AUSTRALIA'S

HONEYBEE NEWS

"The voice of the Beekeeper"

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MERRY CHRISTMAS & HAPPY NEW YEAR

AUSTRALIA'S HONEYBEE NEWS

The Journal of the NSW Apiarists' Association Inc. (NSWAA)

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COVER: Flowering Red Gum to brighten your Christmas edition Photo: Bruce Blunden

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PRESIDENT'S REPORT

Season
Most areas have had good falls of rain, especially in the North. This has helped the flowering of species that were budded, namely Hill Gum, Yellow Box, Red Gum and White Clover.

In the South of the state production has been difficult with not many species budded, dry weather until recently and Paterson's curse not yielding the normal big crop for the spring.

Honey supply is not that strong and stocks in hand to Christmas may have to stretch through to the winter. We would expect prices to remain firm and in some cases increase towards next winter.

Secretary
A number of applications were received for a new secretary and a panel was appointed to interview the short listed applicants. The panel has selected a candidate and negotiations are proceeding with the likely start to be early to mid February.

State Executive
An early reminder to start thinking about who you would like to stand for the State Executive. For too long there has not been a ballot for executive members and I don't believe this is healthy for the Industry.

The honeybee industry is at a point where it is beginning to be recognised as an important industry for agriculture and food security. It is also an industry under threat from pests/diseases, loss of resources and attrition of older beekeepers who are not being replaced by younger people.

The Industry needs representatives who are forward thinking, dynamic and energetic to allow the honeybee industry to take its rightful place in the agricultural, political and public arena.

AFB
The report on AFB prepared by Michael Clarke has been presented to senior NSW Agriculture Bureaucrats. They do not want to act on the report. The executive do not intend to let the matter rest and will be pursuing the problem further.

Dates for your Diary
The 2012 Sydney Royal Easter Show will be held from Thursday 5 April to Wednesday 18 April. Please consider volunteering to work on the Show. Accommodation is provided for our country volunteers which is only a short train ride to the showground. A notice will be in the next edition so please gather a few volunteers from your branch and join us in Sydney.

Plans are well underway for the 2012 Conference (24-25 May) to be held in Coffs Harbour which is always a popular venue. There are many types of accommodation available. Contact: Coffs Coast Visitors Information Centre on 1300 369 070 or go to their website www.coffscoast.com.au.

Bee Trade Show 2012
All suppliers of equipment and services to the Industry are invited to attend the Conference and take part in the Trade Show. We have booked a room just for this purpose and after the success of past years it is something not to be missed. Contact Therese Kershaw (See Ad below) if you are interested. Ecroyd have kindly offered to again sponsor the Trade Show and are having a Wine & Cheese Evening on 24 May.

Sponsors
We also would like to invite sponsors for our Conference. Contact the Interim Secretary on (02) 6732 1263 or nswapiaristsassociation@gmail.com if you would like to sponsor Morning Tea or the Conference Papers.

Christmas Wishes
We are drawing closer to the end of 2011 and Christmas is right here, so on behalf of the Executive I would like to wish everyone a Safe and Happy Christmas and a Prosperous and honey filled 2012.

Bill Weiss
State President

APITHOR™ SMALL HIVE BEETLE HARBOURAGE - SAFE AND EFFECTIVE CONTROL OF SMALL HIVE BEETLE

Dr. Garry Levot, Principal Research Scientist
Elizabeth Macarthur Agricultural Institute
NSW Department of Primary Industries

Many Australian bee keepers are now using APITHOR™ Hive Beetle Harbourage (Figure 1) to control beetles in their hives. APITHOR™ is the culmination of research conducted by the NSW Department of Primary Industries with co-funding from the Rural Industries Research and Development Corporation and commercialisation and production by Ensystex Australasia Pty. Ltd.

The development of APITHOR™ took several years of hard work but can be described in just a few sentences. The behaviour of the beetle convinced me that an insecticide-treated refuge trap, rather than a bait, offered the best option for an 'in-hive' control strategy. The logic behind this decision was that there was already plenty of food potentially available inside a hive but no hiding places protected from the harassment of bees. Not just any insecticide would do either. It was vital that the insecticide should be potent against adult beetles but not produce any toxic vapours that might affect the bees or contaminate honey and wax. A number of potential candidates were tested in laboratory trials and fipronil was chosen. The beetles love to hide inside corrugated cardboard and the cardboard was also well suited for treatment with fipronil solution. The next critical stage was to develop a plastic shell to hold the fipronil-treated cardboard in such a way that bees could not contact the cardboard. Several prototypes later and we had the final design. Beetles seek refuge inside the trap and in doing so, passively receive a lethal dose of insecticide (Figure 2).The product's novelty and innovation was recognised internationally with patents granted in Australia, New Zealand and the United States of America.

Extensive trials were conducted to measure the safety and effectiveness of APITHOR™. Honey ripened during a honey flow while APITHOR™ was installed in the hives was independently tested for fipronil, and no residues were detected. Trials compared the number of frames of bees, brood area and honey production in APITHOR™ treated hives and 'untreated' hives and no significant differences in any of these indicators of hive health were detected. Finally, trials were conducted to measure the changes in live beetle numbers in APITHOR™ treated and untreated hives. These trials demonstrated that in just six weeks beetle numbers were reduced to zero in the treated hives but continued to increase in the untreated hives. With this level of effectiveness and with no apparent adverse effects on bees and no detectable residues in honey arising from the deployment of APITHOR™ harbourages in bee colonies, bee keepers should feel confident that, when used as directed on the product label, APITHOR™ will control small hive beetle in their hives and will not compromise their produce or threaten the health of their bees.

As with any insecticidal product it is vital that APITHOR™ is only used according to the product label. APITHOR™ is easy to use. It is a ready-to-use product. The protective plastic shells are welded together to prevent user access to the fipronil-treated cardboard so that is safe to handle and is tamperproof. A single harbourage is placed flat on the bottom board with the end openings away from the hive entrance. It is important that APITHOR™ sits flat so sufficient area on the bottom board needs to be scraped clean prior to placement. A wire attached to the harbourage can be led through the hive entrance so that APITHOR™ can be removed without the need to dismantle the hive. Full product details, including a copy of the label, can be downloaded from the APITHOR™ website https://apithor.com.au

Because they provide too many alternative hiding places, APITHOR™ should not be used in hives with perforated bottom boards. Also, APITHOR™ should not be used if hives are likely to be subject to flooding, but it is poor practice to locate hives where they might be inundated with water anyway. APITHOR™ has a long shelf life but like any product, does not have an indefinite service life. The label directs users to remove (and replace if necessary) APITHOR™ after 3 months. Failure to remove APITHOR™ could expose beetles to sub-lethal concentrations of fipronil and this could lead to a resistance problem. APITHOR™ has been designed, developed and demonstrated to be safe to bees and effective against small hive beetle if used according to label directions. Read the label carefully. It contains all the vital information and directions.

Figure 1. APITHOR™ installed on the bottom board of an open hive.

Figure 2. Dead beetles inside a deconstructed prototype harbourage.

NPWS VACANT BEE SITES

Consistent with the NPWS policy the Association has been notified of the surrendered sites listed below. **Applications close on 1 February 2012 -** All applicants must be registered beekeepers. If there is more than one interested party for each site a ballot will be conducted.

Applications can only be made in writing to: The Secretary NSWAA PO Box 649 Glen Innes NSW 2370 - Fax: 02 6732 1263 or Email: nswapiaristsassociation@gmail.com

Bee Site ID SF Grid	Bee site ID	SF Bee Range ID	Park Name	Park Number	Area	Region	Branch	Comments
N1064-441	441		Pilliga CCA Zone 1 National Park	N1064	Baradine	Nthn Plains	Western	Queqobla SF
N1091-1102	1102		Pilliga CCAZ3 SCA	N1091	Baradine	Nthn Plains	Western	
N1095-266-537	537	266	Pilliga CCAZ3 SCA	N1095	Baradine	Nthn Plains	Western	
N1090-1643	1643		Pilliga CCA Zone 3 State Conservation Area	N1095	Baradine	Nthn Plains	Western	
N1075-266-1237	1237	266	Pilliga East CCA Zone 2 Aboriginal Area	N1075	Baradine	Nthn Plains	Western	
N1075-266-1282	1282	266	Pilliga East CCA Zone 2 Aboriginal Area	N1075	Baradine	Nthn Plains	Western	
N1075-266-1304	1304	266	Pilliga East CCA Zone 2 Aboriginal Area	N1075	Baradine	Nthn Plains	Western	
N1090-266-1280	1280	266	Pilliga East CCAZ3 SCA	N1090	Baradine	Nthn Plains	Western	
N1090-266-1281	1281	266	Pilliga East CCAZ3 SCA	N1090	Baradine	Nthn Plains	Western	
N0464-1351	1351		Pilliga CCA Zone 1 National Park	N0464	Baradine	Nthn Plains	Western	
N0464-1450	1450		Pilliga CCA Zone 1 National Park	N0464	Baradine	Nthn Plains	Western	
N0464-1530	1530		Pilliga CCA Zone 1 National Park	N0464	Baradine	Nthn Plains	Western	
N1090-266-1141	1141	266	Pilliga East CCAZ3 SCA	N1090	Baradine	Nthn Plains	Western	
N1090-266-1234	1234	266	Pilliga East CCAZ3 SCA	N1090	Baradine	Nthn Plains	Western	
N1090-266-1235	1235	266	Pilliga East CCAZ3 SCA	N1090	Baradine	Nthn Plains	Western	
N1067-274-1526	1526	274	Timallallie CCA Zone 1 National Park	N1067	Baradine	Nthn Plains	Western	
IPA-773-1	1	773	Indigenous Protected Area	IPA	Lwr Darling	Far West	Western	
IPA-773-4	4	773	Indigenous Protected Area	IPA	Lwr Darling	Far West	Western	
N07484-C0011	C0011		Ngambaa NP	N07484	Coffs Coast	North Coast	Coastal	Topo - Eungai
N0124-C0212	C0212		Kumbatine NP	N0124	Macleay	North Coast	Coastal	Topo - Kundabung
N0124-C0213	C0213		Kumbatine NP	N0124	Macleay	North Coast	Coastal	Topo - Kundabung

MERRY CHRISTMAS

TO ALL OUR MEMBERS, READERS, CONTRIBUTORS AND ADVERTISERS

THANK YOU FOR YOUR ONGOING SUPPORT THROUGHOUT 2011 AND OUR BEST WISHES FOR 2012

NEW MEMBERS

A warm welcome to the following new members:

Les Bartlett	Shellharbour
Raymond Evans	Dubbo
Andrew Kenny	Mudgee
Garry Kenny	Mudgee
David Maloney	Broadwater

SYDNEY ROYAL
NATIONAL HONEY SHOW
5 - 18 APRIL 2012

2010 saw the introduction of the National Honey Competition with 3 commercial classes being included and competing for Gold, Silver & Bronze medals.

