



**RURAL INDUSTRIES RESEARCH
& DEVELOPMENT CORPORATION**

RIRDC Completed Projects in 1997-1998
and Research in Progress as at June 1998

HONEYBEE

RIRDC Sub-Program 3.3

Rural
Industries
Research &
Development
Corporation

shaping
the
future

November 1998

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"RIRDC Completed Projects in 1997-98 and Research in Progress as at June 1998 - 3.3 Honeybee"
Publication no 98/93

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FOREWORD

This year RIRDC has produced *Research in Progress, June '98*, which contains short summaries of continuing projects as well as those that were completed during 1997-98 for all of the Corporation's 21 program areas.

The complete report on all the programs is only available in electronic format on our website at <http://www.rirdc.gov.au>

The following report is a hardcopy extract covering Sub-Program 3.3. It contains all entries from continuing and completed Honeybee research projects funded by RIRDC. This program aims to improve the productivity and profitability of the Australian beekeeping industry.

This report is the newest addition to our extensive catalogue of over 250 research reports, videos and CD-Roms of projects supported by RIRDC. Please contact us for the latest publications catalogue or view it on our website.

Peter Core

Managing Director

Rural Industries Research and Development Corporation

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COMPLETED PROJECTS

Project Title

Promotion of native bees in the Torres Strait

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Objectives

- To prevent the movement of *Tropilaelaps clareae* and *Varroa jacobsoni* mites from Papua New Guinea to mainland Australia, via the Torres Strait Islands.

Background

Both of these mites occur in Papua New Guinea, where they have had a devastating effect on the populations of European honeybee (*Apis mellifera*). The Asian honey bee (*Apis cerana*) is the natural host of the Varroa mite. Asian honey bee and the Varroa mite have spread from Irian Jaya into Papua New Guinea and onto three of the islands of the Torres Strait. Currently the nearest population of European honey bees is on Hammond Island, in the Torres Strait, about 100 kilometres to the south of these three islands.

Our best prospect of keeping mainland Australia free of these mites is to maintain this separation of the two populations of honeybees.

However, there is a perception, among some islanders, that honeybees are essential to the production of food plants. In fact, the bulk of traditional crops either do not require pollination agents, or are pollinated by native bees and/or other agents.

Research

The variety of native bees occurring on the islands has been determined. Also, the variety of fruit trees (native and introduced) that are commonly utilised has been catalogued, along with the range of food crops currently under production in the region.

The benefits of the native bees in production of the fruits and crops have been promoted via various booklets and promotional material.

Outcomes/Publications

An illustrated booklet outlining which of the food crops require pollination and which are pollinated by the native bees and other insects. Two thousand of these were delivered to the Torres Strait in January 1997, for distribution through the region.

An activity book for school has been produced and distributed to Primary Schools in the Northern Peninsula Area (NPA) around Bamaga. The book promoted the native (stingless) honeybees (*Trigona* spp and *Austroplebeia* spp.) as the local hero, "Trigon", fighting off the invading Asian honeybees, as well as other quarantine themes.

Heavy duty, plastic baggage tags featuring the 'heroic' Trigon, produced in May 1996, have been distributed. Two thousand of these were produced. The label also features the Top Watch logo which was promoted by Mal Meninga in 1993.

A twelve-page booklet detailing the life histories of selected native bees from the region has been produced. The text is illustrated with line drawings and a four-page colour 'centrefold' shows some of the native bees, as well as a resting swarm of Asian honeybees. Two thousand booklets, plus an extra thousand copies of the colour insert, have been produced and are ready for distribution in the Torres Strait, via the schools extension program.

Project Title

Production of a video on external exotic honey bee parasites

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Objectives

- Honeybees like most living organisms are susceptible to a variety of parasites that have harmful effects on colony development and productivity. Australia is free from serious parasites of honeybees.

Research

The production team of Mr. Phillip McLellan, Research Officer (Media) and Mr. Bruce White, Program Leader (Apiary Products) travelled to Thailand to video footage of exotic parasites and races of bees with the cooperation of Dr. Michael Burgett from Portland in the United States and staff at the University of Chiang Mai in Northern Thailand.

Outcomes

The video will enable beekeepers to identify the honeybee parasites

- Varroa (*Varroa jacobsoni*)
- Tracheal Mites (*Acarapis woodi internus*)
- *Tropilaelaps* (*Tropilaelaps clareae*)

Exotic races of honeybees associated with exotic parasites are also shown on the video the Asian

Honeybee (*Apis cerana*) Giant Honeybee (*Apis dorsata*) and the Dwarf Honeybee (*Apis florea*).

The video has close up shots of all the parasites and exotic races of bees.

For each of the parasites the video shows the relationship of the parasite with the various races of bees and the parasites world distribution.

The biology of the parasites on the European honeybee, effects how to correctly inspect colonies for each parasite, how the parasite could be spread between colonies, control of the parasite and the impact of the parasites should they enter Australia and the action that would be taken.

The video also outlines the strict quarantine surveillance at points of entry and the use of detector dogs.

A section also covers the honeybee quarantine station that with approval from the Australian Quarantine and Inspection Service allows honeybees to be legally imported.

Implications

The video can be shown in total or the section on each parasite played. The video runs for 20 minutes, the script was written by NSW Agriculture and reviewed and improved by all mainland State Departments of Agriculture, Apiary Sections; Dr. Michael Burgett, University of Oregon, Portland, USA; CSIRO; Honeybee Research and Development Committee and the Australian Quarantine and Inspection Service.

