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In This Issue:

- Reports from the 63rd Annual CHC Meeting
- CHC Activities
- Industry statistics

Canadian Bee Research Reports

- Management of Oxytetracycline Resistant AFB
- Impact of Sweet Corn Pest Control on Honeybees
- Evaluating fall and spring pollen supplements

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Canadian Honey Council 1972-2003

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1993-95	Barrie Termeer	Rollyview	AB	National Coordinator			
1995-99	Wink Howland	Yorkton	SK	1998-	Heather Clay	Calgary	AB
1999-01	Merv Malyon	Brandon	MB				
2001-02	Dave MacMillan	Thornloe	ON				
2002-04	Wink Howland	Yorkton	SK				

*deceased
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1955 J.N. Dyment ON, 1956 F.R. Armstrong Ottawa
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Front cover picture

Manitoba Beekeepers Association celebrates 100 years at Fort Garry Hotel Winnipeg

L-R: Lorne Peters, Rhéal Lafrenière, and Jim Campbell

Proceedings of the 60th Annual CHC-CCM Meeting

TABLE OF CONTENTS Page Number

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Minutes of the 63rd Annual Meeting of the Canadian Honey Council

26-29 January 2004, Winnipeg, MB

The 63rd annual meeting of the Canadian Honey Council opened at 9:00 AM, Wednesday 28 January, 2004 at the Fort Garry, Winnipeg MB.

President Wink Howland opened the meeting and welcomed members and guests. There were five new delegates at the table and each was introduced.

Paul Kittilsen NS is a commercial beekeeper from Debert who operates 750 hives.
Glen Ackroyd ON is newly commercial and has 400 hives north of Toronto.
Alain Moyen QC operates 600 hives, for honey and pollination near Montreal.
Ron Rudiak MB operates 85 colonies, is a producer grader and is active in the Red River Beekeepers Association
Neil Specht SK is a commercial beekeeper, pilots a small plane and pollinates canola in Alberta.
Wink Howland SK works with his daughter and wants to expand from 750. He has been involved for eight years with the CHC.
Grant Hicks is a commercial beekeepers east of Peace River in northern AB.
Ed Nowek operates Planet Bee, a commercial operation and agri-tourism attraction in Vernon BC.

Business Meeting

Tuesday 27 January 7-9 pm
Wednesday 28 January 9 am-5 pm

Present: Wink Howland, Alain Moyen, Ed Nowek, Grant Hicks, Neil Specht, Ron Rudiak, Glen Ackroyd, Paul Kittilsen, and the National Coordinator Heather Clay

Minutes of the 2003 meeting

Motion: Moved by Wink Howland, seconded by Alain Moyen.
To accept the minutes of the December 2002 Niagara Falls ON meeting as printed in the proceedings

CARRIED.

There was no business arising from minutes.

2003 Financial Statement

The financial statements Appendices 1, 2 and 3 were presented to the delegates.

Motion: Moved by Wink Howland /Neil Specht to accept the 2003 financial statement as presented.

CARRIED

Motion: Moved by Wink Howland/ Alain Moyen that Jack MacKay be appointed auditor for the year 2004

CARRIED

President's Report

Wink Howland

The past year has been very busy for Honey Council. The item that took the most of our time has been working to lift the ban on the importation of honeybees and queens from the mainland United States. This has been one of the most divisive issues our industry has faced. It has polarized beekeepers since its inception in 1987 and has dominated most of the discussion at each of the annual meetings of CHC. There are beekeepers who see the closed border as having a tremendous negative impact on our profitability, while at the same time, there are almost equal numbers who would argue exactly the opposite.

As the availability of replacement bees and queens from alternate sources has dwindled, and more and more beekeepers across our country encountered problems with resistant varroa mites, resistant American Foulbrood, and high winter mortality, the pressure has mounted to find additional sources of queen bees. In August 2003 the Canadian Food Inspection Agency gave notice of their intention to amend the importation regulation. The CHC convened a meeting of industry leaders in October 2003 and all present unanimously agreed on recommendations for a set of minimum protocols for importation of queens. The majority of provinces now support the importation of continental US queens, subject to these protocols. Whether they can be implemented to everyone's satisfaction is another question. Nevertheless, the risks remain relatively low when queen importation is compared to package importation.

I hope that beekeepers will put this issue behind them, and that they will get involved in some of the other serious issues faced by our industry. Heather Clay will present the activities of Honey Council in the National Coordinators report. I welcome everyone to the meeting and extend congratulations to the Manitoba Beekeepers Association on their 100th Anniversary.

National Coordinator's Report

Heather Clay

Oxalic Acid Registration

The CHC has agreed to facilitate the registration process and we are raising money to go ahead with the application. It is expected to cost at least $30,000 to hire a consultant, prepare the documentation and pay all the required fees. We are asking beekeepers to support us in this process by contributing $0.20 per hive. By mid January we had raised over $8,000. This is a good start but we have a long way to go and hope that all beekeepers will consider a donation to the fund. Oxalic acid is also a potential alternative treatment for resistant mites.

Coumaphos Resistance

The first occurrence of coumaphos (Checkmite+™) resistance in Canadian bees was reported in New Brunswick. The Department of Agriculture, Fisheries and Aquaculture has been monitoring Apistan resistance and during tests in fall 2003 they found that some colonies had as many mites at the end of treatment with Coumaphos as they did at the beginning. This is disappointing news but not surprising as the colonies were close to the USA border and have probably been in contact with resistant mites in migratory US hives. Further testing will take place next spring and the colonies will be treated with formic acid. This finding supports the need to provide beekeepers with alternative treatments.

US Queen import meeting

The CHC convened a meeting of an expert panel of stakeholders representing leaders of national and provincial industry, provincial and national governments. It was held in Kelowna October 21-22, 2003. The meeting was facilitated by an outside management team, Green Isle Consulting, from Victoria BC. The intent was to establish recommendations for minimum acceptable protocols for the importation of honeybees from continental USA.

The group addressed the issues associated with the importation from continental USA according to the health and environmental concerns of diseases, pests and africanized honeybees. The committee did a fantastic job in working through the critical areas of concern. The group came up with unanimous recommendations for queen importation protocols.

CFIA Response

The Canadian Food Inspection Agency (CFIA) sent two representatives to our importation meeting in Kelowna and they were aware that there was unanimous agreement on the recommended protocols for importation. Since then the CFIA has been looking into establishing a provincial federal agreement regarding traceability of imports. We are waiting for the CFIA to make a final decision and gazette the change to the regulation.

Pollination

There has been an increase in demand for hives sent to pollination. Alberta reports 50,000 hives were sent to pollination of canola. In the Maritimes 27,000 hives were sent to blueberries and BC placed 25,000 hives in various crops including apples, cranberries, blueberries, and raspberries. Ontario had a decrease in pollination of squash and canola but an increase in demand from apple growers. The value of pollination rental fees exceeds $1 million.

Maximum Residue Level

Health Canada has recommended an MRL for oxytetracycline residue in honey of 300 ppb or 0.3 ppm. Their experts have determined that this is a reasonable level and it will not cause any health concern. This level also satisfies our producers because there is no such thing as zero in the new high tech detection systems. Beekeepers are aware that there are many countries that will not accept any residue and compliance in Canada does not guarantee acceptability in another country.

Canadian On Farm Food Safety Program (COFFS)

The COFFS program has been progressing slowly but steadily throughout the year. A committee comprising representatives from each CHC member region have worked throughout the year with myself and Rudy Gelderblom (see following report).

Funding for the COFFS program has been provided by Agriculture and Agri-Food Canada under the CARD program. This program ended December 31st 2003 and disappears entirely by March 31st 2004. A new Canadian Food Safety and Quality (CFSQ) program has been announced under the recent Agriculture Policy Framework (APF). It will begin once all the provinces have signed the federal agreement. Unfortunately, not all the provinces are anxious to participate in the new APF program. There is no word as to whether there will be funds to continue in the period between the old CARD fund and the new CFSQ program. We plan to apply for funding to continue the work that is currently underway.

Motion: Moved by Allain Moyen / Wink Howland to accept the National Coordinator's report as presented. **CARRIED**

CANADIAN ON FARM FOOD SAFETY

Heather Clay

The COFFS website is progressing well with the assistance of IT Consultant Rudy Gelderblom. A user name and password has been assigned to each of the steering committee members to assist them in accessing and downloading information. A pilot project was conducted at Tim Townsend's facility and the forms are undergoing a review to reflect the different options and needs.

A HACCP plan and generic model has been produced. The steering committee is now reviewing the latest details in the manual. It is proposed that the CHC will apply for funding under the new CFSQ program and move towards the Technical Review process with the aim of rolling out the program to producers in 2005.

Delegates' Reports

Maritimes

Paul Kittilsen

New Brunswick reported 234 beekeepers with 5,917 colonies of which 18 beekeepers had 50 or more colonies. Inspections were conducted on 12% of the colonies. Chalkbrood and EFB were found, but there was no AFB. Tracheal mite testing will be done later. There was one instance of confirmed Coumaphos resistance and several unconfirmed. Only 3,500 colonies were overwintered.

Nova Scotia reported 413 beekeepers with 20,600 overwintered and 3,000 losses (6%). The number of colonies on blueberries was 16,800.
No varroa resistance to Apistan has been reported and no varroa mites have yet been found in Cape Breton. NS is tracheal mite free.

The fall of 2002 was long, wet and cool, this was followed by a cool wet spring (2003) resulting in slightly higher winter loss than usual. It also resulted in a little later blueberry pollination season. The late pollination season gave beekeepers a chance to recapture some of the winter loss. It is expected that the colonies in 2004 will be down because of colonies sent to blueberry pollination in N.B. & PEI, by Bragg's (Lumber Co.). NS had the largest blueberry crop in its history, in excess of 55 million lbs.

PEI reported 3,000 colonies and 35 registered beekeepers. They have had high winter losses in the past with slightly over 50% average loss. There has been a scarcity of packages for beekeepers on the island. In 2003, 800 acres of canola were planted and 1,400 colonies were sent for pollination.

The honey crop was light through the summer months. Moisture in August and a very hot September resulted in a late honey flow in some areas. With this late honey flow some beekeepers were later treating for varroa then they would have liked.

Honey yields in the Maritimes were average to above average. With a long warm fall 2003 and December 24th cleansing flight beekeepers are very optimistic about a successful wintering

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Québec

Alain Moyen

In the spring of 2003 Quebec lost 50% of their colonies. The count was brought up to around 30,000 through the year. The government announced an aid package of $1.9 million but only $600,000 was direct assistance. The rest was interest free loans. Accessing the funds has been difficult so help is still coming. Many colonies went into winter 2003 in a weak condition.

Pollination was good but there is a serious shortage of hives. There is no provincial apiarist and no extension services to assist beekeepers in Quebec. The industry is served by veterinarians who have little experience with honeybees. Consideration is being given to mandatory registration with fees to generate funds for a provincial apiarist.

Ontario

Glen Ackroyd

Production of honey was variable. Winter losses were 20% higher in some areas because of fluvalinate resistance problems. Spring was slow and colonies were late building up. There were 2,600 beekeepers in ON with 71,000 colonies. At least 250 beekeepers have greater than 50 colonies.

Varroa is widespread across province with the only break being in Thunder Bay. The average honey production was 104 lb per hive which is higher than normal. There has been a conversion from retail to wholesale markets. The competition in stores is fierce with low prices causing many beekeepers to withdraw from the retail market.

Alison Skinner continues working for the Tech Transfer program testing to improve the stock for hygienic bees. The University of Guelph and OMAF are hiring a new researcher and it is hoped the new person will be in place by the end of March.

Open border issue has been discussed but the decision is unanimous to keep mainland queens out of Ontario. There is respect for other provinces and need for imported genetics. We recognize the need to work together to solve national challenges.

Manitoba

Ron Rudiak

Many beekeepers reported higher than normal winter losses for 2002 - 2003. The warm spring of 2003 allowed colonies to recover rapidly for splitting with locally raised or imported queens. Beekeepers who experienced high losses had to import packages, find someone selling surplus hives or purchase nucs. During the growing season some areas of the province had adequate rainfall while other areas were much too dry which caused a loss in honey production.

Manitoba is experiencing problems, in some municipalities, with resistant varroa mites. Coumaphos has been made available for emergency use to control resistant mites as they become established in different areas.

Queen importation from the Continental US is high on the priority list among many of our commercial beekeepers who need quality US queens for expanding their operation rapidly in the spring and for replacements later in the season. Like other provinces, Manitoba has a significant number of beekeepers who raise their own queens as part of their management practices. Producers are selecting from stock that is gentle and easy to work, productive and able to winter well. Mite resistance is another important characteristic that they are selected for. In 2001, beekeepers interested in improving Manitoba queen bee stock joined together to form the Manitoba Queen Breeders' Association. This queen breeding project, using stock selected from the participants, is being conducted under the guidance of Dr. Rob Currie (University of Manitoba) with assistance from the Provincial Department of Agriculture. This ongoing project is funded by the Canadian Bee Research Fund, the Barry Fingler Research Fund, MRAC and the MQBA

Recently Dimo's Tool & Die in Winnipeg has started producing an injection moulded plastic screened bottom which is marketed by the Manitoba Honey Co-Op. This sturdy piece of equipment can be purchased with either an embeded steel or stainless steel screen. The stainless screen is recommended because it will not corrode from formic or oxalic acid fumes. One Manitoba beekeeper, Ted Scheuneman, pioneered the use of screened bottoms and already had them in place several years before varroa mites appeared in Canada. As the advantages of screened bottoms become more widely known, more beekeepers are making use of them.

The West Nile virus is once again a potential problem for honey, forage and organic farming operations in Manitoba. Representatives of the Manitoba Beekeepers' Assoc. are meeting with various government departments to try and minimize the potential risk to bees if widespread mosquito spraying becomes necessary.

Saskatchewan

Wink Howland

The beekeeping season ended quite positively for our beekeepers. Despite the drought and grasshopper situation that persisted in some areas, most beekeepers achieved an average crop, and an average crop at the extremely good prices being experienced at this time, translates into an exceptional year. I understand that extractor and spinner sales are up substantially.

Saskatchewan, as an association, remains opposed to importation of any bees or queens from the mainland United States. At our general business meeting held near the end of November, about 80% of the attending members voted against adoption of the queen import protocols developed in Kelowna. It could be argued that those attending the meeting did so because they opposed importation. Therefore the vote may have unfairly presented the Saskatchewan picture, but we are a democratic organization, and the meeting was appropriately advertised and announced, meaning that all association members had an opportunity to attend and to present their views.

Most of the resistance to importation in SK, comes from the fact that we enjoy a relatively low rate of mite infection, compared to the other provinces. SK has not experienced Apistan resistance in their mite populations, nor has resistant AFB been identified. Our beekeepers believe this is due to the observance of the import ban and to the fact that we do not move our colonies around to the same extent as experienced in other provinces. Moreover, our provincial apiarist, John Gruszka, has maintained good records regarding varroa and tracheal infections, and has been able to assist beekeepers by informing them as to areas of infection, so that they do not inadvertently move beeyards into infested areas. This has slowed the spread of the mites. In addition, many beekeepers have become relatively self-sufficient, and no longer need imports.

I do have some concerns about this stance. I know that, despite claims to the contrary, many of our beekeepers are still relying on queen imports from Hawaii, Australia and New Zealand, to maintain their hive counts. These sources are drying up. The high honey prices have caused many queen producers to look at honey production rather than queen production, and the spread of mites and small hive beetle is reducing the areas in which queens can be produced for export. I suspect that a complete closure of our SK borders to queen imports from Australia and New Zealand would cause immediate hardship to many of our members, and that suddenly, their views regarding import, could change. I lost most of my bees one winter, and I know the fear that comes when it looks as if you can't find replacements. It's like losing your job and having no place to go to earn a living!

At this point in time, import discussions may be rather fruitless. During a conference call with CFIA in early December, it appeared that the gazetting of the mainland US queen importation change was not ready for publication, and there was no indication that its publication was imminent. In addition, no material was available regarding the "Memorandum of Understanding" between the Federal and Provincial governments – this was to foster communication between the federal and provincial governments allowing provincial apiarists to be informed of the details of queen imports into their province. Unless something happens very quickly there, US queen breeders will not have time to prepare extra queens for import.

Alberta

Grant Hicks

There are 245,000 hives in the province and our Board has taken on the goal of increasing that number in the next few years. 50,000 colonies pollinated hybrid canola in the south east of the province and a further increase is expected next year. A honey commission is under discussion and the final vote will be taken at the annual ABA meeting in November 2004.

AFB infection is running in the 2 to 3% range. Tylosin can be attained from a local veterinarian on a prescription basis. Prophylactic treatment of AFB is a thing of the past. Beaverlodge Research Station is developing a reliable method of detecting problematic levels of AFB. Western beekeepers would like to move to a rotational treatment regime, as there are many concerns about resistant AFB.

Close to 100% of beekeepers use Coumaphos. The ABA is requesting the provincial government establish a resistant Varroa mite monitoring program, formic and oxalic acid trials, as well as trials of other food grade solutions.

The honey crop was average because of drought but some areas where moisture levels were higher had a good crop.

The ABA prefers a weighted voting system for CHC but the organization is a hard sell in Alberta and this might not even solve the problem. A commitment of more volunteer time has been given to CHC.