This is the only National Honey Show awarding Gold, Silver & Bronze medals in the Southern Hemisphere.

Entries for the 2012 Sydney Royal National Honey Show will be open in mid December and there are a variety of non-commercial and also commercial classes that are available to enter.

Please ensure that you read the Sydney Royal National Honey Show Schedule. Exhibitors are bound by the terms and conditions set out in the RAS General Regulations, the Special Apiculture Regulations, the Sydney Royal National Honey Show Schedule and the conditions detailed in each Application for Entry.

Please ensure that you have read these documents. For more information or to be added to the 2012 Show Exhibitor mailing list contact:

Elaine Rogers - Coordinator
Honey Competitions & Events
Phone: 02 9704 1449 Email: honey@rasnsw.com.au
Website: www.rasnsw.com.au

AN URBAN HOME FOR THE 21ST CENTURY BEE

A BEEHIVE CONCEPT by PHILLIPS

The collapse of honey-bee colonies is *bad* news. Seventy-four out of 100 different crop types that account for 90 percent of the global food output are pollinated by bees, but the direct cause of the phenomenon called the Colony Collapse Disorder remains unknown. Efforts are being made to bring the bee population back to a healthy level with city councils around the world encouraging the 3000 year old practice of keeping bees in cities. While not proclaiming to solve large scale crop pollination problems, Philips has turned its know-how to the equation with this futuristic concept catering for the needs of the urban beekeeper.

The Urban Beehive concept is a part of the Microbial Home Project - Philips' effort at creating a domestic ecosystem of innovative design solutions to cleaning, energy, human waste, lighting and food preservation. The house is viewed as a biological machine capable of filtering, processing and recycling what we would normally think of as waste.

The bees enter the glass pane mounted beehive via an entry tunnel located just above a welcoming pollen-filled flowerpot.

On the inside the bees encounter a set of honeycomb structures that they use to lay their larvae, as well as store honey and pollen. If you'd rather not meet the bees in person, you can simply watch them toil away safe in the knowledge that there is a gradient-tinted glass barrier between you and the laborious critters (only the orange wavelength of light which is invisible to bees gets through the glass). And if you feel adventurous enough to actually remove the glass cover and collect some honey, you can calm the bees down by releasing smoke into the hive at the pull of a cord.

Philips' idea has one big advantage over the existing urban beekeeping solutions. Jason Neufeld's ceramic Bombus Shelters or the Beehouse from Omlet UK may be equally stylish and foolproof, but they have the drawback of requiring a backyard. To install the urban beehive, all you need is a window. That said, the Philips design is still at the concept stage.

Mr. Malya Peter, a beekeeper asked by Philips to evaluate some early renders of the concept, says the solution could be used for educational purposes but points out that it is not suitable for large scale honey production and that in the long run it would not be sustainable due to low mass of bees. For a sustainable colony (one that does not have to be fed with nectar) you need three kilograms of bees (one kilogram is 30 to 50 thousand insects). Also, regardless of the colony size, the hives need some maintenance at least once a year. This is not to say that the concept is unfeasible, but it may require slightly more skill and attention than the untrained amateur urban beekeepers may be able to offer.

We do see the merits of keeping bees in cities. It's a win-win situation. Bees get a cosy place to stay, the environment benefits from increased pollination, and the nature-deprived city dwellers get to observe the marvelous world of bees from their living rooms, which in itself provides great therapeutic value. And let's not forget the free honey

DOUG'S COLUMN

Doug Somerville
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HOW THE VARROA STORY WILL UNFOLD

I should first state that at the time of writing there are no known live varroa mites in Australia. I have written a series of articles for the Honey Bee News about bee biosecurity, with particular emphasis on varroa mites. My article in the July issue was about surveillance for exotic pests and diseases. This was followed in the September/October issue with an article "What if varroa was found?" Of course this scenario is something no one wants but, given that literally the rest of the beekeeping world is currently dealing with this major pest of honey bees, it is likely that one day in the future Australia will also have to deal with it.

So what can we expect in relation to how fast the mite will spread and what effect will it have? There is a phrase that has been around for a number of decades that describes how fast a disease or pest of honey bees can spread across the countryside. The answer is "As fast as a bee truck." With the regular movement of bee hives over many thousands of kilometres, the mites will very quickly be transported across the operational areas of the commercial beekeeping industry. There are only two distinct boundaries to this movement within Australia, they are Bass Strait and the Nullabour Plans. Thus, if varroa mites were to be found in a major capital city and an eradication program was either not attempted or failed, what would happen next? There may be a restriction on the movement of bee hives, but history tells us that there will always be a few that will ignore the rules. Someone will pick up their bee hives with the naive belief that they have not got any mites in their hives and move them into the countryside. The mite population will constantly be increasing whenever bee brood is present. At some stage, possibly within the year, the mites will have spread to a load of bee hives belonging to a commercial beekeeper. These hives may be moved to several locations during the next twelve months, effectively seeding these areas with mites. Are you starting to get the picture? Given that there are no visual signs of varroa present in a hive until the mite population is extremely high, the beekeeper is unlikely to be aware of the mites' presence until the colonies start to collapse, which could be two to three years after the original first mite entered the hive.

We have an excellent example next door of what may happen in Australia but with some very important differences. Yes, I'm referring to New Zealand. Varroa mites were confirmed in the North Island of New Zealand (NZ) in 2000. The survey that followed identified mites in a large number of colonies scattered across the northern areas of the North Island. After the extent of the spread of the mite had been established, the decision was made to not attempt eradication. Some criticism was levelled at the NZ government for taking three months to complete the survey although, given that the numbers of hives to be inspected would have been considerable, the complications of doing surveillance in and around a city, plus the necessity to follow up with all movements of bee colonies over the previous 12 months, probably suggests that to complete the survey within three months was an exceptional feat and a complement to the NZ government agencies involved.

You get the impression that when varroa mites were found in 2000, the NZ beekeeping industry went into shock. The general fear held by the NZ beekeeping industry on varroa at the time was very strong, causing quite a number of beekeepers to leave the industry. Immediately after varroa was declared endemic in the North Island, quarantine lines were drawn across the map. These were intended to slow the spread of the mite and delay its impact on the south of the North Island. This was successful, but not without causing considerable grief in some quarters of the industry. Beekeeping in New Zealand is largely stationary so a similar approach in Australia is unlikely.

During these turbulent days pollination fees substantially increased, general honey prices increased, and the value of manuka honey went through the roof. Thus, the shock of having to live with varroa was very much cushioned by improved profitability of beekeeping in many areas. The die-off of unmanaged and feral bees was seen as a positive effect of varroa, improving honey yields in managed hives and increasing the demand for pollination services.

New Zealand refers to two stages of mite establishment – the acute phase and the chronic phase. The acute phase is when the mites are first establishing themselves in a given region, followed by the chronic stage. Essentially during the acute stage, the mite populations are very unpredictable because of reinvasion from collapsing colonies. The chronic stage is when the mite population is established and reasonably predictable.

Individual hive or apiary management of pests and diseases is usually sufficient to control the impact of any particular issue. The problem arises during the initial invasion of mites when managed bees can be monitored for mite populations and treated, whereas unmanaged colonies and feral colonies are left untreated in the same geographic region. As these colonies become very weak, the mites will disperse, mainly as a result of the bees absconding or drifting. Occasionally these weak colonies will be robbed by bees from more populous colonies. Thus, the mite populations are very unpredictable for at least two to three years after the initial invasion into a region.

The essential facts on varroa mites:

- Adult mites live for at least 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 estimated 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.

The Australia and New Zealand beekeeping industry operate within different rules. NZ has a protected honey market, no imports allowed, thus the spike in honey price experienced in NZ is not likely to follow in Australia as some honey packers are currently already in the practice of importing honey.

Pollination service fees will no doubt increase but for some crops, growers will have to experience significant crop losses before they start to pay for professional pollination services. In NZ, the pollination fee for kiwifruit increased immediately once varroa was found, even before the mites made their way to the main kiwifruit growing areas. Stone fruit growers, on the other hand, had to experience a number of poor production seasons before the realisation kicked in that lack of pollination was the problem, due to no feral bee activity.

The transition to pay for pollination services will be variable across the various flowering crops. Even though the income to commercial beekeepers increases due to the impact of varroa mites, it does not become the soul source of income for beekeepers. Honey production in the majority of commercial beekeeping businesses will remain the primary income source.

There is a cost associated with managing varroa, besides the price of the treatments applied to each hive. The time factor (labour) is quite considerable. Beekeepers have to be far more tuned-in to what the mite populations are doing in each apiary. This will require beekeepers to regularly check mite populations, possibly every few months in the early years. Failure to keep track of mite populations will lead to substantial losses of colonies. Many colonies will die. From the experience in other countries no matter how much information is provided, many beekeepers will remain complacent until colonies start collapsing from mite infestations.

The collective symptoms associated with very high numbers of varroa mites in a colony are referred to as Parasitic Mite Syndrome (PMS). Signs of high mite populations include: scattered and patchy brood patterns, almost similar in appearance to that caused by advanced EFB; crawling drones; and worker bees with deformed wings. When PMS is obvious, a colony, if not treated to reduce the mite population, will be dead or will have absconded within weeks. Colonies that maintain a brood nest throughout the year will require more careful monitoring of the mite population. When the colony is rearing drone brood, the mite population is able to increase even quicker.

For this reason, regular monitoring of mite populations needs to be undertaken during the acute phase to prevent unnecessary losses of managed bees. Depending on the treatment protocols chosen, one or two treatments may be necessary during the chronic phase, whereas three or more treatments may be necessary during the acute phase.

Key messages from New Zealand in relation to managing varroa are:
Do:

- Check for varroa regularly
- Apply spring and autumn treatments
- Sample in mid-summer (acute phase)
- Be prepared to remove honey early
- Follow label instructions exactly
- Use a method that offers protection
- Alternate chemicals
- Make sure the control method worked

Don't:

- Rely on visual inspections
- Be complacent about varroa
- Get caught out by varroa invasion
- Use unregistered products
- Apply chemicals when honey supers are on hives
- Use strips for longer than instructed on label
- Reduce chemical applications until after the acute phase

The main message from the New Zealand experience with varroa mites was that the economic viability of the beekeeping industry is the over riding factor in being able to deal with the impact of this new pest. Varroa may have been more devastating in NZ if the economic returns had not improved at approximately the same time as the mites were establishing throughout the North Island. The need for fair value for the honey crop was very apparent. Varroa adds extra costs, even with possible increases in yields. There is only so much pollination work to go round and these fees can only go up to levels that can be tolerated by growers. At the end of the day, the wholesale honey price is the underlying factor in the viability of the New Zealand beekeeping industry. This is also the case in Australia. Without a fair return for honey production, with or without varroa, the beekeeping industry will struggle to retain and recruit new players.

In summary, the arrival of varroa mites in Australia will mean:

a) feral bees are all but eliminated
b) honey yields increase
c) pollination prices increase
d) beekeepers who keep bees rather than manage them, abandon beekeeping
e) upward pressure on honey prices
f) seriously ad to the cost of managing honey bee colonies.