Beekeepers viewing the video will be able to identify the exotic parasites and races of bees and be able to contact the right authorities should they see them in Australia. Quick detection gives a better chance of eradication.

Publications

The video was produced by NSW Agriculture, Media Unit, Orange, wholly funded by the Honeybee Research and Development Committee.

Project Title

Australian honey in dry food mixes

RIRDC Project No: UQ-54A
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Objectives

- The aim of the study detailed in this report was to determine if honey had a potential role in the retardation of the staling process.

Research

The performance of honey as a retarding agent in a white pan bread formation was compared to a commercial sugar syrup, dried honey and a no sugar, no honey control. The honey and sugar syrup were added at various levels.

The level and rate of staling during storage was determined both by objective texture measurements and by sensory valuation using taste panels.

Outcomes

The trial described in this report was unable to determine definitely one way or the other whether honey retarded the staling process under the conditions of the study. However, the results for the addition of 3% honey are very encouraging.

Another important result from this study is the strong correlation between taster score and texture measurement of the bread over storage time. That is, the panellists were able to detect the physical changes (as measured by texture analysis) in term of the eating qualities of the loaf. This demonstrated that sensory evaluation is a reliable analytical tool when used to study changes in the texture of a bread loaf during the staling process. A poster presentation entitled *The use of sensory evaluation to determine changes in bread texture during the staling process* was presented at an international sensory science seminar entitled Sensory Science Meeting Industry Needs held in Sydney on 11-12 November 1996.

The project is continuing as a part of a PhD study. A further trial has recently been completed. This trial is a repeat of the study in this report but will less treatments to reduce the complexity and to aid the statistical determination of significant difference. The results of this trial will determine the future direction of the project.

Project Title

Molecular taxonomy of nosema apis

RIRDC Project No: CSE-3H
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Objectives

- To describe the symptoms of the disorder and attempt to show the causative agent.

Background

Disappearing disorder is a honeybee brood disorder that has been reported from colonies in north east NSW and south east Queensland. Although occurring locally, the disorder can lead to significant losses.

Research

During 1994, three outbreaks of the disorder were examined in south east Queensland, the first during early October in the Cunningham's Gap region, the second in late November early December in the same region and, the third in late December in the ranges west of Caboolture. During each reported outbreak, symptoms were noted and samples of brood, pollen and honey were collected for laboratory analysis.

Outcomes

The symptoms of disappearing disorder were observed and clearly described. They were similar to those typically associated with European brood disorder, caused by *Melissococcus pluton*.

No specific pollen type was found to be consistently collected by colonies affected by the disorder and affected colonies in different localities were reported foraging on completely different floral sources. Even though some known pathogenic micro organisms were isolated from a number of affected larvae, no micro organisms were selected in the majority of affected larvae and no particular micrograms was consistently present in affected larvae collected during different outbreaks. Nectar samples collected from colonies affected by the disorder in October 1994 and pollen samples collected from affected colonies during each reported outbreak at Caboolture in December 1994, showed significantly higher levels of trace elements, particularly zinc, than were detected in nectar and pollen samples collected from healthy unaffected 'control' colonies near Canberra. This level of elements was particularly high in the pollen samples collected in December 1994 from Caboolture. These results suggest that disappearing disorder may result from unusually high levels of trace elements in pollen and nectar collected by colonies in the affected areas. Further studies are needed however, to determine which trace elements might be responsible.

Implications

These results suggest that trace elements should be considered in future studies on bee nutrition. The results are also relevant to the areas of human health and honey and pollen quality assurance.

Project Title

Testing an electronic device that emits queen piping sounds to find a queen bee in a colony

RIRDC Project No: CUT-4A
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Objectives

- To record the tooting and quacking sounds of queen bees.
- Develop a computerised system to play the recorded sounds to the queens in the laboratory and field.
- Observe the response of the queens to the recording of the queen sounds in the laboratory and the field
- Develop an electronic device which is capable of attracting the queens to the electronic source of the sound.

Background

At present, beekeepers physically search for the queen when requeening a honeybee colony, a task that is extremely time consuming. The aim of this project was to investigate whether queen piping (quacking and tooting sounds) could be used to attract a queen from a colony to the source of the piping sounds. If the response was consistently positive, then an electronic device that emits the sounds would be developed and placed on a frame to attract queen bees in the colony.

As a result of this objective, the piping sounds of the queen bees were recorded in a Pentium PC using Cool Edit software. The selected components of the piping sounds were played back to the queen bees in a controlled laboratory environment as well as in the field. Encouraged by the response, an electronic device was developed to replace the computer. The operation of the device is found to be satisfactory.

Research

The aim of this project is to develop an electronic device that beekeepers can use for identifying a queen in a colony. This project differed from other published research by attempting to control the behaviour rather than just observing and analysing sounds emitted by the queen bees.

The Curtin University of Technology was successful in developing a programmable device that could imitate the sounds of queen bees. The device is based on 68HC12 microcontrollers and it has a large memory bank such that it can generate previously recorded sounds as well as being able to record sounds *in situ* environment. This gives flexibility to the bee keepers to make use of their own experience of the queen bee sounds that they may have noticed while handling the queen bees.

