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Foreword

The objective of the Honeybee Program is to improve the productivity and profitability of the Australian beekeeping industry.

The RIRDC Honeybee Advisory Committee meets at least twice a year, primarily to discuss Preliminary Research Proposals in November and again in March to discuss Full Research Proposals. Proposals are sought from applicants to undertake research projects into the Honeybee industry in accordance with the objectives of RIRDC's Annual Operational Plan. Successful applicants are contracted to undertake agreed research projects.

Honeybee researchers report to RIRDC twice a year on the progress of their project and this progress is assessed against RIRDC's objectives.

While there are a number of threatening pests and diseases to honeybees, the potential incursion of the Varroa mite, which if it invades Australia, could cost the horticultural and agricultural industries many millions of dollars. Other impacts of such an incursion include a substantial increase in pollination costs and the cost of horticultural produce to consumers. It will also lead to poorer quality fresh produce.

Research into the Honeybee Industry is therefore crucial in ensuring that a potential Varroa mite incursion into Australia is handled as effectively as possible.

This publication, Honeybee Research Report 2008, provides details of honeybee research from July 2007 until June 2008 and lists projects commencing in the 2008-2009 financial year. It follows the Honeybee Research and Development Council Research Report 1980-1995 and the RIRDC Reports 1995-1997, 1998-2005, which were a collection of final report and progress summaries of levy funded honeybee research until June 2005.

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

This report, a new addition to RIRDC's diverse range of over 1800 research publications, forms part of our Honeybee R&D program, which aims to improve the productivity and profitability of the Australian beekeeping industry.

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

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

Peter O'Brien
Managing Director
Rural Industries Research and Development Corporation

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Completed projects and research in progress at June 2008

PRODUCTION - BEE HUSBANDRY & MANAGEMENT (completed)

Project Title	Drone honeybees- semen production
RIRDC Project No.:	DAN-205A
Start Date:	01/07/02
Finish Date:	16/05/08
Researcher:	Mr John Rhodes
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Objectives	To provide data on the effects of drone age, season and breeding lines on the production and quality of drone semen and to determine if volume of semen and number of sperm produced per drone are selectable traits.
Background	An earlier project DAN-182A showed commercially reared queen bees with low numbers of sperm in their spermathecae after mating, this project examines drone semen quality as a possible cause.
Research	Semen quality was determined from examining drones from four breeding lines, at three ages for three seasons for – semen volume, number of sperm, changes in amino acid and fatty acid content of semen, sperm viability and motility, and genetic inheritability by a two-way cross experiment.
Outcomes	Overall, semen quality was found satisfactory for all lines, ages and seasons. In general, sperm numbers per drone were low. Drone survival was low after 21 days. Semen volume and sperm numbers per drone may be controlled by recessive genes. Semen volume, sperm number, viability and motility may be improved by selection in a breeding program. Drone maturation appears to occur over a wide range of ages. Manual eversion was found not to provide accurate data on semen volume and sperm number per drone. Two amino acids and two fatty acids were found present at high levels in drone semen.
Implications	(i) Breeding programs are required for the selection of drone mother queen bees to achieve and retain drone breeding stock producing semen of high quality. (ii) Management practices are required to be developed for the rearing and maintenance of large numbers of drones to a high age at queen bee mating apiaries.
Publications	Four draft papers prepared. RIRDC Publication in press.

PRODUCTION - BEE HUSBANDRY & MANAGEMENT

Project Title	Does *Nosema ceranae* infect bees and contaminate honey in Australia?
RIRDC Project No.:	PRJ-000885
Start Date:	1/08/07
Finish Date:	6/06/08
Researcher:	Dr Michael Hornitzky
Organisation:	New South Wales Department of Primary Industries for an on behalf of the State of NSW
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Objectives	To determine whether *Nosema ceranae* infects bees or can be found in domestic honey or honey imported into Australia.
Background	In 1996 a parasite similar to *Nosema apis* was found in the Asian honey bee (Apis cerana). This parasite called *Nosema ceranae* was found in the European honey bee in Taiwan in 2005 and more recently in the European honey bee in the USA, Spain and Germany. To date, non specific symptoms, such as a gradual depopulation, higher autumn/winter colony death or low honey production have been associated with the presence of this parasite. None of the dysentery or crawling bee behaviour which is sometimes associated with *N. apis* infection has been reported. *N. ceranae* has also been associated with Colony Collapse Disorder (CCD). CCD has been responsible for the loss of hundreds of thousands of hives in the USA. It is not known whether *N. ceranae* infects bees and contaminates honey in Australia.
Research	Samples of adult bees (307) were submitted by state Departments of Primary Industries apiary officers or beekeepers. Thirty seven honey samples of which 30 originated from beekeepers in Australia and seven from overseas were also submitted. All samples were examined for Nosema-like spores using microscopy. All samples were also subjected to polymerase chain reaction (PCR) assays to determine whether they contained *N. ceranae* or *N. apis*. A restriction fragment length polymorphism (RFLP) assay was developed to facilitate the identification of *N. ceranae* and *N. apis* from the PCR products.
Outcomes	*N. ceranae* was detected in adult bee samples from four states. *N. ceranae* was most commonly found in samples from Queensland where 28 (33.7%) of 83 samples were positive. New South Wales had the second highest prevalence with 15 (15.8%) of 95 samples positive. South Australia and Victoria had 4 (16%) and 2 (4.5%) of samples positive. *N. ceranae* was not detected in samples from Western Australia or Tasmania. Of the 37 honey samples tested in this study, 8 (21.6%) were PCR positive for *N. apis* and 3 (8.1%) were PCR positive for *N. ceranae*. The *N. ceranae* positive honey samples originated from beekeepers in Queensland. All 6 of the imported honey samples were negative for both *Nosema* spp.