Given these factors, it is still better to be in an environment without varroa than with, although the presence of varroa creates opportunities for some.

Reference:

A Study of New Zealand Beekeeping –Lessons for Australia_. Rural Industries Research and Development Corporation. Pub. No. 08/060. www.ridc.gov.au

(Acknowledgements: Annette Somerville – editing)

CROP REPORT

NORTHERN NEW SOUTH WALES

At the time of writing this report 150-200 mm of rain over most of the North West has well and truly put a halt to honey production in the short term. Most patches of Hill Gum, Narrow Leaf Ironbark and small pockets of Yellow box will be washed out. The rain will help the White Clover and ground flora and hold bees until possible honey flows from short budders – Silver Leaf Ironbark, Blood Wood or Brush Box.

Honey production up until the 150-200mm of rain has been surprisingly reasonable with some Mugga and Caleys producing and in most areas Hill Gum producing good breeding and honey towards the end of flowering.

Bees came through winter in reasonable condition. Most people reported some swarming but not as bad as last year. Coastal honey prosects are reportedly poor for the next few months.

Bees came off Almonds extremely well as long as they went into the orchard in good condition.

Craig Klingner

SOUTHERN NEW SOUTH WALES

Last autumn was a difficult season. Mid February, rain cut short the honey flow from Snow Gum and Narrow Leaf Peppermint. This left bees light on honey stores to lead into winter. The Blue Weed carried on yielding until late February.

Beekeepers didn't have much of a choice. Grey Box which was budded heavily was disappointing, it didn't yield any honey as it only weakened the hives down more. Mugga Iron Bark nearby was only lightly budded. Lots of beekeepers moved off the Grey Box to the South Coast on Banksia to keep the bees. Rain set in on the coast with a typical westerly winter wind. Some beekeepers chose not to move at all. They sugar fed their bees with a limited supply of pollen from flat weed. Bees went into winter as reasonable strong doubles. These hives came out of winter onto Almond pollination in early August.

After the Almond Pollination bees went to different regions of the state. Mugga Iron Bark, Hill Gum and Green Mallee all yielded honey, considering weather conditions weren't favourable. Canola yielded well, the best I have seen for many years.

Down the Riverina area, Red River Gum is starting to flower but wet weather conditions aren't favourable for these trees.and the purple fields of Patterson Curse are greatly missed in the Riverina Area this spring.

Down the South Coast patches of Grey Iron Bark & Forest Red Gum, produced a good source of honey and pollen.

Presently Blakely's Gum and Yellow Box is flowering on the South West slopes. To date 2-5 inches of rain has fallen in the peak of flowering. Although the rain is appreciated, it has cut short the prospect of a good crop of honey.

The majority of beekeepers down south have turned their extracting plants on and filled a few drums/ IBC'S this spring.

Wishing, your family a Safe and Merry Christmas. May your hives be full of honey for the New Year!

Laurie Kershaw

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AUSTRALIAN HONEY BEE WEEK

It is time to Promote Australian Honey Bee Week

There has been little interest from the Honey Packers & Marketing Association to promote the Australian honey industry when I suggested the industry should promote Australian Honey by conducting BEE WEEK.

I believe it is in the interest of every person who are Beekeepers, packers of pure Australian honey, honey related tourist attractions and retailers to promote our industry. If you agree with the above, please discuss at your next Beekeepers' association meeting.

If the industry gets behind this idea, I suggest that we run BEE WEEK on the first full week in June each year. The following are suggestions to promote BEE WEEK.

- Create press releases and liaising with paper media (rural, provincial, metro, community and consumer), encouraging them to write bee related stories and beekeeper/honey supplier profiles.
- Have Beekeepers and packers contact local radio and television stations suggesting they might run stories relating to our industry during BEE WEEK.
- Develop a schools resource kit, which includes a Bee Week backgrounder, Bee Facts sheet, Word Puzzle, Colouring-in comp etc. (prizes donated by sectors of the industry)
- Liaising with schools to organise beekeeper visits.
- Creating and printing a Bee Week poster.
- Developing a colouring-in comp and pitching it to local provincial/community and internet-based media.
- Organising bee product giveaways through local media.
- Drafting five media releases on bee related issues (i.e. shortage of beekeepers in the industry, value of pollination, effects of varroa, Asian bee etc.) and distributing them each day throughout the week.
- Contacting libraries nationwide and provide them with Bee Week collateral material
- Contacting local councils asking them to get involved and spread the message of the importance of bees to agriculture. Perhaps plant bee-friendly plants in council gardens.
- Ask Beekeepers and Honey Packers to open their processing facilities to the public at least one day during Bee Week and advise the local media of the fact.
- Those of us with our own retail outlets, offer specials or free Beekeeper demonstrations during Bee Week.
- Local street parades or park events / market days focused on honey.

Ross Chrstiansen, Director
Superbee Honey Factory
Phone: 02 6851 1155

SYDNEY HOTEL ROOFTOP

Sticky situation......

Doug Purdie and Victoria Brown tend to rooftop beehives in Market Street Photo: Quentin Jones

From a hotel rooftop in Sydney's inner city, it's surprising how much plant life is visible. There are rooftop gardens a street dweller never sees, pockets of weeds the council hasn't got to and the great green lungs of Hyde Park, the Domain and the botanic gardens.

All of which provides an all-you-can-eat buffet for bees. Busy hoards of them fly from four hives on the roof of the Swissotel, where honey producers Doug Purdie and Victoria Brown of the Urban Beehive check the honey supply.

In deference to Brown's warning that it's best not to get a bee up the nose, Purdie dons a beekeeper's net hat. But both do the job without gloves as, Purdie says, the clumsiness they create can cause accidental bee deaths and then bees can get vengeful. He and Brown are gentle and slow-moving but Purdie scores seven stings on his bare arms, which he brushes off.

The frames they lift from the hives are thick with bees and the waxy honeycomb is nearly filled with honey. The honey is warm - bees keep the hive at a constant 33.5 degrees.

City-centre beekeeping is new to Sydney but other cities have maintained healthy hives for years. Queen of the honey cities is Paris, where there are more than 400 urban hives. The Obamas are honey recruits and give White House Honey in crystal jars as gifts to dignitaries.

The four hives above Myer and the Swissotel are a small percentage of the hives Urban Honey has set up in the past year. There are others in Darlinghurst, Redfern, Newtown and Marrickville. ''It's just a matter of putting a hive under a tree or wherever a swarm is hanging, then shaking the tree so the bees fall into the hive,'' Purdie says.

They will add more hives to the network this season as the cool, rainy spring has produced a bumper pollen season. When times are good, hive populations peak and then split, with a new queen taking over and the old queen setting off to find a new home.

After Brown and Purdie collect the honey, it is strained and bottled. It is sold at the Sydney Sustainable Markets at Taylor Square on Saturday mornings and through Food Connect.

For Purdie, the honey is the delicious by-product of his real concern: the health of the bee. Massive declines in honeybee populations in Europe and North America threaten agriculture and horticulture industries, as well as biodiversity. A combination of factors are driving the death of the bees, including a rise in bee colony diseases, a drop in professional and hobby beekeepers, pesticide use, monoculture practices in agriculture and low prices for sugar.

Purdie believes a decline in our honey-bee populations is only a matter of time unless we all develop a greater appreciation of the bee. Valuing the honey they produce in our own city is a good place to start.

NICK'SNEWS
from DPI NSW

Nick Annand
Livestock Officer (Bees), NSW Department of Primary Industries, Bathurst
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The next few articles of Nick's News will be shortened versions of each of the trials done on small hive beetle (SHB). For those who have seen and heard the presentations on this, I apologise for covering old territory but hopefully you will get something new and useful from reading on. For far more detail on all the trials go to the RIRDC web site (https://rirdc.infoservices.com.au/items/11-044 to get the complete project 'Small Hive Beetle Biology – Producing control options'. I would also like to encourage and share with the readers the success and failures people are experiencing with SHB be it through new novel control methods or the use of commercially available products. Any feedback is welcome.

General SHB info

Note that if you intend to kill bee colonies in the wall cavities of houses that may harbour SHB then remember that SHB can reproduce freely after the colony's death. This can cause sliming of honey and larvae infestations that may penetrate into the house creating a slimy mess on the floor, create odour and have beetle larvae wandering throughout the dwelling seeking a suitable location to pupate.

A beekeeper in the central tablelands has been having good success controlling SHB in his hives using chux dish cloths. Preferable old and fluffy chux as this helps entangle the SHB till they die. He suggests folding them several times and the bees tend to leave them alone so they last longer and it provides what the SHB believe is a safe haven to avoid the bees. He has used them in various locations throughout the hive with success but finds placing them on top of the excluder and below the supers has the added advantage of making cracking the super off the excluder far easier. I have yet to try them but plan on doing so and will report back on there success

Trial 1

Aim

To determine the temperature and humidity thresholds for egg laying and egg hatch.

To provide beekeepers with sound recommendations on techniques and/or appliances that could be used practically in honey sheds to create environmental conditions to inhibit SHB damage to stored honey supers, fulls and stickies.

Methodology

Luckily SHB are an easy insect to keep and raise in a lab. Egg production can be turned on and off by varying their diet. SHB fed white sugar, no protein, do not lay eggs however adding protein such as pollen to their diet stimulates egg production.

SHB between the age of 10 days and 2 months post emergence were used in the trial and were only ever used once. The SHB were primed for 24 hours with a protein food source prior to being exposed to the environmental conditions to be tested.

Ten primed SHB were placed into a 110ml container with 0.7g of pollen and two glass microscope slides squeezed together with some Blue Tak™, leaving a 0.5mm gap for the SHB to lay eggs or oviposit. The containers were covered with nylon flyscreen to contain the beetle.

Figure 1. Container holding 2 glass slides, a lid with some pollen and 10 primed SHB

These containers holding the beetle were placed in and exposed to controlled environments. An incubator was used for temperature control and desiccators within the incubator were used for relative humidity control. The desiccators that arecsmall air tight containers were partially filled with saturated solutions made up from different compounds which allowed a range of constant humidities to be produced.

Figure 2. Desiccators containing saturated solutions within an incubator within a coolroom. Hygro-thermometer sensors were wired into the desiccators.

The primed SHB were put into the controlled environments for 24 hours, later this had to be reduced to 18 hours as for temperatures tested ≥35ºC had eggs hatching in less than the 24 hours. The beetles were then removed sexed and killed and the eggs counted and returned as fast as possible back into the same controlled environment. The eggs were allowed adequate time to hatch and the hatched and unhatched eggs were counted. Because no eggs were laid at 15ºC and 45ºC an alternative source of SHB eggs were used to test egg hatch at these temperatures.

Figure 3. Two slides held apart with Blu-Tak™ with SHB eggs oviposited between the slides.

Results

Only the graphs are shown here but they clearly show the effects that temperature and relative humidity had on oviposition and egg survival.