An extensive number of experiments were designed and conducted, in laboratory and in field, to achieve the objectives of the project. It was found that the response of the queen bees to the sounds generated by the device were arbitrary. In some cases, they demonstrated strong responses and in the others no response at all, without much consistency in either case. Nevertheless, the experience of the investigators indicates that the behaviour of the queen bees can be controlled, but further

comprehensive research is necessary for the identification of all components of sounds generated by queen bees. Also, further tests are necessary which makes use of other mechanisms such as presence of pheromones as well as sounds.

Outcomes

The tooting sounds emanated by the queen bees have been recorded. The first (long) and second (short) syllables of the sounds were identified. A computer based system supported by appropriate software together with an audio amplifier and speakers was set up. A number of carefully designed experiments, spread over a period of time, have been conducted to observe the response of the bees and queen to the prerecorded piping sounds of a queen bee. It was observed that the bees and queen did note the artificial sounds and responded to it from time to time, albeit in an unpredictable manner. This indicated that the communication mechanism of bees via airborne sounds may be much more complex than initially it was thought to be. It became apparent that a much more comprehensive research is necessary to isolate the components of the sounds carefully and identify the codes used by the bees. Investigators are convinced that millions of years of evolution, in very complex form of social structure as demonstrated by the bee colonies, may have created complex coding of sounds that needs to be researched thoroughly.

A programmable digital device was developed which emanates queen bee sounds. This device contains prerecorded queen sounds, which can be played continuously. The programability of the device allows the selection of the first and second syllables to be either on their own or in combinations. Additional features are provided or recording of the bee or queen sounds that the user may consider to be useful from his/her experience. The device is available on request from Curtin University of Technology.

Publications

H. Eren, L. Whiffler and R. Manning (1997) Electronic sensing and identification of queen bees in honeybee colonies, IEEE IMTC' (& Conference, Ottawa, pp. 1052-1055.

Project Title

Development of remote sensing, beehive production status monitoring system

RIRDC Project No: DAN-135A
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Objectives

- To develop a remote sensing computer system for the apiary industry, to determine hive status without visiting the apiary.

Background

The monitoring of beehive's condition in the field takes up a large part of a beekeepers time and resources. Remote monitoring of hives weight will measure the gain in bees, honey and pollen. This will allow beekeepers to reduce costs and allow them more time for production instead of monitoring tasks.

Research

This research project was carried out on the north coast of NSW. The researchers adopted remote sensing systems used in other industries to monitor and record bee hive weights. This was achieved by the use of a load cell onto which one or more hives could be placed and a data recorder to record the weight on a daily basis. Other information can also be collected to give the beekeeper additional information about conditions for bees in the area such as temperature, rainfall and wind speed.

Using a modem linked to a mobile or land line phone and computer, the information is then transferred via the computer software for the beekeeper to access on the computer screen and/or print out.

Outcomes

Data is collected using a data recorder. This enables daily weights of hives on a load cell (weighing platform) to be recorded.

Data hive weights are retrieved from the monitoring site using modem linked cellular phone technology either a land line or mobile phone via the telephone system.

The software was developed to stand alone with ease of use. Software allows for the viewing of data in both text and graphical format. Cost including computer about \$7,000 to weigh five hives (1997).

Implications

Now the research project is completed, the technology will allow beekeepers to access hive weights and other data without visiting the apiary site. To obtain the data a land line phone or mobile phone can be used in conjunction with a weighing platform, modem and the developed computer software. This will reduce visits to apiaries to check on hive conditions thus reducing production costs.

Project Title

Bulk honey containers

RIRDC Project No: GK-1A
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Objectives

- To assist honey to maintain its image as a quality natural product by identifying those areas of production that may adversely affect quality assurance accreditation.

Background

Little is known of the influence of management procedures on metal levels in honey and beeswax and the effect they may have on quality accreditation. Current bulk honey containers were introduced 30 years ago and whilst extraction plants have been upgraded the original bulk containers are still in use. Their metal related suitability was compared to alternative containers.

Research

During honey extraction eleven Apiarists collected random comb and settling tank samples before filling washed waxed, unwashed waxed, washed galvanised, unwashed galvanised and 316, 304 and 430 grade stainless steel drums. The drums were sampled on arrival at the packing plant, stored for 3-6 months, heated, rolled and resampled. This honey and beeswax and specific and spot samples from an additional eight Apiarists was analysed using the ICP – MS4 method for aluminium, chromium, nickel, zinc, copper, lead, cadmium, iron, mercury, arsenic and selenium.

Progress/Outcomes

- Honey mean metal levels were below the Australian maximum permitted concentrations (MPC).
- Levels of known dangerous metals were very low and often below the level of detection.
- Zinc, iron and aluminium below MPC but warrant industry attention.
- Aluminium was associated with unsatisfactory fumigation procedures. The current move to alternative comb storage eg. coldrooms, removes any health implications associated with fumigation..
- Zinc results do not support the continued use of galvanised drums and whilst beeswax lining reduced zinc levels in year 1, it is considered a possible interim measure only pending determination of the future direction of bulk containers.
- Suppliers' newsletters from two packing houses confirm action was taken following the interim reports to minimise possible metal effects on honey quality.
- Beeswax contained higher levels of metals, some as a result of old processing procedures. Modern wax processing plant and moulds should be installed to minimise wax metal levels.

