and China. These fatty acids were also tested against 10 *Melissococcus pluton* isolates from NSW, South Australia, Tasmania, Queensland and the United Kingdom. Fifteen fatty acids had activity against *P. l. larvae* in the following decreasing order of activity; undecanoic, homo-γ-linolenic, capric, 7, 10, 13, 16-docosatetraenoic, 13, 16, 19-docosatrienoic, linolenic, linoleic, myristoleic, lauric, 11, 14-eicosadienoic, ricinoleic, 13, 16-docosadienoic, ricinelaidic, arachidonic and γ-linolenic acid. Eight fatty acids showed activity against *M. pluton* in the following decreasing order of activity; undecanoic, lauric, myristoleic, 13, 16, 19-docosatrienoic, homo-γ-linolenic, ricinoleic, ricinelaidic and myristic. There was generally little variation in the sensitivity of the various strains of either *P. l. larvae* or *M. pluton* to any specific fatty acid.

The activity of the fatty acids against *P. l. larvae* was substantially less than previously reported.

RESEARCH IN PROGRESS REPORT 2002

Project Title	European Foulbrood - investigating control measures

RIRDC Project No.:	DAV-157A
Start Date:	07/12/98
Finish Date:	30/09/02
Researcher:	Mr. Russell Goodman
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Objectives

a) To protect the apiary industry's continued access to domestic and export honey markets by reducing or eliminating industry's dependence on oxtetracycline hydrochloride (OTC) for the control of the bacterial honeybee brood disease, European Foulbrood (EFB) (Melissococcus pluton).
b) To determine the efficacy of reduced doses of OTC and use of OTC extender patties for the control of EFB and to determine if these measures reduce or eliminate the occurrence of OTC residues in honey.
c) 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.
d) 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 (c)

Current Progress

Field trials

OTC (1.0g, 0.5g and 0.3g) was applied in either caster sugar or water to honey bee colonies to determine the concentration of residues in honey that was later extracted from the hives.

The incidence of EFB in 3 groups of colonies fed high protein pollen cakes, treated with 1g OTC or untreated controls was determined. The number of diseased colonies and the severity of disease was lower in colonies fed protein when compared to the controls.

Laboratory investigations

Honey extracted from hives treated with 1g OTC was decanted into vials and placed in 25ºC, 30ºC, 35ºC and 35ºC incubators. Vials were removed from each incubator fortnightly and analysed for OTC residues.

The minimum infectious dose for EFB was determined by inoculating laboratory reared larvae with *M. pluton*. These methodologies provide a rapid assay for determining the efficacy of potential treatments for control of EFB and other diseases affecting honey bee larvae.

Preliminary studies on the potential for larval midgut pH to influence susceptibility to EFB were commenced. Examination of histology sections of EFB infected larvae as part of studies on the pathogenesis of *M. pluton* confirmed the organism not only multiplies in the larval gut but also invades the peritrophic membrane.

RESEARCH IN PROGRESS REPORT 2002

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

RIRDC Project No.:	ANU-57A
Start Date:	01/12/01
Finish Date:	31/12/04
Researcher:	Mr. Ian Wallis
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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

The first objective of this project, started on 1/12/2001, was to appoint a PhD student. This took longer than anticipated. We started searching in July 2001 and Susan Burrows, a graduate of the University of Sydney, started in February 2002. Our second objective was to test whether near infrared reflectance spectroscopy (NIRS) could predict the nitrogen (crude protein) and amino acid content of pollen. Briefly, the procedure involves scanning samples with NIRS, analysing the samples with traditional chemistry and then statistically relating the two data sets. The resulting prediction equation enables future samples to be analysed quickly and cheaply using NIRS alone. We studied pollen (72 samples of 50 species collected between August 1995 and December 1998) donated by Doug Somerville (NSW Dept of Agriculture). While we could justify repeating the nitrogen analyses, we could not justify the expense of reanalysing them for amino acids. Thus, we did NIRS scans of 72 samples, which we related to our nitrogen analyses but to Doug Somerville's published values for amino acids. This pilot study produced an excellent model for predicting nitrogen but poorer models for amino acids. This implies some degradation of amino acids during storage. We are now preparing a website and purchasing bee equipment.

RESEARCH IN PROGRESS REPORT 2002

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

RIRDC Project No.:	DAN-186A
Start Date:	01/01/00
Finish Date:	31/10/02
Researcher:	Mr. Doug Somerville
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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 paper on the Mineral Content of Bee Collected Pollen has been accepted by the Australian Journal of Experimental Agriculture. Information on all areas of Honeybee nutrition has been gathered and is in the process of being compiled into sections on the major nutritional components impacting on the diet of Honeybees.