Figure 4. The predicted mean number of eggs laid/SHB female over 24 h (15ºC, 20ºC, 25ºC and 30ºC) or 18 h (35ºC, 40ºC and 45ºC) at different temperatures at > 80% RH. Bars represent the standard errors of the means and letters above the columns indicate the Least Significant Difference (LSD) ranking at P ≈ 0.05.

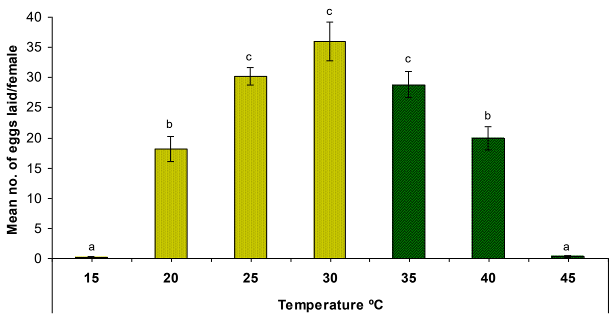


Figure 5. The predicted mean percentage of eggs that hatched after being exposed to different temperatures at > 80% RH. Bars represent the standard errors of the means and letters above the columns indicate the Least Significant Difference (LSD) ranking at P ≈ 0.05.

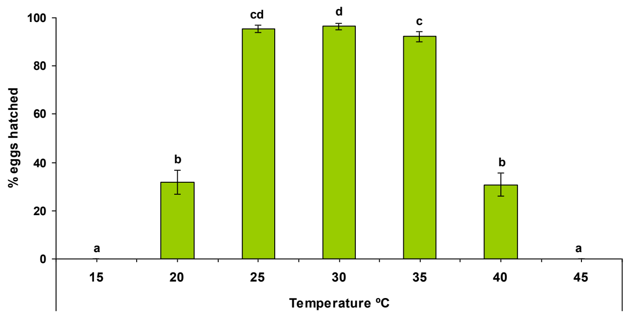


Figure 6. The predicted mean number of eggs laid/SHB female over a 24 h period in different humidities at 30ºC. Bars represent the standard errors of the means and letters above the columns indicate the Least Significant Difference (LSD) ranking at P ≈ 0.05.

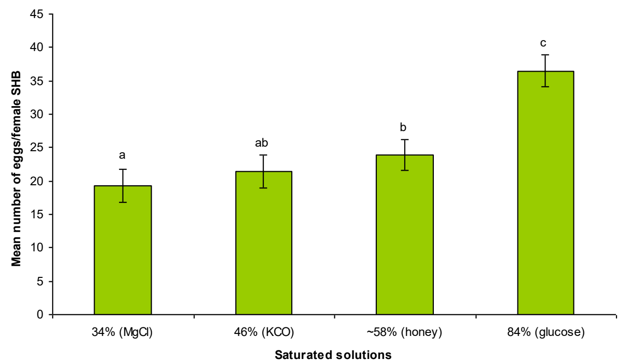
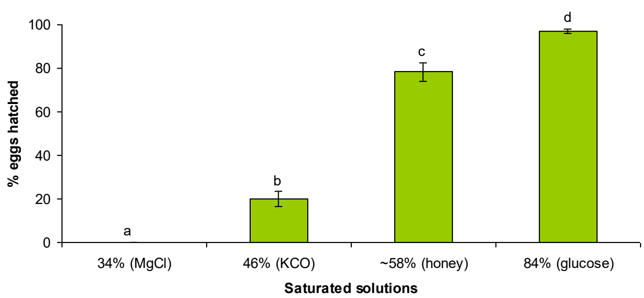


Figure 7. The predicted mean number of eggs that hatched on slides in different humidities at 30ºC. Bars represent the standard errors of the means and letters above the columns indicate the Least Significant Difference (LSD) ranking at P ≈ 0.05.



Discussion

The essential pieces of information to take from this work that can be utilised by beekeepers to manage SHB in the honey shed are when temperatures were ≤ 15ºC or ≥ 45ºC SHB adults were prevented from laying eggs and SHB eggs exposed to these conditions did not hatch. At a relative humidity ≤ 34% SHB were capable of laying eggs however these eggs failed to hatch.

The optimal conditions for both SHB egg laying and survival were maximised at temperatures between 25 to 35ºC under high humidities, which closely correlates with what would be dominant in their natural environment such as a bee hive in Southern Africa. The potential for SHB larval damage therefore is very high within this range. At 20ºC and 40ºC there was a decline in eggs laid and hatching compared to 25 to 35ºC but there is still adequate eggs that survived to potentially cause major larval damage.

When comparing the results you need to recall that for temperatures ≥ 35ºC, the time allowed for the SHB to lay eggs was shortened from 24 to 18 hours because eggs were hatching before 24 hours. This demonstrates how quickly SHB damage can start to occur. An interesting observation was that all SHB adults when exposed to 45ºC were dead when removed after 18 hours. At 40ºC the majority of the SHB adults were still alive after 18 hours but had become moribund, a condition not conducive to egg production. It is suspected further exposure to 40ºC would have killed the adult SHB. So at 40 and 45ºC reducing the hours did not affect the number of eggs laid. It was also observed when counting the eggs laid the proportion that looked unviable appeared to rise at 35ºC and increase further at 40ºC, compared to lower temperatures. The unviable eggs appeared deflated however this data was not collected because it was too unreliable to differentiate between viable and unviable eggs.

As with eggs laid, 15ºC and 45ºC prevented SHB eggs from hatching. Both these temperatures would provide protection to honey supers when SHB adults or eggs are present. The data set suggests that 30ºC is the centre and optimal egg survival temperature with an almost symmetrical decline either side.

Egg laying significantly declined with reducing relative humidity levels but some eggs were still laid at 34%, the lowest humidity tested, so therefore no humidity threshold to prevent SHB laying eggs was determined. The decline in eggs laid was probably caused by moisture being lost in each egg laid and through desiccation of the SHB, depleting the available moisture in the beetle. If water levels in the body decline to a critical point metabolism slows causing egg production to decrease. If SHB can replenish moisture it may allow them to maintain or start laying eggs again. It is suspected that continued exposure to low humidity levels and no access to any water sources, as in the trial, causes the SHB to reduce egg laying to conserve moisture and prolong life, but continued exposure would result in their desiccation and death.

Unlike the adult and larval life stages, the SHB eggs are immobile and depend on the surrounding conditions being favourable for survival. The eggs are very susceptible to desiccation during their short incubation period. Adult SHB can withstand 34% humidity for 24 hours at 30ºC but their eggs cannot survive with only one egg hatching out of 2,185 with minimal air movement. It is suspected that if air movement is increased under low set humidities it would hasten water loss and result in faster desiccation and increase egg losses similar to how clothes dry faster on a windy day. This susceptibility of SHB eggs to desiccation in low humidities can be used effectively to prevent SHB damage within the honey shed. With good air movement the levels of humidity required for SHB management in the honey shed, may not need to be as low as 34%, with suggestions below 50% would be adequate, but this needs further investigation.

The impact different temperatures and humidities have on SHB larvae was not examined in this trial, but it would be interesting to know regards managing them.

The use of cool and warm/hot rooms and humidity controlled rooms will prevent SHB damage but there are advantages and disadvantages between the thresholds, 15ºC, 45ºC and 34% RH. For all, good air movement is essential between and within the supers to obtain and maintain even conditions throughout the room. Honey supers can hold a lot of heat when brought in from the field and if stacked high and tightly together the centre boxes are well insulated by the surroundings supers. To overcome this thermal inertia and to hasten heating or cooling throughout all boxes, they should be stacked to allow good air flow through them. Air movement can be improved with the use of fans. Using an insect proof room in combination with using 45ºC which kills SHB adults in less than 18 hours means the heating could be turned off after adequate exposure. Similarly this will control wax moth (Somerville, 2007). High temperatures also improves honey viscosity allowing easier extracting, but with high temperatures the wax softens and increases the chance of warping and distortion of combs especially when full of honey because of the additional weight. When heating to 45ºC the high temperatures can increase SHB development and the rate of fermentation spoilage of SHB contaminated frames. To use 45ºC to disinfest material rapid temperature elevation and accurate monitoring is required. Another consideration if using high temperatures to prevent SHB breeding is the deterioration of the honey. Storage of any honey above 27ºC should be avoided, even for relatively short times since the deterioration in colour, flavour and enzyme content is particularly rapid. High temperatures also increase the build up of hydroxymethylfurfural (HMF), an unwanted decomposition product of simple sugars in the presence of acid. The chemical reaction is accelerated by the heat (White, 1992). So high temperatures should be used sparingly for only short periods of time if used when storing full honey supers. Using combinations of high temperatures (around 40ºC) and low humidities (50% RH), with a lot of air movement, may also provide effective SHB management but needs further investigation. This would lower the risks of comb distortion. SHB adults can survive but not breed at 15ºC so this temperature would need to be maintained throughout storage. This temperature also prevents wax moth damage (Somerville, 2007). The low temperature can increase candying of honey and reduces viscosity making extracting more difficult. However using lower temperatures is more fool proof with far less accurate temperature monitoring required and less urgency to reach the required temperature. Power and money can be saved by running coolrooms at 15ºC rather than lower temperatures that are commonly used by beekeepers. Using dehumidifiers to create low humidities for SHB is cheaper in infrastructure, setup and running costs and can allow room temperature manipulation to aid extraction. Air tight rooms help maintain humidity levels which is more crucial in humid regions. The low humidity also helps prevent moisture absorption by uncapped honey. However I am unsure how effective low humidities are controlling wax moth.

The approach to SHB management chosen when storing honey supers, full or stickies, will depend on the individuals situation. Consider all possibilities, investigate thoroughly and choose what best suits your situation.

Implications

If beekeepers can keep temperatures in the honey shed either below15ºC or above 45ºC then SHB will be prevented from egg laying and/or having eggs that survive. Similarly by keeping relative humidity at lower than 34% SHB eggs would be prevented from hatching.

The implications are that beekeepers need to be made aware of these thresholds and educated in a variety of ways in which they could modify their existing infrastructure and/or management practises to accommodate change. This may include the use of commercially available products such as dehumidifiers, or making structural changes such as building a cool room. The most successful solutions will be those that keep either temperature or relative humidity in the required range, whilst suiting the individual beekeepers' management style.

References

Somerville, D. (2007).Wax moth - Primefact 658. In *www.dpi.nsw.gov.au* 1-4: Industry and Investment NSW.

White, J. W. Jr., (1992). Honey. In *The hive and the honey bee*, Ch 21 (Ed J. M. Graham). Hamilton, Illinois: Danant and Sons, Inc.

POLLINATION SURVEILLANCE

Hi-tech help is on its way for Australia's honeybees, with researchers developing remote surveillance systems for the hives situated around Australia's ports to catch foreign bees and pests. The aim is to provide information to inspectors almost instantaneously, providing the opportunity to destroy the pests before they can get established and spread.