Implications	*N. ceranae* is an important pathogen of honey bees. However, the detection of *N. ceranae* in bees in four states in Australia indicates that any attempt at eradication would be futile. Overseas reports indicate that *N. ceranae* is more pathogenic than *N. apis*. The emergence of this new pathogen in bees in Australia is likely to be more detrimental to the beekeeping industry in Australia than *N. apis*. It also appears that *N. ceranae* is replacing *N. apis* in Queensland. Further studies are proposed to monitor the impact of *N. ceranae* on honey bee colonies and to determine how lethal *N. ceranae* isolates in Australia are to bees. *N. ceranae* has not been detected in bees in Western Australia and Tasmania. Further testing to confirm the absence of *N. ceranae* may be useful to these states from honey and bee export perspectives.
Publications	A scientific paper on this work is in preparation. RIRDC Publication No. 08/006

PRODUCTION - DISEASES & PESTS (completed)

Project Title:	**A Study of New Zealand Beekeeping – Lessons for Australia**
RIRDC Project No.:	DAN-251A
Start Date:	1/07/06
Finish Date:	30/03/08
Researcher:	Dr Doug Somerville
Organisation:	NSW Department of Primary Industries
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Objectives	To provide to the Australian beekeeping industry the opportunity to learn from the success and failures of the New Zealand beekeeping industry. Primarily focussed on studying the introduction of the exotic bee mite, Varroa, also including pollination management systems, industry managed AFB program and any aspect of value to the Australian beekeeper.
Background	The Australian beekeeping industry is preparing for the eventual arrival of Varroa mites. It is envisaged that this strategic study trip by industry representatives will increase the national awareness of the impact of Varroa mites and heighten the need for surveillance within Australia.
Research	A study group of nine Australian beekeepers and scientists travelled through New Zealand in March 2007, discussing beekeeping issues with a range of beekeepers and scientists on the North Island. Many opinions were voiced on a wide diversity of subjects, not always in agreement with previously expressed opinions from other New Zealand beekeepers. Even so, there were some very strongly held opinions across the industry and many experiences from which the Australian participants could learn.
Outcomes	Some of the key points from the study include: • Adult mites live for five days with no contact with bees • Very low infestations (1-10 mites) in a hive are virtually impossible to detect • Surveillance systems, using pesticide strips, will only kill mites attached to the adult bees and will not provide information on the number of mites in the brood cells • An estimate of two thirds of the resident mite population are within the brood cells at any given time • No Varroa treatments are 100% effective in killing all the mites in a colony • Mites are very mobile and are spread very quickly by beekeepers.
Implications	The economics of the industry will affect the resilience of an industry to adapt to changing circumstances. Varroa may have been more devastating if the economic returns had not improved at approximately the same time as it was establishing throughout the North Island. Australia may not be as lucky.

Publications	
	Manning R (2007). Honey Marketing – reflections on my recent tour of New Zealand. *Bee Informed – The Newsletter of the Western Australian Beekeeping Industry*. 6(2), 1–4. Manning R (2007). Varroa. *Bee Informed – The Newsletter of the Western Australian Beekeeping Industry*. Somerville D (2007). New Zealand Beekeeping Study. *Honey Bee News*. March/April, 8(2), 12–12. Somerville D (2007). New Zealand Beekeeping Study. *Australasian Beekeeper.* 109 (10), 20–21. RIRDC Publication No. 08/060

PRODUCTION - DISEASES & PESTS (completed)

Project Title:	**Sustainable control of small hive beetle through targeting in-ground stages**
RIRDC Project No.:	UWS-22A
Start date:	1/08/06
Finish date:	31/12/07
Researcher:	Prof Robert Spooner-Hart
Organisation:	University of Western Sydney
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Objectives	1. Conduct laboratory bioassays using commercial strains of the entomopathogenic nematodes *Steinernema* spp. and *Heterorhabditis* spp. and the entomopathogenic fungus *Metarhizium anisopliae* to assess their efficacy against larvae and pupae of small hive beetle (SHB), *Aethina tumida*. 2. Evaluate efficacy of these above treatments in simulated field-soil conditions. 3. Generate preliminary data for use of drenches of entomopathogens in field apiary sites.
Background	SHB, an important pest of bee hives was discovered in Australia in 2002, and is spread in the coastal areas of the eastern states. Previous projects had investigated use of temperature manipulation (DAN-215A) and insecticidal control (DAN-216A), as well as in-hive traps. One of the options for sustainable control of SHB was use of entomopathogens (insect diseases) for controlling larvae and pupae in ground. There was some overseas evidence to support this view, and from Australia there were already examples of successful entomopathogen control of soil-dwelling insect pests.
Research	The research comprised assessing the ability of several species of commercially available insect attacking nematodes (*Heterorhabditis bacteriophora* and *H. zealandica*) and green muscardine fungus (*Metarhizium anisopliae*) against wandering larvae and pupae of SHB in the laboratory. Initial screening tests conducted using varying concentrations of nematodes and fungal spores, in Petri dish bioassays were inconclusive, so subsequent bioassays were conducted which more closely represented field conditions, where SHB larvae/pupae were subjected to varying concentrations of infective stage nematodes and fungal spores in potting media/sand contained in specimen tubes. Larger tubes were used in subsequent bioassays with nematodes. The optimal concentration of nematodes required to optimise SHB mortality in the laboratory was calculated, to provide estimates of what might be required in the field. In addition, the residual activity (i.e. longevity of action) of nematode treatments was assessed.

Outcomes	The initial container/medium bioassay work demonstrated the high efficacy of the entomopathogenic nematode, in which there was >90% mortality of SHB larvae/pupae. Further bioassay investigations with the large containers confirmed the results from the previous bioassays, with optimal doses being similar to recommended field rates for other pest species. Results for the *M. anisopliae* treatment were less encouraging, with no SHB mortality occurring. The investigations on residual activity demonstrated that there was significant activity up to seven days after the initial application of nematode treatments, as evidenced by the reduced adult SHB emergence.
Implications	This work has implications for the Australian honeybee industry in its attempts to sustainably control SHB. Provided field trial data confirm the results reported here, drenches of entomopathogenic nematodes can be applied to soil areas surrounding hives to control SHB in apiary sites. As these are currently commercially available, registered strains of nematodes, uptake of this technology should be quite rapid.
Publications	RIRDC Publication in press.

