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

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 RIRDCs diverse range of almost 400 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 at www.rirdc.gov.au/pub/cat/contents.html. 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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Project Title	Development of a specific aggregation lure for *Apis cerana javana*
RIRDC Project No:	CSE-81A
Researcher:	Dr Michael Lacey
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Objective	To develop a long-range attractant for the Asian hive bee *A. cerana javana* from synthetic compounds corresponding to its queen pherome and to incorporate the resulting multicomponent blend into slow release lures for protective monitoring of this exotic pest.
Background	Recent incursions of the Asian hive bee into Darwin and Brisbane heighten the possibility that this pest could establish itself on the Australian mainland. If it were successful, it would seriously damage the honeybee industry by competing aggressively with the European honeybee *A. mellifera* and by introducing parasitic mites. It would also disrupt pollination, worth over one billion dollars per annum to the economy, and threaten the survival of native bee populations. The development of a species-specific bait would greatly facilitate protective monitoring measures to counter this serious threat to Australia.
Research	A five-component synthetic blend of chemicals based on the queen pheromone of the Asian hive bee strongly attracted its worker bees in laboratory bioassays and field trials in Papua New Guinea, Indonesia and the Torres Strait. The worker bees of the Asian hive bee were not attracted to the synthetic queen pheromone blend for the European honeybee, illustrating that the synthetic lures are species-specific. The synthetic pheromone blend for the Asian hive bee has been incorporated into a slow release dispenser that was found to prevent deterioration of the various components and to prolong their evaporation.
Outcomes	The outcomes will be an increase in the effectiveness of protective monitoring measures and the safeguard of the Australian honeybee industry against this serious competitor.
Implications	The multi-component synthetic pheromone blend within controlled release dispensers is a potent attractant for scout bees of the Asian hive bee and can be incorporated into appropriate artificial nest cavities to lure feral swarms of the pest. It is likely that the Methodology can be adapted for protective monitoring of other *Apis* species, such as the giant honeybee *A. dorsata*, that threaten Australia's rural industries.
Publications	None to date

RESEARCH IN PROGRESS REPORT 2000

Project Title	Improving queen bee production

RIRDC Project No:	CSE-85A
Start Date:	1/07/99
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:

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

Current Progress

Effects of nutrient supplements on queen cell-building colonies

Seven different nutrient supplements were each fed to five queen cell-building colonies of equal strength to test their effects on queen quality. These supplements were those recommended by queen producers and participants of the 'Honeybee Nutrition Workshop' held in Sydney in May 1998. Four days after the colonies consumed the supplements, 10 genetically related 1-day-old worker larvae were grafted into 10 queen cell cups in each. The resulting queen cells were later moved into standardised 3-frame full-depth mating nuclei located in the same apiary. Following emergence, the virgin queens were open-mated and, three weeks later, captured, caged, and removed to the laboratory for testing. This testing is currently in progress.

Disappearing Disorder

Outbreaks of DD were reported from two locations in Southeastern Queensland in late October 1999. Samples of affected larvae, and pollen and nectar samples, were collected from each site for laboratory analysis. At one site, extracts obtained from larvae with DD were injected through bacterial filters into healthy white-eyed bee pupae to test for replication of viral pathogens.

Both outbreaks were mild; less than 2% of larvae at both sites showed clinical signs of DD and the average brood-spottiness in affected colonies at both sites was less than 24%. Levels of trace elements in honey and pollen samples from DD-affected colonies were no different from levels detected in honey and pollen removed from a colony without DD near Canberra. Levels of trace elements in DD-affected larvae were no greater than recorded previously in larvae tested from areas outside those with DD. There was no evidence that larvae with DD died from acute viral infections.

RESEARCH IN PROGRESS REPORT 2000

Project Title	**Introduction and early performance of queen bees - some factors affecting success**
RIRDC Project No:	DAN-182A
Start Date:	1/09/99
Finish Date:	31/07/00
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Objectives

- To determine whether the age of the queen bee at introduction influences introduction success.
- 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.
- To examine the effects of temperature and humidity during transport of queen bees on their introduction success.

Current Progress

Laboratory and field data collections were complete in March, 2000. The Final Report on the project has been completed to first draft stage.

Queen bee survival rates at 14 days and 15 weeks after introduction were obtained for sister queen bees caught from mating nuclei at 7, 14, 21, 28 and 35 days of age.

Ovariole numbers, sperm counts, Nosema disease status, as well as the number and amounts of mandibular gland pheromones present have been obtained for a separate group of sister queens examined at 7, 14, 21, 28 and 35 days of age. Temperatures, humidities, the number of hours in transit and the number of dead bees in each cage on arrival at their destination were obtained for 10 consignments of queen bees, following transport between the queen bee breeder and the honey producer's apiary.

RESEARCH IN PROGRESS REPORT 2000

Project Title	Can the technique of 'shaking bees' and antibiotic therapy be used as a means of controlling American Foulbrood?