Publications

Kleinschmidt G.J. (1996) "Keeping Apiary products natural".
Australian Beekeeper 98 (1): 18,25
Australian Bee Journal 77 (7): 16-18

Project Title

Strategic Planning and Action Meeting for Honey Bee Nutrition

RIRDC Project No: GK-2A
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Objective:

- Top develop and underpin honey bee nutrition with R, D & E proposals for further advances.

Background

Australia is endowed with a range of climates and flora that necessitate varied management procedures. The inability of apiarists to match program with environment or to modify research results to suit specific situations has slowed industry application of nutrition.

Research

Prior to the meeting, 120 randomly selected apiarists were surveyed to determine current general nutritional practices and the problems that inhibit increased use of nutrition strategies.

Fifteen workshop delegates discussed past practices, survey results, participant statements and quality assurance implications and recommended an eight point action plan.

Outcomes

- Two draft research proposals have been received. HBRDC has decided on the composition of a committee that will progress the development of the proposals in parallel with the proposed queen bee program.
- Three 1998/99 mid-term projects are expected to be recommended to RIRDC.
- Discussions are being held with Agriculture NSW regarding upgrading nutrition publications.

Implications

The projects in commercial apiaries will require active apiarist participation in the programs and appropriate remuneration included in the project budgets.

RESEARCH IN PROGRESS

Project Title

Introduction and performance of queen bees - survey of queen bee breeders' apiaries

RIRDC Project No: AQB-1A
Start Date: 1 September, 1997
Finish Date: 30 June, 1998
Researcher: Mr. Colin Wilson
Organisation: Australian Queen Bee Breeders' Association
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KURRI KURRI NSW 2327
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Objectives

- To identify critical areas during the production of queen bees which influence introduction and early performance levels by sampling and recording conditions under which queen bees are reared during spring 1997 and autumn 1998.
- Data from this project and from the project Introduction of Queen Bees - Introductory Apiary Status and Post Introduction Results to be analysed together.

Current Progress

Approximately one month before field trials were to commence, commercial queen bee breeders supplying queen bees to DAN-164A had apiaries at each stage of queen bee production examined by a Government Apiary Officer. Nutrition, disease and population strength characteristics were recorded, or samples taken for examination. Production stages examined included Breeder Queen Hives, Cell Builders, Mating Nuclei, Drone Mother Hives and Queen Banks, if used. A bulk sample of adult bees was collected from each apiary for Nosema Disease examination.

Of the 55 queen bees provided by each queen bee breeder for each trial, 15 queen bees were sent to 3 commercial honey producers in NSW for field evaluation (DAN-164A) and then 10 queen bees were sent to the University of Sydney for Spermatozoa counts and Nosema Disease examination.

Spring: Field examinations and sampling of the 3 Queensland-based queen bee breeders supplying queen bees to the Spring Trial were completed in October and November 1997, by a Queensland DPI Apiary Officer.

Sperm counts were below 5 million sperm/queen. Nutrition requirements were adequate to good for all apiaries inspected. Brood disease levels were absent to low. Nosema levels in queen bee production apiaries in general, were "LOW" with no major negative effects able to be identified.

Autumn: Sperm counts ranged up to 7.1 million sperm/queen and other parameters the same as in spring.

Project Title

Identification and application of the aggregating pheromone of *Apis cerana*

RIRDC Project No: CSE-74A
Start Date: 1 July, 1996
Finish Date: 30 June, 1998
Researcher: Dr. Michael Lacey
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Objectives

- Isolate and identify the constituents of the aggregation pheromone of the Asian hive bee, *Apis cerana*, and develop a blend of synthetic chemical analogues to attract this exotic pest to increase the effectiveness of protective monitoring measures to safeguard the Australian honeybee industry.

Current Progress

Our research focused initially on the chemical analyses of Nasonov glands dissected from worker bees of *A. cerana javana* that were collected from the Torres Strait and preserved at -80°C. The most abundant of the volatile constituents have now been identified but terpenoid compounds were barely evident, in complete contrast to *A. mellifera* and *A. cerana javana* but analogous to very recent studies in Japan of *A. cerana japonica*. A different strategy has therefore been developed to recover pheromone exclusively from fanning bees and extracts have been obtained in this manner from *A. cerana javana* in PNG. Even though the quantities recovered are thousands of times less than those from *A. mellifera*, trace amounts of terpene have now been identified for the first time as possible components of the pheromone blend.

The outcomes of this research will be an increase in the effectiveness of protective monitoring measures and the safeguard of the Australian honey bee industry against this serious competitor.

Project Title

Crude protein and amino acid levels of pollens collected by honey bees in southern NSW

RIRDC Project No: DAN-134A
Start Date: 1 March, 1995
Finish Date: 30 December, 1998
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Objectives

- To collect and test various pollens originating from NSW for crude protein and amino acid levels
- To measure any yearly variation in the levels of crude protein and amino acids from the one source of pollen
- To utilise this information to inform beekeepers of appropriate management strategies

Current Progress

Pollen samples have been collected from a range of species found in southern NSW. Thirty beekeepers are involved directly in the project in trapping pollen. Pollen and flower parts are frozen. The pollen source and thus species, is identified. The pollen is then tested for crude protein using the Macro Kjeldahl method. Amino acid, using high pressure liquid chromatography and fat using extraction with petroleum spirits.

The variation of the quality of pollen from the one site will also be investigated. It would seem as though pollen from the same species, but from different geographic sources, varies in the crude protein and amino acid levels. Pollen will be trapped from one or more sites over the flowering period of Paterson's Curse over a three year period. This would then give a guide to the potential variations in crude protein that may occur in this species.