Further case studies, particularly for Tasmania, WA, Queensland and Victoria are scheduled to be collected in the winter and spring of 2002.

The publication will be delayed if necessary, within reason to include the results of a number of current RIRDC funded projects, including data on Fatty Acid Analysis of Pollen's, the effects of Fatty Acids on Honeybee pathogens, the use of protein supplements in the role of Queen Bee production system's and the implications of minerals in pollen and nectar, linked to a condition referred to as Disappearing Disorder.

RESEARCH IN PROGRESS REPORT 2002

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

RIRDC Project No.:	DAW-100A
Start Date:	01/05/01
Finish Date:	01/12/04
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

Approximately 130 pollen samples have been analysed from 40 major honey and pollen producing species. Samples have come from Western Australia, Queensland, NSW and Tasmania. With the drought and honey shortage being experienced nationally the pollen collections have been poor when compared to project expectations. However, as a speaker at 3 Beekeeper annual general meetings (NSW, VIC & SA) over the next couple of months, the pollen collections should improve once beekeepers further understand the project.

The cold storage tests have also commenced.

RESEARCH IN PROGRESS REPORT 2002

Project Title	Natural resource database for the South Australian apiary industry

RIRDC Project No.:	DEH-1A
Start Date:	05/07/99
Finish Date:	31/05/02
Researcher:	Dr. Chris Holden
Organisation:	Department of Environment, Heritage and Aboriginal Affairs (SA) Biodiversity Conservation Program Heritage and Biodiversity Division PO Box 1047 ADELAIDE SA 5000
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Objectives

To create a database of floral resource information for the South Australian apiary industry, which includes details of:

1. the floral resource base on which the industry is dependent, including the reliance of the industry on native vegetation and the most valuable and reliable floral species for honeybees;
2. the distribution of various native plant species as they relate to beekeeping;
3. the frequency with which these resources are used, the land tenure on which they currently exist, and the relative values for honey and pollen as they relate to honeybee nutritional requirements and honey production; and
4. estimates of the value of currently used apiary sites on both private and Crown lands in terms of dollar value or as a percentage of the State annual production.

Current Progress

The researcher Dr David Paton has employed research assistant Emma Crossfield to compile the report. Subsequent to the poor response to the initial questionnaire (sent to 237 registered beekeepers), information was distributed through the South Australian Apiarists Association newsletter, meetings arranged with small collections of beekeepers, a simpler form distributed to non-respondents, and finally phone-calls to those beekeepers who had still not responded. Of the beekeepers approached, 50% have responded. This accounts for 30% of the hives in South Australia and suggests a higher proportion of smaller operators had responded. At best, another 20% of beekeepers may provide information. At least 10% and perhaps as high as 30% of South Australian beekeepers refuse to provide information.

Map production will be finalised in May 2002.

This project is on track for publication in June 2002.

RESEARCH IN PROGRESS REPORT 2002

Project Title	Eucalypt regrowth thinning trails to optimise leatherwood honey production

RIRDC Project No.:	FTA-1A
Start Date:	21/01/99
Finish Date:	30/06/03
Researcher:	Ms. Frieda Heese
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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

This year the measurement of stem growth has shown a mark increase in the plots where stem injection occurred compared to the control plots. The stem injected plots now have reduced canopy cover and the lower canopy is undergoing significant change. In some plots leatherwood saplings are appearing but whether is a result of reduced canopy cover or disturbance during the stem injection process is not clear.

Flowering was conducted in late February as the cold weather made the leatherwood trees flower much later then previous years. The flowering within all experimental plots appeared not as intense as the previous years although a small number of trees are flowering that had previously not. Consultation with beekeepers with sites in the area have lead me to believe that the cold summer and late flowering was indicative of the area and the reduced flowering within the experimental plots was due to climatic effects.

RESEARCH IN PROGRESS REPORT 2002

Project Title	Economic evaluation of honeybee pollination services

RIRDC Project No.:	CIE-15A
Start Date:	01/08/01
Finish Date:	31/03/02
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Objectives

The economic value of honeybee pollination services will be established.

Current Progress

The project aims to estimate the economic contribution honeybees make to the agricultural sector. Previous estimates put the value of pollination services at between $600 million and $1.2 billion (Gill 1989), and more recently at $1.2 billion (Gibbs and Muirhead 1998). Replicating the approach taken by Gill and expanding the crops included from 27 to 35, but allowing for import substitution, the value of pollination is estimated as $2.4 billion for 2001.

While these large numbers are comparable with some estimates of the value of honeybee pollination in the United States and New Zealand, the approaches taken attribute the total value of production to the pollinator, discounting it only for the dependence of the crop on honeybee pollination. While pollination is an essential element in production, this approach to valuation is similar to attributing the total value of production to the seed, or any other essential input, which is only a fraction of the cost of production. The real value of pollination services is what farmers would pay if the services were not available free from honeybee producers and feral bees.