British Columbia

Ed Nowek

With one of our hottest and driest summers behind us now, British Columbian's are hoping for above normal snow packs to bring back the seriously deprived soil moisture levels. If one ray of optimism can be drawn from our worst fire season in history, it would be for extensive increases to the forage of fireweed over the next several years.

BC Ministry of Agriculture, Food, and Fisheries (MAFF) production survey figures show average per colony honey yields at 74 lbs. just 3 lbs. under the long term provincial average of 77 lbs. Figures for 2003 winter losses were high again despite a milder than normal winter with the average mortality reported at 26%, and the Peace and Fraser Valley regions leading the province with 46% and 35% respectively. Replacement queen and package stocks were once again at a premium and many complaints registered about the marginal quality and high prices. Total hive count for the province came in at 42,194, which was up marginally from the previous year. This value refers to resident colonies and does not include the seasonal influx of wintering colonies arriving from Alberta (estimated at 22,000). Total honey yield is estimated at 3,136,000 lbs. selling for a average price of $2.39 and a total value of $7,505,000 with a large shift to wholesale from retail being reported in 2003.

The BC MAFF has requested a review and refinement of the *Policy on the Movement of Bees* in our province and has asked our industry association to participate. A vote of our membership indicated that there was support for the continued existence of such a policy and a standing committee of beekeepers has been assembled to identify

- the diseases of concern to the industry,
- the criteria (level of infestation) to be used to determine when a disease has been established in an area,
- the sampling procedure / protocol to be used to determine if the above criteria have been met, and
- the process for amending, communicating and distributing the policy.

There has been a strong positive response from our membership over the past three years for supporting the importation of queen bee stock from mainland USA.

There is a continuous shortage of good queen stock and package bees available to honey producers in this province and others. The positive economic impact of opening the US border to the importation of honeybees would be extremely significant. High honey prices have not been fully capitalized upon because of severe limitations on honeybee supplies. The supply of bees for pollination, always in short supply, in turn reduces the potential production of other agricultural food crops. Many thousands of colonies of bees from Alberta are overwintered in the lower Fraser Valley because of this shortage and uncertainty of supply for the spring pollination season, this leads to extreme competition with local apiaries for the limited amount of bee forage. We believe that this will be much less of a problem after the opening of the border. The disease profiles in New Zealand with the widespread presence of varroa mites and Australia having the small hive beetle means we can no longer justify the preferential treatment to their supply over that of mainland USA. In addition the quality at best has always been inferior from these countries due in part to the fact that they travel from the Southern Hemisphere in opposite seasons and are extremely stressed by (very expensive) air travel, air conditioning and artificial environments. Our membership has not expressed a concern or mandatory requirement for traceability of imported queen stock, as it does not exist with off shore suppliers at present. Honeybee colonies fly freely back and forth across the border all along "0 Avenue" between Surrey and Abbotsford and have always been doing this. Our disease profile on the Canadian side of this portion of the border has never been different from the USA side and is not expected to be. The Canadian Government funded risk assessment of this past year has also summarized that there is not a significant additional risk involved with importation from mainland USA. The past few years have shown much greater wintering losses due to the varroa and tracheal mites and without new stock which have already adapted to these pests, we are extremely slow in gaining a position against them. We understand the urgency of moving ahead promptly with these new regulations in order to meet a greater portion of the high demand for queens this coming spring.

BeeMaid

Neil Specht

BeeMaid has 2 packing plants, one in AB and the other in MB. Each cooperative elects a board and each board has members on BeeMaid, the marketing arm of the coop. The membership wants 100% Canadian honey packed but competition in the market place dictates that blends have to be allowed. Chemicals are the biggest issue for the packers. Labeling is another issue and has to be improved. The structure of CHC is of interest – maybe there should be a seat for pollinators. We need funds to do more work, and BeeMaid urges more volunteers to help.

Motion to accept the delegate reports moved by Alain Moyen / Grant HIcks.

CARRIED

Government Reports

2003 Canadian Honey Situation and Trends

Farid Makki MISB,
Agriculture & AgriFood Canada

General Market Conditions

According to the preliminary data released by Statistics Canada, Canadian honey production in 2003 reached 33,566 tonnes, representing a 9% decrease from 2002. The sharp decline is attributed to fewer colonies as a result of heavy winter losses (due to weather and disease) and reduced yields in eastern and western Canada. The weather in eastern provinces was characterised by a cool spring and many wet days, while the western provinces experienced excessively dry conditions. Poor weather conditions and high varroa mite infestation rates led to above normal losses, making 2003 an average year overall.

Honey Bee population

The Canadian honey bee population peaked at about 700,000 hives in the mid-eighties and dropped to around 500,000 hives in the early nineties. However, in the past decade the number of hives has slowly risen to reach just over 600,000 in 2001. Preliminary estimates indicate that the number of hives was 576,685 in 2003, representing a 2% drop from 2002.

The number of Canadian beekeepers continues its downtrend and is estimated to have fallen to 8,340 in 2003, down almost 7% from 2002. This clearly indicates that while there are fewer beekeepers, the average number of hives per beekeeper is on the increase. For 2003, it is estimated that on average there were 69 colonies per beekeeper, up from 66 in 2002. Alberta had the highest average in 2003 with 369 hives per beekeeper, while New Brunswick had the lowest average with 26 hives per beekeeper.

Honey Yields and Prices
With the exception of 1998, which was a record year for honey production with an average yield of 180 pounds per colony, the average yields have been in the 117-142 pounds per colony over the last 10 years. The estimated average yield for 2003 is 128 pounds per colony, down almost 8% from the previous year, but well within the last 10-year average.

Estimates of the value of the 2003 Canadian honey crop are not available yet. However, historical data show a continuing upward trend in the average producer prices for bulk raw honey, rising steadily from $0.86/lb in 1999 to a peak of $1.97/lb in 2002. The price of honey has increased during that period on account of a world shortage of honey, due in part to drought in major producing areas, loss of Chinese honey from the market caused by antibiotic residue concerns as well as anti-dumping actions against China and Argentina by the U.S.

Imports and Exports
Canada is a net exporter of honey. Total Canadian honey exports for the calendar year 2003 were 13 million kg, down 41% from 2002 which was an exceptional year with a record 22 million kg in honey exports, but well within the average for the last 8 years. The decline in 2003 exports reflects a combination of the lower domestic production, a rapidly appreciating Canadian dollar and reduced demand for Canadian honey in the United States, Canada's number one market for honey exports (almost 90% of total exports).

Imports of honey into Canada peaked at 13.4 million kg in 1996, then levelled off to about 2-3 million kg until 2000 and have been growing steadily since then reaching 8.8 million kg in the calendar year 2003. Argentina captured half of the Canadian import market for honey, while imports from China represented 21% and US honey captured 12% of that market in 2003. There appears to be a resurgence in imports of Chinese honey in 2003 following the CFIA's 2002 recall of Chinese honey related to chloramphenicol residues.

Canadian honey exported in 2003 fetched an average of $2.19/lb, 20% more than in 2002, while imported honey fetched an average of $1.3/lb on the Canadian market in 2003, unchanged from 2002.

<u>**Situation in Quebec**</u>
As mentioned above, the recent harsh Canadian winter and the prevalence of varroa mite infestations throughout all provinces in Canada led in 2003 to above normal losses among bee colonies. Quebec experienced the most significant losses in the number of beekeepers and colonies since colony numbers dropped by half from 31,710 in 2002 to 15,855 in 2003 and production (481 tonnes in 2003) was between a quarter and a third of the usual amount. Losses were so significant that the Quebec government put in place a $1.9 million program to assist Quebec beekeepers whose colonies suffered the most.

The current CFIA ban on importation of live bees from the continental United States has been in effect since 1987. It was originally designed to control the spread of Varroa mites and more recently of treatment-resistant Varroa. This coupled with a worldwide shortage of queen bees will make it unlikely that the bee colonies in Quebec can be restored to the previous levels any time soon. This reduction in the number of colonies in conjunction with the on going shortage of queen bees, will in all likelihood affect the production for the 2004 season, which in turn will exert pressure on honey prices in that province.

Average producer prices for bulk raw honey were $1.8/lb in Quebec in 2002, compared to the national average of $1.97/lb.

Importation of Honey Bees
Samira Belaissaoui, CFIA

The CFIA completed a risk assessment of the importation of queen bees from the USA in March 2003. The agency has also has taken into consideration the recommendations from the meeting of stakeholders held in Kelowna last October. A change to the regulation is in the process of being gazetted but no firm date has been set for publication of the notice.

Pesticide Registration
Greg Malis PMRA

Greg presented a discussion of the process of registering a chemical with the Pest Management Regulatory Agency. Currently there is no process for low risk pesticides. The submission is treated the same as high risk. The fees charged to a non profit association would probably be reduced by PMRA but it is likely the cost will still be a substantial.

Resolutions

1

Whereas the Canadian Food Inspection Agency (CFIA) is proposing to amend the current regulation that prohibits the importation of honeybees from the States. The amendment will allow the importation of honeybee queens and their attendants from continental USA. Packaged bees will continue to be prohibited from importation.

Whereas the proposed amendment will not result in the uncontrolled entry of honeybee queens into Canada. The existing provisions of the Health of Animal Regulations require importation to occur with the use of an import permit. The conditions of the import permit will be further developed with industry and other stakeholders.

Be it resolved that the CHC support the CFIA proposed amendment to allow the importation of queens from the continental United States under the conditions of the import permit developed with industry and other stakeholders.
Moved by Ron Rudiak/ Grant Hicks

CARRIED

2

Whereas the ad hoc Committee comprised of stakeholders on the importation of Honeybee Queens has developed industry recommendations to the CFIA regarding proposed permit conditions for importing honeybee queens from Continental USA and other importing countries.

Be it resolved that the CHC endorse the proposed permit conditions for importing honeybee queens as recommended by the CHC ad hoc committee, published in Hivelights.
Moved by Ron Rudiak/ Neil Specht

CARRIED

3

Be it resolved that provided that CFIA will require a provincial permit before issuing a federal permit, then the CHC (Canadian Honey Council) supports the Queen Importation Protocol developed this fall in Kelowna BC.
Moved by Glen Ackroyd/ Alain Moyen

WITHDRAWN

4

Be it resolved that the Canadian Honey Council supports the Ontario Beekeepers Association request to the Ontario Ministry of Agriculture and Food to deny import permits under the Ontario Bees Act to any beekeeper importing from Mainland USA, excluding research breeding stock brought in under the supervision of the Provincial Apiarist.
Moved by Glen Ackroyd/ Alain Moyen

CARRIED

5

Be it resolved that Canadian Honey Council change the name of Canadian Honey Council to Canadian Beekeepers Council
Moved by Glen Ackroyd/ Neil Specht

DEFEATED

6

Be it resolved that Canadian Honey Council change the name of the newsletter from Hivelights to Hivelights, The Canadian Bee Journal.
Moved by Glen Ackroyd/ Alain Moyen

DEFEATED

7

Whereas the expiry date of the current border legislation is to expire December 31, 2004

Be it resolved that the Canadian Honey Council recommend the extension of the border closure legislation for packaged bees or bees on comb, for another 2 years.
Moved by Glen Ackroyd/ Alain Moyen

CARRIED

8

Be it resolved that the Canadian Honey Council support Option Two of the ‘Review of the Structure of the Canadian Honey Council Draft Report’, whereby BC would get one seat; Alberta, six seats; Saskatchewan, three seats; Manitoba, two seats; Ontario, two seats; Quebec, one seat, and Maritimes, one seat.
Moved by Grant Hicks/ Neil Specht

CARRIED

9

Be it resolved that the Canadian Honey Council seeks out a national insurance policy that will cover beekeeping operations and third party liability.
Moved by Ed Nowek/ Paul Kittilsen

CARRIED

10
Whereas Canada produces more honey than it consumes and therefore does not need to import honey, and

Whereas there is a substantial amount of cheaper imported honey appearing on Canadian grocery shelves, and

Whereas many consumers do not realize that a product carrying the Canada Grade sign does not mean that the honey is Canadian in origin,

Be it resolved that the Canadian Honey Council pursue the development of a label or trademarked sticker which can be applied to honey packaging that is 100% Canadian and which would be available to Canadian Honey Producers for a fee to be determined.
Moved by Wink Howland/ Ron Rudiak

CARRIED

11
Whereas Canada produces some of the best and most flavourful honey in the world, and

Whereas the advertising and promotion of Canadian honey is costly, and

Whereas, our industry is continually required to conduct research to find newer and better ways of remaining viable in the face of disease and pest threats,

Be it resolved that the CHC again investigate the possibility of establishing a national levy program for raising the funds needed to promote Canadian honey in our marketplace and abroad and to support research and development efforts.
Moved by Wink Howland/ Alain Moyen

CARRIED

12
Whereas the current legislation allows the labelling of the source of packaged honey to be displayed in a very obscure manner, and

Whereas consumers are often unaware that the honey they are purchasing does not contain 100% Canadian honey, and

Whereas, the current legislation does not require that the percentages of foreign source honey be shown on the label.

Be it resolved that the CHC work to have labelling requirements changed so as to advertise the use of imported honey, by country of origin, in a bold manner so as to be noticeable by the consumer, and secondly, to show the percentage of imported honey utilized in the blend.
Moved by Wink Howland/Alain Moyen

CARRIED

13
Whereas many products are currently marketed indicating that they contain honey and honey is displayed prominently in their label, and,

Whereas the manufacturer is usually attempting to capitalize on the good name of honey, and

Whereas the product involved often uses little or no honey,

Be it resolved that the CHC work towards more accurate labelling of those products actually containing honey, by working with the CFIA and Consumer Affairs to ensure that products not containing honey, cannot mislead the public by using the word honey on their labelling.
Moved by Wink Howland/ Paul Kittilsen

CARRIED

14
Be it resolved that the CHC proceed in having Oxalic Acid registered for use in Canada.
Moved by Alain Moyen/Glen Ackroyd

CARRIED

15
Whereas the treatments using formic acid fit within Integrated Pest Management and will be used on an immediate and long term basis.

Be it resolved that the Canadian Honey Council asks the PMRA to maintain the existing C94-05 to permit using Formic Acid in beehives for a further 2 years.
Moved by Alain Moyen/ Glen Ackroyd

CARRIED

16
Be it resolved that the CHC support efforts to register Thymol based products as part of Integrated Pest Management.
Moved by Alain Moyen/Grant Hicks

CARRIED

17
Whereas the majority of Quebec beekeepers oppose the application of the protocol on the importation of queens coming from the continental USA.
Be it resolved that the Federation of Quebec

Beekeepers' requests the creation an interprovincial committee in the event that the importation protocol is granted. This committee should represent each province that opposes the importation of continental USA queens. The committee's mandate will be to identify the appropriate actions for reducing the risks associated with the entry of US queens.
Moved by Alain Moyen

WITHDRAWN

18
Whereas the ad hoc importation committee developed and unanimously supported an importation protocol at Kelowna,

Be it resolved that the CHC continue to communicate to the federal government by all means necessary need to have the regulation amendment process completed and queens accessible by 01/04/04.
Moved by Grant Hicks/ Paul Kittilsen

CARRIED

19
Whereas the CHC Board is composed of the delegates appointed from the various Provincial organizations, and

Whereas at present these various Provincial organizations only appoint said delegates on a one year basis, and

Whereas this can lead to a loss of continuity on the CHC Board.

Be it resolved that the CHC recommend to the various provincial or other seat holders on CHC that they appoint their delegates for a minimum 2 year term.
Moved by Wink Howland/ Alain Moyen

CARRIED

20
Whereas it has been demonstrated that the risk of transferring Small Hive Beetle (SHB) with the queens and attendants which have been inserted into individual queen cages by hand is extremely low, and

Whereas queens shipped from Australia could meet that shipping criteria, and

Whereas a greater number of queens could be available for the Canadian market if there was no SHB area restriction for the production of Australian queens,

Be it resolved that the CHC, having confirmed the risk level is very low through consultation with CAPA request that CFIA delete the 25 km SHB radius restriction applying to the export of Australian queens.
Moved by Wink Howland/ Alain Moyen

CARRIED

21
Whereas the membership fee structure for CHC has not changed for several years,

Be it resolved that the CHC membership classification and fees be revised for the 2004/2005 fiscal year as follows:
Hobbyist (1 to 49 Colonies) $50
Small commercial (50 to 299) $100
Large commercial (300 +) $200
Industry $250
Moved by Glen Ackroyd/ Wink Howland

CARRIED

22
Whereas the Manitoba Beekeeepers' Association have graciously hosted the combined CAPA, CHC, and MBA convention,

Be it resolved that the CHC thank the MBA for their efforts for hosting an excellent convention.

Moved by Alain Moyen/ Grant Hicks

CARRIED

BYLAW AMENDMENTS

1.
That Article VI – Members, clause (1) be amended as follows:
add the following sub clause:
(h) one delegate from the Honeybee Pollinators Association of Canada.