PRODUCTION - DISEASES & PESTS

Project Title	Feasibility study into in-hive fungal bio-control of small hive beetle
RIRDC Project No.:	PRJ-000037
Start Date:	01/07/07
Finish Date:	31/07/08
Researcher:	Ms Diana Leemon
Organisation:	The State of Queensland through the Department of Primary Industries and Fisheries
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Objectives	To carry out a feasibility study into the fungal bio-control of Small Hive Beetle (SHD) using endemic isolates of the fungi *Metarhizium anisopliae* and *Beauveria bassiana.*
Current progress	Strains of *Metarhizium anisopliae* from both the DPI&F Animal Research Institute fungal collection and newly isolated from small hive beetle adults and larvae were screened against these beetle stages. Assay systems were designed to expose larvae and adults to fungal spores in a manner similar to that which would be practical in or around hives. Of the 20 isolates screened against larvae, seven isolates caused more than 90% mortality after seven days, whereas 16 of the isolates caused 100% mortality after 14 days. Fungal soil treatments under hives are currently being evaluated for larval control. Twelve assays have been conducted against adults using eight isolates. Different methods of exposing the adults to fungal spores have been trialled. Despite initial positive results, these assays have failed to deliver either consistent results or levels of beetle mortality that would be useful to industry. Several investigations into possible factors that might account for the poor results have also failed to provide useful leads. Additives such as diatomaceous earth that might increase adult beetle mortality have also been investigated with limited success. Further investigations with adult beetles are ongoing. Spore powder dispersed within hives was found to be cleaned up by worker bees within seven days. Although some dead bees collected later had Metarhizium infections, there was no clear effect of the fungal spores on these hives.

PRODUCTION - DISEASES & PESTS

Project Title	Small hive beetle biology providing control options
RIRDC Project No.:	DAN-250A
Start Date:	1/06/06
Finish Date:	30/12/08
Researcher:	Mr Nick Annand
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Objectives	• To determine temperature, humidity and air movement thresholds to prevent any small hive beetle (SHB) damage to stored honey supers (fulls and stickies) and what techniques/appliances could be used practically in the sheds of beekeepers. • To determine if weak hives and queen-less hives are more attractive and more susceptible to SHB damage than strong healthy hives. • To identify the usual daily movements of SHB in and out of managed beehives during each season of the year. • To find the number of SHB in the immediate vicinity (ground surrounding and under the hive) of a bee hive compared to the SHB inside the hive for each season of the year. • To identify ways of cleaning combs that have been 'slimed' as a result of SHB larval damage causing honey fermentation.
Current Progress	Trial 1- Has yet to be started however equipment and SHB should be ready to start in June/July, to determine SHB temperature and humidity thresholds for egg laying and egg survival. Trial 2 - All the field work and data collection for this trial was completed between Feb-March. Photos of all the brood frames have yet to be analysed which will provide hive strength data. All the data then needs to be analysed to see if there is any correlation between hive strength and queen rightness to hive susceptibility to SHB damage. Trial 3 & 4 - Both were started in February 08. Data collection for both is on going throughout the proceeding year. Trial 3 - Four hives are being monitored by CCDVR over a 24 hour period each time. So far this has been done twice. Recording has yet to be reviewed and analysed, but SHB have been observed on screen entering the hives. Trial 4 - Six traps have been made and are being used in combination with six hives. They have been set twice, with only small numbers of SHB being collected within the traps relative to SHB numbers in the hive. Trial 5 - A trial has been developed however the summer season ended prior to implementing the plan so it has been delayed until next summer.

PRODUCTION - DISEASES & PESTS

Project Title	A study of Gluconobacter – gluconic acid producing bacteria, symbionts of bees: development of biological control for chalkbrood
RIRDC Project No.:	ANU-58A
Start Date:	01/01/02
Finish Date:	30/11/08
Researcher:	Dr Murali Nayudu
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Objectives	• To isolate and characterise bacteria from varied Australian bee hives that produce antifungal agents effective against the chalkbrood disease. The results of this strategic basic research will provide specific information to carry out applied research in the future to develop a biological control of chalk brood disease.
Current Research	This project is studying the important symbiotic association of bacteria with Australian honeybees (in the gut). A major Australia-wide ecological study of intestinal flora of bees has shown that healthy hives have high bacterial counts and a significant number of bacterial species inhibit chalkbrood. While chalkbrood diseased hives have much lower bacteria counts and virtually no bacterial strains in the bee gut that can inhibit chalkbrood. Bacteria have been isolated from almost all regions of Australia and characterized. We have stored about 120 different bacterial isolates from bee guts, which can strongly inhibit the chalkbrood fungus. There seems to be a propensity of different gram negative bacterial species such as *Pseudomonas*, *Klebsiella* and *Gluconobacter*. *Bacillus* gram positive bacterial species have also been isolated that can inhibit chalkbrood. We are currently studying the mechanisms by which these bacteria are able to inhibit chalkbrood. One mechanism we have identified is the production of the anti-fungal agent gluconic acid. We are currently testing the feasibility of a number of these bacterial isolates and the pure gluconic acid to be used as a probiotic by feeding, in protecting against the chalkbrood disease in Apiaries.

PRODUCTION - DISEASES & PESTS

Project Title	Development of treatment options for European foulbrood

RIRDC Project No.:	DAN-245A
Start Date:	01/01/06
Finish Date:	31/07/08
Researcher:	Dr Michael Hornitzky
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Objectives

- To determine the minimum infectious dose of *Melissococcus pluton* required to initiate European foulbrood (EFB) in artificially raised honey bee larvae.
- To determine whether eight fatty acids (previously demonstrated to inhibit the growth of *M. pluton*) can protect honey bee larvae from infection with *M. pluton*.
- To determine the minimum inhibitory concentration of oxytetracycline to *M. pluton* in artificially raised honeybee larvae.

Current Progress

The optimised larval assay has been used for testing further candidate fatty acids as well as oxytetracycline for the treatment of European foulbrood (EFB).

The larval assay involves grafting individual larva (less than 24 hours old) into a single well in a micro-titre plate. Each larva is fed a basic larval diet containing 500,000 *Melissococcus plutonius* organisms. After three days the larvae are also fed 60,000 *Paenibacillus alvei* spores to better mimic the development of EFB as this is the most common secondary invader associated with EFB in Australia. Most larvae infected using this protocol will die from EFB. To determine the efficacy of the fatty acids, infected larvae were concurrently fed with 20 µg/ml or 200 µg/ml of the fatty acids.

A further three fatty acids (ricinoleic acid, ricinelaidic acid, homo-y-linolenic acid) have been tested in the larval assay. However, like the previously tested fatty acids, these three did not protect larvae from EFB. The work with the 8th fatty acid (docosutrienoic acid methyl) is being finalised.

Further work has been carried out regarding the efficacy of oxytetracycline for the treatment of EFB. The minimum inhibitory concentration of oxytetracycline to effectively prevent EFB developing in artificially raised honey bee larvae was determined to be 2.5 µg/ml.