RIRDC Project No:	DAN-176A
Start Date:	1/12/98
Finish Date:	31/1/01
Researcher:	Mr. Michael Hornitzky
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Objective

To determine whether the technique of shaking bees from hives with American foulbrood (AFB) onto foundation or irradiated hive equipment followed by treatment with oxytetracycline hydrochloride is an effective alternative to current control strategies.

Current Progress

Currently there are five cooperating beekeepers with 101 hives involved in this project.

The number of treatment procedures has been reduced to three. These are:

1. "Shaking" bees onto foundation
2. "Shaking" bees onto irradiated material with one treatment of oxytetracycline hydrochloride (OTC) and
3. "Shaking" bees onto foundation with one treatment of OTC.

The other three treatment procedures were eliminated, as they were considered impractical or unlikely to be successful from a commercial beekeeping stand point.

Five hives from two cooperating beekeepers with 35 hives have become re-infected with American Foulbrood. There are three beekeepers with 66 hives where all treatments have been successful. The major losses of hives in these trials are from dead outs and absconding or loss of queen bees. Further hive examinations need to be carried out next spring, to confirm the success of these treatments.

The project is expected to be completed on schedule.

RESEARCH IN PROGRESS REPORT 2000

Project Title	European Foulbrood - investigating control measures

RIRDC Project No:	DAV-157A
Start Date:	7/12/98
Finish Date:	30/06/02
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 the 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

Preliminary OTC dosage rates trial

Forty-one hives infected with European foulbrood (EFB) were treated with various doses of OTC to determine their efficacy. Pre-and post treatment counts of diseased larvae were conducted 12, 22 and 41 days after treatment.

OTC doses and minimum inhibitory concentration of OTC for M. pluton

Field trials were conducted to determine if various doses of OTC applied to honeybee colonies of different sizes would provide honeybee larvae with sufficient medication to meet the minimum inhibitory concentration of OTC for *M. pluton*. Investigations were also conducted to the concentration of OTC in whole honeybee larvae and the mid-guts of larvae.

Degradation of OTC in honey

Studies on the degradation of OTC in honey continued throughout the year. Samples were taken on a monthly basis from honey extracted from hives treated with 1g active OTC and stored at ambient temperature. Samples were also obtained from six different floral honeys spiked with OTC and held at 22ºC and 35ºC.

Epidemiology of M. pluton

Ben McKee, research team member and PhD student, visited the Elizabeth Macarthur Agricultural Institute, NSW, to obtain skills in Polymerase Chain Reaction (PCR) techniques. The techniques were further developed, tested and shown to be specific for *Melissoccus pluton* the causal organism of EFB.

Effect of nutrition on EFB

A total of 110 hives were purchased and requeened in preparation for a major trial to commence in Autumn. A supplementary high protein cake was developed for feeding to hives belonging to one of the treatment groups of this trial.

RESEARCH IN PROGRESS REPORT 2000

Project Title	Guidelines for honeybee disease barrier systems and wax dipping sterilisation

RIRDC Project No:	DAV-167A
Start Date:	1/07/99
Finish Date:	10/06/00
Researcher:	Mr. Russell Goodman
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Objective

To assist the apiary industry reduce and control the spread of the notifiable honeybee brood disease, American Foulbrood (AFB), and other diseases, by developing an extension manual of 'best practice' hive barrier management systems and hot wax dipping sterilisation techniques for use by Australian apiarists.

Current Progress

A literature search using the electronic webspirs (Internet) data bases, Agricola and CAB abstracts, was conducted to identify current trends in apiary disease barrier management and hot wax dipping sterilisation techniques used in other countries.

Evaluation of current Australian industry practices has commenced. The principal investigator, Mr Russell Goodman, visited selected apiarists to document and photograph various methods of hot wax dipping of beehive components. Best practice and operator safety concerns were identified as important issues for inclusion in a draft manual that was nearing completion at the time of writing.

Information on bee disease, barrier management systems, was sourced, with permission, from two South Australian apiarists, firstly by way of a comprehensive video and secondly from a printed presentation produced for the Victorian Apiarists' Association Inc. 1999 annual conference. Compilation of an illustrated draft manual on barrier management has commenced.

Project Title	**Crude protein, amino acid and fat levels of pollens collected by honeybees primarily in southern NSW.**

RIRDC Project No:	DAN 134A
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Objective

To trap and analyse pollens from a range of floral species to determine their nutritional values for amino acids, crude protein and fat levels, as this relates to honeybee dietary requirements. In the process of the study, investigate the possible variation of qualities of pollen originating from the same species with a major focus on Paterson's curse *(Echium plantagineum)* pollen.