That Article VI, Clause (1), sub-clause (c) be amended as follows:
delete present sub-clause (c), and substitute the following:
(c) one delegate from the Honeybee Queen Breeders Association of Canada.
Moved by Neil Specht/ Wink Howland

CARRIED

2
That Article VIII – Delegate Appointment, be amended to read:
VIII – DELEGATE APPOINMENT
Each provincial organization, Honey Packer Organization, *Honeybee Pollinators Association of Canada, Honeybee Queen Breeders Association of Canada,* Co-ops, - - - as long as those organizations shall desire,

subject to the provisions of Article IX below.
Moved by Neil Specht/ Wink Howland

CARRIED

3
That ArticleVIII – Delegate Appointment be amended to read:
VIII – DELEGATE APPOINTMENT
Each provincial organization, Honey Packer organization, Producer Packer organization, Co-ops, or any other organization who is at present, or may in the future become a member of the Corporation, is responsible for appointing or electing their own delegate to the Corporation. Those persons who are appointed as delegates by their respective organizations, *also must hold an active individual membership in CHC, and* shall remain delegates as long as those organizations shall desire, subject to the provisions of Article IX below.
Moved by Neil Specht/ Wink Howland

CARRIED

4
That Article X – Meetings of the Corporation, clause (1), (c), Notice of Meeting - 1. Be amended to extend the scope of notice by inserting the words "or by electronic means, such as fax or email," after the word "mail" and before the words "a notice of meeting."
Moved Alain Moyen/ Ed Nowek

CARRIED

5
That Article X – (2), Special General Meeting – (b), Notice of Meeting – sub- clause (2) be amended by adding the words "or, if feasible, by electronic means, such as fax, email, or other electronic data transfer system," after the words "last known address."
Moved Alain Moyen/ Ed Nowek

CARRIED

6
That Article X – Meetings of the Corporation, Sub-clause (2), (a), be amended by adding a new subsection of sub-clause (a) to be inserted after sub-section (2) as follows:
Meetings held via telephone or other electronic means.

At the discretion of the Executive, a special general meeting of the Corporation may be convened, with proper notice, and members may participate in a meeting so convened, by means of such telephone, electronic or other means of communications facilities as permit all persons participating in the meeting to communicate adequately with each other, and a member participating in such a meeting by such means is deemed to be present at such a meeting.

That Article XIV – Voting at General Meetings, Clause (1), Right to Vote, be amended by adding the phrase, "being also an active individual member of CHC," and said phrase being inserted immediately following the word "Corporation" and before the words "may vote at" in the body of Article XIV. The amended version of Article XIV would then read:

XIV – VOTING AT GENERAL MEETINGS
(1) Right to Vote
Every delegate member of the Corporation, *being also an active individual member of CHC,* may vote at all general, annual, or special meetings of the Corporation, through its member delegate or by proxy given to a member delegate.
Moved Alain Moyen/ Ed Nowek

CARRIED

Elections
Scrutineer was Jacquie Bunse.

Elections were held and the positions were filled as follows:
President: Wink Howland
Vice President: Alain Moyen
Executive Directors:
Ed Nowek and Paul Kittilsen

CBRF Awards
Cynthia Scott Dupree
Project funding has been awarded to **Rob Currie**, University Manitoba, Winnipeg, "Environmental and Chemical Control of Varroa in Indoor Wintering Facilities." $10,000
Steve Pernal, Agriculture and Agri-Food Canada, Beaverlodge, "Management of Oxytetracycline Resistant American Foulbrood Disease in Honey Bees" $10,000
Albert Robertson, SBA Saskatoon, "Evaluation of Varroa and Tracheal Mite Tolerance in Selected Honey bee Lines and Attempted Correlation of Tolerance with DNA Markers." $7,500.

Fred Rathje Award

The recipient of the Fred Rathje award was Mark Winston, Professor, Simon Fraser University, BC. Due to a death in the family Mark was not present to receive the award. Heather Higo accepted on his behalf.

Adjournment

Motion to adjourn the meeting by Alain Moyen, seconded by Ed Nowek.

CARRIED

SECTION 2 Canadian Bee Research Reports

Integrated Management of Oxytetracycline-resistant American Foulbrood (AFB) Disease in Honey Bees

Stephen F. Pernal and
Adony Melathopoulos
Agriculture and Agri-Food Canada
Beaverlodge, AB T0H 0C0

Objectives/Deliverables:

1. Reduced Residue Risks with Alternative Antibiotics
To determine effective formulations and use patterns for the antibiotics tylosin and lincomycin that minimizes the risk of contaminating honey. The research will deliver guidelines for applying antibiotics to reduce the risk of producing honey with residues while maintaining full treatment efficacy.

2. Predicting AFB Infection by Examining *Paenibacillus larvae* subsp. *larvae* Spores in Honey
To conduct a survey to determine the diversity and distribution of *Paenibacillus larvae* subsp. *larvae* spores in Western Canadian honey. Survey results will be compared to the disease history of colonies to determine the best number and distribution of samples that must be taken to predict the risk of AFB. Several laboratory methods will also be evaluated for their ability to discriminate among *P. l. larvae* strains and closely related microorganisms in honey. This research will deliver protocols to government and private labs as how to best sample honey from producers, and accurately assess the level of AFB within a beekeeping operation.

3. Improved AFB Resistance Among Bee Stocks
To evaluate different protocols for screening AFB-resistant traits among honeybee breeder colonies and determine the best system to increase resistant characters within a commercially managed breeding population. The research will deliver guidelines to Canadian queen breeders to select for stock more resistant to AFB.

Project Summary 2003 - 2004

In the last year, our collaborators at the Agri-Food Laboratories Branch of Alberta Agriculture, Food and Rural Development (AAFRD) in Edmonton have continued to analyze antibiotic residue samples, completing our data set for 2003 and analyzing any outstanding samples from 2002.

At Agriculture and Agri-Food Canada (AAFC) in Beaverlodge, our current efforts have focussed on completing field-based experiments towards all objectives of the project and performing microbiological assays for the detection of American foulbrood spores in honey and adult bees. This year, our ongoing survey of honey samples from several commercial producers in Alberta has been supplemented with samples of honey and adult bees from commercial producers in Manitoba. These samples have proven to be valuable to examine inherent levels of AFB in producers' operations, and to determine relationships between levels of bacterial spores and clinical incidence of the disease. In addition, spores cultured from honey or adult bee samples permit the identification of oxytetracycline-resistant strains of AFB.

The co-operation of five Alberta queen breeders in selecting and propagating hygienic stock continued during the spring and summer of 2003. We have now analyzed data collected during this period to determine the success of our selection efforts undertaken during the spring and summer of 2002.

(1) Reduced Residue Risks with Alternative Antibiotics
Based on the use of our published LC-MS/MS technique, all of the data from the 2003 residue experiment and any outstanding samples from 2002 have now been processed. Examination of these data has revealed several interesting trends relating to the formulation of the treatments applied to colonies.

Based on our 2002 antibiotic residue experiments, it is clear that target dose applications of lincomycin and tylosin formulated in sucrose syrup leave hazardous residues in the brood nest of honey bee colonies (Fig. 1). When honey supers were added to colonies in early July, levels in the brood nest were still > 1 ppm, after medicated syrup applications during the spring. In turn, this resulted in residue levels in the high ppb range for harvestable honey from these colonies (not shown). Fifty-one weeks after application, levels as high as 3.4 ppm for lincomycin and 240 ppb for tylosin could still be detected in the brood nest.

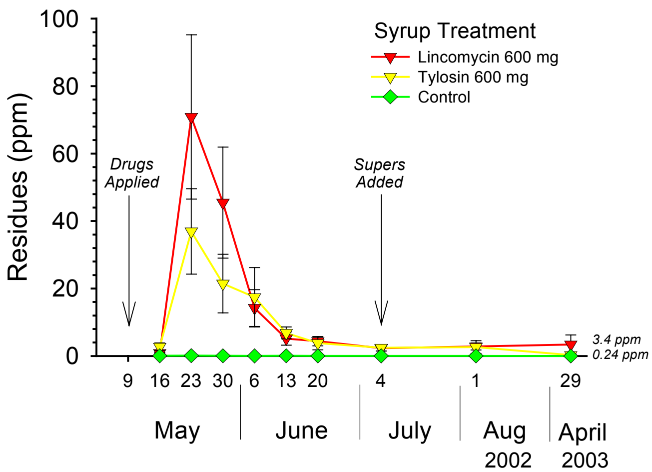

Figure 1. Residue levels of lincomycin and tylosin in the honey of brood nests of colonies after spring applications of these drugs in 2M sucrose syrup (2002). Antibiotics were applied at target dose (600 mg a.i.) and residue levels were determined by LC-MS/MS (detection limit = 10 ppb).

In 2003, we examined a wide range of dosages of lincomycin and tylosin in pollen patties, because initial results from 2002 indicated that residue deposition from these formulations was minimal. Data from abusive treatments, target doses, and less than target doses showed that residue deposition in the brood nest was relatively low for all of these treatments, particularly at the time during which honey supers were applied to colonies (Fig. 2). Moreover, if abusive doses are excluded, residues in the brood nest remain below 20 ppb for the period during which honey supers are applied.

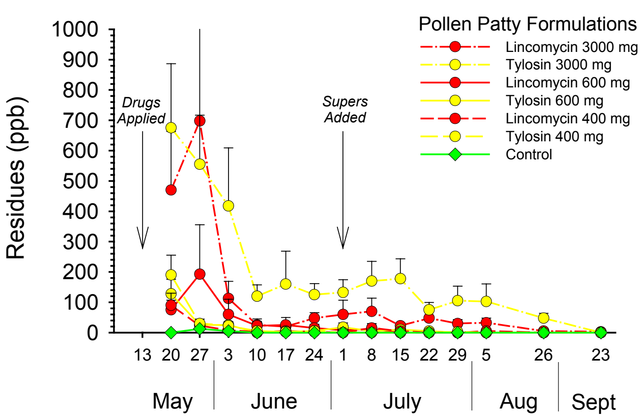

Figure 2. Residue levels of lincomycin and tylosin in the honey of brood nests of colonies after spring applications of these drugs formulated in pollen patties (2003). Antibiotics were applied at abusive doses (3000 mg a.i.), target doses (600 mg a.i.), and less than target doses (400 mg a.i.). Residue levels were determined by LC-MS/MS (detection limit = 10 ppb).

Figure 3 shows drug residue levels in the harvestable honey in 2003. It is readily apparent that all pollen patty formulations, including abusive doses, leave residue levels that are at or near the level of detection for our LC-MS/MS technique. Hence, they are extremely effective at minimizing residue hazard to the consumer of the food product. The three upper lines in this figure represent 600 mg target doses of the drugs formulated as icing sugar dustings, applied either in a single application (1 x 600) or as 3 weekly applications of 200 mg (3 x 200). These latter application methods, though at target doses, leave residues in the harvestable honey at levels of 100-300 ppb. These levels may exceed potential maximum residue levels to be set by Health Canada for tylosin and lincomycin in honey, and as such seriously question the use of these drugs when formulated as sugar dustings and applied in the spring.

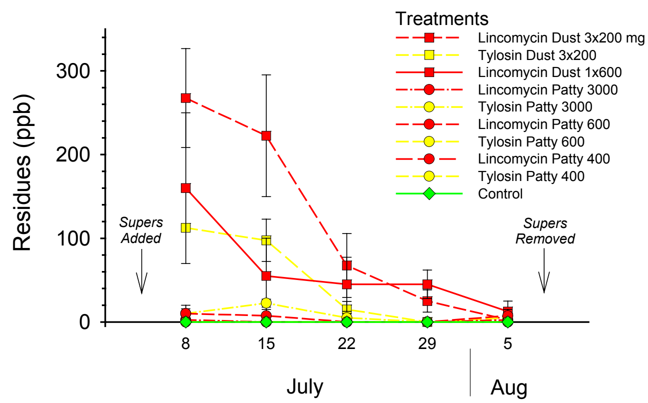

Figure 3. Residue levels of lincomycin and tylosin in harvestable honey, after spring applications of these drugs formulated as icing sugar dustings or in pollen patties (2003). Antibiotics were applied at abusive doses (3000 mg a.i.), target doses (600 mg a.i.), and less than target doses (400 mg a.i.). Sugar dusting formulations were applied as one application of 600 mg a.i. (1 x 600) or as 3 weekly applications of 200 mg a.i. (3 x 200). Residue levels were determined by LC-MS/MS (detection limit = 10 ppb).

In residue experiments during 2002 and 2003, the development and survival of immature and adult bees were monitored to detect any acute or chronic toxicity effects of the drugs among treatments. The first technique involved counting the number of dead adults removed by "undertaker bees" that were deposited in specially constructed dead bee traps attached to the entrance boards of colonies. For both the 2002 and 2003 experiments, antibiotics were not found to affect the seasonal rate of adult bee mortality as measured from the time of treatment application until the end of August of each year (data not shown). The second technique involved monitoring immature bees by "mapping" the location of two patches of 100 first instar worker larvae per colony and then assessing their development and survival at prescribed intervals. This commenced when antibiotics were first applied to colonies and continued until the patches of brood had emerged as adult bees; the process was then immediately repeated for a second cohort of brood. Figure 4 shows larval cohort survival to adulthood among treatments in the 2003 residue experiment. Similar to the adult survival data, no differences were detected among treatments for brood survival. Hence, tylosin and lincomycin did not affect honey bee development or survival based on the application methods and dosages used in our experiments.

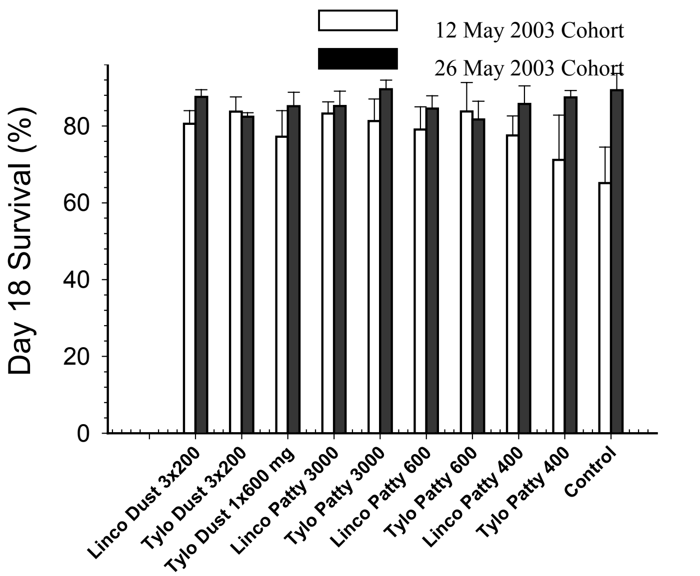

Figure 4. Target animal safety data for honey bee brood in 2003 antibiotic residue experiment. Depicted is cumulative survival from egg to adulthood over two successive brood cycles. Assessments commenced with the initial application of antibiotics to colonies. No significant differences were detected among treatments for either brood cohort.

(2) Honey/Adult Bee Sampling
(2.1) Alberta Producers
Similar to 2002, 14 producers from Alberta cooperated with us in the fall of 2003 by collecting honey samples from their extraction lines based on a predetermined protocol in which the number of samples collected was related to their total production (1 sample per 10 drums). In addition, each co-operator was asked to fill out a survey which outlined the number of colonies they inspected and the number of colonies found with visible symptoms of AFB.

The honey samples were incubated this winter on a selective microbiological medium for *Paenibacillus larvae* subsp. *larvae* (the causative agent of AFB). The number of colony forming units per plate was determined, which serves as a relative indicator of the number of spores per gram of honey. Samples of honey received from producers also permitted testing for oxytetracycline-resistant strains of AFB. Resistance tests are currently being processed in our laboratory for Alberta producers and these results will be presented later.

Over the last two years of sampling, it appears that the number of honey samples in which AFB spores can be detected (Fig. 5A), and the average number of spores per gram of honey (Fig. 5B), have gross relationships to the disease history of honey bee operations. We have seen that the average number of spores per gram of honey are higher in operations with greater clinical incidence of disease, and that these numbers are affected by major changes in the management of disease within such operations. We are presently evaluating the quantitative relationships between disease history and spore data in Alberta to determine the best application of these data for use in disease control.

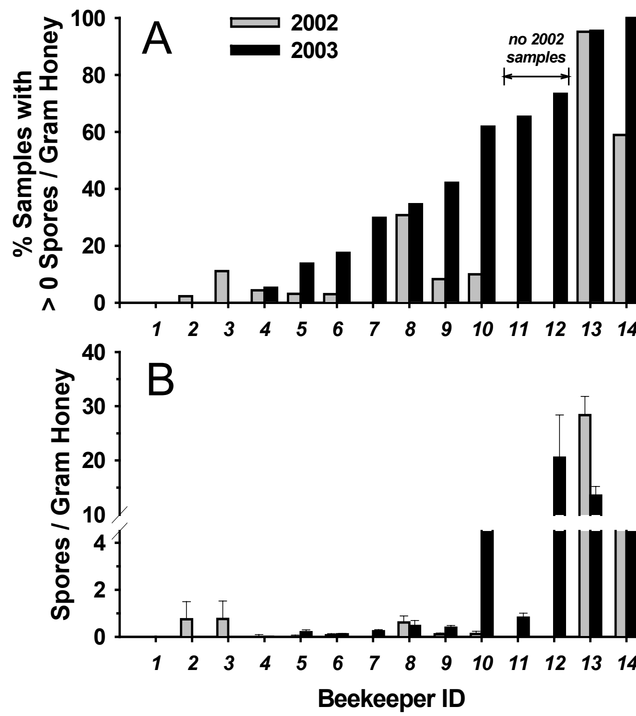

Figure 5. Commercial honey samples from Alberta producers for 2002 and 2003. (A) Proportion of honey samples containing detectable numbers of American foulbrood spores; (B) Average number of spores per gram of honey. Number of honey samples submitted by producers in 2002 =432 and in 2003=586.