The Australian honeybee industry is currently free from many potentially devastating pests & diseases mainly due to surveillance programs at sea ports. These programs rely on bait hives that are manually inspected for pests and diseases which is costly and time consuming.

The research project is being funded by the Pollination Program and undertaken by the National Centre for Engineering in Agriculture (NCEA) based at the University of Southern Queensland. The Pollination Program is run as a partnership between the Rural Industries Research and Development Corporation (RIRDC) and Horticulture Australia Limited (HAL).

NCEA Team leader, Dr Cheryl McCarthy, says they're looking at ways to utilise existing technology and develop new tools to enable the automated or remote detection of the arrival of a swarm of bees at a bait hive. "This project aims to give the Australian honeybee and pollination industries the best possible chance of being prepared to identify, contain and control any pest and disease incursions.

Remote sensing of beehives can also reduce the labour and direct transportation costs associated with manually inspecting bee pest surveillance sites. The timing of inspections is also likely to improve with more information to hand," Dr McCarthy said.

Dr McCarthy says the use of technology to sense the arrival of a swarm may be in the form of camera surveillance or by monitoring the weight or temperature of the hive remotely. "There is also the added potential for any pest incursion to be diagnosed remotely through the proposed wireless transmission of hive data to an apiary inspector," she said.

WHY DO BEEKEEPERS NEED TO BE REGISTERED?

Mick Rankmore, Regulatory Specialist Apiaries, NSW DPI, Agricultural Compliance, Biosecurity Branch, Gunnedah.

It is important for any one keeping bees in New South Wales to be registered for the following reasons:

Statutory requirement
By law, it is a requirement for any one keeping honey bees (*Apis mellifera*) in New South Wales to be registered as a beekeeper with the NSW Department of Primary Industries (DPI).

The *Apiaries Act* 1985:
- regulates the keeping of bees in NSW,
- requires and provides for the registration of beekeepers,
- helps prevent the introduction of certain diseases and pests which affect bees and apiaries,
- helps control and eradicate diseases and pests in apiaries in NSW.

The need for disease and pest control
The Act, while providing for and requiring all beekeepers to be registered, basically revolves around disease control. There are a number of serious pests and diseases of honey bees that have the potential to decimate the Australian apiary industry, as has occurred in many other countries.

The apiary industry plays an important part in the state's economy, through honey and wax production, the export of queens and package bees, and pollination services to the horticulture and cropping industries.

The Australian honeybee industry produces honey and other bee products for domestic consumption and export, through apiculture of *Apis mellifera*. The industry has an estimated GVP of A$80 million. In addition, the annual benefit of apiculture to general agriculture through plant pollination in Australia is estimated to range from A$4 to 6 billion.

(Reference: Future Surveillance Needs for Honeybee Biosecurity - Denis Anderson, Simon Barry, David Cook, Rob Duthie, David Clifford, published 2.8.2010 – Rural Industry research and Development Cooperation - https://rirdc.infoservices.com.au/items/10-107)

Alerting registered beekeepers to disease or pest outbreaks
When a disease or pest outbreak occurs in any particular area, registered beekeepers can be alerted so they can take the necessary precautions to eliminate any potential outbreak in their own apiaries.

Disease or pest tracing
When diseases or pests are detected in an apiary, a trace back can be conducted to locate the source of the contamination. If the source is located it can then be eradicated.

A trace forward can help assess what other hives may have been in contact with the infected bees.

Market access
Some markets require a system in place to ensure that the authorities can declare that products sent for export meet export requirements. A bee registration system allows a disease history check to be conducted on registered beekeepers.

Ownership of hives
The owner of beehives can be traced using the bee registration system. Beekeepers are required to display their registered number on the external wall of the brood boxes.

Good identification allows departmental Regulatory Officers to locate owners of beehive material to trace disease outbreaks. In emergencies such as fire or when aerial spraying occurs, good identification of beehive material helps authorities to contact the owners without delay.

Beekeepers are encouraged to display their registration number on all hive components and not just the brood box. This is common practice within the industry and helps to deter theft of beehive materials and assists in the recovery of stolen materials.

The requirement to be registered and to correctly identify beehives provides a traceability system consistent with the National Livestock Identification System.

Movement of beekeepers out of or into the apiary industry
Registration is required to be renewed every two years. This is partly due to the movement of beekeepers in and out of the industry. Ownership of hives can be traced using the registration system.

How to register
Registration is made by completing and returning an Application for Registration as a Beekeeper form with the required payment.

Application forms can be obtained from:

Department of Primary Industries
PO Box 108
Gloucester NSW 2422
Phone (02) 6558 1707 or from
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/116972/application-for-registration-as-beekeeper.pdf

For further information about beekeeping
www.dpi.nsw.gov.au/agriculture/livestock/honey-bee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SICK BEES

by Randy Oliver - ScientificBeekeeping.com
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PART 5

MULTIBLE INFECTIONS

I ended the last installment of this series by asking the question, what happens when there are multiple parasites suppressing the bee immune system simultaneously? In this article I'd like to briefly discuss the complex interactions involved when bees are infected by more than one pathogen.

I have previously cited research by Diana Cox-Foster, Dennis vanEnglesdorp, Jay Evans, Jerry Bromenshenk, and other CCD researchers indicating that in collapsing colonies the bees were often being ravaged by infections of multiple pathogens (especially nosema and viruses).

The question then is, whether it was the co-infection that initiated the collapse, or whether suppression of the bee immune response by environmental causes was allowing the explosive growth of opportunistic parasites to the point that the colony was simply overwhelmed?

Colonies of bees are invariably infected by several parasites at any time, but their normally robust colony- and individual-level immune systems generally either clear or suppress the infections (other than that of varroa) provided that environmental conditions are favorable. In the case of colony collapse, that normally effective immune function is clearly faltering. ***It appears to me then, that the key issue is to try to figure out just why the colony immune systems are failing.***

My proposed model (Fig. 5) suggests that it is due to positive feedback loops engendered by a combination of co-infection and environmental stresses (generally chilling and poor nutrition). It may not be so important as to which particular pathogens are involved, but rather that ***at some point the balance is tipped*** from the colony being able to purge the pathogens by altruistic self removal of infected workers, to a situation in which thermal and nutritional stress caused by infection eventually (or suddenly) leads to hive depopulation due to the exodus of sickened bees.

Since different CCD studies have found co-infections by different combinations of pathogens, my feeling is that colony collapse is a generic phenomenon, rather than something due to a specific culprit. It may be that we are looking at a "Which came first, the chicken or the egg?" phenomenon—the multiple pathogen infection or the immune suppression that led to it? To me, it appears to be a moot point; what is important is that once a co-infection starts, it may then become self perpetuating despite the return of favorable environmental conditions (as happened in my Beeologics trial last May, when colonies continued to collapse despite enjoying an excellent nectar and pollen flow, albeit punctuated by weekly chilling storms).

THE PROBLEM OF CO-INFECTION

Every single honey bee is co-infected by more than one species of bacteria, generally more than one species of virus, and often nosema, fungi, "amoeba", and trypanosomes as well. ***But they normally don't get noticeably sick from such infections!*** In the first place, some of the bacteria are highly beneficial endosymbionts, without which bees would be vulnerable to yeasts, AFB, EFB, and Chalkbrood (Fig. 1)(Reynaldi 2004; Nayudu 2009; Forsgren 2010).

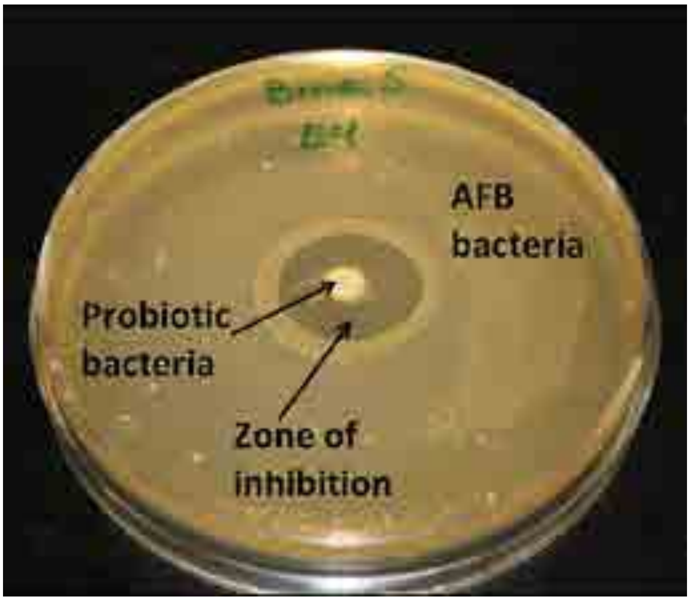

Figure 1. The beneficial bee gut bacteria suppress the growth of pathogenic bacteria and yeasts. In this petri dish, Dr. Eva Forsgren inoculated the agar with AFB bacteria, and placed a disc of beneficial bacteria in the center. The growth of AFB bacteria was inhibited by the presence of the beneficial bacteria. Photo courtesy Dr. Eva Forsgren.

There is a pitched and dynamic battle going on every second in the bee gut between parasites that would exploit the bee for their own advantage, and endosymbionts that protect the bee for their own, or mutual, benefit. The bee's immune system is faced with the difficult task of recognizing (and cooperating with) the beneficials, while still fighting the bad guys; and the bad guys don't play fair!

The immune system is actually forced to act more akin to a bouncer at a club, rather than as an indiscriminant defense force which attempts to kill all foreigners (Travis 2009).

At this point I should define some terms (Table 1):

Table 1. Definitions of Parasite Relationships	
Parasite	Any organism that lives on or in a host, and obtains nourishment from the host is called a "parasite."
Parasitism	A relationship wherein the parasite benefits at the expense of the host. Most bee viruses and nosema fit this bill.
Pathogen	A parasite that causes disease in the host. Many normally "benign" bee parasites have the potential of acting as pathogens, especially if the bees are stressed.
Endosymbiont	An organism that lives inside another (endo = within; sym = together; biosis = living). Generally used for those exhibiting mutualism.
Mutualism	A relationship in which both the host and parasite benefit (such as the *Lactobacillus* bacteria which suppress yeasts and foulbrood; or gut bacteria that produce critical nutrients for the host).
Commensalism	A relationship wherein the parasite neither benefits nor harms the host (e.g., many gut bacteria).
Semelparous parasite	A parasite that is an "obligate killer." I.e., the parasite needs to kill the host to complete its life cycle and to transmit to another host. AFB, chalkbrood, and (often) varroa and Sacbrood act as semelparous parasites. Semelparous parasites are generally easy to diagnose by the presence of dead brood or colony collapse.
Virulence	In this discussion, "virulence" is the capacity to cause disease. An "avirulent" parasite doesn't normally cause disease.