PRODUCTION - NUTRITION

Project Title	Development of a pollen substitute meeting the nutritional needs of honeybees
RIRDC Project No.:	JLB-4A
Start Date:	01/07/06
Finish Date:	30/11/09
Researcher:	Dr John Black
Organisation:	John L Black Consulting
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Objectives	• Develop specifications for an effective pollen substitute that is attractive, meets the requirements of honeybee colonies and is as economically viable as possible.
Current Research	Successful artificial pollen must meet three essential criteria. It must be attractive to foraging bees. It must provide all nutrients essential for a rapidly growing colony other than energy including amino acids, fatty acids, minerals, vitamins and hormone precursors. It must not include toxic substances such as starch and oligosaccharides. Previous pollen substitutes have been manufactured ad hoc from a range of ingredients and not met these criteria. They have been partially successful only because they contained bee-collected pollen. The complete nutrient requirements for viable honeybee colonies were developed in a previous RIRDC project (JLB-2A). Twenty nine lipid-based or other materials have been evaluated for their attractiveness to honeybees by measuring the amount to an artificial pollen patty eaten and the number of bees congregated on standard patties when the materials were included at 2%. Consumption of the patties containing linseed oil, coconut oil and Bundaberg rum was significantly higher than red gum pollen. Lavender, fish and sage oils were the least attractive materials examined. The most attractive oils are next to be included in an artificial pollen consumption experiment that will examine the suitability of fifteen different protein sources from eggs, milk, blood, lupins, soybeans, canola and micro-algae while meeting mineral, vitamin and other essential nutrient requirements. This latter experiment is due to be completed by November 2008. However, because of quarantine issues in Western Australia, commencement of this cage experiment has been delayed and will not be completed until April 2009.

PRODUCTION - NUTRITION

Project Title	Testing pollen substitutes that meet the nutritional needs of honeybees
RIRDC Project No.:	DAW-121A
Start Date:	01/11/06
Finish Date:	30/11/09
Researcher:	Dr Robert Manning
Organisation:	Department of Agriculture and Food (WA)
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Objectives	• To test ingredients and feedstuffs developed by John Black Consulting (RIRDC Project JLB-4A) for preference and palatability. • To test the final substitute feeds in cage experiments for their effect on honeybee longevity.
Current Progress	Progress to date has been hampered by the principal investigator being seconded on a biosecurity matter since September 2007. There were delays in data analysis for the first experiment. This analysis was necessary for the second experiment to get underway. The project is now to be completed in November 2009. The statistical analyses of experiment one has been completed and now allow the project to continue by identifying the significant oils identified as being attractive and palatable to be included (mixed) in the next experiment where different protein will be tested against redgum pollen. It is proposed to start the next series of experiments in spring as any manipulation of hives in winter will cause an effect on the experiment. The final cage experiments testing a range of substitutes with mineral and vitamin mixes was due to commence by 30 June 2008 and will not be occurring until after completion of experiment two and further statistical analysis. J Black Consulting has been advised of the delays here and for the next experiment to commence in Spring.

PRODUCTION – INCOME DIVERSITY (completed)

Project Title	Analysis of the market for pollination services in Australia
RIRDC Project No.:	PRJ-001228
Start Date:	October 2007
Finish Date:	May 2008
Researcher:	Michael Monck
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Objectives	The aim of the study is to better inform agricultural industries that are dependent on honeybee pollination services of the impact on the price and availability of these services under different possible futures. This information should help them in developing strategies to ensure they have access to pollination services in the future at reasonable prices. Similarly the study aims to inform the honeybee industry of the opportunities that may emerge through changes in demand for pollination services. It also provides information about the likely impacts of a *Varroa* incursion on the output of certain agricultural industries.
Background	Australia is one of the few countries yet to be affected by *Varroa destructor*, a mite that affects the health of honeybees substantially reducing their lifespan and the vigour of the colony. Incursions of the mite have affected New Zealand in recent years providing good experience of how the honeybee industry can cope with the problem which tends to eliminate or substantially reduce feral honeybee populations. This has significant consequences for pollination dependent agricultural industries from almonds to pasture production. The importance of honeybee dependent pollination industries for Australian also appears to be growing, with a major expansion in almonds in recent years. At the same time the honeybee industry is facing other pressures from an aging workforce and uncertainty over access to native forests important for access to protein essential for colony health. Colony collapse disorder is emerging as a major problem in the United States, and although the cause has yet to be determined, it is clear that *Varroa* and overwork of hives in pollination are contributing factors. The honeybee and pollination dependent industries have recognised these threats and are working together to develop an alliance that will help them to ensure a sustainable future. This process is being supported by the Industry Partnership Program (IPP) and RIRDC is playing a key role in anticipation of delivering the underpinning R&D to support the industries' planning for a sustainable future.
Research	The research developed a partial equilibrium model of the market for pollination services capturing approximately two thirds of the 200,000 hives used for pollination. This required developing a derived demand for pollination services based on the scale and use of the pollination service dependant industries. A short run and long run supply function for pollination services was estimated based on the maximum capacity of the industry to double the number of hives every three years, and the current costs of supply. The pollination service market is complex with issues arising from the timing of services required and location of the crops and hence how many crops a hive can service, to the value of the crop for honey production. Thus prices for pollination services will vary by the time, location and implicit payment for the nectar and pollen. While the model allows for some of these complexities (value to honey production and transport costs) the information is not available to predict prices and quantity of pollination services at different times and locations. It estimates prices and quantity of pollination services over time under

the different scenarios, and identifies which industries will be willing to pay the price and which are likely to miss out on services if demand expands faster than supply. In the short run how much an industry is willing to pay for services depends on its dependence on the honeybee for pollination and whether returns on production will cover variable costs once the cost of pollination services is included. In the longer run, the level of fixed capital invested will be taken into consideration, and unless pollination services are available at a reasonable price, growers may switch to other crops.

Outcomes

The first scenario is the business as usual situation where there is modest growth in area of production of pollination dependant industries and little increase in the adoption of paid pollination services. Over the modelling horizon (to 2015) the expansion in demand can be largely met by current honey producers shifting into paid pollination services. This may have some minor impact on honey production, but it was beyond the scope of the study to estimate this change. It is estimated that by 2015 the portion of the pollination market included in the model will grow around 128,000 hives to nearly 225,000 hives. If the pollination industry expands as modelled over time the average price will rise from $60 to $83 per hive. The price varies by crop, with the price for almonds rising from $57 to $81 a hive.