Background

Honeybees require a range of elements to satisfy their nutritional requirements including proteins, carbohydrates, minerals, fats (lipids), vitamins and water for normal growth and development. Pollen normally satisfies the dietary requirements for proteins, minerals, lipids and vitamins. The proteins are composed of a series of amino acids, 10 of which have been identified as being essential for honeybee nutritional requirements.

Ample protein promotes a high birth rate and long-lived bees, whereas protein deficient conditions minimise the birth levels and length of life of adult bees.

The quality of pollen is paramount to the success of a beekeeper. This research set out to determine the more valuable pollen sources to honeybees with a particular interest in southern NSW.

Research

Many hundreds of pollen samples were gathered during the course of the research but, for a range of reasons, only 194 samples were analysed. Samples were tested for nitrogen (crude protein), 17 amino acids and fat percent.

This information was then used to report on the suitability of 61 species of plants, as to the quality of the pollen produced, as it relates to honeybee nutritional requirements.

Outcomes

It is apparent from this research that pollen qualities vary within the one species. Each species may fall within one or two groupings, ie, a pollen, when judged by its quality, may be either poor, average, above average, or of excellent quality.

What beekeepers have traditionally observed is that bees may do well on one source of pollen but not on another, also the same source of pollen may not produce the same results increasing populations and brood area each time it becomes available. What is possibly happening is a lack of knowledge on the adult body, crude protein levels, before going onto a new pollen source. Bees with high body, crude protein levels, will remain in reasonable condition and recover quickly if placed on an average pollen source. Whereas bees with very low body crude protein levels, (eg, coming off sunflowers) will run down very quickly if placed on a medium to heavy honey flow with average quality pollen support. Recovery of a colony after these circumstances could be as much as four months, to obtain a populous hive ready to work another honey flow.

	Armed with the knowledge that different pollen species contain different levels of nutrients, it should be possible for beekeepers to better manage their bees, paying more attention to the ongoing nutrition status of the colony.
Implications	Improved productivity, longer lived queens and workers, drones with high fertility and lower potential disease risks are all possible implications from beekeepers incorporating the knowledge of this research into their management strategies.
Publications	Somerville, DC (2000). "Crude protein, amino acid and fat levels of pollens collected by honeybees primarily in southern NSW". Final Report: DAN-134A for the Rural Industries Research & Development Corporation. NSW Agriculture, Goulburn, NSW. Somerville, DC; Peasley, W (1996). "Eucalyptus pollens and their value to honeybee nutrition". Proceedings: 3rd Asian Apicultural Association Conference, Hanoi, Vietnam (In Press). 6–10th October 1996. Somerville, DC (1997). "Value of pollens collected from agricultural crops". Proceedings: Crop Pollination Association Inc., 5th Annual Conference, Tatura, and Victoria. 14–15 October 1999.

RESEARCH IN PROGRESS REPORT 2000

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

RIRDC Project No:	DAN-186A
Start Date:	1/01/00
Finish Date:	31/10/02
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Objective

To produce an extension publication on honeybee 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

Interviews with a few commercial beekeepers on their management strategies using protein and carbohydrate supplements have taken place. These include Warren Taylor (Australian Queen Bee Exporters) who is Australia's largest exporter of package bees based in the central tablelands of NSW; Kevin and Glen Emmins, Mildura, Victoria; Leigh Duffield, South Australia; Geoff Smith, South Australia; John Fuss, South Australia; Graham Wagenfeller, South Australia; Ian and Shirley Stephens, Tasmania; and part interview with Stan Hughston, Wanaaring, NSW

RESEARCH IN PROGRESS REPORT 2000

Project Title	**Export package bees - evaluating a lupin flour based feed for increased live bee production**
RIRDC Project No:	DAW-75A
Start Date:	1/01/97
Finish Date:	30/04/01
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Objectives

- Develop a lupin flour feed that is more palatable than expeller soyflour and/or Torula yeast.
- To enhance live bee production by developing a lupin based feed that is cost effective in comparison to other high protein feeds.

Current Progress

This project has been on 'hold' for a couple of years as the research apiary was destroyed under instructions from Agriculture WA veterinary officers following the finding of the exotic disease Chalkbrood.

Currently the re-establishment of the apiary has been refunded and two thirds of the number of hives required for the experiment have been purchased from Agriculture WA funds. The rest are to be delivered soon.

Procuring lupin flower has been difficult since the previous supplier no longer supplies lupin flour.

When a few more technical issues have been solved, the experimental plan will be resubmitted to RIRDC for approval before the project recommences.

RESEARCH IN PROGRESS REPORT 2000

Project Title	**Pollen analysis of Eucalyptus patens (Blackbutt), E. accedens (Powderbark) and E. wandoo (Winter Wandoo variety) in Western Australia**

RIRDC Project No:	DAW-91A
Start Date:	1/07/98
Finish Date:	15/07/00
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Objective

Provide 'first-time' analysis of amino acids of two important melliferous eucalyptus species to the beekeeping industry which are major contributors to the profitability of Western Australian honey and pollen producers.