Farmers have three options if there was to be a decline in the availability of these free services. They could:

- live with the yield and quality decline, which may be the preferred option for crops where honeybees contribute only a small share of pollination;
- purchase pollination services at a price to be determined by the market for pollination services; or
- switch to crops that do not require honeybee pollination. The maximum loss in the longer term under this option is limited to around 25 per cent of the value of production as labour and capital can always be diverted to other uses.

The work in progress aims to provide a more realistic estimate of the value of honeybee pollination services by classifying crops into these three categories. Appropriate modeling techniques will be used to estimate the upper and lower bound on the economic losses that farmers and the community (in terms of higher prices for fruit and other crops) may face in the absence of free honeybee pollination services.

Project Title:	The use of Australian honey in moist wound management
RIRDC Project No.:	DAQ-232A
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Objectives	• Develop a set of guidelines for beekeepers and honey processors • Correlation of antimicrobial activity with components in "active" honey • Investigate the registration of honey as a therapeutic good
Background	This project was undertaken to add value to the existing honey resource by developing products with therapeutic benefit (*i.e.* for the treatment and management of moist wounds such as burns and ulcers). The production of such valuable honeys requires the honey to be collected and processed under prescribed conditions. This involves the identification of the appropriate floral sources, the development of procedures for harvesting and handling, the evaluation of the "active" agent(s), and investigation into the registration of honey as a therapeutic agent.
Research	Research in the project has been focused on the specific antimicrobial potency of *Leptospermum* honey. Initial investigations tested the efficacy of these honeys against one particular bacteria (*Staphylococcus aureus*), while later studies assessed the effect of this honey on a range of food pathogens, animal pathogens (*e.g.* in mastitis) and human medical pathogens (*e.g.* golden *Staph*). Using honeys sourced from around Australia and screened against several reference microorganisms, the anti-microbial potency of one particular Australian honey (from *Leptospermum polygalifolium*) was shown to be comparable to NZ Manuka honey (from *Leptospermum scoparium*). The results of this screening of active honeys against pathogenic bacteria has supported the registration of honey by Capilano Honey Limited as a "Drug" with the Therapeutic Good Administration based on its antimicrobial activity.
Outcomes	The recent registration of Jellybush honey as a "Drug" with the Therapeutic Good Administration has been the project highlight. In 1999, Capilano Honey Limited completed the registration of their product - "Medihoney" - which is pure, sterile *Leptospermum* honey packaged in a 50gm tube and promoted as a "high-potency antibacterial honey" which can be used as "a topical application for the treatment of minor cuts, abrasions and minor wounds". The listing of this product (AUSTL69532) is the first of its kind in the world, and represents an acceptance of the therapeutic benefit of natural products by the TGA. Capilano have recently added a second product to their range – Medihoney Active+ Honey in a 375 gm jar – which is again registered with the TGA (AUSTL77311) and has the claim of being an "oral therapeutic". The routine screening of honeys from apiarists and processors is now complete, and over 5000 honeys have been screened. An area in Northern NSW has repeatedly produced the "active" honey. Beekeepers are now receiving a premium in excess of 10 times the traditional price for these *Leptospermum* honeys if they are identified as florally-"active". A final report and two PhD theses are currently in preparation. Specific geographic region(s) in Australia which produce "active" honey have been identified, the potency of the *Leptospermum*-derived honeys against a range of bacteria has been defined, the particular chemical characteristics of these honeys have been examined, and the honey has been registered as a "Drug"

	with the Therapeutic Good Administration. Work is continuing to better define the specific agents responsible for the antimicrobial activity (which have been elusive to date) and to evaluate the opportunity for therapeutic benefit from honey beyond its antimicrobial activity (*i.e.* its direct wound healing benefit).
Implications	The registration of honey as a "drug" has significant implications for the production of high value products from the Australian honey industry (and for the entire agricultural sector). The community is becoming increasingly aware of the nutraceutical market place.
Publications	-

Project Title:	Glycemic index of honey
RIRDC Project No.:	UNS-17A
Researcher:	Dr. Jayashree Arcot and Prof. Jennie Brand-Miller
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Objectives

1. A clear understanding of the differences between the blood glucose responses of the different floral varieties of honey based on sugar and organic acid contents
2. The identification of various honeys with a low GI factor and to use it as a major marketing strategy by the honey industry to increase consumption of honey

Background

Honey, has played an important part in the human diet as far back as recorded history.