(2.2) Manitoba Producers
In 2003, we expanded our survey to include 19 producers from Manitoba. This allowed us to assay spore loads from honey and adult bees sampled within the same beekeeping operations. Moreover, the standardized disease inspections conducted by the Province of Manitoba also permitted a more consistent disease rating standard against which our spore results could be compared.

The two-year incidence of AFB disease among cooperating Manitoba producers is shown in Figure 6. Producers were chosen so that a wide range of clinical disease histories could be examined. The average number of colonies in these beekeeping operations was 790 and an average of 19% of colonies per producer were examined by provincial inspectors during the spring of 2003. The proportion of honey samples containing AFB spores (Fig. 7A) and the average spore load in honey samples (Fig. 7B) are also illustrated below. Unlike the Alberta samples, we found that the proportion of samples in which spores could be detected was not a reliable indicator of disease status, as we readily detected some level of spores in most samples from Manitoba. However, the average number of spores per gram of honey appeared to be more directly related to the disease history of beekeeping operations.

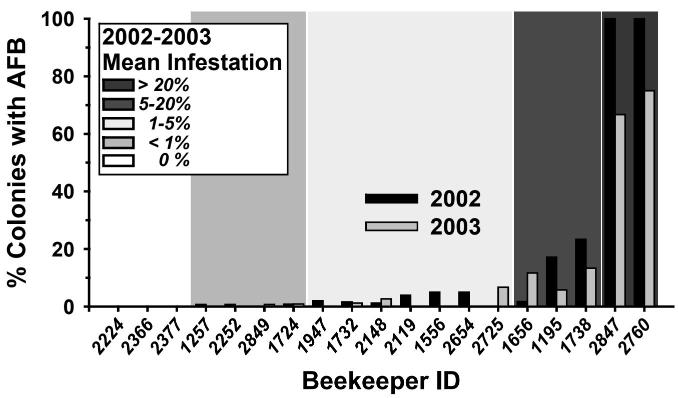

Figure 6. Two-year AFB disease history of cooperating beekeepers in Manitoba. Proportions of colonies with AFB symptoms determined by Provincial inspections each spring. Different shades (carried through in succeeding figures) represent arbitrary categories of disease severity.

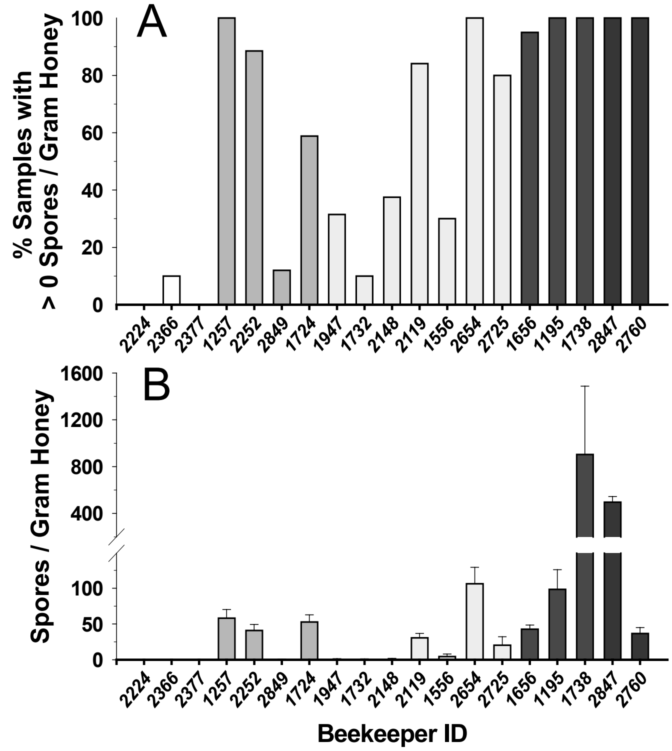

Figure 7. Commercial honey from samples from Manitoba producers in 2003. (A) Proportion of honey samples containing detectable numbers of American foulbrood spores; (B) Average number of spores per gram of honey. (*N* =462).

The analysis of AFB spores from the digestive system of adult bees proved to be a sensitive technique to detect the presence of the disease within a beekeeping operation (Fig. 8). A tighter relationship with clinical inspection data appears to exist than with the honey sampling. This technique appears likely to single out operations that have actively cycling infections of AFB and may be more amenable to use as a monitoring tool whereby action thresholds could be employed for disease management.

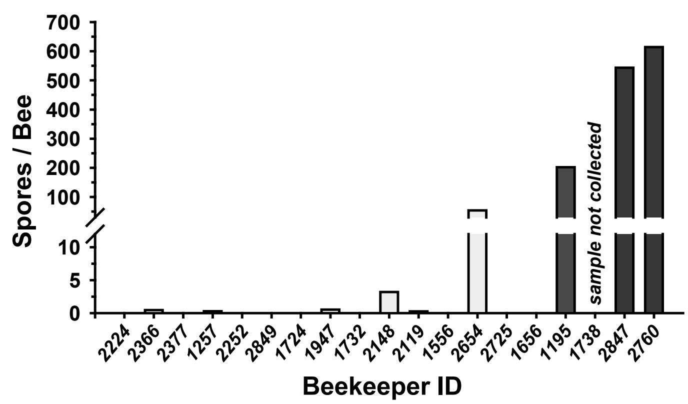

Figure 8. Mean numbers of spores per bee from adult bee samples taken from the brood nest of colonies in Manitoba during spring Provincial disease inspections. An average of 172 (±4.4, SE) bees were processed from each beekeeper .

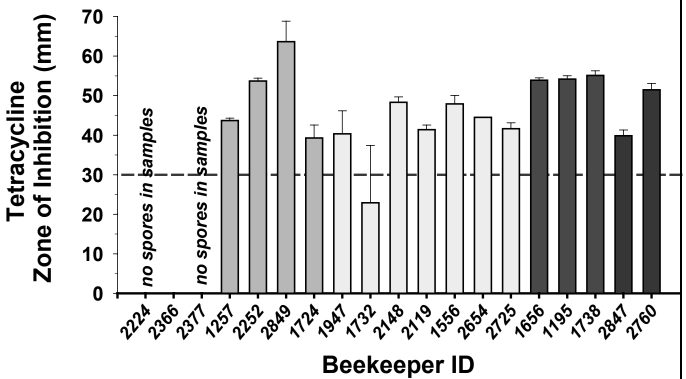

Figure 9. Average zones of inhibition to tetracycline by AFB strains found in Manitoba honey samples. Designation of resistance status is based on an antibiotic disk-diffusion assay, in which the extent of inhibition of *P. larvae* subsp. *larvae* growth is measured on selective microbiological media when exposed to a disk impregnated with tetracycline. Values less than 30 mm denote highly resistant strains, while values of >50 mm indicate high susceptibility; beekeepers #2366, 1732 and 1947all have at least one isolate which was classified as highly resistant (*N* = 144).

Isolates of *Paenibacillus larvae* subsp. *larvae* from honey and adult bee samples were used to carry out antibiotic resistance tests to tetracycline. Preliminary results based on isolates from honey samples are seen in Figure 9. Although the average zone of inhibition for most samples was large (indicating susceptibility to the antibiotic) two beekeeping operations (2366 and 1733) had average zones that were below 30 mm, indicating that they harbour strains of the bacteria that are highly resistant to tetracycline (and, implicitly, oxytetracycline). In addition, beekeeping operation 1947 was found to have 2 isolates highly resistant to the drug, even though the average inhibition zone for all strains cultured was > 30 mm. These are the first discoveries of antibiotic resistance from these beekeeping operations and are highly novel in being detected directly from honey samples. This lends credence to the utility of this technique in managing antibiotic-resistant strains of AFB and provides these producers with advanced warning about the management of AFB in their operations.

(3) Hygienic Behaviour Selection

Hygienic behaviour is a heritable character that confers resistance against AFB. Colonies carrying these traits detect early AFB infections, uncap the cells and then remove the larvae before the disease has had an opportunity to produce spores. During 2003 we continued to evaluate the feasibility of increasing the frequency of these traits using standard open-mating breeding practices commonly used in the establishment of nucleus colonies in Western Canada.

This research was initiated in May 2001 when colonies from several commercial beekeeping operations in the Alberta Peace River Region were evaluated for hygienic behaviour using a freeze-killed brood assay. Colonies with the highest expression of hygienic behaviour were selected as breeding stock and mated to unselected drones flying within the vicinity of each beekeeping operation. Evaluation of colonies headed by these mated daughters (F_1) was conducted in May 2002 and from these daughters selection was made of breeder mothers for a second generation (F_2). In May of 2003, breeder mothers of a third generation (F_3) were selected and their offspring mated. Although all the drone fathers of the F_1 mating were not selected for hygienic behaviour, it was expected that for the F_2 and F_3 matings of virgin queens there would be an increasing proportion of drone fathers sired from selected mothers, as a high proportion of selected queens are introduced into these operations every year.

We have observed an increase in the number of commercial breeder colonies testing positive for hygienic behaviour following selection, with more colonies testing positive following selection (2002 and 2003) than prior to selection (2001) (Fig. 10). Although a decrease in the number of breeder colonies testing positive for hygienic behaviour was observed following 2002, it is not clear that this change has an underlying genetic cause. While the expression of hygienic behaviour depends on the presence of specific traits, it is also influenced by environmental conditions such as nectar flow. Therefore, variation in environmental conditions between years could affect the precision of year to year comparisons for hygienic behaviour.

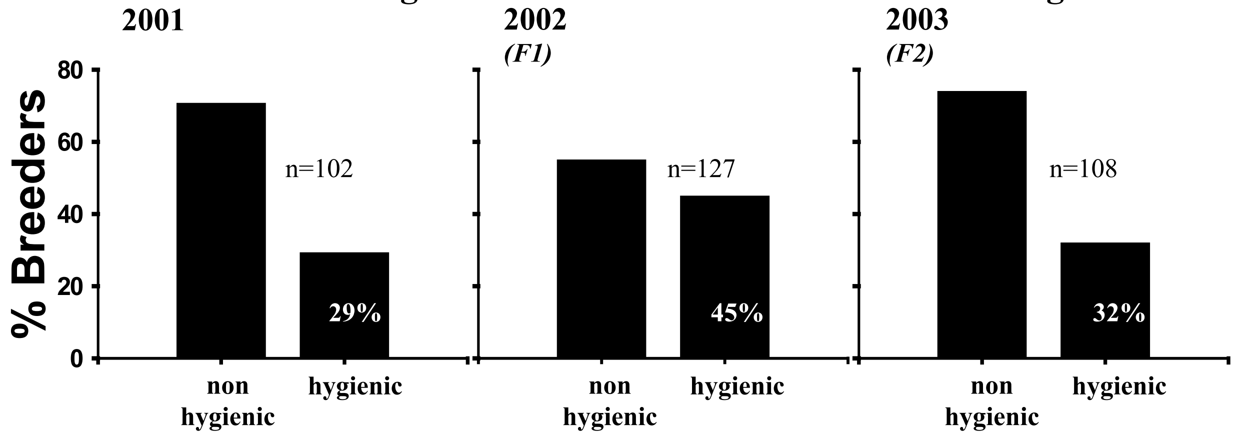

Figure 10. The percentage of breeder colonies removing > 85% of frozen-killed sealed brood within 48 h. Colonies tested in 2003 were the progeny of 2002 colonies with the highest number of cells removed in 48 h. Similarly, colonies tested in 2002 were the progeny of 2001 colonies with the highest number of cells removed in 48 h. Tests were performed in mid-May in all three years.

We attempted to uncouple the effects of maternal genetics, drone source and environmental factors on the expression of hygienic behaviour by establishing progeny apiaries in 2002, and again in 2003. One of each of these apiaries was located within a cooperating beekeeper's operation and each apiary contained representative breeding lines from all of the other cooperating producers, as well as unselected stock. The virgin queens introduced into these "progeny apiaries" were allowed to freely mate with the drone source found within the beekeeping operation in which it was situated.

Figures 11 and 12 show results based on the evaluation of the progeny apiaries founded with selected F_2 queens in June 2002. These progeny apiaries were evaluated for hygienic behaviour once during September 2002 and twice during May 2003. Differences in the expression of hygienic behaviour attributable to the maternal genetic source of the selected lines are shown in Fig. 11. We found significant differences between hygienic lines of bees bred by different beekeepers, which are likely indicative of the degree to which hygienic traits are fixed in those source breeding populations. In Fig. 12, the expression of hygienic behaviour is seen to be uninfluenced by the location in which the stock was mated and raised. This result suggests that the genetic composition of the drone populations, and environmental factors that affect expression of hygienic traits, are similar among progeny apiary sites for 2002.

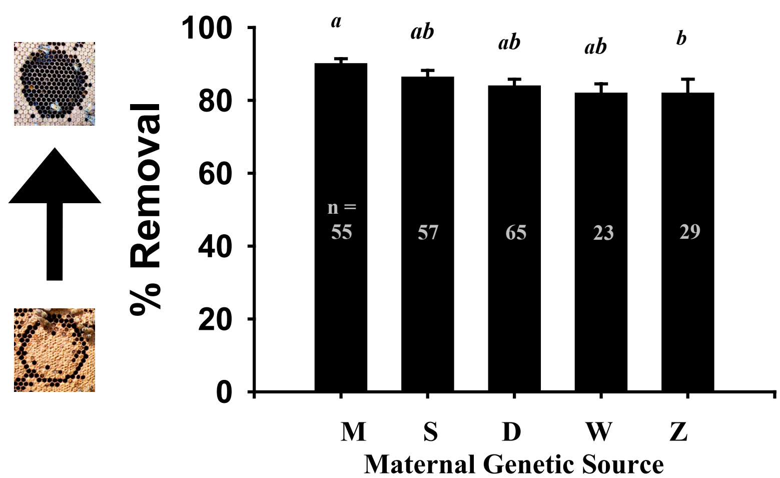

Figure 11. Proportion of frozen-killed sealed brood removed within 48 h in progeny apiaries, founded with F_2 queens in June 2002. Plotted are averages derived from three evaluation periods, one in September 2002 and two in May 2003. Results are grouped by the source of maternal genetics (different beekeeping operations); bars with different letters denote significant differences.

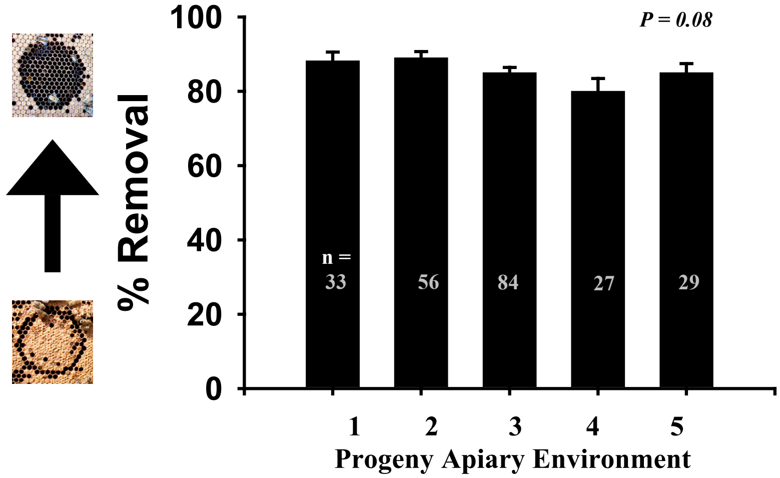

Fig. 12. Proportion of frozen-killed sealed brood removed within 48 h in progeny apiaries, founded with F_2 queens in June 2002. Plotted are averages over three evaluation periods, one in September 2002 and two in May 2003. Results are grouped by the location of the progeny apiary (one within each cooperating beekeeper's operation). No significant differences were detected among apiaries (representing variation in drone source genetics and environmental conditions) on the expression of hygienic traits.

Our 2002 progeny apiary data were also very useful in highlighting two factors that required modification in the establishment of our progeny apiaries for 2003. The first was safeguarding against disproportionate mortality of specific lines, in particular the unselected (control) line, which in 2002 resulted in certain comparisons to be very statistically unbalanced. This imbalance did not allow us to make a robust evaluation of whether, overall, significant increases in hygienic behaviour were made for the 2002 progeny apiaries. Consequently, we took steps to increase and number and acceptance of queen cells used in the establishment of new progeny apiary sites in June 2003.

The second change was the incorporation of "benchmark lines" into the 2003 progeny apiaries. These benchmarks were: 1) queens from a participating Peace River beekeeper that had never selected for hygienic behaviour, 2) queens from a commercial stock widely used by Alberta beekeepers and 3) queens from lines inbred for hygienic behaviour at the University of Minnesota. All the colonies in progeny apiaries will be assayed for hygienic behaviour in May 2004. These lines are mated elsewhere, and will allow us to better partition out the effects of environment, maternal genetics and drone source genetics on the expression of hygienic behaviour.

(4) Plans for 2004

An ambitious summer is planned for 2004. One final antibiotic residue experiment will evaluate the effects of fall applications of tylosin and lincomycin in sugar dustings and pollen patty formulations. Two large-scale studies will also be undertaken to evaluate the efficacy of the same antibiotic formulations on colonies having well-established AFB infections, during the spring and fall. In addition, we plan to work with the manufacturers of tylosin and lincomycin to prepare an initial submission of the 2002 and 2003 residue data sets to Health Canada in order to initiate the process of label extension for these products.