Current Progress

The project ran into problems regarding the collection of sufficient samples of pollen from Powderbark and Blackbutt (due to environmental effects). Both these species flower well every second year, but in this last season both failed to flower well.

Approval was given to include pollen analyses from *Jarrah (Eucalyptus marginata)* and Karri *(E. diversicolor)* which were flowering at the time. The analyses have all been completed and are waiting on the delivery of Amino acid results for these species.

Pollen protein deficiencies have been found for Jarrah and the three flowering ecotypes of Wandoo. Redgum *(Corymbia calophylla)* and blackbutt *(E. patens)* have no protein deficiencies. Fatty acid and mineral analyses have proved to be interesting and may provide another insight into the ecology of bee diseases and nutritional requirement of European honeybees under Australian conditions.

The report is in the process of being compiled and should be completed on time.

RESEARCH IN PROGRESS REPORT 2000

Project Title	Breeding hygienic disease resistant bees

RIRDC Project No:	US-39A
Start Date:	1/07/96
Finish Date:	30/11/00
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Objectives

- To develop DNA markers for hygienic behaviour genes so that hygienic breeding stock may be rapidly and cheaply identified.
- To train a PhD student in honeybee molecular biology and to establich facilities and protocols that will allow genetic markers developed in other laboratories (eg for honey production) to be utilised by the Australian honeybee industry.
- To develop protocols for molecular analysis of other economic traits.

Current Progress

We have developed a first class molecular genetics lab at Sydney University with significant expertise and experience in analysing samples of bee DNA. Keryn Wilkes (a Ph.D. student in the lab) has made excellent progress identifying DNA markers for hygienic behaviour (uncapping and removal of dead pupae by workers).

The collection of molecular data is complete and a comprehensive genetic map has been produced. Combined analysis of the behavioural and genetic data has identified five putative genetic markers for removal behaviour and six putative genetic markers for uncapping behaviour. Exhaustive analysis is continuing in order to more precisely identify markers and their relative level of influence over the uncapping and removal traits.

A field study on 32 colonies derived from various lines was carried out in conjunction with Mr. Linton Briggs between December 15-17, 1999. Samples of both drone and worker brood were taken from each of these colonies for testing of the candidate markers identified by our study. DNA is currently being extracted from these samples, along with others identified as either highly hygienic or non-hygienic in an earlier backcross experiment. The diagnostic power of the identified putative genetic markers will then be tested on these samples.

Project Title	Floral resource database for the NSW apiary industry
RIRDC Project No: Researcher:	DAN 155A Doug Somerville
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Objective	To create a database of floral resource information for the NSW apiary industry.
Background	Floral resources are the basis of the Australian beekeeping industry but there is increasing pressure on the beekeeping industry from: • reduced physical resources due to forestry, land clearing, urban expansion, firewood cutting and biological control of weed species; • reduced health of vegetation due to lack of regular flooding of western rivers, dieback, salt inundation, drought and fire; • Policy adverse to the farming of honeybees on National Park estate, Water Board and State recreation areas. A Honeybee Research and Development Council national workshop, held in Canberra in 1989 advocated documentation of the floral resources on which the beekeeping industry is dependent in each state.
Research	Beekeepers with 200 or more hives registered with NSW Agriculture were surveyed for the purpose of collecting information on floral species of major importance to the beekeeping industry, including data on honey and pollen values, land tenure, location of sites, frequency of flowering and flowering period. Information was also collected on number of hives, nucleus colonies, yield per hive, total number of bee sites on various land tenures, persons employed and gross income distribution. Three mailings were conducted, these were also supported by interviews of some non-respondents. A total response of 81% was achieved. The total number of hives for all beekeepers surveyed was approximately 200,000 hives. Average honey yields per hive per year was 89.4 kg. There were 23,479 bee sites: 5,365 State Forests; 412 National Parks & Wildlife Service; 749 Crown Lands; 2,972 Rural Lands Protection Board and 13,981 for private properties.
Outcomes	The results obtained give a clear picture of the significant floral resources of NSW as they relate to the beekeeping industry. This information will be used to illustrate the floral species of major importance on each land tenure and the characteristics of those floral resources as far as beekeeping activities are concerned.
Implications	The report will be readily used by new and existing beekeepers to assist them in their decision-making processes and help minimise poor decision making and costly management strategies. The information collected can also be utilised by various land managers and land use planners to take beekeeping requirements into consideration. The information will also be of considerable benefit to those in the scientific community studying nectarivores and/or the general flowering characteristics of a range of floral species in the NSW landscape.
Publications	Floral resource database for the NSW apiary industry by Doug Somerville, RIRDC Publication No. 99/174

Project Title	**A comprehensive study of beekeepers' use of honey and pollen flora resources in Victoria**

RIRDC Project No:	DAV 109A
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Objectives

- To identify apiary sites on public land in Victoria
- To list nectar and pollen resources at each site and link these to the production of honey and other apiary products
- To identify those sites which are currently under-utilised by apiarists and identify areas which may have a potential for beekeeping.