A very important point in the above table is that most bee parasites are not semelparous at the colony level, and do not benefit from actually killing a colony (AFB and varroa are notable exceptions). Several common bee parasites are semelparous at the individual bee level—e.g., chalkbrood must kill the pupa in order to sporulate. I can't think of any example, however, of any bee parasite that benefits by actually killing adult bees. ***Neither nosema nor bee viruses are necessarily semelparous—they do not benefit by killing either an individual bee nor the colony. In fact, it is generally to their advantage for the bee and colony to remain healthy so that they can continue to produce and transmit spores and virions!***

There is a fine line between a parasite acting as a pathogen, or being considered as a beneficial symbiont (reviewed by Rigaud 2010). The symbionts run something akin to a "protection racket," in which they demand a payment to protect the host from other parasites. The payment is generally in the form of some nutrient provided by the host (in the case of bees, sugar is likely the preferred payment, but it could be in the form of a protein or some limited nutrient). To the bee, a payment of a tiny bit of sugar and protein in return for protection from AFB, EFB, and Chalkbrood is a pretty good deal! ***A promising avenue of research would be to investigate just how the beneficial gut bacteria derive the necessary protein in their diet—do they extract it from the vitellogenin-rich jelly fed to all other bees by the nurse bees?*** And if so, what happens to those bacteria when the flow of jelly is diminished in a nutritionally-stressed colony?

The endosymbiotic bacteria of bees likely form "biofilms" in the gut and other surfaces which assist the bees in avoiding infection by more virulent bacteria, fungi, and likely viruses. Recent studies have found that the bacteria in such films actually communicate with the host and each other, and can cooperate by coordinating the release of proteins (Kleerebezum 1997, West 2007). Although bacteria have not been implicated in CCD, they are fairly well studied, and exhibit good examples of the kinds of unseen skirmishes that are going on within a bee's gut.

THE BATTLE OF THE BROOD PATHOGENS

The complexity of the battles raging within the bee gut becomes mind-boggling! Take, for instance, the wrestling match between the beneficial endosymbiotic bacteria, the virulent bacteria that cause AFB and EFB, and the fungus that causes chalkbrood. Friendly bacteria such as *Bacillus subtilis, Lactobacillus and Bifidobacterium* inhibit the growth of the pathogenic organisms by secreting antibacterial and antifungal substances (Reynaldi 2004; Forsgren 2010).

Should the causative agent of EFB (*Melissococcus pluton*) manage to infect a larva, it appears to open the door for co-infection by at least five species of opportunistic bacteria commonly associated with the disease (Alippi 1999). However, EFB and AFB are never found in the same larva—AFB bacteria secrete a substance that suppresses the growth of EFB and a whole slew of other bacteria (Holst 1946, Shimanuki 1992). And it's even more complex than that! The causative agent of AFB is a particular subspecies of *Paenibacillus larvae*; there are many different strains of that subspecies, which then vary at least tenfold in their virulence (Genersch 2005). To add to the confusion, the strains of *Paenibacillus* differ in their susceptibility to different phage (bacteria-killing) viruses, and duke it out by infecting one another!

The Chalkbrood fungus muscles in by producing linoleic acid, which has been shown to inhibit both AFB and EFB bacteria (Feldlaufer 1993). So the hierarchy of bee brood diseases appears to be: chalkbrood fungus weighing in as the toughest, followed by AFB, with EFB getting the bronze. Not that any beekeeper is rooting for Chalkbrood, but sometimes an enemy of your enemy might be an ally!

One aspect of the beneficial gut endosymbionts that needs much more study is the effect of antibiotics on the tenuous balance between the good vs. the bad bacteria. ***Of particular concern is the long-term effect of the very persistent antibiotic tylosin, which when (illegally) fed in syrup, has an expected active effect upon bacteria in the***

hive for at least six months! I'm eager to see what the ARS Tucson lab discovers as they research this topic.

Practical application: beekeepers often ask, how can I tell when I should rotate out an older brood comb? Simple answers such as "by age" or "by color" do not directly take into account the actual reason for comb rotation—the removal of combs contaminated with pathogen spores, environmental toxins, or miticide residues. As such, combs from colonies exhibiting good health and/or minimal exposure to miticides should be "safe" to use for more years than those with obvious contamination.

One answer: look at the brood in that comb. If it is healthy and evenly aged as in Figure 2, that would indicate that nothing in the comb is causing harm to the larvae (although it could still carry nosema spores, which affect only adults). On the other hand, if the brood age pattern is uneven (as in Figure 3), then you can suspect that the comb should either be disinfected or discarded.

Figure 2. In this healthy frame of young brood you can see the solid, even age progression of larvae from the center out. There are few empty cells or larvae of the "wrong" age that might indicate that larval death had occurred.

Figure 3. In this broodnest, nearly every cell contains an apparently healthy larva, but note that the larval ages are scattered, rather than in an even progression. Something has likely been killing the larvae. The hygienic mid-aged workers then removed them, and the queen returned to fill in the empty cells. At first glance, one would see a frame of solid brood, but much of that brood is apparently dying young, although no sick larvae are to be seen! This phenomenon is likely a sign of excessive levels of miticides, bacterial or virus infection, or of the poisoning of larvae by fungicides, insecticides, or heavy metals.

I was recently demonstrating a midsummer hive inspection to a group of beekeepers, and pulled out several solid frames of brood from a strong colony. Each time, the group would say "ah, nice frame of brood." But then I would point out that each frame contained a few pupae that were dying from what appeared to be a virus, and that there were bees with shriveled wings on the combs, indicating to me that that the strong, apparently thriving hive (with a moderate mite level) was actually on the edge of succumbing to a DWV epidemic!

Again, let me repeat that there is no particular evidence implicating bacteria in CCD. However, the case of EFB cited above gives pause for thought--even though *M. pluton* bacteria initiate the disease, it is generally other bacteria that take over (oddly, the "corn-yellow" brood that we've been noticing of late contain nearly pure culture of *M. pluton*, and in my experience, when they are evident, colonies simply do not grow). This leads us to the subject of what occurs when one or more pathogens take advantage of an infection by another pathogen.

When a bee is infected by more than one parasites things can get complicated: "direct competition between species or interactions through the host immune system may either increase or decrease the immediate virulence and transmission of one of the interacting parasites" (Rigoud 2010). In his recent review, Rigoud gives examples of stepwise infection by various parasites, and points out that ***there may be great differences in outcome dependent upon the specific strains involved, and the effects of environmental factors (which in the case of the bee would include the sublethal effects of miticides and other pesticides).***

Pathogens may compete against each other, or more commonly, share the benefits of each other's immune suppression. An infection by a combination of two relatively benign pathogens whose immune suppression mechanisms happen to synergize, can result in virulent disease, or an opening for other opportunistic pathogens to exploit. Oddly, though, infection by Acute Bee Paralysis Virus or varroa does not appear make larvae more susceptible to AFB (Brødsgaard 2000)!

I'll allow three European giants in insect immunity to speak for themselves (Siva-Jothy, Moret and Rolff 2005):

"Given the omnipresence of pathogens and parasites in the natural world, the most likely scenario is that concomitant infections are prevalent. A recent study...shows that avirulent [normally not harmful] microorganisms out-compete virulent parasites in simultaneous infections once the virulent parasite breaks down the host's immune defence. Therefore, the 'mix' of the pathogen cocktail will be crucial to the infection (and host response) outcome. This observation poses considerable challenges for studies of insect immunity. How are concomitant infections dealt with by the host? Can resources for defence (e.g. essential amino acids), be depleted during these complex insults?"

THE COST OF IMMUNITY

Have you ever gotten a flu shot or other inoculation? Do you remember how sore your arm got, and how you felt a little under the weather the next day? The vaccine did not contain live pathogens—it simply upregulated your immune response. But by doing so your body paid a price—the cost of immunity. When your system is fighting an infection, much of what makes you feel "sick" is the effect of the cascade of your own immune response against the invading microorganism. Well, bees are no different. A bee carrying an infection is not the bee that it could be if it were uninfected. The bee must redirect resources toward fighting the infection (Laurenco 2009), resulting in depletion of its critical supply of the storage protein vitellogenin. Other immune proteins may result in "autoreactive self harm" to the bee (Sadd 2006). ***The immune response is energetically costly, and sick bees require more food and warmth (Moret 2000). This is a major point when we remember how critical thermoregulation is in maintaining colony health!*** I'll return to this point soon when I discuss co-infection by nosema.

Of course, the major cost of infection to a colony is that bees which feel sick (Ruppell 2010) fly or crawl (in the case of nosema or DWV) off to die. The effect of the loss of these bees can rapidly change the size and organization of the colony population, resulting in chilling and poor nutrition (Fig. 5).

But there may be yet another mechanism at play. It has long been noted that bees will "pick" at nestmates infected with Chronic Paralysis Virus, resulting in the removal of their body hair, leading to the symptom of "hairless black disease." But one must then ask the question, just how do the other bees determine that the infected bee is sick? Recent research suggests that bees may express an "I'm sick" pheromone in the form of a family of proteins called "pherokines" Dostert (2008). I'm very curious as to whether such chemical signals may help to explain the odd behavior of bees in collapsing colonies (Fig. 4), and the hygienic removal of sick or varroa-infested pupae (Salvy 2001).

Figure 4. The broodnest of a colony in mid collapse in May. Note that the bees are not clustered normally over the brood, as was typical in the sick hives. Could this be due to chemical immune signals that disrupt normal behavior?

OPPORTUNISTIC PATHOGENS

When a parasite gains a foothold in the bee, perhaps by taking advantage of some sort of environmental stressor, that initial infection may then open the door for other pathogens that normally aren't virulent. I already mentioned that this occurs with EFB, which initiates the disease but may then be outcompeted by other bacteria.
An example of the above was illustrated by an experiment by Hughes and Boomsma (2004). They infected ants simultaneously with both a virulent and an avirulent (opportunistic) fungus. To their surprise, the normally harmless fungus took advantage of the immune suppression begotten by the virulent fungus, and then outcompeted it, eventually becoming the dominant infection which finally killed the ant! This sort of co-infection, in which a second parasite strain or species infects "on top of" another parasite and then supplants it is called a "superinfection" (Rigoud 2010).

The authors concluded: ***"Our results demonstrate that the outcome of within-host competition between parasites may not necessarily be as would be predicted from the virulence of parasites infecting in isolation, and that avirulent parasites may play a far greater role than is generally recognized."***

So what does this have to do with bees? Well, most bee pathogens (other than varroa) may well be considered to be relatively harmless at the colony level, so long as the colony is not "stressed." But once the colony is stressed, then even a relatively harmless parasite can cause serious disease, or even colony collapse! ***In the end, the pathogen with the highest prevalence may have dealt the final blow, but it was actually the stress event or initial infection that started the snowballing downhill slide*** (Fig. 5).

Figure 5. A hypothetical model for the mechanics of colony collapse. Note the interrelationships of chilling, poor nutrition, toxins, and infection. Please refer to the September ABJ for more explanation.