Project Title

Oxytetracycline sensitivity, diversity and study of *Melissococcus pluton* (European Foulbrood)

RIRDC Project No: DAN-136A
Start Date: 1 July, 1995
Finish Date: 30 June, 1998
Researcher: Dr. Michael Hornitzky
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Department of Agriculture
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Objectives

- To determine the oxytetracycline sensitivity of Australian *Melissococcus pluton* isolates.
- To determine the diversity of Australian *M. pluton* isolates.
- To determine whether *M. pluton* isolates contain plasmids (antibiotic resistance transfer vectors).

Current Progress

Each State Department of Agriculture (except Western Australia and the Northern Territory) will be requested to send at least 20 brood samples, each infected with EFB, from various areas within each State. The principal investigators will also collect samples as required. *M. pluton* will be cultured from these samples and the minimum inhibitory concentration of OTC will be determined by incorporating OTC at various concentrations in the prescribed medium. The technique employed will be based on that described by Hornitzky (1985) which reflects standard procedures for this type of work.

DNA restriction endonuclease profiles and typing of geographically diverse *M. pluton* isolates and their plasmid content will be determined using methodologies based on the work described in our previous project. This section of the project will provide information regarding the diversity of *M. pluton* in Australia and whether *M. pluton* has the ability to develop resistance via plasmids.

The three year project is near completion. More than 100 *M. pluton* isolates have been collected from various parts of Australia. All *M. pluton* isolates tested to date have been demonstrated to be sensitive to low concentrations of OTC and most *M. pluton* isolates are very similar to each other. This suggests that the variations in disease impact reported from various areas in Australia are due to environmental conditions rather than resistance to OTC or variations in strain pathogenicity.

Project Title

Floral resource database for the NSW apiary industry

RIRDC Project No: DAN-155A
Start Date: 1 February, 1996
Finish Date: 31 December, 1998
Researcher: Mr. Doug Somerville
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Objectives

- To create a database of floral resource information for the NSW apiary industry.

Current Progress

A postal survey was conducted in 1997 of all beekeepers with 200 hives plus who were listed in the NSW Agriculture Beekeeping Registration System. Follow up interviews of beekeepers at industry meetings and forums have occurred and will continue to occur for the

remainder of 1998. Thus far of the approximately 450 beekeepers surveyed a 65% response has been achieved. The project is due for completion by the end of 1998.

As a component to the state survey, studies of beekeeping in all State forest districts in NSW have been conducted. A survey form was sent to all beekeepers with occupation permits as at January 1997. These reports are close to completion.

The state floral resource database for the entire state is still in progress. Nine reports on Beekeeping in various State Forests districts have been completed and published a further nine. Publications are in various stages of completion and are all expected to be finalised in 1998.

The final report is due in December 1998. This report and the reports on individual State forest districts will clearly state the floral resource on which the NSW beekeeping industry is reliant.

Project Title

Introduction and performance of queen bees - introductory apiary status and post introduction results

RIRDC Project No: DAN-164A
Start Date: 1 September, 1997
Finish Date: 30 June, 1998
Researcher: Mr. John Rhodes
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RMB 944
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Objectives

- To identify critical areas during the introduction of commercially reared queen bees which have been transported by mail and introduced into commercial honey production hives.

Current Progress

The three commercial honey producers each ordered 55 queen bees for delivery in November 1997 and 55 queen bees for delivery in February 1998 from a commercial queen bee breeder in Qld of NSW (five queen bee breeders participated).

At the queen bee breeders mating yards test queens were caught, marked, caged and despatched by QDPI and NSW Agriculture Apiary Officers in conjunction with the queen bee breeders. Each honey producer supplied the use of two apiaries each containing 65 hives of similar strength.

Data collected from each test apiary included:

- The presence or absence of marked queen bees, or presence of queen cells, or a self-raised virgin or mated queen.
- The number of frames containing bees, brood, honey and pollen.
- One bulked apiary sample of adult bees for Nosema counts (where the bulk sample had a reading > 0.1 million spores per bee, then each hive to be sampled individually).
- Completion of a survey form providing a summation of the overall apiary conditions based on nutrition, disease, hive population strength, drug treatments and supplementary feeding.
- Field evaluation of apiaries carried out by three NSW Agriculture Apiary Officers and the apiary owners.

Project Title

The development of a natural resource database for the Queensland apiary industry

RIRDC Project No: DAQ-199A
Start Date: 1 February, 1995
Finish Date: 30 June, 1997
Researcher: Mr. Fraser Trueman
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Objectives

- To document current natural resources of the Queensland apiary industry, by investigating and recording the honey productivity, economic value and geographic significance of apiary sites within Queensland
- To develop a model for identifying potential bee foraging areas in Queensland not currently utilised for commercial honey production

Current Progress

Queensland beekeepers owning more than 50 hives have been surveyed and information on apiary sites, honey production, prime flora and other relevant details entered on a computer database. Tables and maps are being prepared to present the resources and their value.

Returns of questionnaire forms supplying useful data were received from 248 (59.2%) of the 419 beekeepers able to provide data. Figures have been produced on the production of honey, beeswax, queen bees, pollen, package bees and the number of apiary sites currently in use on Crown land, leasehold land and freehold land. Significant honey flora for each area of the State was identified. Other information that was collected relates to paid and unpaid pollination of cultured crops, effects of

fire and American Foulbrood on the industry and feral bee densities in areas of Queensland.