Background

The viability of the apiary industry depends on apiarists' continued access to nectar and pollen yielding flora. Apiarists may move their hives up to seven times per year to take advantage of flowering plants. While not owning the sites and not using them all each year, commercial apiarists hold a high number of sites as insurance against the spasmodic flowering of many Eucalypt species.

The apiary industry is heavily dependant on public land because it contains the majority of remaining native forest on which the industry is so reliant. In Victoria, beekeeping is permitted in designated public land apiary sites located in State forests, parks and reserves including selected National Parks, and other public land provided the appropriate licence or permit fee is paid.

In 1989, the Honeybee Research and Development Committee convened a national workshop to discuss the effects of honeybees on the Australian environment and the industry's continued access to the nectar and pollen resource. One major recommendation of the workshop was that each State should conduct a survey to determine industry's use and value of apiary sites.

Research

Survey questionnaires seeking information on public land and private apiary site usage were designed, trialed in cooperation with the Victorian Apiarists' Association Inc. and then amended before a full mail-out to all Victorian apiarists owning 50 or more beehives registered with the Department of Natural Resources and Environment.

A total of 170 (40.5%) of 420 apiarists mailed survey forms responded to the survey. Of the respondents, 155 apiarists (91%) provided useful data. The remainder having retired from the industry or only recently commenced beekeeping and so therefore, unable to provide useful information.

Information supplied by respondents was entered in a Microsoft Access computer database specially designed for the purpose. Apiarists supplied information about important honey and pollen flora, apiary site location, frequency of site use, crop pollination, production of honey, pollen and queen honeybees.

Outcomes	The results of the survey: • provide comprehensive information on species of nectar and pollen producing flora targeted by apiarists throughout Victoria. • include a ranking as supplied by individual respondents for each species targeted and growing within an area corresponding to a specific Victorian Mapsheet number (grid). • provide detailed information on apiary sites, their use and significance, pollination plus production of honey, pollen package bees and queen bees. Respondents were unable to identify areas of the State for possible expansion of the apiary industry in Victoria.
Implications	This report will ensure that the Victorian apiary industry will have access to detailed information that demonstrates the value and importance of native nectar and pollen flora for the economic survival of apiary enterprises. The completed survey provides, for the first time, detailed information that the industry may use in submissions to agencies involved in determining the future availability of particular apiary sites. The information contained in the report will also be useful to public land managers and government agencies when determining the use of public land for apiculture.
Publications	Final Report for Project DAV-109A: "A study of beekeepers' use of honey and pollen resources in Victoria."

RESEARCH IN PROGRESS REPORT 2000

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

The 100-hectare research site, established in 1999, was pre-commercial thinned in January 2000, using a stem injecting process. Early results indicate that the stem injecting process was successful.

Analysis of the 10 research plots constructed last year, have found no flowering of the leatherwood.

The second research site was established in an area where Eucalypt regeneration was poor (or, naturally thinned forests). The leatherwood in these plots was more advanced in both flowering and height, than those in the other research sites, pre-commercial thinned forests.

In fact, analysis of regeneration forest for pre-commercial thinning, has found that in forests where Eucalypt regeneration is highest, there is little or no regeneration of leatherwood. Compared to areas where the regeneration of eucalypts is poor, the regeneration of leatherwood is significantly higher.

Project Title	Developing a communication and marketing strategy for honeybee crop pollination services

RIRDC Project No:	DAV 119A
Researcher:	Russell Goodman
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Objectives

- To improve and promote an effective honeybee crop pollination service by developing a national marketing and communications strategy.
- To develop a technology transfer resource package to enhance the delivery and use of commercial honeybee crop pollination services.

Background

Honeybees (*Apis mellifera*) are important pollinators of many fruit and seed crops and can be introduced to flowering crops in large numbers to provide optimum fruit or seed set and improved crop production. Many apiarists provide a honeybee crop pollination service to growers on a fee for service basis.

A survey of the delivery and use of honeybee crop pollination services in Victoria in 1995 found that:

- Generally, growers did not understand honeybees, their activities and aspects of honeybee pollination.
- Growers needed more information that was readily accessible and they largely depended on apiarists for advice on pollination. They generally lacked the skills to judge the suitability of a honeybee colony for pollination.
- Many apiarists had a good knowledge of the basics of pollination but some required additional information on pollination in order to me more helpful to growers.
- Growers perceived some apiarists to be unprofessional because they did not have brochures to advertise their pollination service and provide basic information to their clients.

This project was designed to address these issues by developing suitable written and illustrated material for apiarists and growers.

Research

A literature search was conducted to glean information about the pollination of a range of crops.