Honey is a viscous, sugary substance produced by bees, exclusively from nectar and other plant exudates. Honey, being termed a carbohydrate food will have different blood glucose responses depending on the composition of sugars in honey and its pH. The composition of sugars in honey varies according to floral source. Honey has always been termed a high sugar food and hence not suitable for people suffering from Diabetes. This study aimed to identify and differentiate those varieties of honey which can actually be classified as having a low glycemic response when consumed.

Research

Six common floral varieties of honey from across Australia namely, Red Gum, Salvation Jane, Ironbark, Yellow Box, Stringybark and Yapunyah and two commercial blends depending on the season were selected.

Sample collection: The honey samples were collected from producers in NSW, South Australia and Western Australia to obtain pur varieties and mixed commercial blends for the study.

Chemical analysis: The composition of honey in terms of sugars and starch was analysed by standard HPLC techniques and organic acid contents using AOAC (1999) method.

GI studies: A minimum 10 healthy subjects were recruited for testing each sample, from the student community within the University of Sydney. Standard procedure (Holt and Brand-Miller, 1994) for testing blood glucose response (on consumption of honey) in humans was used. Based on the available carbohydrate content of the honey, a 25g carbohydrate equivalent portion was given to the subjects to be eaten after an overnight fast. The blood glucose levels were monitored for 2 hours (at intervals of 15 mins in the first hour and then 30 mins in the second hour) after the consumption of honey in relation to a standard reference food (glucose). Honeys with a high GI value contained rapidly digested carbohydrate which produced a large rapid rise and fall in the level of blood glucose. In contrast, honeys with a low GI value contained slowly digested carbohydrate which produced a gradual, relatively low rise in the level of blood glucose.

Outcomes

This research provided information on the blood glucose responses of individual varieties of honey. Some honey varieties with low and moderate GI factors were identified. They were Yellow Box, Stringybark, Red Gum, Iron Bark and Yapunya with Glycemic Index values of 55 or less. Some others such as one commercial blend obtained from South Australia and Salvation Jane were of moderate GI. This study showed that different honeys can have significantly different effects on blood glucose and insulin levels due to differences in their sugar content and physical form, and emphasised the fact that not all types of honey should be classified as one type of food for people with Diabetes. A higher production of these honeys would be encouraged and

	also promote the fact that honey is natural and has a relatively moderate to low GI which would increase the marketability of honey.
Implications	This project identified the floral varieties of honey with a low GI factor. The honey industry would directly benefit by utilising the health benefits as a marketing strategy to produce more, improve domestic consumption as well as boost exports. Although people with diabetes may be the target population, everyone would benefit by the knowledge that honey does not produce high blood sugar levels. Overall the food industry will also benefit by the use of such varieties of honey in their products to add value from a health point of view to promote their products.
Publications	The GI study will be presented at the 26th Annual Nutrition Society of Australia meeting in Wollongong, in December 2002. The study will also be published in relevant Nutrition journals subsequently.

Project Title:	Improving the Movement and Use of Liquid Australian Honey Within Manufacturing Processes

RIRDC Project No.: UQ-84A

Researchers: Bruce D'Arcy, Bhesh Bhandari, Nola Caffin, Peter Halley, Peter Sopade, Brenda Mossel, Margaret D'Arcy, Lihu Yao, Christine Doebler

Organisation: School of Land and Food Sciences, The University of Queensland, BRISBANE, QUEENSLAND 4072

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Objectives

To increase the inclusion of honey in manufacturing processes, particularly commercial baking operations, by developing an understanding of the physical properties and flow characteristics of honey, and by developing key technology for the movement of liquid Australian honey in a number of commercial processes by 2001.

Background

Selected but most common floral types of Australian honey were studied for their rheology, pumping, glass transition, sorption and crystallisation behaviour. These properties have implications for the handling, transport, processing and storage of honey.

Research

Samples of a number of floral types of honey were analysed for their rheological behaviour using steady and oscillatory techniques. The viscosity of honey was analysed for a wider range of temperatures (–15 °C to 60 °C) than ever before. The majority of the floral types of honey displayed Newtonian behaviour. The effect of sugar composition on viscosity was also studied, and it was found that the viscosity of honey can be predicted reasonably on the basis of their individual sugar concentration. Various models such as Arrhenius and WLF were tested to predict honey viscosity as influenced by temperature. The glass transition temperature (T_g) of 10 floral types of honey with or without dilution were analysed and fitted to various models to describe the effect of moisture content on the T_g. The T_g of undiluted honey samples ranged from -38.4 °C to -45.9 °C. For the given experimental conditions, it was found that the water present in honey at a level of as high as 29% is not frozen at subzero conditions. Samples of four commercial honey types that were studied behaved as Newtonian liquids during pumping, which agreed with the rheometric information. The Rabinowitsch-Mooney equation was suitable for analysing the pumping characteristics of the honey. Based on this pumping work, a spreadsheet has been developed for calculating the pumping requirements for honey in a simple piping system. Further, two representative honeys were investigated for their sorption behaviour, and it was demonstrated that honeys behave similarly to sugar solutions. In another study, for two representative honeys it was found that the heating of honey delays crystallisation, whereas seeding induces crystallisation. In addition, this work investigated the feasibility of spectrophotometric and thermal (DSC) analyses for determining the degree of crystallisation of glucose monohydrate in honey.