Data has been presented in formats able to be used by the beekeeping industry and by Government Departments when matters concerning honey bees and land use requires discussion.

Project Title

A quality survey of Australian honeys

RIRDC Project No: DAQ-231A
Start Date: 1 July, 1997
Finish Date: 30 September, 1998
Researcher: Mr. Fraser Trueman
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Objectives

- To survey the quality (chemical residues, microbial flora and some honeybee disease agents) of honey samples produced and packed in each state and territory of Australia to provide further information on which to establish acceptable standards for honey quality.

Current Progress

Fifty nine (59) honey samples have been collected including eight (8) samples purchased from retail outlets. Commercial and hobbyist apiarists have provided nine (9) samples from Qld, seven (7) from NSW, eight (8) from Vic., seven (7) from SA, seven (7) from WA, six (6) from NT and seven (7) from Tas. The samples from retail outlets were purchased at various suburban stores in Brisbane and represent packers from the following States:

One (1) from Qld, two (2) from NSW, three (3) from Vic., one (1) from SA and one (1) from WA. Samples provided by individual apiarists in all states were taken from the drums destined for the honey packers.

Screening for American Foulbrood (AFB) disease on all samples has been completed. A total of eight (16.9%) of the honeys returned culture positive results for *Paenibacillus larvae*. Four of these positive samples originated from individual apiarists and four (4) originated from the seven (7) samples purchased from retail outlets.

Bacterial plate counts have been performed on ten (10) honey samples representing Qld and nine (9) representing NSW. A result of 335 colony forming units (CFU's) per

gram honey is the highest recording to date. This honey sample was purchased from a retail outlet.

Project Title

The use of Australian honey in moist wound management

RIRDC Project No: DAQ-232A
Start Date: 1 July, 1997
Finish Date: 30 June, 2000
Researcher: Dr. Craig Davis
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Objectives

- To develop a set of guidelines for the commercial production of honey as a therapeutic agent.

Current Progress

Development of guidelines is based on specifying the required handling parameters and conditions to ensure production of honey which is antimicrobially active. The specifications may be based largely on knowledge obtained from previous research in the factors which may affect the activity of honeys.

Guidelines for beekeepers collecting "active" honey

The guidelines for honey beekeepers specify procedures for the collection and extraction of the honey. Factors discussed and specified include floral source of the honey flow; the importance of healthy beekeeping practices, especially the non-use of antibiotics within the hive; extraction of honey without heat treatment and honey storage conditions.

Guidelines for processors of "active" honey

These guidelines outline recommended handling and processing procedures. Treatments which may compromise the antimicrobial activity of these honeys have been described. The most important of these is heat treatment, which is used to facilitate honey processing. Initial research on jelly bush honey indicated that antimicrobial activity was fully retained even after treatment to 80°C. However, it has since been found that some honeys lose the activity at this temperature. The effect of typical honey processing conditions on antimicrobial activity is currently being reassessed. Consequently, the guidelines currently suggest that any heat treatment of active honey should be avoided, if possible.

Project Title

A comprehensive study of beekeepers' use of honey and pollen flora resource in Victoria

RIRDC Project No: DAV-109A
Start Date: 1 July, 1995
Finish Date: 30 June, 1999
Researcher: Mr. Russell Goodman
Organisation: Institute for Horticultural Development
 Department of Natural Resources & Environment
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Objectives

- To identify Victorian apiary sites on public land.
- To list nectar and pollen production 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.
- To catalogue the information on a data base and adapt it for use by industry.

Current Progress

Two questionnaires, one for public land sites and the other for privately owned sites were designed and mailed to the majority of apiarists who owned 50 or more hives. In an attempt to ease the workload, questionnaires for private sites were not mailed to those apiarists who used a large number of public land sites until they had first responded to the public land questionnaires.

In June 1997, a second invitation with questionnaires marked 'Commercial in Confidence' were mailed to those apiarists who had not responded to the initial invitation of 1996.

One hundred and eleven (27%) apiarists responded to the initial invitation by returning 590 individual questionnaires, many of which related to multiple apiary sites. A further 44 apiarists responded to the invitation of June 1997, returning 340 questionnaires.

Due to a lengthy involvement by the researcher during 1997-98 in a campaign designed to eradicate the exotic pome fruit disease Fire blight in Melbourne, Victoria, little progress has been made on this project. In view of this, approval has been obtained for a 12 month postponement of the final reporting date for this project.

Project Title

Developing a communications and marketing strategy for honeybee crop pollination

RIRDC Project No: DAV-119A
Start Date: 1 July, 1996
Finish Date: 30 November, 1998
Researcher: Mr. 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 and a technology transfer resource package to enhance the delivery and use of commercial honeybee crop pollination services.

Current Progress

In collaboration with apiarists, crop pollination associations, grower organisations and State departmental horticultural and seed crop advisers, guidelines and procedures for the effective delivery and use of pollination services for a range of fruit, vegetable and seed crop industries are being developed.

The following documents have been compiled and at the time of writing were subject to final review processes:
Honeybee Crop Pollination Services Business and Marketing Strategies for Apiarists and Crop Pollination Associations.
Code of Practice - Honeybee Crop Pollination Services.