Brochures were developed in co-operation with grower and apiarist organisations. The latter involved the Crop Pollination Association (Southeastern Australia) and the Pollination Association of Western Australia. Individual providers of honeybee crop pollination services were also extensively consulted.

Outcomes	The following documents were produced: • Honeybee crop pollination services business and marketing strategies for apiarists and crop pollination associations. • Honeybee crop pollination services draft code of practice for apiarists. • Draft code of practice for the use of bee tubes. • Honeybee crop pollination services contact list (database) for growers and apiarists. • Sixteen pamphlets providing flow-charts and guidelines for effective pollination of specific crops. • Seven papers on pollination including: principles of pollination; honeybees, their life cycle and habits; efficient use of honeybee crop pollination services; honeybee pollination of crops in greenhouses, small enclosures and under hail netting. • Four posters and a set of 35 mm colour slides for use by apiarists. Presentations on honeybee crop pollination services were delivered to meetings of the Northern Victorian Fruit Growers' Association and the Crop Pollination Association.
Implications	Growers and apiarists will have access to detailed user-friendly information about honeybee crop services and the benefits and use of bees for pollination. The publications will help to provide greater understanding of the special requirements of both apiarist and grower, relating to supply and use of pollination services. The business and marketing strategies will assist apiarists who wish to establish a pollination service business. The draft Honeybee crop pollination services code of practice will assist crop pollinators establish appropriate standards and develop a greater degree of professionalism within the growing crop pollination service industry.
Publications	Final Report for Project DAV-119A: "A communication and marketing strategy for honeybee crop pollination services."

Project Title	Non-fungicidal and biological control of core rots in pome fruit

RIRDC Project No:	TAR-1A
Researcher:	Mr Chris Archer
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Objectives

- Development of a low cost and efficacious method of management of the core rot disease in susceptible pome fruit varieties.
- An increase in fruit quality by a reduction in the incidence of core rot.
- A decrease in grower production costs through replacement of the four fungicide sprays currently used to control the disease.
- Use of honeybees as a transfer vector for any biological control agents determined during the study (thereby value adding to the honeybee industry by apiarists charging fee for service for use of bees to deliver material to apple blossom during the full bloom period).

Background

Core rots (also known as mouldy core) of apples is a major problem for Australian apple growers and exporters. The disease is caused by a complex of fungal pathogens (*Alternaria* and *Pezicula* spp. predominate), and results in a zone of rotting tissue around the apple core. The disease develops from infections that occur during flowering but remains latent until after harvest when the apples are held in controlled atmosphere storage. Because of the discrete period (full bloom) and site (senescing apple blossom) at which infection occurs, there is a strong potential for control of the disease by way of competitive or antagonistic biological control agents.

Research

Laboratory investigations undertaken as a component of this project have revealed a fungal species that occurs in apple cores but does not cause rots. This fungus (*Gliocladium roseum*) has been found capable of reducing the incidence of core rots due to *Alternaria* infections in disease susceptible varieties. A further outcome of this project has been the determination of an inexpensive method for large scale bulking of the *Gliocladium* material.

Investigations are being undertaken to determine methods of integrating this organism, as a biological control agent, into conventional orchard management practices used for the control of other diseases (such as powdery mildew). Core rot is promoted in those apple varieties that possess an open sinus, that is, a continuous passage from the calyx into the core region. Within this project an investigation of new apple varieties demonstrated that three varieties (Johnagold, Royal Gala, Sundowner) have the morphology to promote core rot development with two (Johnagold and Sundowner), exhibiting similar levels of rot occurrence to Red Fuji (considered a susceptible variety).

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. For the core rot pathogens the site of infection is the apple blossom. When using inundative sprayers there is a significant quantity of material that misses the blossom and is effectively wasted. What is required, is a method of accurately placing the control agent in an adequate concentration solely on the flowers. As beehives are normally placed in apple orchards during the full bloom period for the purposes of pollination there is an opportunity to use honeybees as a transfer vector for biological control material to the apple blossom.

Trials conducted in the 1998 season demonstrated bees to be more efficient in the

	transfer of material to the flowers than high volume inundative spraying. Material transferred by bees, resulted in a similar concentration of biocontrol material at the flowers compared with spraying, however the sprayed material declined rapidly in concentration over time as compared with that transferred by bees. There appear to be no adverse effects on the honeybees from the biological control agent.
Outcomes	• Determination of a fungal species (*Gliocladium roseum*) capable of reducing the incidence of *Alternaria* type core rots. • Established a cost-effective method for bulking the biological control fungi. • Examined new apple varieties for potential susceptibility to core rot pathogens. • Established that honeybees have greater efficacy in transferring biological control material than inundative sprayers.
Implications	The use of a biological control for *Alternaria* type core rots in pome fruit provides the opportunity to reduce fungicide applications for disease control. This bio-control fungus needs to be successfully integrated into the conventional orchard management practices of an orchard.
Publications	None to date