Outcomes

Rheology of honeys was characterised with respect to temperature, composition and floral types. This information is useful for the transport of honey and for honey use in medical dressings. The pumping property of honeys is described in terms of an equation and a spreadsheet, which can be used by honey handlers for calculating their honey pumping requirements. The glass transition property studied can be useful in formulation, processing and storage of honey. The sorption property defined the minimum temperature and humidity conditions that should be maintained in the honey handling environment. This study also introduced two novel methods for studying the relative degree of crystallisation

	of glucose in a candied and creamed honeys.
Implications	The results obtained have direct implications for honey handlers. The viscosity and pumping studies provide a means to evaluate the movement property of honey, whether in a pipe or in a medical dressing. The sorption and crystallisation studies provide data that are useful for industries involved in processing or packing honey, or using honey as an ingredient in food formulations.
Publications	Five journal publications (3 published, 3 in press/submitted); Conference papers.

RESEARCH IN PROGRESS REPORT 2002

Project Title	Honeybee industry survey

RIRDC Project No.:	ABA-15A
Start Date:	01/03/02
Finish Date:	31/08/02
Researcher:	Mr. Peter Martin
Organisation:	Australian Bureau of Agricultural and Resource Economics (ABARE) Survey Data Analysis Section GPO Box 1563, CANBERRA ACT 2601
Phone:	(02) 6272 2363
Fax:	(02) 6272 2318
Email:	pmartin@abare.gov.au

Objectives

To generate a consistent set of estimates for the production and financial characteristics of honeybee producers in Australia.

Current Progress

The objective of this project is to generate a consistent set of estimates for the production and financial performance characteristics of honeybee producers in Australia. To achieve this objective, ABARE will survey 150 honeybee producers across Australia in May-June 2002. Results from the survey are to be reported in August 2002.

Sample selection

The original intention was to draw a sample from the Business Register maintained by the Australian Bureau of Statistics. However, on receipt of the ABS frame it was apparent that the majority of establishments listed as honey producers were not specialist producers. The population derived from this frame would not have adequately represented the honeybee industry.

Hence ABARE approached all state and territory registration authorities requesting that their lists be made available for the purpose of the survey. Apart from Victoria all other states agreed to provide population lists. The Northern Territory was subsequently excluded from the survey as there are only 4 producers there. The registration lists will now form the frame, and the sample has been designed and selected in a manner very similar to the way other ABARE farm surveys are designed, with the number of hives being the size variable.

Privacy legislation in Victoria prevents the release of registration listings. For Victoria ABARE will design and select from a list with alpha-numeric identifier and number of hives only, the selections to be sent the Victorian Department of Natural Resources and Environment, who will then send letters to those selected, with covering letters from ABARE and the Australian Honey Bee Industry Council. Those who agree to take part will then have their contact details passed to ABARE, and will subsequently interviewed.

Survey progress

Sample selections have now been made in all states and contact letters have been forwarded to selected honeybee producers. Interviews with producers will commence on May 29 2002.

Sample have been selected that will enable reliable estimates for honeybee producers who produce 90 per cent of Australian honey production.

RESEARCH IN PROGRESS REPORT 2002

Project Title	Commercial beekeeping in Australia
RIRDC Project No.:	FSB-1A
Start Date:	01/07/01
Finish Date:	31/12/02
Researcher:	Mr. Frederick Benecke
Organisation:	Frederick S Benecke 27 The Chase Road TURRAMURRA NSW 2074
Phone:	(02) 9487 2828
Fax:	--
Email:	fbenecke@ozemail.com.au
Objectives	To produce a document on Commercial Beekeeping in Australia based on the information contained in six documents published by the Honeybee Research Council, and later the Honeybee Research and Development Council, from 1990 to 1996. The document will be a new publication and will incorporate additional information garnered from industry sources throughout Australia.
Current Progress	The draft document is completed except for additional information to be obtained at the RIRDC meeting in Canberra at the end of April; the NSW Apiarists' Association meeting at the end of May; and, a meeting in Darwin at the beginning of July. Sections of the document are currently being reviewed by appropriate specialists.