Surveys of honey and adult bee samples from Alberta and Manitoba will continue during 2004, at a similar scale as 2003. Increased emphasis will be placed on building predictive indices between clinical disease history and spore incidence/ intensity in samples.

Our selection for hygienic behaviour will also continue in 2004. In May 2004 breeder colonies within each cooperating beekeeper's operation will be evaluated for hygienic behaviour, as will the progeny apiaries established in June 2003. The two most hygienic colonies from the pool of breeders within each operation will be used to produce the selected F_4 queen lines. These, along with unselected and benchmark lines will be used to establish the 2004 progeny apiaries in June. These apiaries will undergo a final evaluation during May 2005.

(5) Acknowledgements

We wish to acknowledge Don Noot, Tom Thompson and Ken Manninen, Food Safety Division, AAFRD, who collaborated with us in determining antibiotic residue levels in honey. We also wish to thank the following organizations and companies for providing financial assistance: Canadian Bee Research Fund, Alberta Crop Industry Development Fund, AAFC Matching Investment Initiative, Medivet Pharmaceuticals Ltd., Bee Maid Honey Ltd., Alberta Beekeepers' Association and Kona Queens. We further acknowledge the efforts of Rhéal Lafrenière and Lynda Klymochko, of Manitoba Agriculture, Food and Rural Initiatives, for their collection and facilitation of honey and bee sampling from 19

Manitoba producers. Honey samples from Alberta were graciously collected and sent to us by 14 individual producers. The cooperative efforts of the following Peace River Beekeepers are also highly valued for our hygienic breeding study: Paul Benoit, Jack Cage, Robert Dickson, Peter Jessing, Denis McKenna, Fernando Sanchez, Mike Williams, Gilbert Wolfe and Elmer Zumwalt. Last, but in no way least, we thank the many individuals who have worked with us at AAFC Beaverlodge on this project: Robert Albright, William Farney, Christel Leonhardt, Mary Rose Lunam, Peter Mills, Amy Misko, Ryan Scorgie, Sterling Smith and Wendy Walter.

Efficacy of Alternative Sweet Corn Pest Control Agents and Their Impact on Honey Bees

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Abstract
This research involves investigation of new control strategies for insect pests attacking sweet corn and their impact on foraging honey bees. Spinosad, a new reduced-risk biological insecticide is now registered for European corn borer (ECB) control in Canada. Sweet corn cultivars producing the genes for the toxin from *Bacillus thuringiensis* (Bt) var. *kurstaki* also are available. The efficacy and impact of these control strategies requires evaluation under Ontario conditions. Imidacloprid, a chloronicotinyl seed treatment insecticide, currently banned in France due to its possible association with bee/hive kills, is registered in Canada for corn flea beetle (CFB) control. More recently, the new chloronicotinyl seed treatment insecticide, clothianidin, has been registered for CFB control in Canada. Since honey bees seeking pollen frequently forage in pollen-shedding sweet corn, particularly during dearth periods, the potential impact of these pest control agents on honey bees must be investigated.

Introduction
Sweet corn, with a farm value exceeding $22 million in 2002, is an important field vegetable in Ontario. Several insect pests attack sweet corn resulting in reduced yields and cobs of unmarketable quality. For any agricultural commodity, damage by, or presence of insect pests in harvested produce is unacceptable to consumers or processors who demand a product free of insect contamination. To maintain a quality product, sweet corn producers commonly rely on application of foliar insecticides.

Two important pests of sweet corn include the European corn borer (ECB), *Ostrinia nubilalis* (Hübner) and the corn flea beetle (CFB), *Chaetocnema pulicaria* Melsheimer. ECB is considered the most destructive pest of sweet corn. Larvae attack all above ground parts of the plants, with the most important damage caused by larval feeding on ears. If control measures are not implemented, yield losses due to ECB feeding have been estimated at 10% per larvae per plant. CFB transmits the bacteria *Erwinia stewartii* (Smith) Dye, the causal pathogen of Stewart's bacterial wilt (SW). When SW susceptible sweet corn varieties are grown, losses during epidemic conditions have been estimated at 40–100%.

The beekeeping industry is also a significant component of the agricultural sector in Ontario. For years, the beekeeping industry in Ontario has raised the concern that insecticides currently used for ECB control have a negative impact on honey bees foraging for sweet corn pollen. Honey bees are not usually attracted to sweet corn as a pollen source. However, sweet corn plants can produce in excess of 170 kg of pollen per hectare, making this crop a useful pollen source for bees, especially during dry growing seasons or periods of dearth, when more favorable protein sources are not available. Unfortunately the critical time for ECB control is during pollen shed, when honey bees are most likely to be foraging in the sweet corn. Specifically, beekeepers have attributed serious and continuing bee kills to the foliar insecticide carbofuran (FURADAN® 480F, FMC Corp.). FURADAN is the insecticide of choice for controlling ECB. New, alternative ECB control agents, with potentially reduced-risk to honey bees, include the biological insecticide spinosad (SUCCESS® 480SC, Dow AgroSciences Canada Inc.) or the planting of Bt-sweet corn (ATTRIBUTE™, Syngenta Crop Protection Canada Inc.) which expresses the Cry1Ab Bt-endotoxin (var. BC 0801). Another currently registered insecticide with supposed reduced-risk to honey bees is MATADOR™ 120EC (lambda-cyhalothrin, Syngenta Crop Protection Canada Inc.).

Recently, the chloronicotinyl insecticides, GAUCHO® 480FS (imidacloprid, Bayer CropSciences Inc.) and PONCHO® 600F (clothianidin, Bayer CropSciences Inc.) have been registered as seed treatments for CFB control in Canada. Systemic seed treatment insecticides are a new alternative option to foliar insecticides for CFB control in sweet corn. Systemic insecticides move through all parts of the developing plant and often show up in the pollen and nectar. In the past, beekeepers have expressed concern about the possible negative impact of imidacloprid seed treated crops on honey bees. Since PONCHO is closely related to GAUCHO, in terms of chemical structure, the beekeeping community has also raised concern over the risk of this control agent to honey bees.

The objectives of this research were to:

1. Determine the relative effectiveness of currently registered insecticides (FURADAN and MATADOR) with that of recently registered alternative control agents (SUCCESS, Bt sweet corn, GAUCHO and PONCHO seed treatments) for European corn borer and corn flea beetle control in sweet corn;
2. Measure the impact of these pest management strategies on honey bees; and,
3. Make recommendations on alternative efficacious control agents with reduce-risk to honey bees.

Materials and Methods

Fields Trials – Effectiveness in Controlling Sweet Corn Insect Pests

Relative effectiveness of currently registered control agents – FURADAN and MATADOR compared to the alternative reduced-risk control agents - SUCCESS, Bt-sweet corn, GAUCHO and PONCHO was evaluated for control of ECB and CFB. Field trials were conducted at the University of Guelph – Cambridge Research Station in 2002 and at the Agriculture and Agri-Food (AAFC) Delhi Research Farm (Delhi, ON) in 2003. Results in both years were similar, so for the sake of brevity we will report only 2003 data.

Conventional (cultivar: Seneca dancer) and Bt-sweet corn were planted at the Delhi Research Farm using standard planting methods. The Bt-sweet corn was isolated from the conventional corn to comply with government regulations that are established to prevent dispersal of Bt-corn pollen to conventional plantings. Some of the conventional sweet corn seed had been treated with either GAUCHO or PONCHO prior to planting. The remaining insecticides were applied, using recommended label rates, at the late-whorl stage of sweet corn development using a Hahn High Boy™ sprayer.

ECB and CFB damage assessments were made throughout the growing season to the end of harvest.

Laboratory Bioassays – Determining Toxicity to Honey Bees

We measured the risk of each control agent to honey bees using 2 different laboratory bioassay techniques: residual contact and oral feeding.

Residual Contact Bioassays. Ten honey bee colonies containing naturally mated sister queens were established at the Townsend House Bee Research Facility - University of Guelph, Guelph, ON. Cohorts of 20 forager age bees (> 20 days old) were placed in 250 ml glass jars using a modified Dust Buster® as an aspirator and held for use in the bioassays. Pollen shedding tassels were harvested from conventional sweet corn treated in the recommended manner with the foliar treatments FURADAN, MATADOR and SUCCESS or grown from seed treated with GAUCHO or PONCHO at the Delhi Research Station. Tassels from Bt sweet corn were harvested from an adjacent block. Honey bees were exposed to tassels collected 12 h prior to foliar treatment (Pre-Trt) and Day 1, Day 2, and Day 3 after treatment (DAT). Tassels harvested from sweet corn grown from insecticide treated seed or Bt-sweet corn were collected at the start of pollen shed (Day 1) and for 3 consecutive days thereafter (Days 2, 3 and 4). Treatments from each collection day were replicated 4 times. All jars containing bees and tassels were provisioned with water and carbohydrate solution (1:1 w/v sugar:water) *ad libitum* via gravity feeders, a Bee Boost® strip (0.4 Queen Mandibular Pheromone (QMP) equivalents) and held as described earlier. At 24 h, the number of dead bees in each jar was recorded.

Oral Bioassays. Brood frames containing capped cells were obtained from 10 colonies maintained at the Townsend House Bee Research Facility. Frames were incubated at 33±1°C and 85±5% RH. Cohorts of 20 newly emerged bees (< 24 h old) were collected from frames and placed in wooden cages (11 x 8 x 13 cm) with wire screened bottoms and glass fronts. Sweet corn was collected from the same fields at the Delhi Research Farm using the same timing and collection methods indicated in Residual Contact Bioassays section. To remove potential contaminants, test pollen was sieved through # 20, 120 and 240 mesh plastic sieves. Each cage of bees was provisioned with a 0.9-1.0 g pollen:honey (1.5:1 w/w), water *ad libitum* via a gravity feeder and a Bee Boost strip (0.4 QMP equivalents) and held as described earlier. At 24 h, the number of dead bees in each cage was recorded.

Results and Discussion

Field Trials

The results indicated that compared to the untreated sweet corn control treatment, SUCCESS (Fig. 1) provided ECB control equivalent to that of FURADAN, the preferred insecticide, and to MATADOR, the insecticide considered the second choice by growers. In addition, Bt-sweet corn provided significantly better control of ECB compared to the untreated control treatment (Fig. 2). We also determined that treatment of sweet corn seed with either GAUCHO or PONCHO reduced the amount of

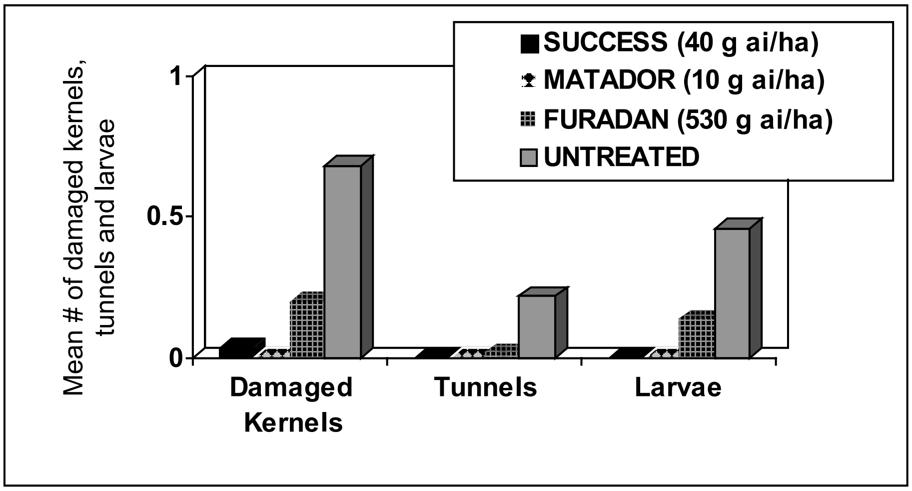

Figure 1. Mean European corn borer damage on ears harvested from sweet corn treated with the insecticides SUCCESS (spinosad), MATADOR (lambda-cyhalothrin) and FURADAN (carbofuran).

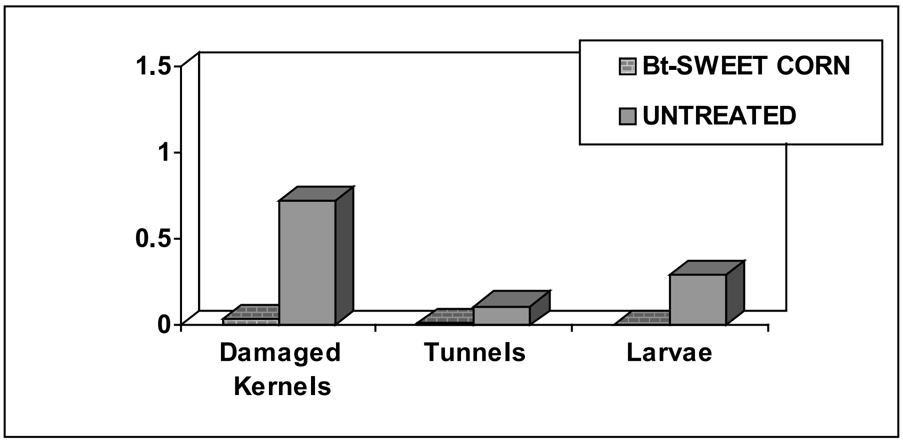

Figure 2. Mean European corn borer damage on ears harvested from sweet corn engineered to express the *Bacillus thuringiensis* endotoxin (Bt-sweet corn, ATTRIBUTE™).

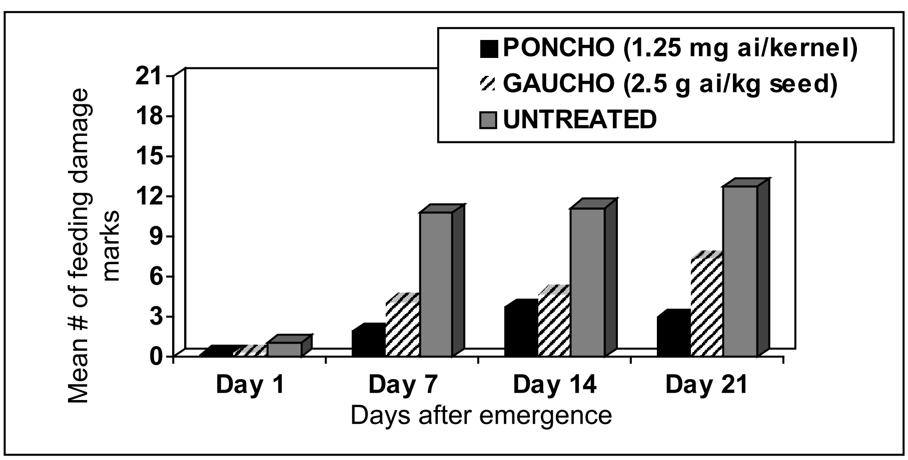

Figure 3. Mean corn flea beetle feeding damage marks on sweet corn plants grown from seed treated with PONCHO (clothianidin) or GAUCHO (imidacloprid).

CFB feeding damage, with PONCHO proving more effective than GAUCHO (Fig. 3).results indicate that the residual contact toxicity of FURADAN was higher than all other insecticides tested for tassels collected

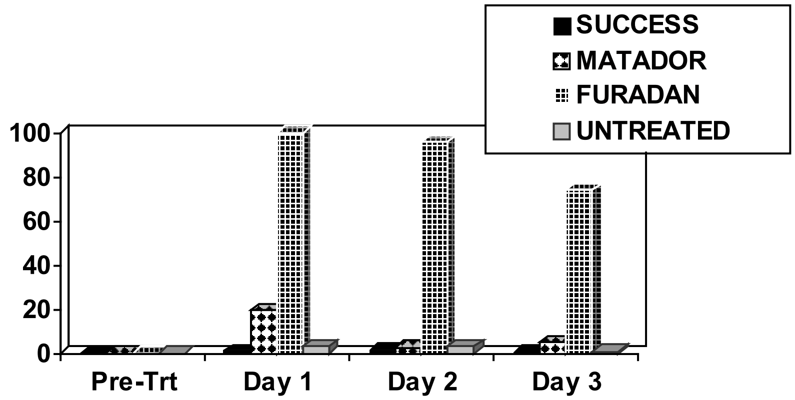

Figure 4. Residual contact toxicity to honey bees after 24 h exposure to tassels from sweet corn treated with selected foliar insecticides.

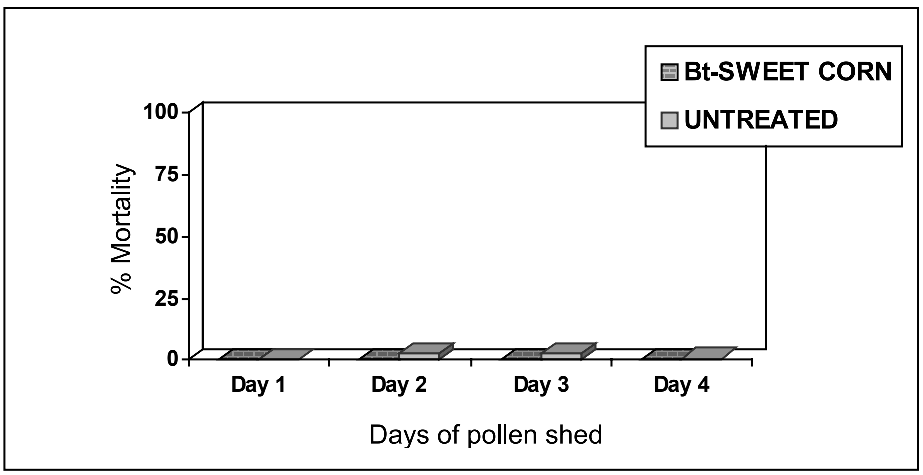

Figure 5. Residual contact toxicity to honey bees after 24 h exposure to tassels from sweet corn genetically engineered to express *Bacillus thuringiensis* endotoxin (Bt-sweet corn).