RESEARCH IN PROGRESS REPORT 2000

Project Title	**Pyrrolizidine alkaloids in honey: levels of contamination and methods of removal**
RIRDC Project No:	CSA-9A
Start Date:	10/06/99
Finish Date:	15/07/00
Researcher:	Dr. Steven M Colegate
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Objectives

- Continuation of the analysis of honeys initiated in April 1999 to assist the industry in an assessment of the problem posed by pyrrolizidine alkaloid (PA) contamination of honeys for the domestic and export markets.
- A concurrent investigation into the potential for removal of PA contaminants, which may yield an industry-friendly, economically viable
- procedure for removing PAs from contaminated honeys.

Current Progress

Pyrrolizidine alkaloids (PAs), identified as being derived from *Echium plantagineum* (Salvation Jane) and *Heliotropium* spp. (purple top and common heliotrope), were detected in 19 of 20 honey samples provided for analysis. Only six of these samples were actually described as being sourced from a PA-containing plant such as Salvation Jane.

Several types of capture resin were trialed in various formats to investigate their potential for removal of PAs from honeys. The PAs could be removed (>95%) from the honeys using a batch mixing process that is compatible with current honey processing methods. However, the removal process adversely affects other qualities of the honey such as water content, acidity and mineral content. The effect on water content was minimised to acceptable levels by using specially prepared capture resins.

Selective blending of treated honeys ameliorated the effects on acidity and mineral content. These additional steps add cost to the process which, in addition to the cost of the capture resin, would tend to make the process economically non-viable. Regeneration and re-use of the resin (currently being investigated) has potential to lower this cost to a level as yet undetermined, but probably still too high for economic justification.

Other quality parameters potentially affected by the treatment have not yet been investigated.

RESEARCH IN PROGRESS REPORT 2000

Project Title	**The use of Australian honey in moist wound management**
RIRDC Project No:	DAQ-232A
Start Date:	1/07/97
Finish Date:	30/06/00
Researcher:	Dr. Craig Davis
Organisation:	Department of Primary Industries (Qld) Centre for Food Technology 19 Hercules Street HAMILTON QLD 4007
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Objective	To develop a set of guidelines for the commercial production of honey as a therapeutic agent.
Current Progress	The recent registration of Jellybush honey as a "Drug" with the Therapeutic Good Administration (TGA, the National drug registration body) has been the project highlight. In December 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". The listing of this product (TGA# AUST L 69532) is the first of its kind in the world, and represents an acceptance of the therapeutic benefit of natural products by the TGA. The routine screening of honeys from apiarists and processors has continued at the Centre for Food Technology where over 4000 honeys have now been screened. An area in Northern NSW has repeatedly produced the "active" honey. Recent testing has suggested that at least one further area with floral-derived activity may have been identified. It is likely that beekeepers will submit samples of honey from a wider range of geographical sites as the returns from the commercialisation of the "active" *Leptospermum* honey are further realised. 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".

RESEARCH IN PROGRESS REPORT 2000

Project Title	Flavour quality assurance of Australian floral honeys by chemical fingerprinting

RIRDC Project No:	UQ-67A
Start Date:	4/08/97
Finish Date:	31/10/00
Researcher:	Dr. Bruce R D'Arcy
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Objective

To increase the accuracy of the flavour quality authentication of Australian floral (straightline) honeys by developing a commercially available quality assurance procedure based on chemical fingerprinting by 2000.

Current Progress

A three-step procedure for authenticating the floral source of Australian floral (species-specific) honeys is being developed, together with the collection of chemical data on the volatile composition of samples of 16 Australian honey types.

Such data has been tabulated for samples of the following 12 honey types: yellow box, blue gum, leatherwood, red gum, jelly bush, yapunyah, clover, brush box, tea tree, mallee, Caley's ironbark and crows ash. Analysis of spotted gum, stringybark, heath, and grey iron bark honeys is nearing completion.

The first step in the authentication procedure involves the extraction of natural honey volatiles. The second step involves gas chromatographic (GC) analysis of the honey extracts to quantify the volatiles, while gas chromatography-mass spectrometry (GC-MS) is used to identify these substances. This research has recently established a data bank of mass spectra and GC 'chemical fingerprints' of natural volatiles in Australian floral honeys. The third step in the authentication procedure involves multivariate statistical analysis of the chemical data.

So far, chemical data of samples of five honey types have been analysed using this method, with work in progress to include another 11 floral types. This analysis groups samples of each honey type, thus permitting floral source identification.