The second scenario is a *Varroa* incursion taking widespread effect in 2010. This pushes up the costs for suppliers by $40 per hive due to the higher labour input required (20 per cent less hives can be managed) and higher costs of chemicals and supplements (estimated to rise by 20 percent). While these cost increases are substantial, the impact on demand is much greater. In 2015 the number of hives supplied is 327,000, a substantial increase on the baseline scenario. Despite the relatively small change in the quantity of hives supplied the underlying demand increase and upward pressure on costs for pollination prices sees prices peak at $219 in 2011 and 272,000 hives provided for pollination. This is less than what would be demanded by the agricultural industry to maintain current output and represents lower agricultural production in the industries that cannot access enough pollination services. Some industries, such as almonds and cauliflower seed production, will see output decline by 10 per cent or more.

Over time there will be a response to the price signals by the pollination providers. Existing providers will increase their capacity while new entrants will emerge. By 2015 the price is estimated to have fallen to $162 which is higher than the base case reflecting the higher costs of hive management with *Varroa*. The value of crop losses is somewhat dependent on the alternative options for farmers. Some farmers may opt to employ their current resources such as land and capital in non-pollination dependent ventures while others may choose to leave the agricultural sector altogether. Estimating the value of these losses was beyond the scope of this modelling exercise.

The third scenario looks at the *Varroa* incursion scenario under the situation where supply constraints are being addressed more proactively. This is called the "insurance" scenario. The modelling exercise is not concerned with how the constraints are dealt with but simply assumes they are overcome and the industry is thus able to expand more rapidly. The cause of this does not have to be specified as the focus is on how such actions would change the outcome in the case of a *Varroa* incursion. The model assumes that growers are also proactive and support the growth of the pollination industry by increased adoption of paid services. Speeding up the response of growers and pollination providers changes the estimated price of pollination services in 2011 from $219 to $142, and the volume of services purchased in 2011 from 272,000 to 443,000.

Implications	The implications of the analysis are quite clear – that there is considerable value for both the agricultural industries and potential pollination service providers in actions to speed up the responsiveness of supply of pollination services. There is also clearly value to agricultural industries dependant on honeybee pollination in improvements in productivity in the pollination service industry as, given that the assumptions of a competitive industry are correct, the benefits will flow to predominantly to the service using industries. The analysis shows that under a business as usual situation the pollination service providers are able to expand to meet the growing needs of the industry as long as these needs remain modest. That is, as long as there are feral honeybees that provide the services for free. If this situation changes, the current honeybee industry will not be able to adjust in time to keep up with demand. In this, the analysis confirms the motivation for the formation of the Pollination Alliance.
Publications	RIRDC Publication No. 08/058

RESOURCES (completed)

Project Title	Securing long-term floral resources for the honeybee industry

RIRDC Project No.:	UA-66A
Start Date:	01/07/04
Finish Date:	15/01/08
Researcher:	Dr David C Paton
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Objectives

- The broad aims of this project are to better document the use and importance of native plants (particularly woodland eucalypts) in different landscapes (natural bushland, paddock and revegetation) to commercial beekeepers, identifying deficiencies in the resource base where they exist. This information will then be used to assist in maintaining the health and productivity of current trees from a beekeeper perspective while growing the floral resource base through appropriate revegetation and restoration programs.

Background

The Australian honeybee industry depends on floral resources provided by a variety of native and exotic plants. These resources are changing as a consequence of vegetation clearance, dieback of rural trees, improved control of exotic plants, and intensification of agriculture. Climate change also has the potential to affect floral resources. To be able to plan for the future, the honeybee industry needs to better document the floral resources that are currently being used and to establish baselines from which to monitor changes in these resources over time.

Research

Significant quantities of nectar accumulated in the flowers of key eucalypts even close to apiaries, indicating that honeybees were unlikely to be having a detrimental effect on native nectarivores in heavily cleared areas. This was particularly true for scattered paddock trees that were used less frequently by nectar-feeding birds than trees in intact native vegetation. The high levels of nectar present in flowers were due to a lack of visitation by native fauna (and honeybees) and were not due to changes in rates of production which varied no more than two fold within a species for a wide range of species and settings. In comparison flowering levels varied dramatically from one year to the next. A simple method was developed for scoring flowering levels of eucalypts.

Baseline measures of floral production were established for 24 species of eucalypt and three key understorey species. Droughts, fires and frosts all affected the quantity of flowers produced by eucalypts, native understorey shrubs and introduced weeds. Only a few plant species provided pollen for honeybees at each of the six primary study sites. These included native epacrids, selected eucalypts and introduced weeds. The distribution and abundance of key floral resources used by honeybees were mapped at four study sites in the Mt Lofty Ranges against which future changes in resources can be measured.

Revegetation programs can offset floral resources lost to beekeepers provided planting densities are kept low.

Outcomes	The floral resources used by honeybees are sensitive to drought, fire and cold temperatures, and these can affect the quantities of flowers produced for more than just a single flowering season. Since the numbers of flowers and not the quantity of nectar produced by flowers is the major variable affecting resource production, monitoring the quantities of flowers produced each year over extended periods is required to document long-term changes in resources. South Australian beekeepers will commence monitoring some of their floral resources in 2008 using the simple technique developed for this study.
Implications	Given that droughts, fires and extremes in temperature are all likely to increase with climate change, floral resource availability is likely to decline in the future. The honeybee industry is therefore likely to be significantly affected by predicted climate change. In general the low visitation rates by honeyeaters to flowers during this study may indicate that these birds are also vulnerable to the impacts of climate change, and sounds a warning for wildlife managers.
Publications	RIRDC Publication No. 08/087

RESOURCES (completed)