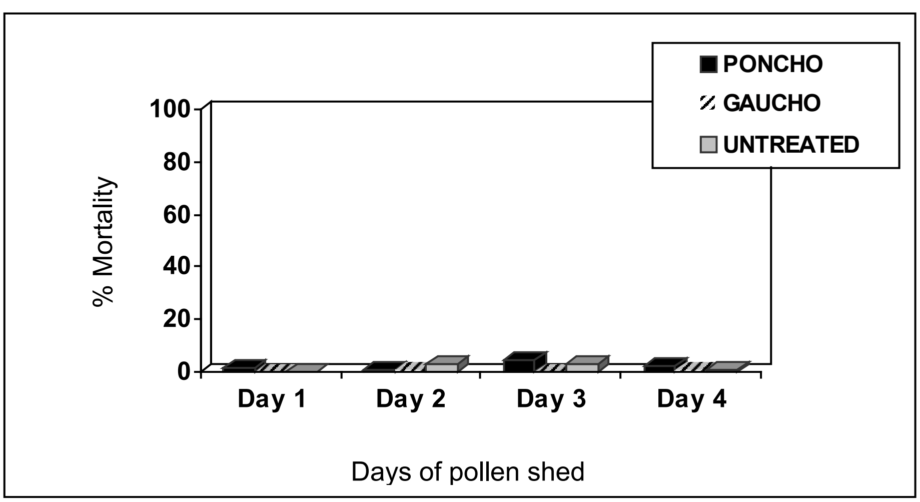

Figure 6. Residual contact toxicity to honey bees of sweet corn tassels collected from seed treated plants.

up to 2 days after treatment (DAT) (Fig. 4). Tassels collected from MATADOR treated sweet corn caused higher honey bee mortality than SUCCESS for up to 1 DAT; mortality was much lower, however, than that caused by FURADAN. SUCCESS and Bt-sweet corn were found not to be harmful to honey bees (Fig. 4 and Fig. 5). The insecticidal seed treatments, GAUCHO and PONCHO, also were found (Fig. 6).

Oral Bioassays. The results indicate that none of the foliar ECB insecticides had a significant impact on honey bee mortality (Fig. 7). The observed lack of oral toxicity of these foliar insecticides is likely due to the structure of the anthers, located on the tassels of sweet corn, and the pollen collection techniques employed. Sweet corn pollen is produced within anthers that extend well outside the plant floret via elongated filaments. A distal pore at the base of each anther allows pollen to escape when shaken by the wind or disturbed by insects. Honey bees forage for sweet corn pollen by walking along the floret, moving the anthers and releasing the pollen which falls on their bodies. During foraging it may be that pollen, which is 'protected' from contamination within the anther, comes into contact with residual foliar pesticides on floret surfaces. The pollen collection technique used in this study involved shaking pollen from the treated tassels into bags. This technique allowed the pollen to fall freely without contacting the floret surface, therefore providing little opportunity for contamination of the samples. Our results also indicate that pollen collected from Bt-sweet corn or sweet corn treated with insecticidal seed treatments, PONCHO or GAUCHO, had no impact on honey bee mortality (Fig. 8).

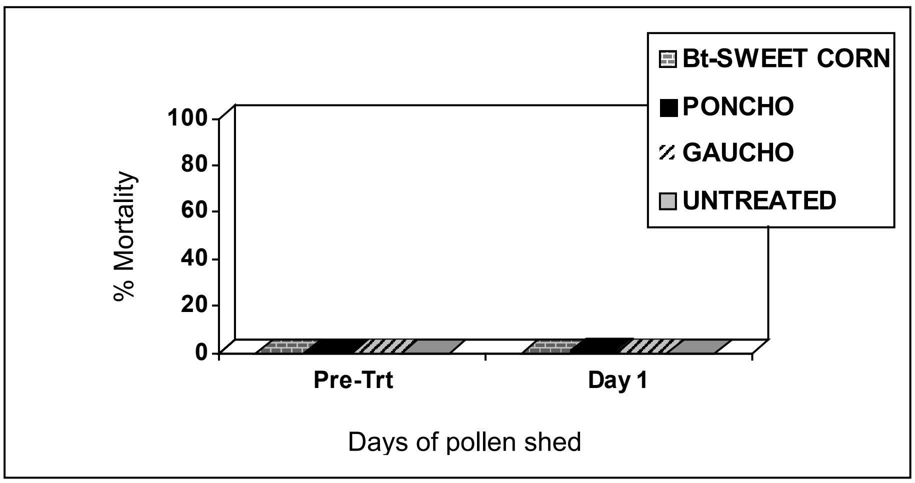

Figure 8. Oral toxicity to honey bees of pollen collected from sweet corn plants treated with seed treatment insecticides or engineered to express *Bacillus thuringiensis* endotoxin (Bt-sweet corn).

Conclusions

In summary, the combination of field trials to determine effectiveness of control agents and laboratory bioassays used in this study have led to possible solutions to the conflict between Ontario sweet corn growers and beekeepers. Overall results demonstrate that alternative control agents, SUCCESS® 480SC, GAUCHO® 480FS, PONCHO® 600F and Bt-sweet corn (ATTRIBUTE™) are effective at controlling ECB or CFB on sweet corn and have no significant impact on mortality of honey bees. In turn, recommendation of these alternative control agents for sweet corn pest control should be considered as these insecticides were found to be effective at controlling the respective target pest as well as safe for honey bees foraging in, or feeding on, pollen collected from plants treated with these control agents.

Acknowledgements

The authors express their sincere thanks to Brenda Harris – Dow AgroSciences Canada Inc. for her valuable advice and assistance throughout the project. We also extend our thanks to: the staff at the AAFC-Delhi Research Farm and the University of Guelph- Cambridge Research Station; T. Welsh, P.Kelly, S.Hilton, D.McArthur , J.McNeil and K. Callow for assistance and expertise.
This research was supported, in part, by the Ontario Fruit and Vegetable Growers' Association; Ontario Food Processors' Association; Ontario Beekeepers' Association; Canadian Bee Research Fund; Agriculture and Agri-Food Canada; Dow AgroSciences Canada Inc.; NSERC-IPS Scholarship Fund; University of Guelph - Ontario Ministry Agriculture of Food (OMAF) Plants Program and the OMAF Special Research Fund. Material donations were received from Syngenta CPC Inc., Bayer CropSciences Inc. and Gustafson Partnership LLC

Evaluating the effects of fall and spring pollen supplements on honey bee colonies and individual worker bees

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The pollen supply available to overwintering honey bees is limited to what has been stored in the colony during the previous fall, along with small amounts of protein stored in the bees' bodies (hypopharyngeal glands and fat bodies). As spring approaches, workers recommence brood rearing and utilize the remaining stored pollen and body proteins as sources of protein for developing larvae. If these reserves are utilized faster than they can be replaced by spring pollen foraging, colonies can become protein stressed. This stress can be seen in colonies that produce smaller bees than usual or reduce (or cease) brood rearing in the spring (Otis, pers. obs.), which implies a trade-off in the quality and quantity of bees that are produced at that time. Our preliminary work (2002) indicated that colonies with spring surpluses of pollen started rearing brood 5 weeks earlier than colonies with pollen deficits and had reared 4 times more brood by the end of April. These pollen-rich workers also lived an average of 15 days longer than workers reared in pollen stressed colonies. These differences translated into two times more honey by the end of the summer for pollen-rich colonies compared to colonies with spring pollen deficits. Our present work (2003) has more fully examined the effects of pollen deficits (fall pollen trapping) or pollen surpluses (fall/spring feeding with pollen or substitute patties) on such parameters as fall and spring sealed brood production, seasonal honey production, worker longevity, worker nursing and foraging capacity and the size and development of the overwintering population.

Study #1 – Differences in worker longevity and colony productivity.

Methods. Colonies (n = 35) received one of five treatments (7 colonies per treatment): 1) pollen-trapped during the fall (Sept.-Oct.) with OAC pollen traps (pollen deficit treatment), 2) provided with pollen patties throughout the fall prior to overwintering (Sept-Oct.), 3) provided with pollen patties in the spring (mid-March-April), 4) provided with pollen substitute patties (Bee-Pro®, Mann Lake Ltd., Hackensack, MN) in the spring (mid-March-April), or 5) left with natural pollen levels (control). Treatments 2 to 4 were pollen surplus treatments that were given a 500 g patty every ten days throughout the feeding period. Patties consisted of bee-collected pollen or Bee-Pro mixed with sugar syrup until a thick consistency was reached. The patty was placed between sheets of wax paper over the frames of the brood chamber.

Sealed brood production was estimated every 12 days (turn-over time) throughout the spring and early summer. Brood measurements were suspended when the mean cumulative brood production of colonies in each treatment reached equilibrium. The cumulative amount of sealed brood produced during April and up to early June was compared between treatments. Honey production was estimated monthly by weighing the honey supers on each colony (empty supers were pre-weighed). In late April, frames with sealed brood were placed overnight in an incubator. The next day (Day 0), newly emerged bees were collected from each frame (10 per colony) and frozen at -80°C. Other newly emerged workers were paint marked and reintroduced to their source colony when the frames were returned. Eight days later (Day 8), colonies were examined and a sample of paint-marked workers (10 per colony) was collected from each colony and frozen at -80°C. Workers from these samples had their stings and digestive tract (ventriculus and hind-gut) removed and were freeze-dried for 48 hours. Dry weights of the head, thorax and abdomen (and total dry weight) were determined for each worker and changes in worker dry weights were compared over time between treatments. These samples remain frozen at -80°C and the protein content of each body part will be determined in the future.

Results and Discussion. There was a significant effect of treatment on sealed brood production throughout April ($F = 5.8$, $p = 0.002$). Colonies that were supplemented in the spring generally reared more sealed brood throughout late March and April than fall pollen-fed, control and fall pollen-trapped colonies (Fig. 1). Colonies that were fed pollen or Bee-Pro in the spring reared statistically similar amounts of brood, but pollen fed colonies did not rear more workers in the spring than the other treatments that had lower brood production. A contrast between colonies fed in the spring and those that were not revealed that spring-fed colonies reared significantly more brood ($F = 13.8$, $p = 0.001$). Any differences in brood production due to pollen availability were lost by early June (Fig. 2, $F = 0.6$, $p = 0.66$) when the more stressed colonies caught up to the amount of production seen in the colonies with spring pollen surpluses. At this time, a contrast between the brood rearing of spring-fed colonies and the other treatments showed no significant difference ($F = 0.7$, $p = 0.40$). This is reflected in honey production by the end of the 2003 season – total yield was not affected by spring levels of pollen in the colonies

(Fig.3, F = 1.4, p = 0.25). The difference in results from our first year (2002) reflects a spring in 2003 when bees had regular opportunities to forage for pollen from mid-April onwards, unlike the previous year when a cold snap from late-April to mid-May prevented this for an extended period of time.

Dry weight increased with the age of the workers that were sampled for all body regions (total: F = 312.9, p < 0.0001; head: F = 949.7, p < 0.0001; thorax: F = 739.5, p <0.0001; abdomen: F = 188.3, p < 0.0001), but there was no effect of pollen availability on this change over time (total: F = 0.5, p = 0.74; head: F = 2.5, p = 0.08; thorax: F = 1.5, p = 0.25; abdomen: F = 0.4, p = 0.84). The dry weight of workers did not change differently over time between treatments (total: F = 0.4, p = 0.83; head: F = 1.4, p = 0.28; thorax: F = 0.7, p = 0.61; abdomen: F = 0.2, p = 0.91). The change in total dry weight over time is shown in Figure 4. It is possible differences in protein content due to spring pollen inputs might be found for some or all of these body compartments (to be determined in future analyses).

Nutritionally stressed honey bees have two options in the spring when they are trying to maximize colony growth: either they can rear as many bees as possible and have them be of lower quality, or they can rear high quality bees in limited quantities. Spring-fed colonies reared more bees, but there were no size differences between the treatment groups or tendency to gain more weight over time and no lasting colony-level effects. Our next study will provide insight into differences in quality between the treatment groups in terms of worker longevity, brood care ability and foraging capacity.

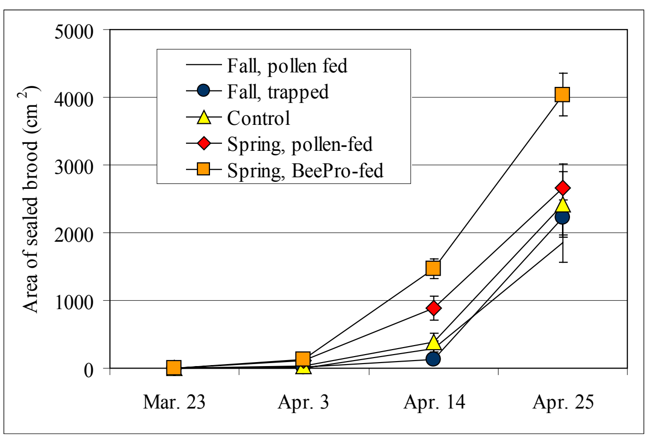


Figure 1: Cumulative sealed brood production up until Apr. 25th, for colonies (n = 35) given one of five pollen treatments in either Fall 2002 or Spring 2003.

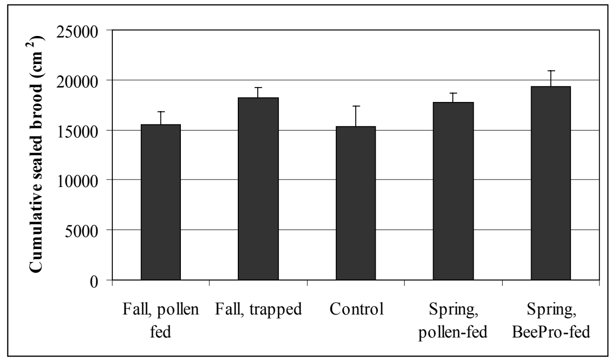


Figure 2: Mean cumulative amount of sealed brood produced by colonies from the beginning of spring to early June for colonies (n = 35) given one of five pollen treatments in either Fall 2002 or Spring 2003

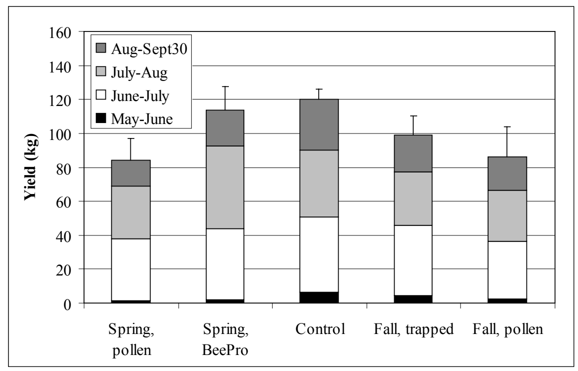


Figure 3: Mean honey production (n = 35), in monthly intervals, for colonies given one of five pollen treatments in either Fall 2002 or Spring 2003

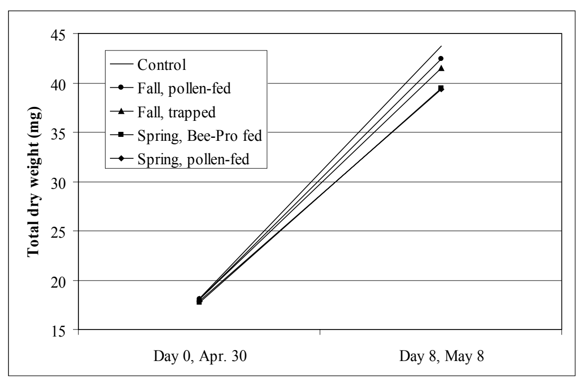


Figure 4: Change in mean dry weight (total body) for workers from colonies (10 workers per colony on each date, n = 35 colonies) collected on emergence (April 30) and at 8 days of age (May 8) from colonies given different pollen treatments in Fall 2002 or Spring 2003.

Study #2 – Longevity, nursing and foraging behaviour of spring-reared bees.

Methods. Workers reared in colonies used for the five treatments implemented in Study #1 were removed as newly emerged adults from their parent colonies (5 colonies per treatment) in late April, marked with numbered tags and introduced into an observation hive (5 cohorts of 20 bees per treatment, 500 bees total). A grid was drawn on each glass wall of the observation hive (8 squares across and 16 squares down). Using this grid, the frames of the observation hive were mapped daily (type and location of food or brood) so that behaviours could be explicitly described (e.g., inspecting an empty, egg, larva, pollen or honey cell). Each side of the observation hive was scanned twice daily from top to bottom along the grid throughout May. When a marked worker was encountered in a square, it was observed for 1 second and its behaviour was recorded according to a list of 30 described hive tasks (Kolmes 1985). The proportions of behaviours that were recorded that were associated with brood (inspecting eggs or larvae; mouthing, capping or uncapping sealed brood) were compared between pollen treatments and over time. Observation hives were fitted with glass runways so that marked foragers could be observed leaving or returning to the hive. Foraging activity was monitored for 0.5-1.0 hour each morning and marked foragers were recorded leaving or returning (with or without pollen) to the hive. From these data, the development of the foraging population, foraging intensity and foraging productivity were compared between treatments.