Practical application: There is one critical concept to keep in mind with bee diseases--that so long as the colony is able to maintain productive broodrearing, the negative effects of a parasite infection may be largely overlooked by the beekeeper. Sick bees self purge themselves from the hive—generally disappearing unnoticed. Infections may not become noticeable except during pollen dearths, or in late summer when the colony shuts down broodrearing and there are no longer as many fresh recruits to take the places of the lost sick workers.

So what are the factors that make the bee (at the individual or colony level) susceptible to pathogens? ***And why do normally benign parasite infections suddenly become virulent and cause colony morbidity (symptoms and disease)?*** The generic term thrown about would be "stress." More specifically, the major stressors would be:

1. Cold, especially unexpected chilling due to sudden weather change or lack of stores for metabolic heat production. Here's an interesting observation: bees taken from hives in winter and placed in an incubator are more susceptible to Israeli Acute Paralysis Virus than are bees taken from the same hives in summer (Nitzan Paldi, pers comm).

Practical application: winter bees in sunny, protected locations (or in sheds at constant temperature). Make sure that they have plenty of honey stores.

2. Poor nutrition; lack of honey stores is obvious; however, often unrecognized are the depressed vitellogenin/protein levels in a malnourished colony, often due to a lack of sufficient high-quality pollen intake. I've previously covered this topic in some detail.

Practical tip: A buddy asked me this fall how my bees coming back from Nevada looked. I said that they were really light in weight, and that I was throwing the feed to 'em. He then said, yes, but how about the bees—were the bees OK? The short answer is that even if the hives were full of bees, a colony lacking in abundant stores in late summer/fall is not going to invest in rearing that last round of brood that is critical for forming the winter cluster. I could have boxes full of bees in late October, but <u>those</u> older bees generally abandon the hive at the beginning of winter. By that time it is too late to stimulate broodrearing. It's not just about having bees in the box in late fall; it's all about the age, nutrition, and health of those bees!

3. Toxins, whether natural plant products, environmental pollution, agricultural pesticides, or beekeeper-applied miticides. However, other than miticides, beekeepers have little control over which toxins their bees are exposed to.

Practical apps: minimize the use of miticides that leave persistent residues; avoid if possible areas with heavy pesticide use; rotate out contaminated combs.

4. Pre-infection by another parasite. At the top of this list is the varroa mite, followed by nosema, and then by viruses.

Practical application: In order for the beekeeper to effectively deal with bee disease in practice, it helps greatly to understand the how and why of how pathogens are able to initially overcome the bee immune system. Most importantly, the parasites that finally take a colony down can generally be considered to be opportunistic--that is, they require either an environmental stress or an initial infection by a more virulent parasite in order to be able to successfully reproduce within the colony.

This suggests a paradigm shift in beekeeping mentality. Instead of worrying about suppressing any specific pathogen, instead focus on promoting colony overall health via good husbandry. The most successful commercial beekeepers follow this model (I've been very impressed by ABF President Dave Mendes' presentations about his successful management strategies, which focus on mite monitoring, good nutrition, pesticide avoidance, and comb rotation).

In this article, I want to focus on pre- and co-infections. When we say that a bee is "stressed" by an infection, what exactly do we mean?

Just as the bees fight infection (and attempt to "clear" themselves of the pathogen), pathogenic microbes fight back too--and they fight tricky, sneaky, and dirty. They do everything they can to evade, block, obstruct, or overpower the bee immune response. This becomes a very complex, mostly chemical, never ending game (well reviewed by Schmid-Hempel 2008). Any specific pathogen might use several mechanisms, and perhaps different ones at each stage of infection.

The most insidious thing that parasites do is to intentionally suppress the host immune response. A parasite may chemically interfere with the crucial phenoloxidase cascade, manipulate the host's immune signaling network, disable the host's antimicrobial peptides, tweak the RNAi response, or create "superantigens" that can overwhelm the host immune system. ***Unfortunately for the host, there may be other opportunistic pathogens waiting in the wings for just such an opportunity to invade when the immune system is impaired! (Fig. 6).***

Figure 6. The very air is full of opportunistic microorganisms just waiting for an unprotected place to proliferate. I inoculated this petri dish with a 5-second exposure to the dust in the air after slapping my sofa. Note the variety of molds (fuzzy), yeasts (slimy), and bacteria (small colonies); the air would also be full of virus particles, but they can't grow in the agar medium. Consider the fact that I breathe in far more spores than settled on this dish in every breath I take! Without constant effort by our immune systems, we would all soon become mere heaps of diseased and rotting flesh.

Of note is that if a bee ramps up its defenses against one type of pathogen (say a virus), it often tends to decrease its defenses against others (like bacteria). So attack by the first pathogen may leave the back door open for invasion by another! Or, infection by one pathogen may provide a necessary product (at the expense of the host) for the reproduction of another opportunistic pathogen that may then become the major infection (Diggle 2007).

Numerous studies over the years have found that bees suffering from multiple infections exhibited more mortality than those that were (apparently) singly infected. Even co-infection by the closely related nosemas (*apis* and *ceranae)* appears to be more deadly than infection by either alone (Evans 2010; Zachary Huang, unpublished data). Unfortunately, nowadays most of our colonies are concurrently afflicted with the two major "prime" parasites, either of which, especially in conjunction with poor forage conditions, appear to be able to trigger multiple infection cascades:

VARROA AND NOSEMA

Varroa is clearly the 800-pound gorilla in bee disease. Even the slightest varroa infestation depresses colony health and production, and every aspect of colony performance suffers as varroa levels go up. Plus varroa completely changed virus dynamics in the European honey bee. The mite often goes hand in hand with DWV, and opens the door for three nasty virus cousins--KBV, ABPV, and IAPV. I will devote a section to varroa soon.

Practical application: If you monitor for mites obsessively, and keep levels below 2 mites per 100 bees, most of your disease problems will go away.

The other prime parasite is nosema, formerly *N. apis* (which was generally only a serious problem in cold winter areas), and now *N. ceranae* (which may be prevalent at any time of the year). Again, most recent studies are finding *N. ceranae* alone to be relatively harmless to well-fed colonies, although it may suppress buildup and honey production (Dr. Frank Eischen, unpublished data), likely due to shortened forager longevity.

A more pernicious effect of nosema infection is that it usurps the bees' most precious commodity—energy. Nosema is energy hungry, and depletes the blood storage sugar (trehalose) in the bee (Naug, Mayack 2010). ***This effect may have huge ramifications in an insect that is dependent upon having ample stores of trehalose to fuel its massive flight muscles, which are used not only for foraging, but even more importantly for generating the critical heat necessary for colony thermoregulation!*** Note how this effect plays into the "Chilling Loop" in Figure 5—nosema-infection impairs the ability of bees to generate heat, which leads to chilling, which further increases the bee' susceptibility to nosema, toxins, and other pathogens.

The sixty-four thousand dollar question for *N. ceranae* is why it causes rampant and harmful infections in some operations, but seems much more benign in others. A very important clue was discovered by Judy Wu (working with Dr. Steve Sheppard). ***Their initial data (in prep) indicate that on combs contaminated by miticides, a greater proportion of bees become infected with nosema, and that the infected bees reach higher spore counts.*** This finding may help to explain why *N. ceranae* appears to be much less of a problem in my "clean" operation, and more of a problem in typical commercial operations that tend to have high levels of miticide residues in the combs (there are clearly other issues involved, however, as Hawaiian operations without a history of miticide use report substantial nosema infections).

Should nosema go rampant, then the entire colony can dwindle rapidly, and suffer from nutritional stress as the field force is decimated (Higes 2008). Another deleterious effect of nosema infection may be indirect, in that it ravages the lining of the gut, thus hampering digestion and breaching the gut defenses against viruses. Black Queen Cell Virus appears to depend upon nosema to gain entry into the bee (Bailey 1983); Kashmir Bee Virus is also normally harmless unless bees are infected with nosema (Anderson 1991).

This brings us to the topic of infection by viruses, with which I will continue in the next installment.

REFERENCES

Alippi, AM (1999?) Bacterial diseases. http://www.culturaapicola.com.ar/apuntes/cursos/99600235.pdf

Anderson, DL (1991) Kashmir Bee Virus—a relatively harmless virus of honey bee colonies. ABJ Dec 1991: 767-770.

Aubert, M (2008) Virology and the Honey Bee. European Commission. Free download—Google the title.

Bailey L., BV Ball, JN Perry (1983) Association of viruses with two protozoal pathogens of the honey bee, Ann. Appl. Biol. 103, 13-20.

Brødsgaard, CJ, et al (2000) Interactions among *Varroa jacobsoni* mites, acute paralysis virus, and *Paenibacillus larvae larvae* and their influence on mortality of larval honeybees in vitro. Apidologie 31: 543–554.

Dostert, C, et al (2008) Innate immunity of insects to infection in Virology and the Honey Bee.

Evans, J (2010) The role of multiple pathogens in colony collapse disorder. 110th General Meeting of the American Society for Microbiology.

Feldlaufer, MF, WR Lusby, DA Knox and H Shimanuki (1993) Isolation and identification of linoleic acid as an antimicrobial agent from the chalkbrood fungus, Ascosphaera apis. Apidologie 24: 89-94.

Forsgren, E, TC Olofsson, A Vasquez, I Fries (2010) Novel lactic acid bacteria inhibiting *Paenibacillus larvae* in honey bee larvae. Apidologie 41: 99–108.

Genersch, E., Ashiralieva, A., Fries, I., 2005. Strain- and genotype-specific differences in virulence of *Paenibacillus larvae* subsp. *larvae*, a bacterial pathogen causing American foulbrood disease in honeybees. Applied and Environmental Microbiology 71: 7551–7555.

Higes, M, et al (2008) How natural infection by *Nosema ceranae* causes honeybee colony collapse. *Environ Microbiol* 10**:** 2659–2669.

Holst, EC (1946) Process of preparing an antibiotic substance from Bacillus larvae. US Patent 2,442,006.

Hughes, W. and J Boomsma (2004). Let your enemy do the work: within-host interactions between two fungal parasites of leaf-cutting ants. Proc. R. Soc. Lond. B 3 (Suppl), S104–S106.

Kleerebezum, M (1997) Quorum sensing by peptide pheromones and two-component signal-transduction systems in Gram-positive bacteria. *Molecular Microbiology* 24(5): 895-904.

Mayack, C and D Naug (2010) Parasitic infection leads to decline in hemolymph sugar levels in honeybee foragers. J. Insect Physiol. doi:10.1016

Moret, Y., and P. Schmid-Hempel. 2000. Survival for immunity: the price of immune system activation for bumblebee workers. Science 290:1166–1168.

Nayudu, M and S Khan (2009) Anti-fungal Bacterial Symbionts of Bees. RIRDC Publication No 09/120.

Reynaldi, FJ, MR De Giusti, and AM Alippi (2004) Inhibition of the growth of *Ascosphaera apis* by *Bacillus* and *Paenibacillus* strains isolated from honey. Revista Argentina de Microbiologia 36: 52-55.

Ribière, M, B Ball and MF Aubert (2008) Natural history and geographical distribution of honey bee viruses in Virology and the Honey Bee.