Project Title	Long-term flowering patterns of south-east Australian melliferous flora
RIRDC Project No.:	UD-3A
Start Date:	1/07/05
Finish Date:	12/05/08
Researcher:	Dr Maria Gibson
Organisation:	Deakin University
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Objectives	• Determine long-term flowering patterns of south-east Australian melliferous flora (including Eucalyptus, Banksia and Eucryphia species) • Investigate pollen-related bee nutrition • Investigate occurrence of 'toxic' nectar in Victorian eucalypts • Compile a written, accessible record of anecdotal information sourced from highly experienced apiarists • Investigate Bogong moth visitation, logging and their effects on nectar production.
Background	Studies of flowering ecology which use long-term data are hugely important and enable implementation of management practices which ensure the sustainability and growth of natural resources and industry. Thus, the importance of producing a database of flowering ecology derived from apiarists' long-term observations is vital.
Research	Face-to-face interviews and surveys were used to collect 66 commercial apairists' knowledge of flowering ecology and pollen-related bee nutrition. Investigation of nectar toxicity to bees involved collection of nectar from the floral cups of four melliferous species, and analyses to determine the presence/absence of yeasts and alcohol.
Outcomes	Flowering and nectar production patterns were determined. Factors which influence flowering ecology are included, as are tools used by apiarists to successfully predict flowering and nectar production. Long-term decreases in flowering intensity and nectar yield were observed. Nectar toxicity to honeybees is caused by nectar fermentation and could cause those symptoms observed by apiarists of honey bees and hives. Pollen quality affects honeybee and hive health.
Implications	This important research has contributed greatly to the database of Australian melliferous resources, and is of value to the beekeeping industry, science and the community. Our investigation into nectar toxicity enables beekeepers to better manage their use of floral resources. Recognising which factors affect flowering and nectar production enables predictive resource management by beekeepers and other land managers. This research represents a strengthened relationship between scientists and the beekeeping industry. Information provided by beekeepers provides vital baseline information which can be used by scientists for a raft of applications, the outcomes of which benefit the beekeeping industry.
Publications	Birtchnell, M J and Gibson, M (2006). Long-term flowering patterns of melliferous *Eucalyptus* (Myrtaceae) species. *Australian Journal of Botany*. **54**, 745 – 754. Birtchnell, M J, Tyshing, C and Gibson, M (2005). 'Drunken' honey bees. *The Victorian Naturalist.* **122**(2), 120.

OFF-FARM ISSUES

Project Title	An investigation into the therapeutic properties of honey
RIRDC Project No.:	US-128A
Start Date:	31/07/04
Finish Date:	30/09/08
Researcher:	Dr Dee Carter
Organisation:	The University of Sydney School of Molecular and Microbial Biosciences Building G08 UNIVERSITY OF SYDNEY NSW 2006
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Objectives	• The objectives of this study are to conduct an ongoing screen of Australian honeys for therapeutic properties, and to build on our previous work on the antimicrobial and wound healing properties of honey. This will lead to an increase in the use and acceptance of honey as a therapeutic agent in conventional medicine.
Current Progress	Testing for our survey of antibacterial activity in Australian honeys has been completed, with 503 honeys tested (477 Apis, 26 Trigona). Honeys were obtained from all states except NT (NSW: 275 honey samples; WA: 92; TAS: 46; QLD: 28; VIC: 21; SA: 15), from 142 different floral sources, with 78% from native Australian flora. The antibacterial activity of the honeys varied greatly. Therapeutically beneficial total activity (ie activity against S. aureus > 10% phenol equivalence) was found in 57.5% of the honey samples. Very high levels of activity (> 20% phenol equivalence) were found in 17.9% of honeys tested, while 40% of the honeys had insignificant therapeutic value (< 5% phenol equivalence). Therapeutically beneficial non-peroxide activity was rare, and was found in 14.3% of the honeys tested. Of these honeys 77.5% were from Leptospermum floral sources, and the most active Leptospermum honeys came from northern NSW and southern QLD. Data analysis is ongoing; however the wide variation in antibacterial activity of honeys, including variation among different samples from the same floral source, points to the necessity of testing each batch for activity. This indicates that while antibacterial activity is associated with floral source, numerous other factors are likely to contribute.

OFF-FARM ISSUES

Project Title	Investigate the value added potential of the prebiotic components of Australian honeys
RIRDC Project No.:	PRJ-000041
Start Date:	1/07/07
Finish Date:	1/05/09
Researcher:	Patricia Conway
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Objectives	The aim of this project is to investigate the prebiotic capacity of Australian honeys and to determine which Australian honeys have the greatest capacity to act as prebiotics to promote beneficial bacteria and hence have the potential for imparting health benefits to the consumer. These findings will then be available to promote the sales of honey to the food industry, for both the local and export markets.
Current Progress	A detailed review of the literature has been carried out to cover methodology and findings from other countries of the prebiotic properties of honey. In addition the micro-nutrient composition of honeys and characteristic that could impact on growth of beneficial bacteria has been included in the review. Honey samples have been sourced from all states and the Northern Territory. Seventeen samples in total have been obtained and are representative of many floral varieties. Honey contains high levels of easily digestible simple sugars including fructose and glucose which would be rapidly absorbed in the human body and is not available to function as a prebiotic. Consequently, honey samples are being extracted to retain the more complex sugars. Both natural honey and the extracted complex sugars are being tested to determine the prebiotic potential. In preliminary trials, several honeys exhibited prebiotic potential when tested using six different species of beneficial bacteria. Results to date hold promise for providing evidence that several Australian floral varieties have prebiotic potential and consequently can be anticipated to provide health benefits to the consumer. These findings will assist in adding value to Australian floral varieties.

COMMUNICATION AND EXTENSION

Project Title	Honey Industry Survey 2006/07

RIRDC Project No.: PRJ-000968
Start date 30/4/07
Finish date 1/08/08
Researcher: Milly Lubulwa
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Objectives

- The objective of this project is to generate a consistent set of estimates for the production and financial characteristics of honeybee producers in Australia, in line with the survey done by ABARE in 2001-02.

Current progress

Milestone 1 Exchange of contract 25/2/08
The contract was signed by all parties. ABARE signed on 29 February 2008 and RIRDC on 3 March 2008.
Milestone 2 Questionnaire design 28/2/08
The questionnaire was developed by ABARE in consultation with representatives from RIRDC, Australian Honey Bee Industry Council (AHBIC) and the industry. It was finalized at the end of March in time for the survey which began on 14 April 2008.
Milestone 3 Statistical Clearing house 29/2/08
The Statistical Clearing House template was submitted on 12/3/08 and the survey was approved on 8 April 2008.
Milestone 4 Sample selection 6/3/08
The sample was selected from lists of honey bee producers compiled by state registers of apiarists. We had very good cooperation from the state representatives in obtaining the lists. The sample was randomly selected from each strata (state). In designing the sample survey, care was taken to enable representative estimates to be obtained for each state and for the two regions in NSW. This process was completed in time for the survey.
Milestone 5 Field work commenced 15/3/08
Data collection started on 14 April 2008 via telephone interviews.
Milestone 6 Field and data entry work completed 30/4/08
Data collection is nearly completed. Approximately a third of the surveys have been entered into the data base. Data entry will be finalised by 16 May.