Results and Discussion. Workers reared in colonies that received pollen or BEE-PRO patties in the spring were more frequently observed performing behaviours typically associated with brood (38-43% of all observed behaviours) compared to workers from colonies that were not supplemented in the spring (19-21%) (Fig. 1, F = 19.6, $p < 0.0001$). Examined over time, the frequency of brood care behaviour was significantly different between treatments from 9 days of age (F = 7.2, $p = 0.01$) to 23 days of age (F = 8.1, $p = 0.01$) (Fig. 2). Worker longevity was also affected by treatment (F = 3.0, $p = 0.02$), where workers from colonies that were pollen-trapped in the fall lived significantly longer than workers from colonies that were fed pollen in the spring (Table 1). The average length of time that bees foraged was significantly influenced by pollen availability in the source colony (F = 3.0, $p = 0.02$); workers from spring pollen-fed colonies spent less time foraging than workers from pollen-stressed and fall pollen-fed colonies (Table 1). Of the cohort of 20 workers that were introduced to the observation hive from the original source colonies, generally fewer bees from spring pollen-fed colonies foraged over time compared to the other treatments, particularly the fall pollen-fed and pollen-trapped colonies (Fig. 4). Foraging productivity (a summation of the total number of days spent in the field collecting resources by each cohort) was also significantly affected by treatment (Table1, F = 3.1, $p = 0.04$). On average, a cohort of bees from a spring pollen-fed colony collectively spent approximately half the time foraging that was spent by bees from fall pollen-fed or fall pollen-trapped colonies. Increased access to pollen/protein is typically correlated with longer worker lifespan because more time is spent in-hive performing protein-depleting duties such as nursing before moving on to riskier outside tasks. It is possible that because these pollen-rich workers were introduced to an unsupplemented

Treatment	Worker longevity	Foraging time (days)	Foraging productivity
Spring, pollen-fed	22.8 ± 1.59 a	4.0 ± 0.69 a	76.0 ± 14.73 a
Spring, Bee-PRO-fed	27.5 ± 1.55 ab	5.5 ± 0.69 ab	98.2 ± 14.73 ab
Control	23.5 ± 1.49 ab	5.9 ± 0.66 ab	115.6 ± 14.73 ab
Fall, pollen-trapped	28.9 ± 1.46 b	6.8 ± 0.65 b	135.2 ± 14.73 b
Fall, pollen-fed	25.6 ± 1.48 ab	7.0 ± 0.66 b	137.2 ± 14.73 b

Table 1: Mean worker longevity, the mean length of time that workers were observed foraging and the mean number of days spent foraging (or foraging productivity) ± SEM for workers from cohorts that had been reared in pollen-stressed or pollen-rich colonies and introduced as adults into a common observation hive. Differences between treatment means are indicated by letters (Tukey's SRT).

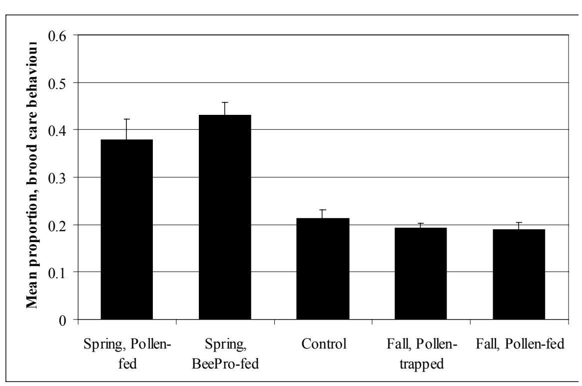


Figure 1: The mean proportion of observed behaviours that were associated with brood-related activities ± SEM for the entire period of observation (1 to 35 days of age) for marked workers from pollen-stressed and pollen-rich source colonies.

observation hive, their superior capacity to care for brood relative to their nestmates partially exhausted their ability to forage, thus reducing lifespan (although the data are not a direct measurement of nursing capacity per se but rather the frequency of brood-associated behaviours). Previous research has indicated that the time workers spend foraging is static and longevity is determined by the length of time spent in-hive(Neukirch 1982). Our data suggest that the capacity of a worker to forage can be affected by the duration of previous brood care behaviours. It is interesting that despite a reduction in foraging, pollen-rich workers exhibited brood care behaviours at the same time that the bees in the cohort reached a high level of foraging activity. This is contrary to the current hypothesis of worker polyethism, which states that workers move from brood rearing to foraging as a behavioural caste (Seeley 1982).

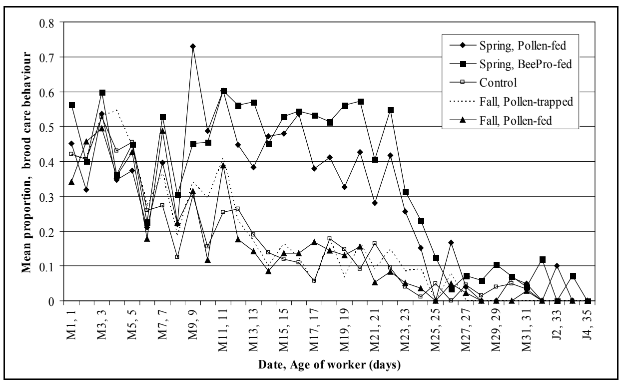


Figure 2: The mean proportion of behaviours that were brood-associated (inspecting egg or larval cell, mouthing, capping or uncapping sealed brood) observed over time for cohorts of marked workers from pollen-stressed or pollen-rich colonies.

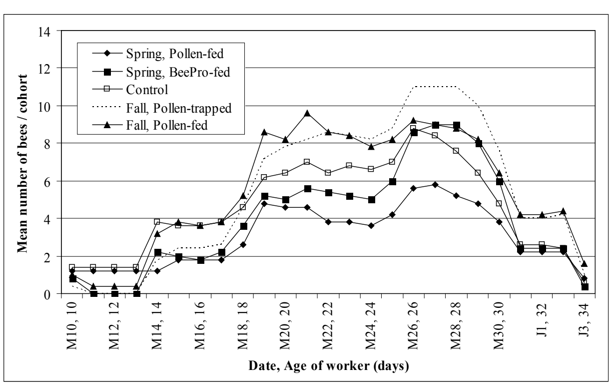


Figure 3: The mean number of bees foraging over time for a cohort of 20 workers reared in pollen-stressed or pollen-rich colonies and introduced into a common observation hive as adults.

Study #3 – Development of the overwintering population.

Methods. We manipulated fall pollen levels to determine the effect of pollen surpluses or deficits on the size and timing of the development of the overwintering population, worker longevity, dry weight and protein content, and colony brood rearing and honey production in the spring. Three of the previously implemented treatments were included in this study (5 colonies per treatment): fall-trapped (Sept. to Oct. with OAC pollen traps), fall pollen-fed (Sept. to mid-Oct. with previously described pollen patties) and control. Sealed brood production was estimated every 12 days from the end of August until brood rearing stopped in the fall and then from early April when brood rearing recommenced until early May

Worker survivorship was estimated by introducing a cohort of marked bees (< 1 day old) to each colony every 12 days for the duration of fall brood production. Because the sealed brood observed in a colony when measured will emerge sometime over the next 12 days, the cohort of marked workers was introduced at the mid-point between measurements of sealed brood so its survivorship would be representative of the sealed brood present 6 days earlier. This was done from early September until brood rearing stopped for each colony (3-5 cohorts). Workers were obtained from a frame of sealed brood that was removed from each colony and placed overnight in an incubator. The next morning, 75 newly emerged workers were marked with a coloured and numbered tags and re-introduced to their source colony. Some of the newly emerged bees were marked with paint so that they could be collected from the source colony throughout the fall and spring. Colonies were examined two days later to determine the acceptance of tagged bees and this value was used as the size of the cohort on Day 0. Whenever the acceptance of marked bees was checked, the presence of previously introduced marked workers was recorded. This cycle ended after acceptance of the last cohorts was checked on 23 October. A final fall observation of the presence of marked bees was made on 20 November prior to overwintering, after which colonies were placed in an overwintering room from December until the end of March. Colonies were checked weekly in the spring from 14 April until marked bees were no longer observed in the colonies. These data were used for estimates of worker longevity and cohort survivorship.

The proportion of workers that overwintered and the area of sealed brood present in the colony prior to worker emergence were combined for each cohort to create estimates of the number of winter bees produced by colonies over time and the total size of the overwintering population (*sensu* Mattila *et al.*

2001). In order to integrate the worker production and longevity in the fall, the number of "bee days" available to each colony was estimated in the following way:

Σ [(# $bees_{cohortN)}$*(worker $longevity_{cohortN}$)]

Results and Discussion. Fall pollen availability significantly affected the total amount of brood that colonies produced from the end of August until fall brood rearing ceased (F = 5.2, p = 0.02), where colonies with fall pollen surpluses produced the most brood, control colonies produced an intermediate amount and fall pollen deficit colonies reared the least amount of brood (Fig. 1A). Fall worker production was 36% greater in colonies with fall pollen surpluses compared to colonies with pollen deficits, which translated into 14 500 more workers produced before colonies overwintered. Brood production in colonies with natural levels of pollen was not significantly different from colonies with either fall pollen surpluses or deficits. Once brood rearing resumed in the spring, fall pollen availability no longer influenced worker production (F = 0.5, p = 0.63), where the total number of workers reared by the beginning of May ranged from 22 000 to 27 000 between treatments (Fig. 1B).

The survivorship curves for marked workers introduced into colonies throughout the fall show that a proportion of each cohort was short-lived and disappeared before the colonies overwintered and that the remainder of the cohort experienced a low rate of mortality and was present in the colonies until the following spring (Figs. 2A-2E). The winter survival of workers was uniformly low between treatments for the first cohort (Fig. 2A), but the percent of each cohort that overwintered increased as the fall progressed for all treatments (Figs. 2B-2E). Cohort survivorship was generally high for workers from pollen trapped colonies in the 27 Sept. and the 8 Oct. cohorts relative to the other treatments, and this was especially evident from the proportion of workers that overwintered (Figs. 2C-D). The differences in survivorship curves between treatments for each cohort are reflected in mean worker longevity. There was a significant effect of fall pollen availability on the longevity of marked workers for four out of five of the cohorts introduced into colonies throughout the fall (1 Sept.: F = 16.7, p < 0.0001; 14 Sept.: F = 18.9, p < 0.0001; 27 Sept.: F = 27.0, p < 0.0001; 8 Oct.: F = 29.0, p < 0.0001; 21 Oct.: F = 1.5, p = 0.23). In three cohorts, workers reared in pollen-deficient colonies had significantly longer lives than workers from colonies with pollen surpluses or control colonies (last two cohorts only) (Fig. 3). By 27 Sept. and 8 Oct., workers from pollen-stressed colonies lived 42 to 52 days longer than workers from surplus or control colonies, which were not significantly different from each other.

The number of overwintering workers that each cohort contributed to the overwintering population is shown in Fig. 4. Pollen availability did not affect the number of winter bees produced for the first 3 cohorts (1 Sept.: F = 0.7, p = 0.53; 14 Sept.: F = 0.4, p = 0.68; 27 Sept.: F = 3.0, p =0.09). Significantly more pollen-rich workers of the 8 Oct. cohort entered the overwintering population than control cohorts; pollen-stressed workers were not different from either treatment (F = 5.7, p = 0.02). Pollen surplus colonies added more workers to the overwintering population in the final 21 Oct. cohort, when very low numbers of bees were contributed to the population by the pollen deficit and control colonies (F = 9.6, p = 0.003). The addition of winter bees to the overwintering population by the pollen surplus colonies towards the end of fall reflects the prolonged period of brood rearing that these colonies underwent. Although pollen-rich colonies had the largest mean overwintering populations (Fig. 4), this input was not enough to significantly increase the total number of bees that overwintered relative to the other treatments (F = 1.7, p = 0.22).

It is apparent that the reduction in brood rearing that was observed in colonies that had a pollen deficit was counterbalanced by the increased longevity of the workers that made up the overwintering population. Conversely, more intensive fall brood rearing and reduced worker longevity was seen in pollen surplus colonies. An estimation of the interaction of the number of bees reared in the fall and the longevity of those bees for each cohort summed over time, or the number of "bee days", shows that there was no difference in the amount of time each fall population contributed to the colony (F = 1.3, p = 0.30). Pollen-rich colonies had a mean of 2 861 000 ± 297 200 bee days, pollen-stressed colonies had a mean of 3 136 000 ± 520 800 bee days and control colonies had a mean of 2 258 000 ± 312 100 bee days.

Pollen availability significantly affected the brood rearing capacity of colonies, where pollen-fed colonies reared more bees in the fall than pollen-trapped colonies. Interestingly, cohort survival was generally higher for workers from pollen-trapped colonies, which is reflected in the mean worker longevity. Of the three cohorts that contributed most significantly to the overwintering population, workers from pollen-stressed colonies lived 1.6 to 1.9 times longer than workers from pollen-rich colonies. Pollen-fed colonies had the greatest rearing capacity, but cohort survivorship and longevity were generally lower and closer to that of the control colonies. This means that the reduced brood rearing in pollen-trapped colonies was compensated for by an increase in longevity of the workers that made up the overwintering population. For this reason, there was no difference in the size of overwintering population, the "bee days" available to an overwintering colony, spring sealed brood production or the amount of honey collected in the subsequent summer due to treatment. If pollen deficits reduce brood rearing and lower nursing loads, this may increase cohort survivorship and extend worker longevity (Maurizio 1950), thereby counteracting any anticipated effects of pollen deficit. All of these factors may have had an equalizing influence, where winter bee production, worker longevity and cohort survivorship had a buffering effect on one another. Analyses of the dry weight and protein contents of the paint marked workers that were collected over time remain to be completed.

These final results may provide insight into the relationship between fall pollen availability, nursing loads and the likelihood of workers entering the overwintering population.

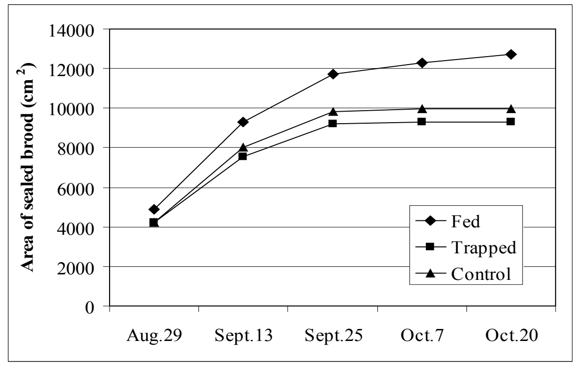


Figure 1A: The mean cumulative sealed brood reared throughout the fall for colonies that were provided with pollen patties, fitted with pollen traps or left to collect pollen naturally

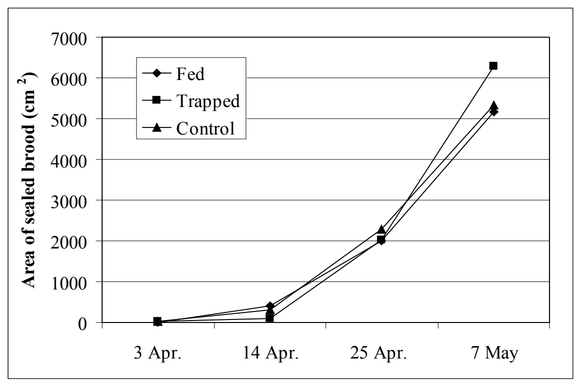
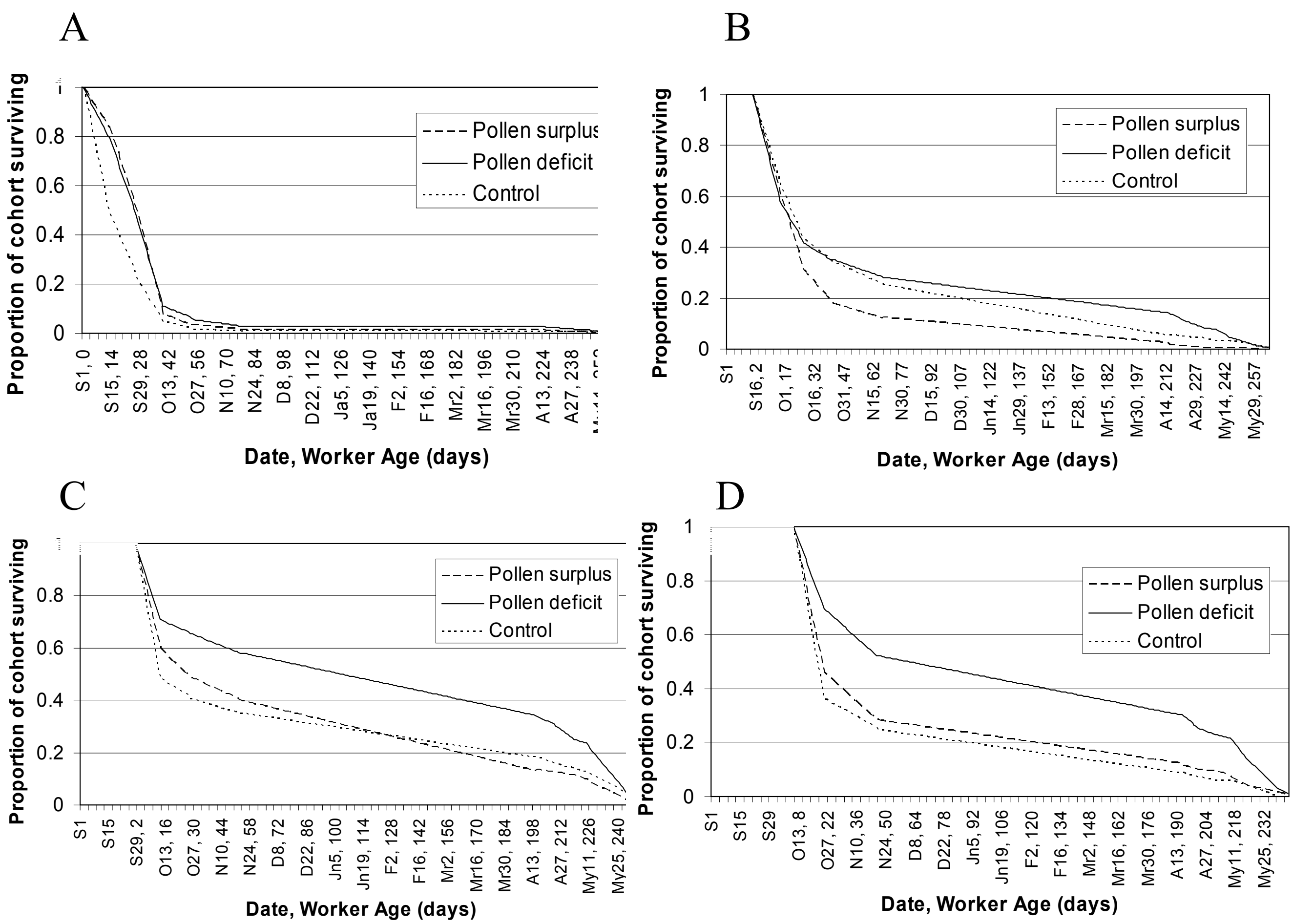


Figure 1B: The mean cumulative sealed brood reared throughout the spring for colonies that were provided with pollen patties, fitted with pollen traps or left to collect pollen naturally in the fall.