Rigaud, T, Marie-Jeanne Perrot-Minnot and Mark J. F. Brown (2010) Parasite and host assemblages: embracing the reality will improve our knowledge of parasite transmission and virulence. *Proc. R. Soc. B* published online 28 July 2010

Rueppell, O, MK Hayworth, NP Ross (2010) Altruistic self-removal of health-compromised honey bee workers from their hive. Journal of Evolutionary Biology 23(7):1538–1546.

Sadd, BM and MT Siva-Jothy (2006) Self-harm caused by an insect's innate immunity. Proc. R. Soc. B 273: 2571–2574.

Salvy, M, et al (2001) Modifcations of the cuticular hydrocarbon profle of *Apis mellifera* worker bees in the presence of the ectoparasitic mite *Varroa jacobsoni* in brood cells. *Parasitology* 122: 145-159.

Schmid-Hempel, P (2008) Parasite immune evasion: a momentous molecular war. Trends in Ecology and Evolution Vol.23 No.6: 318-326.

Shimanuki H, Knox DA, Feldlaufer MF (1992) Honey bee disease interactions: the impact of chalkbrood on other honey bee brood diseases. Am Bee J 132, 735-736

Siva-Jothy, MT, Y Moret and J Rolff (2005) Insect Immunity: An Evolutionary Ecology Perspective. Advances in Insect Physiology 32: 1-48.

Smith-Sommerville, H (1995) Journey into the cell. hhtp://www.rockfeller.edu/rucal/journey/journey.html

Travis, J (2009) On the Origin of The Immune System. Science 324:580-582.

West, A, et al (2007) The Social Lives of Microbes. Annu. Rev. Ecol. Evol. Syst. 2007. 38:53–77.

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The following is an update of recent activities of AHBIC if you should seek further clarification please do not hesitate to contact the AHBIC office.

UPDATE AHBIC ACTIVITIES

It has been a busy two months for AHBIC and we are happy to report to Industry members the following update:

1. At long last the Scientific Committee for the Asian Honey Bee Containment Program has met and an update from Plant Health Australia is included in this addition.

2. It is pleasing also to report that some progress has been made in relation to Pyrrolizidine Alkaloids (PAs). An update of recent development is provided by Dr Ben McKee.

3. Last week AHBIC attended the Annual General Meeting of Animal Health Australia and Dr Roly Niepier has retired as Chairman and has been replaced by Mr Peter Milne.

4. As a result of the season the office has been receiving a high level of calls and emails in relation to swarms. To deal with this situation more efficiently we have updated the website to enable the Industry to more effectively respond to request for assistance from the public. Should you wish to add any further information from your State please contact the AHBIC office.

5. The AHBIC Executive met in Melbourne on 31 October and as per the 2011 AGM resolution the Minutes have been sent to AHBIC delegates and State & Sector Secretaries.

6. One issue of interest and importance to the entire Industry will be the ongoing work by AHBIC and Government to prepare for the possible introduction of Varroa. Mr Peter McDonald attended the AHBIC meeting as Chair of the Varroa Preparedness Committee and also took part in an Industry/Government committee organised by Plant Health Australia.

7. Industry again would put on record its thanks to the more than 70 volunteers who have assisted in Asian Honey Bee suppression work in Cairns. In this issue of the newsletter we have also received an article from Minister Ludwig outlining the Government's position in this matter.

8. AHBIC continues to receive voluntary contributions from members and new names are added to our newsletter (unless otherwise requested). In respect of contributors if you wish to receive a receipt please contact the AHBIC office. Could members receiving this update please advise other members that if they wish to receive a copy they need to supply their email address.

9. The AHBIC Executive also agreed to provide Industry with a new five year Business Plan to be approved at the 2012 Annual General Meeting. A summary of key headings has also been sent to all State and Sector bodies asking for further input.

10. **The AHBIC office will be closed for the Christmas holidays from 22 December 2011 till 16 January 2012.**

11. **Finally on behalf of the AHBIC Executive and office may I take this opportunity to wish all a Happy Christmas and Prosperous New Year and may there be many honey flows for you and your family.**

NEXT STEPS IN THE MANAGEMENT OF ASIAN HONEY BEES

The following article was submitted to the AHBIC Newsletter by Senator the Hon Joe Ludwig, Minister for Agriculture, Fisheries and Forestry

Following my announcement in May this year that the Australian Government would be investing $2 million over two years to help manage the Asian honey bee, I am pleased to announce the release of a strategic action plan which sets out how that funding will be allocated.

The *Plan for the Transition to Management of the Asian Honey Bee* gives greater certainty to efforts to confront this pest which was first identified in Australia in 2007. Fortunately there is no evidence that these bees are carrying the Varroa mite.

This investment is being made in partnership with Biosecurity Queensland, the Australian Honey Bee Industry Council and the Federal Council of Australian Apiarists Association, which will also contribute funding and undertake activities in complementary programs.

The plan will be overseen by a management group which includes senior representatives of each of the funding parties and the program is being administered by Plant Health Australia. A Scientific Advisory Group of scientists, industry and government experts and Plant Health Australia, will provide technical support. Both of these groups have already met and further meetings are planned.

I am confident that this plan will support efforts to reduce the impacts of these bees on our agricultural industries, apiarists, the natural environment and local communities.

The transition plan is a test of a new policy between the Gillard Government, states and territories, to tackle the challenges of exotic pests and diseases that cannot be eradicated.

Under the current national emergency response agreements the Commonwealth, state and territory governments and industry members provide financial contributions to undertake incursion management activities. Traditionally, if after attempts to manage the incursion, it is no longer considered eradicable, the host state or territory and affected industries have been left to manage the incursion with little or no support.

The new transition program aims to develop a longer term management solution that can be applied in situations where serious pests cannot be eradicated. A similar program is being trialled for the plant disease, Myrtle rust.

The Asian honey bee plan includes a range of community engagement activities to ensure the public and industries are well informed about the bees and how best to deal with them. It also includes a number of scientific studies aimed at developing mechanisms to help in the battle against the bees. Experience gained during the program, particularly in relation to the behaviour of the Asian honey bee and its management, will be applied to refine emergency response plans for the Varroa mite and other exotic pests and diseases of bees.

The plan identifies ways to suppress the bee to minimise its impact on honey production. The plan will develop environmentally friendly invasive bee control methods to be used in areas of threat and that are of ecological significance.

The plan will provide tools for the community, land owners, honey bee industry, and commercial and hobby apiarists to identify the Asian honey bee and apply measures to limit its impact.

It is not known how the Asian honey bee entered Australia in 2007, but the Queensland Government immediately started a state-based eradication program.

The eradication program was subsequently funded nationally until 31 March 2011. The National Management Group met in January 2011 and determined that eradication was not technically feasible and a transition to management program needed to be developed.

This decision was revisited after the Senate Rural Affairs and Transport Reference Committee inquiry into the Asian Honey Bee. Although consensus was not reached, in May the National Management Group confirmed it was not technically feasible to eradicate the bees.

However, in reviewing this case I recognised the need for a new policy area to assist in the transition from eradication to management of pests and diseases. This is an important opportunity for our biosecurity system and I welcome the involvement of apiarists and the bee industry in its development.

The eventual impact that Asian Honey Bees will have on communities, farmers and the natural environment is not known, and it will take time to assess how the bee will operate under Australian conditions.

As we learn to adapt to life with the Asian honey bee, the experience gained by beekeepers who have volunteered their services to work with the Queensland Government, to find and destroy nests and swarms, will greatly benefit the transition program.

I appreciate the efforts of all people in the transition to management in policy development and on the ground work, including the apiarists, DAFF, Biosecurity Queensland and the wider industry.

The Asian honey bee plan can be found at:

Plant Health Australia www.planthealthaustralia.com.au

WHO IS PLANT HEALTH AUSTRALIA?

Plant Health Australia (PHA) is the national coordinator of the government-industry partnership for plant biosecurity in Australia. As a not-for-profit company, PHA services the needs of Members and independently advocates on behalf of the national plant biosecurity system. PHA supports its industry and government Members by contributing to decision making and management groups directing responses to incursions, as well as assisting with some operational response roles.

The EPPRD
PHA is the national custodian of the Emergency Plant Pest Response Deed (EPPRD) and PLANTPLAN on behalf of the Australian honeybee industry, as well as the other 35 industry and government signatories. The EPPRD is a legally binding agreement between PHA, the Australian Government, all state and territory governments and national peak industry body signatories. It covers the management and funding of responses to Emergency Plant Pest incidents, including the potential for Owner Reimbursement Costs for producers. It also formalises the role of plant industries' participation in decision making. Underpinning the EPPRD is PLANTPLAN, the agreed operational plan that guides responses to eradication of plant pests. Honeybee pests and diseases became covered by the EPPRD in 2009.

Background
The Australian Honey Bee Industry Council (AHBIC) is currently a Member of both PHA, and Animal Health Australia (AHA).

From 2002 – 2009 AHBIC was a signatory to the Emergency Animal Disease Response Agreement (EADRA), the equivalent agreement to the EPPRD that covers animal disease eradication response. During the Asian honeybee incursion in Queensland, it was recognised that as this pest did not fall under the category of an animal disease it could not be managed using the EADRA.

Despite this outcome, the Asian honeybee response was still managed using principles of the EADRA, however, the process highlighted to the Parties involved that the EPPRD was better suited to handle honeybee pests, diseases and pest bees.

In addition, as a result of the benefits provided to plant industries by pollination due to honeybees, and the impact that a pest of honeybees would have on pollination dependent industries, it was determined that future pest emergency responses for the honeybee industry would be better covered under the EPPRD.

This also allows the various horticultural industries that benefit from pollination activities to potentially share the costs of a future emergency response to an exotic pest or disease of honeybees.

Although honeybee pests and diseases were covered by the EPPRD in 2009, the Asian honeybee incursion could not be managed retrospectively under EPPRD rules. However, Parties saw the benefits in developing a management framework for the Asian honeybee response to be based on EPPRD principles. Following the change from eradication to transition to management, PHA is facilitating the coordination of the program as contract manager.

Any future incursions of honeybee pests or pest bees would be managed under the EPPRD and AHBIC and pollination dependent industries would be involved in both decision making and any cost sharing of an agreed response.

2012 AHBIC ANNUAL GENERAL MEETING

The venue for the 2012 Annual General Meeting will be the Colonial Inn, Cnr George & Elizabeth Streets, Launceston Tasmania in conjunction with the Tasmanian Beekeepers' Association (TBA) Conference.

People attending the AGM/Conference need to make their own accommodation bookings – Phone: 03 6331 6588. The cost is $120.00 per room per night for two persons – extra person $35.00 pp. Business Class room is $150.00 per night.

The Colonial Inn is located in central Launceston so alternative accommodation to suit all is available.

If you require any more information contact:

Mrs Maxine Ewington, Secretary, TBA
Phone: 03 6442 3916
Email: secretary@tasmanianbeekeepers.org.au

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