State/Territory	Targeted sample	To-date sample
NSW	33	33
QLD	27	26
Tasmania	18	14
WA	21	21
SA	21	21
Victoria	24	24

PRODUCTION - GENETIC IMPROVEMENT

Project Title	Development of two genetic markers for hygienic behaviour of honeybees

RIRDC Project No.:	US-123A
Start date	1/07/03
Finish date	30/11/08
Researcher:	Ben Oldroyd
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Objectives

- Identify two genes related to hygienic behaviour at the level of their sequence
- Produce a diagnostic test for identification of individuals carrying the allele that confers hygienic behaviour without field testing.
- Develop general procedures for the identification of economically important behavioural genes for the honeybee and protocols for their exploitation by industry.

Background

Lapidge, Oldroyd and Spivak (2002) identified seven putative genetic markers for hygienic behaviour.

Research

The markers identified by Lapidge et al were cloned and sequenced. The sequence data was used to mine the honey bee genome resources for candidate genes, as well as to develop a more reliable DNA test.

A novel breeding system allowing control of queen mating flight time was investigated using genetic markers to assess its success.

Outcomes

The density of the genetic map was insufficiently high to allow discrimination of causative genes near the genetic markers.

Three genetic markers were field tested and two shown to correlate with hygienic behaviour. One of these markers was successfully developed into a more robust test. However, this new test did not deliver an identical genetic diagnosis as the original marker, probably due to cryptic alleles. One such allele was identified, but further cryptic alleles were still implicated, and the test was unable to be developed commercially.

A new genetic backcross of hygienic bees was created, which is capable of being evaluated using superior molecular resources recently made available. Results from this test are expected to both reveal gene candidates and provide suitable genetic markers for commercial application, through marker assisted selection.

The novel queen controlled mating flight time facility was found to be extremely effective in preventing feral colonies from mating with the queens, with less than 1% of offspring shown to come from feral drones.

Implications

Marker assisted selection has been shown to be a feasible method of identifying individuals that display a greater tendency for hygienic behaviour. This can be effectively combined with a controlled mating system such as the one investigated, to allow improvement of honey bees through selective breeding.

Publications

Oxley, PR; Hinhumpatch, P; Gloag, R; Oldroyd, BP (2008) A genetic evaluation of a system for controlled mating of the honey bee Apis mellifera that does not involve isolated mating or artificial insemination. In prep.

Oxley, P; Thompson, G; Oldroyd, B (2008) Four QTL that influence worker sterility in the honey bee (Apis mellifera). Genetics, in press.

RIRDC Publication No. 08/092

POLLINATION (completed)

Project Title	Pollination Australia – comprehensive risk management strategy consultancy
RIRDC Project No.:	PRJ-002587
Start date	19/10/07
Finish date	24/05/08
Researcher:	Rob Keogh
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Objectives	To inform the pollination industry on issues relevant to the identification and the quantification of the risk associated with the incursion of Varroa mite (and other exotic pests and diseases) and the risk associated with structural change that could occur to the honeybee industry and pollination dependent industries.
Background	The report is concerned with highlighting the key issues that need to be considered in identifying, prioritising and actioning strategies to manage the risks for pollinators and growers dependent upon pollination for the production of crops. Investment in risk management strategies will assist in securing to reliable, consistent quality and cost effective pollination services to support the sustainability without which many Australian rural industries would not be productive.
Research	A prime focus of this study has been the risks posed by an incursion of an exotic pest or disease of significance to the pollination industry and the mite, Varroa destructor in particular. Research and consultation undertaken as part of this study suggest that the pollination industry should have a broader view of pests and diseases than might have been anticipated and have identified four broad groups that require attention.
Outcomes	
Implications	
Publications	RIRDC Publication No. 08/054

POLLINATION (completed)

Project Title	Pollination Australia – Education and Training
RIRDC Project No.:	PRJ-002588
Start date	19/10/07
Finish date	24/05/08
Researcher:	David Brous
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Objectives

Determine the education and training needs of pollinators that allow them to develop a business model and appropriately price services including:

- identification and measurement of the risks involved in offering paid pollination services
- identification and measurement of the benefits provided by paid pollination services to the grower
- pricing of services that provide a return commensurate with the expanded risks from supplying paid pollination services, and
- development and use of a business model that leads to a more profitable and sustainable paid pollination business;
    - investigate the education and training needs for the development of a quality assurance program within the pollination industry;
    - investigate the opportunities for formal recognition of training such as national certificate diplomas and the use of units of competency already established and cross training in other pollination dependent industries, including
- development of education and training competency units,
- development of materials required to undertake training courses,
- locations of training courses,
- incorporation of education and training into existing programs (eg within the honeybee industry and the horticultural industries),
- the overcoming of impediments to education and training, such as the current state-by-state arrangements,
- estimated costs of training requirements,
- investigation of alternative avenues of funding
- determination of the likelihood of receiving sufficient funding from potential avenues, and
- development of an implementation plan

Background

A briefing paper was prepared to support the preliminary analysis and assist in the determination of issues for discussion at a workshop on 10 December 2007 in Canberra. The paper addressed current education and training initiatives in the pollination industry and pollination dependent industries. The skills and competencies required to develop paid pollination services, including:

- the supply of services,
- the economic impact,
- yield increase differentials,
- crop quality considerations,
- reliability, and
- differences between crops, etc;
- education and training implications of alternative pollination approaches; and
- initial thoughts on the pollination industry and pollination dependent industry education and training gaps and future needs.