New Projects –2002/2003

The following projects have been approved by RIRDC for commencement in the 2002/2003 year:

Drone honey bees - semen production (HBE02-01)	*Mr John Rhodes* *☎(02) 6763 1206*
Evaluating alternative antibiotics for control of European Foulbrood disease (HBE02-05)	*Mr Russell Goodman* *☎(03) 9210 9222*
Transmission of American Foulbrood (AFB) disease of honeybees through replacement of queen bees (HBE02-06)	*Ms Patricia Greer* *☎(07) 3362 9684*
The effect of high and low fat pollens on honey bee longevity (HBE02-09)	*Mr Rob Manning* *☎(08) 9368 3567*
The effect of logging on nectar production in NSW forests (HBE02-11)	*Dr Brad Law* *☎(02) 9872 0162*
High power ultrasound for candied liquid honey liquefaction and controlled creamed honey crystallisation (HBE02-18)	*Dr Bruce D'Arcy* *☎(07) 5460 1384*

RURAL INDUSTRIES RESEARCH & DEVELOPMENT CORPORATION

RIRDC HBRDC

HONEYBEE Publication Catalogue

Diseases and Pests

Nosema Disease in Honeybees – Genetic Variation and Control
By R. Rice
Examines the base composition of structural DNA sequences specific to the adult honeybee parasite *Nosema apis*. *N. apis*, the causative agent of nosema disease in honeybees.
2001, 45pp, Pub. No. 1/46. $10

Honey Bee Disease Barrier Management Systems – Case Studies
by R Goodman
Considers best practice of honey bee disease barrier management systems for the prevention and control of American Foulbrood disease. It presents information from case studies of selected apiarists who successfully practice these strategies as part of their disease management programs.
2001, 28pp, Pub No 01/052; $10

Hot Wax Dipping of Beehive Components for Preservation and Sterilisation
by R Goodman
Considers best practice hot wax dipping of beehive components for preservation from effects of weather, fungi and other causes of decay; and for sterilisation from hives infected with the honeybee brood disease, American foulbrood. A handy manual for apiarists. *2001, 30pp, Pub No 01/051; $10*

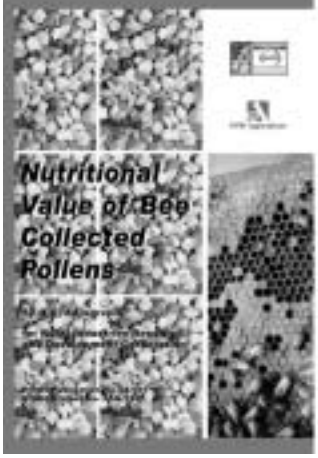
Treating American Foulbrood
by KH McIlvide
Outlines the findings and recommendations from a honeybee workshop in July 1998 for the development of suitable management programs to control and reduce the level of American Foulbrood Disease (AFB).
1998, 18pp Pub No 98/144; $10

European Foulbrood
by Dr M Hornitzky & Dr S Djordjevic
This research was designed to determine current sensitivity of the EFB causative organism *Melissococcus pluton* to OTC. *1999, 30pp, Pub No 99/020; $10*

Literature review of chalkbrood – a fungal disease of honeybees
by M. Hornitzky
Chalkbrood of honeybees was first diagnosed in Australia in 1993. It now endemic in most areas of Australia and can cause substantial production losses. This report reviews the literature on chalkbrood and identifies areas that could be investigated to expedite the development of control strategies to minimise the economic losses caused by chalkbrood.
2001, 25pp. Pub. No. 01/150; $10

Controlling American Foulbrood – Assessing Effectiveness of Shaking Bees and Antibiotic Therapy Strategies
by M Hornitzky & B White
American foulbrood is a major bacterial disease of honeybees in Australia. This report determines, under field conditions, the effectiveness of shaking bees onto disease free hive material with and without treatment with OTC as an alternative control strategy. It demonstrates that shaking bees and antibiotic treatment is not an effective alternative AFB control strategy. *2001, 30pp. Pub No. 01/048; $10*

Breeding hygienic disease resistant bees
By K Wilkes et al
Presents an accurate determination of the number, location within the genome and relative level of influence of loci that directly influence hygienic behaviour in *Apis mellifera*. This not only provides a deeper genetic understanding of complex social behavioural traits in honeybees, but may also enable the development of molecular methods of identification of hygienic stock, thus having direct commercial application for the Australian honey industry.
2002, 35 pp. Pub. No. 02/048 $10



Nutrition

Nutritional Value of Bee Collected Pollen
by D. Somerville
Discusses the pollen qualities of 60 floral species. The findings are presented in a format to ensure beekeepers benefit from, and increase their understanding of honey bee nutrition.
2001, pp, Pub No 01/047; $10