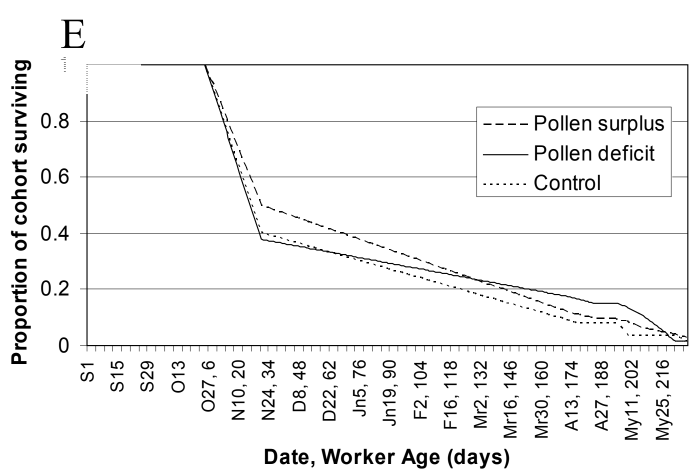


Figure 2, A-E: The mean survivorship curves for cohorts of marked workers reared and re-introduced into colonies that were provided with pollen patties, fitted with pollen traps or left to collect pollen naturally in the fall. Cohorts were introduced on A) Sept. 1, B) Sept. 14, C) Sept. 27, D) Oct. 8 and E) Oct. 21.

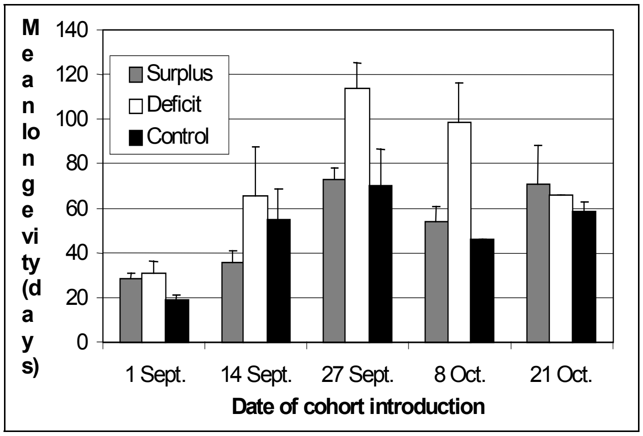


Figure 3: The mean longevity of cohorts of bees introduced throughout the fall from colonies that were either provided with pollen patties, fitted with pollen traps or left to collect pollen naturally.

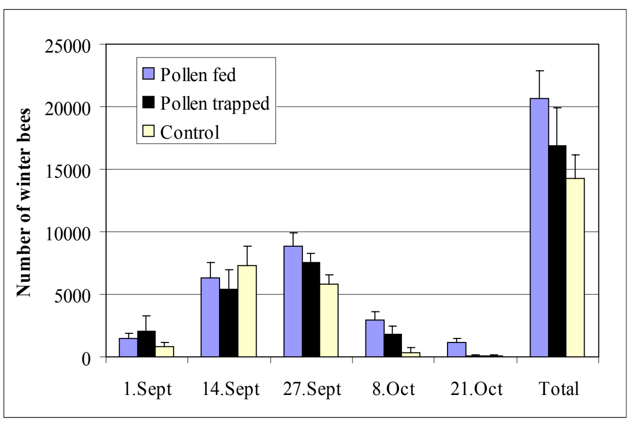


Figure 4: The mean number of overwintering bees contributed to the wintering population by each cohort of bees marked throughout the fall in colonies that were either provided with pollen patties, fitted with pollen traps or left to collect pollen naturally in the fall.

We can make several conclusions from our 2002-2003 studies that are pertinent to beekeepers across Canada:

- ❖ Spring feeding with pollen or substitutes (BEE-PRO® in this case) can increase spring sealed brood production and worker longevity (therefore an increase in both worker quantity and quality), which can have lasting effects on honey production.
- ❖ These effects may be lost if the bees have adequate pollen foraging opportunities in the spring, but this possibility is less likely in areas outside of Southern Ontario.
- ❖ Pollen availability will have significant effects on the brood care and foraging capacity of workers
- ❖ Fall feeding does not improve the overwintering ability of colonies or its nutritional status the following spring. We saw that fall pollen-fed colonies were similar in performance (sealed brood production, quality of workers with respect to brood care and foraging) to control and pollen stressed colonies (fall-trapped). This may be because fall-fed colonies do not store as much pollen in the fall (Mattila, pers. obs.).

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Appendix I: Consolidated Balance Sheet and Statement of Income

Canadian Honey Council
2003 Financial Statement
General Fund Balance Sheet as at October 31, 2003
(Unaudited)

	2003	2002
Assets		
Current Assets		
Cash	**4,378**	
Short-term investments	**68,119**	66,414
Accounts receivable	**1,847**	1,951
Inventory	**210**	315
Accrued interest receivable	**294**	9
	74,848	68,689
Fixed Assets, net book value		
Equipment	**1,403**	1,942
	$76,251	$70,631
Liabilities		
Current Liabilities		
Bank overdraft		27
Accounts payable - note 4	**2,452**	1,345
Deferred income	**4,941**	5,510
	7,393	6,882
Members' Equity		
Reserves for Future Expenditures		
Capital reserve	**5,440**	5,440
Unappropriated Retained Earnings	**63,418**	58,309
	68,858	63,749
	$76,251	$70,631

Canadian Honey Council
Consolidated Statement of Income
For the year ended October 31, 2003
(Unaudited)

	2003	2002
Revenue		
Membership fees	**58,492**	50,021
Annual meeting	**6,350**	11,084
Canadian on Farm Food Safety Program	**63,686**	13,150
Donations - Canadian Bee Research Fund	**1,710**	6,993
Hive lights	**19,073**	17,777
Interest	**2,024**	592
Promotional materials	**127**	1,276
Other		4,605
	151,462	105,498
Operating Expenses		
Advertising and promotion	**180**	35
Annual meeting	**3,989**	10,250
Awards and donations	**175**	163
Bank charges	**154**	121
Canadian Bee Research Fund – Donations	**1,710**	6,993
Canadian on Farm Food Safety Program	**63,680**	13,150
Credit card charges	**43**	81
Hive lights	**19,772**	20,991
Memberships and subscriptions	**3,273**	
Office	**1,624**	2,064
President's honorarium	**2,000**	2,000
Professional fees	**1,356**	1,273
Rent - building	**1,200**	1,200
Telephone	**1,798**	1,511
Travel	**3,833**	937
Wages and benefits	**41,027**	38,616
	145,814	99,385
Net Income Before Amortization	**5,648**	6,113
Amortization	**539**	754
Net Income for the Year	**$5,109**	$5,359

Appendix II: General Fund Balance and Statement of Income

Canadian Honey Council
2003 Financial Statement
General Fund Balance Sheet as at October 31, 2003
(Unaudited)

	2,003	2,002
Assets		
Current Assets		
Short-term investments	**20,000**	10,084
Inventory	**210**	315
Accrued interest receivable	**289**	1
	20,499	10,400
Fixed Assets, net book value		
Equipment	**1,402**	1,941
	$21,901	$12,341
Liabilities		
Current Liabilities		
Bank overdraft	**7,755**	2,636
Accounts payable	**2,451**	1,342
Deferred income	**4,941**	5,510
	15,147	9,488
Members' Equity		
Unappropriated Retained Earnings	**6,754**	2,853
	$21,901	$12,341

Canadian Honey Council
General Fund Statement of Income
For the year ended October 31, 2003
(Unaudited)

	2,003	2,002
Revenue		
Membership fees	**58,492**	50,021
Annual meeting	**6,350**	11,084
Donations – Canadian Bee Research Fund	**1,710**	6,993
Hive lights	**19,073**	17,777
Interest	**648**	178
Promotional materials	**127**	1,276
Other		4,605
	86,400	91,934
Operating Expenses		
Advertising and promotion	**180**	35
Annual meeting	**3,989**	10,250
Bank charges	**154**	121
Canadian Bee Research Fund – Donations	**1,710**	6,993
Credit card charges	**43**	81
Hive lights	**19,772**	20,991
Memberships and subscriptions	**3,273**	
Office	**1,624**	2,064
President's honorarium	**2,000**	2,000
Professional fees	**1,356**	1,273
Rent – building	**1,200**	1,200
Telephone	**1,798**	1,511
Travel	**3,833**	937
Wages and benefits	**41,027**	38,616
	81,959	86,072
Net Income Before Amortization	**4,441**	5,862
Amortization	**539**	754
Net Income for the Year	**3,902**	5,108
Unappropriated Retained Earnings, beginning of year	**2,852**	(2,255)
Unappropriated Retained Earnings, end of year	**$6,754**	$2,853

Appendix III: Canadian Bee Research Fund Financial Statement

Canadian Bee Research Fund
2003 Financial Statement
Consolidated Balance Sheet as at December 31, 2003
(Unaudited)

	2003	2002
Assets		
Current Assets		
Cash	**16,542**	6,842
Short-term investments	**493,648**	509,097
Accounts receivable	**335**	482
	$510,525	$516,421
Liabilities		
Current Liabilities		
Accounts payable - note 5	**777**	452
Equity		
General Fund Balance	**21,039**	30,935
Endowment Fund Balance	**488,709**	485,034
	509,748	515,969
	$510,525	$516,421

Canadian Bee Research Fund
General Fund Statement of Operations and Changes in Fund Balances
For the year ended December 31, 2003
(Unaudited)

	2,003	2,002
Revenue		
Donations	**8,735**	25,889
Investment income	**95**	602
Other		148
	8,830	26,639
Less: Transfers to Endowment Fund	**2,184**	14,336
	6,646	12,303
Operating Expenses		
Bank charges	**39**	24
Office	**68**	23
Professional fees	**435**	452
Research grants	**16,000**	20,000
	16,542	20,499
Net Income for the Year	**(9,896)**	(8,196)
Fund balance, beginning of year	**30,935**	39,131
Balance, end of year	**$21,039**	$30,935

Appendix IV Fred Rathje Award

- 2003 Mark Winston (British Columbia)
- 2002 Doug McRory (Ontario)
- 2001 Don Nelson (Alberta)
- 2000 John Gruszka (Saskatchewan)
- 1999 Doug McCutcheon (British Columbia)
- 1998 Jean Pierre Chapleau (Quebec)
- 1997 Merv Malyon (Manitoba)
- 1996 Lorna and Jack Robinson (Ontario)
- 1995 Gordon Kern (British Columbia)
- 1994 Kerry Clark (British Columbia)
- 1993 Linda Gane (Saskatchewan)
- 1992 Babe and Charlie Warren (British Columbia)
- 1991 Gerry Paradis (Alberta)
- 1990 Cam Jay (Manitoba)
- 1988 Don Dixon (Manitoba)
- 1987 John Corner (British Columbia)
- 1986 Gerry Smeltzer (Nova Scotia)
- 1985 Paul Pawlowski (Alberta) First year of

Appendix V: Canadian Honey Production, Statistics Canada

Estimates of the Number of Beekeepers, Colonies of Bees, Production of Honey and Value in Canada[1] by province[2], 2003 and 2004 with five year averages, 1999 – 2003

Province(1) and year / Province(1) et année	Beekeepers(3) / Apiculteurs(3)	Colonies(3)	Honey – Total Production / Production totale		Valeur
	number nombre	number nombre	lb '000 liv '000	metric métriques	$'000
Prince Edward Island –Ile-du-Prince-Edouard					
Average/Moyenne 1999 - 2003	46	1,837	108	49	198
2003	35 r	2,190 r	115 r	52 r	225
2004 P	30	2,250	90	41	..
Nova Scotia - Nouvelle-Écosse					
Average/Moyenne 1999 - 2003	423	19,416	833	378	1,436
2003	405 r	19,080 r	825 r	374 r	1,650
2004 P	400	19,000	720	327	..
New Brunswick - Nouveau-Brunswick					
Average/Moyenne 1999 - 2003	247	5,609	258	117	495
2003	230	5,060 r	265 r	120 r	530
2004 P	225	4,470	197	89	..
Quebec - Québec(4)					
Average/Moyenne 1999 - 2003	245	30,051	2,892	1,312	4,911
2003	200 r	22,805 r	1,435 r	651 r	3,445
2004 P	190	25,000	1,505	682	..
Ontario					
Average/Moyenne 1999 - 2003	3,130	77,200	8,388	3,805	13,010
2003	2,650	71,000	8,605 r	3,903 r	17,505
2004 P	2,650	72,000	6,690	3,035	..
Manitoba					
Average/Moyenne 1999 - 2003	773	89,000	14,883	6,751	19,976
2003	550	80,000	14,560	6,604	29,100
2004 P	580	81,500	11,820	5,362	..
Saskatchewan					
Average/Moyenne 1999 - 2003	1,325	100,000	20,400	9,253	26,588
2003	1,285 r	100,000	19,500 r	8,845 r	39,000
2004 P	1,055	100,000	15,000	6,804	..
Alberta					
Average/Moyenne 1999 - 2003	733	219,400	26,652	12,089	36,510
2003	755 r	221,000 r	27,845 r	12,630 r	56,845
2004 P	750	235,000	31,725	14,390	..
British Columbia - Colombie-Britannique					
Average/Moyenne 1999 - 2003	2,262	45,865	3,226	1,463	6,927
2003	2,200	42,195	3,135	1,422	7,505
2004 P	2,110	43,126	4,465	2,025	..
Canada(2)					
Average/Moyenne 1999 - 2003	9,183	588,378	77,640	35,217	110,053
2003	8,310 r	563,330 r	76,285 r	34,603 r	155,805
2004 P	7,990	582,346	72,212	32,755	..

(1) Figures are compiled by Statistics Canada from provincial data, with the exception of N.B. and P.E.I. where data are collected through a Statistics Canada mail survey.
(1) Les chiffres sont compilés par Statistique Canada à partir de données provinciales, à l'exception des données pour le Nouveau-Brunswick et l'Île-du-Prince-Édouard, qui sont recueillies par Statistique Canada au moyen d'un sondage par la poste.
(2) Does not include Newfoundland and Labrador -Ne comprend pas Terre-Neuve-et-Labrador
(3) Beekeeper and colony numbers include pollinators that may not extract honey.
(3) Les chiffres pour les apiculteurs et les colonies incluent les insectes pollinisateurs qui n'extraient pas nécessairement le miel.
(4) Quebec production and value figures exclude inventory. Les chiffres pour la production et la valeur au Québec excluent les stocks.
r Figures are revised - Chiffres sont révisés
P Preliminary -Nombres provisoires
.. Figures not yet available - Chiffres pas encore disponible

Note: 1 Pound = 0.453 kilogram; 2,204,000 pounds = 1 metric tonne.
Nota: 1 livre = 0.453 kilogramme; 2 204 000 livres = 1 tonne métrique.