Research	The education and training strategies being studied in detail in this project and the identification of opportunities for implementation, will provide input into consideration of the R&D gaps and priorities. The outcomes of this consultancy will be taken up by the CIE in its development of a business plan for the proposed Pollination Australia.
Outcomes	
Implications	
Publications	RIRDC Publication No. 08/059

New Projects –2008/2009

New projects being funded or under consideration in the 2008/2009 financial year are as follows:

Title	Researcher
Hygienic behaviour of the Western Australian bee breeding program	Robert Manning
A study of Nosema ceranae in Australia	Michael Hornitzky
Simulation model of an incursion (and workshop)	(TBA)
Determination of the Glycaemic Index of Australian Honeys	Jennie Brand-Miller
Marcus Oldham Rural Leadership Program	Joanne Stavrakis

Non-RIRDC Publications and Videos

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

Beekeeping in the NSW State Forest Districts
by NSW Agriculture, $5 each, phone (02) 4823 0616 to order

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

Current reports in the series are:

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

- Beekeeping in the Urunga State Forests (1998)
- Beekeeping in the Casino State Forests (1998)
- Beekeeping in the Gloucester/Walcha State Forests (1998)
- Beekeeping in the Dorrigo State Forests (1998)

Chalkbrood Disease of Bees

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

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

Bee Parasites Exotic to Australia

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

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

Endemic Bee Diseases (VDO5) 1992

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

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

Package Bee Production in Australia

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

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

RIRDC PUBLICATIONS

Analysis of the Market for Pollination Service in Australia	08/058 (2008, 20pgs)	$26
Introduction and Performance of Queen Bees - Introductory Apiary Status and Post Introduction Results	(08/099 DAN-164A)	Web only (free)
Development of Two Markers for Hygienic Behaviour of Honeybees	08/092 (2008, 31 pgs)	$16
Securing Long-Term Floral Resources for the Honeybee Industry	08/087 (2008, 41 pgs)	$21
A Survey of the Fatty Acid Composition of Australian Pollens	(08/034 DAW-100A	Web only (free)
The Effect of High and Low Fat Pollens on Honeybee Longevity	(08/031 DAW-105A)	Web only (free)
A study of New Zealand Beekeeping – Lessons for Australia	08/060 (2008, 48pgs)	$25
Pollination Australia – Research and Development Priorities	08/055 (2008, 71pgs)	$20
Pollination Australia – Biosecurity risk management	08/054 (2008, 97 pgs)	$20
Pollination Australia – Education and Training	08/059 (2008, 90 pgs)	$25
Nosema Disease – Literature review and three year survey of beekeepers – Part 2	08/006 (2008, 36pgs)	$15
Insecticidal Control of Small Hive Beetle : Developing a ready-to-use product	07/146 (2007, 34pgs)	$20
High-power Ultrasound to Control of Honey Crystallisation	(07/145 UQ-101A)	Web only (free)
The Effects of Logging Nectar-Producing Eucalypts: Spotted Gum and Grey Ironbark	07/138 (2007, 68pgs)	$21
Honeybee Research Compendium 2007	07/139 (2007, 85pgs)	$20
Field Trials to Test Supplementary Feeding Strategies for Commercial Honey Bees	07/119 (2007, 63pgs)	$16
Honeybee Industry Linkages Workshop	07/067 (2007, 10pgs)	Free
Commercial Beekeeping in Australia (Second Edition)	07/059 (2007, 46pgs)	$21
Honeybee Five year Plan 2007-2012	07/056 (2007, 39pgs)	Free
Honeybee Nutrition – Review of research and practices	06/052 (2006, 79pgs)	$16
Honeybee Research in Progress Report 2006	06/051 (2006)	Free
Nosema Disease-Literature Review & Survey of Beekeepers	05/055 (2005, 26 pgs)	$21
Honeybee Research Reports (Version 3)	CD05/001	$26
Fat Bees Skinny Bees-A Manual on Honey Bee Nutrition for Beekeepers	05/054 (2005, 150 pgs)	$30
Honeybee Research Report 2005	05/053 (2005, 33 pgs)	Free
Antioxidants in Australian Floral Honeys – Identification of health-enhancing nutrient components	05/040 (2005, 94 pgs)	$21
A Preliminary Assessment of the Glycemic Index of Honey	05/027 (2005, 33 pgs)	$16
Oxytetracycline Sensitivity of Paenibacillus Larvae.SUBSP. Larvae Isolates	05/021 (2005, 12 pgs)	$16
Improving Queen Bee Production	04/153 (2004, 23 pgs)	$16
Disappearing Disorder	04/152 (2004,18 pgs)	$16
Evaluating Alternative antibiotics for Control of EFB	04/095 (2004, 54pgs)	$16
A beekeeper's guide to understanding control measures for European Foulbrood	04/091 (2004, 43pgs)	$21
Floral Resources used by the South Australian Apiary industry	04/089 (2004, 74pgs)	$21
Honeybee Research Report 2004	04/078 (2004, 33 pgs)	Free
Valuing Honeybee Pollination	03/077 (2003, 47pgs)	$16
Small Hive Beetle in the USA	03/050 (2003, 69 pgs)	$21
Introduction & Early Performance of Queen Bees	03/049 (2003, 45pgs)	$16
Honey Industry Survey	03/039 (2003, 39pgs)	$21
Commercial Beekeeping in Australia	03/037 (2003, 86 pgs)	$21
Fatty Acids – an alternative control strategy for honeybee disease	03/028 (2003, 19 pgs)	$16
R&D Plan for the Honeybee Program 2002-2007	02/081 (2002, 21 pgs)	Free
Breeding hygienic disease resistant bees	02/048 (2002, 35pgs)	$16
Techniques for the detection of adulterated honey	02/047 (2002,16pgs)	$16
The Use of Honeybees as a Transfer Vector for Control of Core Rot in Apples	02/046 (2002,54pgs)	$16
Literature Review of Chalkbrood-a Fungal Disease	01/150 (2001, 20pgs)	$16
Pollen Analysis of Eucalypts in Western Australia	01/053 (2001, 63pgs)	$16

Honeybee Disease Barrier Management Systems	01/052 (2001, 23pgs)	$16
Hot Wax Dipping of Beehive Components	01/051 (2001, 28pgs)	$16
Beekeepers Use of Honey & Pollen Flora Resources in Victoria	01/050 (2001, 104pgs)	$21
Quality Survey of Australian Honeys	01/049 (2001, 42 pgs)	$16
Controlling American Foulbrood	01/048 (2001,14pgs)	$16
Nutritional Value of Bee Collected Pollens	01/047 (2001, 166pgs)	$21
Nosema Disease in Honeybees-Genetic Variation & Control	01/046 (2001, 36pgs)	$16
Honeybee Research Reports (Version 2)	C01/001	$26
Pollination Manual 2001	C00/001	$26
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