RESEARCH IN PROGRESS REPORT 2000

Project Title	**Improving the movement/use of liquid Australian honey within manufacturing processes**
RIRDC Project No:	UQ-84A
Start Date:	1/07/98
Finish Date:	30/11/01
Researcher:	Dr. Bruce R D'Arcy
Organisation:	The University of Queensland School of Land and Food Food Science and Technology GATTON COLLEGE QLD 4345
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Objective	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.
Current Progress	Viscosity work continued, with another eight varieties of unprocessed honey samples being analysed within the temperature ranges of 1 - 40^{o}C using a Brookfield viscometer and 10 - 70^{o}C using an Ares Rheometer. With these two studies and previous work, the temperature effect on honey viscosity was confirmed to be Newtonian for 14 varieties of honeys. An Arrhenius viscosity model for these honeys has been developed and accepted for publication. Preliminary Differential Scanning Calorimetry (DSC) measurement of the glass transition temperatures for samples of nine honey types is complete and is presently being related to their viscosities. Further work in this area is continuing. Additionally, the compositional analysis of a large number of honey samples for sugar and moisture content is complete. These chemical data will be correlated to previously collected data on crystallisation rates and viscosity behaviour. In addition to the above work, an extensive DSC study was done to establish a procedure to analyse the degree of crystallisation of glucose in honey. This method was also tested on several creamed honey samples and was found applicable. Finally, honey-pumping systems used by Australian honey packers have been identified, and a pilot scale trial is presently being undertaken.

Projects 1999/2000 – still to be contracted

The following project had funding approved in the 1999/2000 financial year, exchange of contract has not yet happened:

Natural resource database for the South Australian apiary industry (DEH-1A)

Mr Peter Alexander
☎ *(08) 8204 8764*

New Projects –2000/2001

The following projects have been approved by RIRDC for commencement in the 2000/2001 year:

Device for finding queen bees in managed beehives (HBE00-01)

Mr Alan Roberts
☎ *(02) 6663 5224*

Glycemic index of honey (HBE00-09)

Dr Jayashree Arcot
☎ *(02) 9385 5360*

Publications

Floral Resource Database for the NSW Apiary Industry

by Doug Somerville, RIRDC Publication No. 99/174, $15

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

Australian Liquid Honey in Commercial Bakery Products

by Bruce D'Arcy, Nola Caffin, Bhesh Bhandari, Nicole Squires, Paul Fedorow, Darren MacKay, RIRDC Publication No. 99/145, $15

Honey has the potential to retard the staling of bread. This report examines the effect of Australian liquid honey on the functional properties of bread doughs and cake batters, including dough development and gelatinisation of batters and doughs, in addition to the effect of honey on the staling of bread. 1999, 145pp

Natural Resource Database for the Queensland Apiary Industry

by John Rhodes and Fraser Trueman, RIRDC Publication No. 99/43, $10

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. 1999, 68pp

European Foulbrood – Determining Oxytetracycline Sensitivity and Diversity

by Michael Hornitzky and Steven Djordjevic, RIRDC Publication No. 99/20, $10

Oxytetracycline (OTC) has been the recommended treatment for European Foulbrood diseases (EFB) for the past 21 years. This research was designed to determine current sensitivity of the EFB causative organism *Melissococcus pluton* to OTC. 1999, 30pp

Impact of Commercial Honeybees on Flora and Fauna in Ngarkat Conservation Park

by David Paton, RIRDC Publication No. 99/15, $10

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, South Australia. 1999, 33pp

Treating American Foulbrood – Development of a National Control Program

by Keith McIlvride, RIRDC Publication No. 98/144, $10

Outlines the findings and recommendations put forward by participants at 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

Bulk Honey Containers

by Graham Kleinschmidt, RIRDC Short Report No. 10, free

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 (stainless steel, zincalume, galvanised waxed and galvanised drums) as well as apiary procedures. 1997, 12pp

Strategic Planning and Action Meeting – for Honeybee Nutrition

by Graham Kleinschmidt, RIRDC Publication No. 98/128, $10

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

Beekeeping and Secure Access to Public Land

by Roderic Gill, RIRDC Publication No. 97/026, $10

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, 58pp

Honeybee Research Report 1999

by RIRDC, Publication No. 99/61, free

Details honeybee RIRDC-funded research from July 1998 to June 1999 and lists projects beginning in the 1999-00 financial year. 1999, 40 pp

Honeybee Research Report 1998

by RIRDC, Publication No. 98/48, free

Details honeybee RIRDC-funded research from July 1997 to June 1998 and lists projects beginning in the 1998-99 financial year. 1998, 53 pp

Honeybee Research Report 1995-97

by RIRDC, Publication No. 97/58, free

Details of honeybee research from July 1995 until June 1997 with lists of projects beginning in the 1997/98 financial year. Provides access to recommendations and research in progress, with researcher contact details in an easy-to-read format. 1997, 61pp

Research Report 1980-95

by Honeybee Research and Development Council, $5

A collection of one to two page summaries of research projects supported by the Honeybee Research and Development Council between 1980-1995. 1996, 104pp

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)

Videos

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