Strategic Planning and Action Meeting – for Honeybee Nutrition
by G Kleinschmidt
Findings of a workshop commissioned to explore ways and means to both upgrade current nutrition techniques and to expedite their transfer to a wider cross section of industry in advance of expected increased external pressures.
1998, 22pp; Pub no 98/128; $10

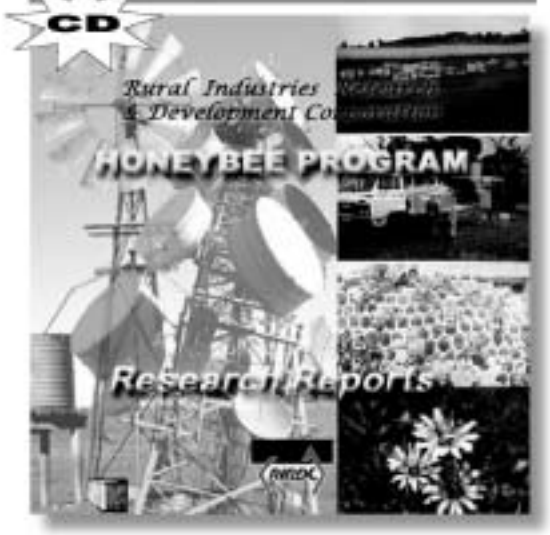
Pollen Analysis of Eucalypts from Western Australia
by R Manning
Studies the nutritive value of six Western Australian pollens and highlights the necessary adoption of supplementary feeding of honey bees using artificial feedstuffs or quality pollens. This will maximise the performance of honey bees and improve beekeeper incomes. *2001, 72pp, Pub No 01/053; $10*

Corporate

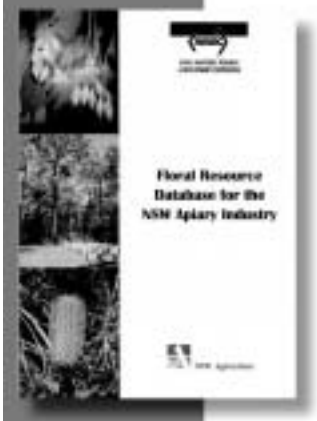
Honeybee Research in Progress - June 2001. *free*
Honeybee Research in Progress - June 2000. *free*
Honeybee Research Report 1999. *free*
Honeybee Research in Progress - 1998. *free*
Honeybee Research in Progress - 1995-1997. *free*
R&D Plan for the Honeybee Program 1998-2001. *free*

Honeybee Research Reports on CD

This CD contains a comprehensive set of all research projects undertaken in Australia since 1980. It has been developed using the latest electronic software which make it very user friendly.
2001, CD No. CD1/001, $20



Resources



Floral Resource Database for the NSW Apiary Industry
by D Somerville
Provides a clear database of the significant floral resources for the NSW apiary industry, including floral species, honey and pollen values, land tenure, location of sites, frequency of flowering and flowering period. Also provides information on hive numbers, nucleus colonies, yield per hive, total number of bee sites on various land tenures, persons employed and gross income distribution. *1999, 154pp, Pub No 99/174, $15*

Beekeepers' Use of Honey and Pollen Flora Resources in Victoria
by R Goodman
Nectar and pollen flora is a major resource required by the honeybee industry. This publication provides detailed information on apiary sites, their use and significance, honey production, pollination and important nectar and pollen flora targeted by apiarists. The data will be useful to relevant government departments and industry when considering a range of issues relating to the industry's future access to apiary sites.
2001, 117pp, Pub No 01/050, $15

Impact of Commercial Honeybees on Flora and Fauna
by D Paton
Addresses the issue of whether or not to allow commercial beekeepers access to major reserves and whether such access permanently damages the natural environment. Specifically looks at Ngarkat Conservation Park in SA.
1999, 33pp, Pub No 99/015, $10

Natural Resource Database for the Queensland Apiary Industry
by J Rhodes & F Trueman
Details the development of a beekeeping resource database for the Queensland industry and includes data on the productivity and economic value of apiary sites, the most valuable and reliable honey flora, and areas of potential commercial production. Invaluable reference for beekeepers. *1999, 68pp, Pub No 99/43, $10*