Guidelines for growers and a national database of apiarists associations, grower organisations, advisers and consultants likely to have interest in pollination are nearing completion.

Project Title

Export package bees - evaluating a lupin flour based feed for increased live bee production

RIRDC Project No: DAW-75A
Start Date: 1 January, 1997
Finish Date: 30 April, 2001
Researcher: Mr. Robert Manning
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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

The experiment compares 49 different feed mixes. Part of the experiment was carried out from 9 May to 24 October 1997. Consumption of 150 patties containing the various ingredients was measured with replications.

A mix of lupin and sucrose fed as a patty was most preferred by honey bees over similar mixes containing soyflour or torula yeast fed together in the same hive. Consumption of the lupin-sucrose mix was ranked third and behind a soyflour and torula yeast-sucrose mix in palatability tests. Torula yeast was the most palatable feed when fed individually into one hive at a time.

Lupin based feeds still need further development with different ingredients to achieve higher consumption rates and increased brood rearing.

Preference testing should be replaced by palatability tests as more qualitative information about each of the feeds can be gathered. The advantage is that the actual effect of the feedstuffs can be seen from hive measurements of burr-comb and live-bee production.

Project Title

Laboratory and field trials relating to heat treatment of AFB infected bee equipment

RIRDC Project No: QBA-2A
Start Date: 1 July, 1997
Finish Date: 30 June, 1998
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Objectives

- To determine if heat treatment can be used to sterilise beekeeping equipment that has been infected with American foulbrood (AFB) spores.

Current Progress

A commercial kiln run at 130°C will be carried out if the laboratory trials show that 130° C will kill the spores. To date the laboratory trial at 130°C has been carried out. Pieces of painted and unpainted timber were seeded with AFB spores. Each site was estimated to have 3×10^8 spores of *Paenibacillus larvae*. These spores originated from many different geographical sites in south east Queensland and New South Wales. Swabs were taken from the seeded sites at 3, 5 and 7 hours.

The swabs were prepared and cultured for 12 days. At the end of the 12 days, there were no viable AFB spores cultures. All controls returned a positive result.

The work in the experimental kiln and the laboratory heating at 110°C for 5, 7 and 9 hours is currently in progress.

As there were no viable spores at 130°C, a commercial kiln run will be carried out if there is no degradation of the boxes in the experimental kiln work.

Project Title

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

RIRDC Project No: TAR-1A
Start Date: 1 July, 1997
Finish Date: 30 July, 2000
Researcher: Mr. Chris Archer
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Objectives

- Develop a low cost and efficacious method of management of the core rot diseases in susceptible pome fruit varieties by the year 2001.
- Value add to the honeybee industry by way of utilising bees for transfer of the antagonists to the apple blossom.
- Pesticide reduction in apple orchards.

Current Progress

The main experimental trial site examining alternative control mechanisms for core rot (mouldy core) was established at an orchard site near Grove research Station, Huon Valley (Tasmania), in early September 1997.

Treatments are based on fungal and bacterial material removed from apples during prior sampling and have been tested for biological activity against the disease organisms. In addition to the sampled antagonists, a

commercial biofungicide (Binab™ – based on a *Trichoderma spp* mix) is being trialed. The cost of the commercial biofungicide applications. All treatments with the exception of the Binab™ have been isolated and subsequently bulked in the laboratory.

In addition to the main spray trial, subsidiary trials have been established to evaluate the ability of Honey bees (*Apis mellifera*), to act as a vector to disseminate the more promising biological control agents. There has been no apparent deleterious effect on either the hives, or honey production, through the introduction of the antagonistic fungal material to the hives.

Project Title
Australian liquid honey in commercial bakery products (formerly HBRDC project UQ-2H)

RIRDC Project No: UQ-50A
Start Date: 1 July, 1995
Finish Date: 31 October, 1998
Researcher: Dr. Bruce D'Arcy
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Objectives

- To investigate the use of Australian liquid honey in commercial bakery products and to determine the effect of the incorporation of honey on shelf life and product quality.
- To communicate research findings to the Australian food processing industry.

Current Progress

Breads were made using a commercially available formulation (courtesy Defiance Mills Ltd, Research and Development Centre) with honey (manufacturing grad ironbark, courtesy Capilano Honey Ltd.) at 2%, 3% 4% and 6% levels. All treatments were compared against a bread incorporating comparable level of a model sugar solution (the same fructose, glucose and maltose as the honey sample) as well as a control, containing no honey or model sugar solution.

Although not all analyses have been completed and statistically analysed (as at 5/5/98), the following is noteworthy:

Proofing: Breads formulated with honey appeared to produce a slightly larger dough volume after proofing than the control or those using a model sugar solution.

Baking: Breads formulated with honey all appear to have a finer crumb structure, while both the honey and model solution produces a slightly thicker crust than the control.

Storage: Over the four day storage period, breads formulated with honey appeared to consistently have a softer texture than the control and breads using the model sugar solution. Water activity did not appear to be changed with different levels of honey or model sugar solution; however, over time there is a trend for the water activity to decrease slightly.

Project Title
The use of honeybees to deliver biocontrol agents to Geraldton waxflower

RIRDC Project No: UQ-65A
Start Date: 30 June, 1997
Finish Date: 30 June, 1998
Researcher: Assoc. Professor Alan Wearing
Organisation: Department of Plant Production
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LAWES QLD 4345

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Objectives

To determine the efficacy of honeybees (*Apis mellifera*) as delivery vectors for biological control agents of the fungal pathogen *Botrytis cinerea* on Geraldton waxflower (*Chamelaucium uncinatum*).