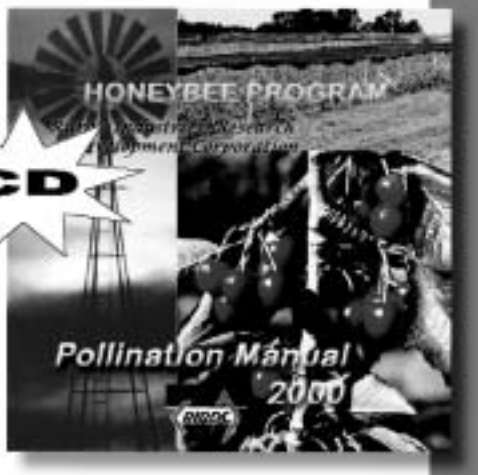
Beekeeping and Secure Access to Public Land
by R Gill
Considers the access of beekeepers to forested areas under government control. Provides environmental and economic information on the debate and recommends a procedure for resource security arrangements.
1997, 56pp, Pub no 97/026 $10

Pollination

The Use of Honeybees as a Transfer Vector for Core Rot in Apples
By C Archer
A common difficulty with biological control programs is the method by which a bio-control agent is delivered to the appropriate site on a plant. When using inundative sprayers there is a significant quantity of material that misses the blossom – the site of core rot infection - and is effectively wasted. This project has demonstrated that honeybees are able to transfer biocontrol material to blossom more effectively than spray application. Beehives are normally placed in apple orchards during the full bloom period for the purposes of pollination, providing an opportunity to use honeybees as a transfer vector for biological control material to the apple blossom.
2002, 54 pp, Pub. No. 02/046, $10

Pollination Manual 2000
by Agriculture Victoria
Comprehensive CD manual on honeybee pollination, to assist both growers and beekeepers.
It contains:
- Pollination guides
- Draft Codes of Practice
- Pollination undercover
- Planning an orchard for effective pollination
- Honeybee colonies, beehives & pollination
- Business & marketing strategies
- Contact list of apiarists association & advisors
- Honeybee foraging and successful pollination

2000, Pub No C00/001, $20

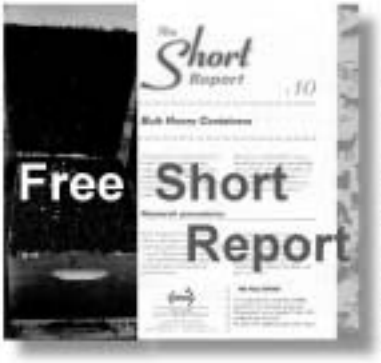


Off-Farm Issues

Techniques for the detection of adulterated honey
By W Korth et al
New analytical techniques for the detection of adulterated honey based on isotope ratioing mass spectrometry needed to be developed for the detection of corn or cane sugar adulteration of honey. This report summarises the work undertaken by the National Residue Survey (NRS) to establish whether or not the isotope ratioing technique could be used to detect the adulteration of pure Australian honeys with synthetic honey (based on C_4 plant sugars) and if so, at what level.
2002, 16 pp, Pub. No. 02/047, $10

A Quality Survey of Australian Honeys
by WH Ward & KF Trueman
Presents information on the quality of Australian honeys in terms of microbiological and chemical residue contamination, and recommends some standard test procedures to ensure the suitability of honey as a food product for human consumption.
2001, 44pp, Pub No 01/049, $10

Australian Liquid Honey in Commercial Bakery Products
by B D'Arcy et al
Examines the effect of Australian liquid honey on the functional properties of bread doughs and cake batters, including dough development and gelatinazation of batters and doughs, in addition to the effect of honey on the staling of bread.
1999, 145pp, Pub No 99/145, $15



Bulk Honey Containers
by G Kleinschmidt
A short report on research which identifies production and transport procedures that might vary honey metal levels and adversely affect quality assurance certification and product image. Examines the metal related quality implications of current and alternative containers as well as apiary procedures.
1997, 12pp
Short Report no. 10, free

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

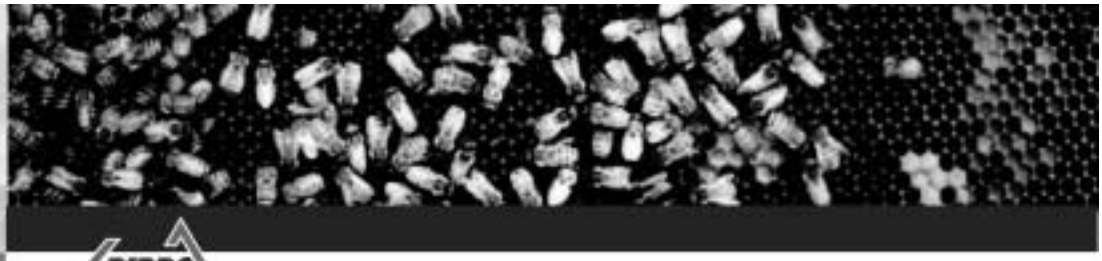
by NSW Agriculture, $30 (includes postage), phone (02) 6391 3433 or 1800 028 374 to order

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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Suggestions for future catalogues

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