Current Progress

Bees are used by commercial fruit growers to improve flower pollination and fruit yields. Pollen dispensers are placed inside beehives and exiting bees pick up the pollen as they leave the hive and subsequently deliver it to the flowers. A similar principal will be utilised to deliver biological control agents (ie. antagonistic micro-organisms) to flowers.

A single honeybee colony will be enclosed inside a nylon mesh cage (2m x 2m x 2m high) along with potted Petunia flowers. The honeybees will be given a 24 hour period to acclimatise to the inoculum dispenser before a biological fungicide is introduced. Foraging will be permitted for 24 hours. Immediately following the foraging period, two replicate flowers will be removed from each flowering Petunia plant. The flowers will be washed using a laboratory blender and the blended samples will then be diluted and grown on a selective

agar medium in order to quantify the amount of fungus delivered to the flowers by the bees.

Potential long-term implications include reduced reliance on pesticides for the control of fungal pathogens and also the implementation of integrated pest management (IPM) systems in Geraldton waxflower. Biological control (using bees as vectors) may improve the value of Australian Geraldton waxflower exports and Australia's reputation as a cut flower supplier. Waxflowers also provide a useful model system, since consumer acceptance of biological control in this context is likely to be forthcoming. The experience gained working with bees as vectors for biological control agents on Geraldton waxflower could be transferred to other crops, such as tree fruits.

Project Title

Flavour quality assurance of Australian floral honeys by chemical fingerprinting

RIRDC Project No: UQ-67A
Start Date: 4 August, 1997
Finish Date: 31 October, 2000
Researcher: Dr. Bruce D'Arcy
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Objectives

- 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

The study (1997-2000) will extract and identify the volatiles and organic acids from samples of many different floral types of Australian honey. The eight floral honey types that were analysed prior to the proposed project include: blue gum, yellow box, leatherwood, red gum, yapunyah, jelly bush, brush box and clover. The data analysis of these results is presently in progress. This research is creating a data bank of the mass spectra and 'chemical fingerprints' of volatiles and organic acids, since they have been shown in the literature and through the work of Dr. D'Arcy, to be most important for the floral sourcing of 'chemical fingerprinting' of honey. Any method that sources the floral origin of honey also authenticates honey flavour quality since flavour quality and floral origin are very closely linked. Additionally, some method development

is being undertaken, as part of the evaluation of new chemical techniques for the isolation of volatiles (including aroma volatiles) and organic acids. Presently solid phase microextraction is one analytical technique being optimised for use with honey volatiles. No previous work has been reported for the application of this technique to honey analysis.

Project Title

Breeding hygienic disease resistant bees

RIRDC Project No: US-39A
Start Date: 1 July, 1996
Finish Date: 30 June, 2000
Researcher: Dr. Ben Oldroyd
Organisation: The University of Sydney
The University of Sydney
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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 establish 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

Chalk brood disease causes losses to production which may be as much as 5-10%. Best prospects for control are the use of resistant bees and good beekeeping practice. Recently, a very large number of genetic markers have been developed for honey bees. This project proposes to identify genetic markers close to those genes which control hygienic behaviour. By this means, we will develop markers that may be used diagnostically by queen breeders to identify hygienic stock. If all commercial bees were hygienic, potential savings to the industry would be \$1million p.a.

Experimental backcross colonies have been established and evaluated for hygienic behaviour. This involved challenging the colonies with freeze-killed brood and subsequent scoring for phenotypic variation in behavioural patterns. As expected, both hygienic and non-hygienic colonies were present in the colony set. These field experiments were conducted in replicate and hygienic queens have since been distributed to queen breeders. Individual drones from the segregating population have been sampled and total DNA extracted from each. Molecular techniques to be used in the construction of the genetic map have been trialed and optimised and the population is currently being screened

with RAPD markers. Genetic markers which are associated with hygienic behavioural morphs in the backcross will be field tested as candidate markers for hygienic behaviour.

Project Title

Investigations into disappearing disorder - a problem of honey bees in south east Queensland

RIRDC Project No: DAQ-205A
Start Date: 1 September, 1995
Finish Date: 30 April, 1997
Researcher: Mr. Fraser Trueman
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Objectives

- To investigate disappearing disorder in south east Queensland, with the aim of clarifying the epidemiology of the disorder and the causal agent.

Current Progress

The apiary outside Beaudesert was visited at approximately two weekly intervals to replenish supplements and check for disappearing disorder symptoms. At monthly intervals the adult bee population and brood areas were scored, the hives were weighed and adult bee samples collected for protein and *Nosema* estimations. Observations commenced on 25 September 1997 and concluded on 16 February 1998.

Preliminary results

While a few cells of disappearing disorder were observed on a number of visits, an outbreak situation did not occur. Averaged honey production from the hives are as follows:

Sugar and Pattie	45.1kg
Sugar	45.8kg
Pattie	48.1kg
Control	40.3kg

There was considerable weight variation within treatments and when fully analysed statistical difference is unlikely.

Adult bee numbers look to be similar across all groups. Protein analysis is not finalised. *Nosema* was not a problem in the apiary at any sampling time. The sugar and pollen patties were readily used by the bees and very little remained after two weeks.

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