CANADIAN ASSOCIATION

OF

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PROFESSIONAL APICULTURISTS

L'Association canadienne de professionels de l'apiculture

Proceedings 2001

CAPA Proceedings 2001

Contents

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MINUTES

CANADIAN ASSOCIATION OF PROFESSIONAL APICULTURISTS
ANNUAL MEETING
MONCTON, NEW BRUNSWICK
JANUARY 31 – FEBRUARY 01, 2001

Members present
R. Currie, F. Desjardins, D. Dixon, J. Gates, J. Gruszka, S. Javorek, P. Keating, P. Kevan, K. MacKenzie, D. McRory, J. Moran, M. Nasr, D.Nelson, G. Otis, C. Prouse, C. Scott-Dupree, K. Tuckey, P. Vautour, M. Winston.

Guests & Speakers
H. Clay, B. Jamieson, J. McCool, M. Malyon, J. Pettis, T. Jadczak.

MINUTES OF BUSINESS SESSION

Meeting called to order by President, C. Scott-Dupree. Introductions of members present.

Nominating Committee
A new Secretary-Treasurer will be appointed during this meeting. Nomination Committee members appointed: Nelson, Winston, MacKenzie.

Budget Committee

Acceptance of Agenda

Minutes of the 2000 Annual Meeting
Motion: *It was moved by Dixon and seconded by MacKenzie to accept the 2000 Minutes and waive the requirement of reading the Minutes.* ***Carried***

President's Report ***C. Scott-Dupree***

I think it is fair to say that the issue that was a primary focus of attention for many CAPA members in 2000 was the confirmation on 11 April that Varroa mites had been discovered in 4 apiaries in South Auckland, New Zealand not far from the international airport. Many CAPA members, AAFC officials, CHC executive and New Zealand MAF officials spent countless hours on conference calls trying to ingest all the available information and arrive at a decision that would maintain the integrity of the Canadian and New Zealand beekeeping industries. Our primary effort was to establish whether the Varroa mite in NZ was susceptible to fluvalinate treatments and that a second parasite, *Tropilaelaps clarae*, was not a disease threat. Once this was done we could deal with proposed changes to import conditions. The most recent conference call dealing with this issue was on 24 January, 2001. I know that there will be considerable discussion regarding the NZ situation during the Import Committee and AAFC reports so I prefer not to go into details at this point. A special thanks to all the dedicated CAPA members who participated in the NZ discussions and an expression of gratitude to Brian Jamieson and Debbie Barr for coordinating the talks.

Although the NZ varroa situation was of great importance there were other activities that kept us busy throughout 2000.

- Rheal Lafreniere chaired the group responsible for pulling together the literature review on the small hive beetle, *Aethina tumida* Murray. I know this was a considerable undertaking and I would like to thank Rheal and all others involved in producing such a fine document. I believe that all CAPA members should have been emailed a copy of this literature review. A condensed version of this paper was used to generate the section on small hive beetle that was added to the 2nd Edition Revision of the Honey Bee Diseases and Pests publication.
- Mark Winston continued as Director of the Canadian Bee Research Fund (CBRF) in 2000 but formally indicated to me in November that he wished to be relieved of his duties in 2001. Mark has recommended that Rob Currie (Board Member - CBRF) would make an excellent replacement. Rob is willing to take on

these duties but we will wait to hear the official word on the new Director during these meetings. On behalf of all CAPA members I would like to extend our sincere thanks to Mark for all his work on behalf of CBRF. He has truly helped to establish an enduring legacy for the Canadian beekeeping industry.

- A revision 2nd Edition of the Honey Bee Diseases and Pests publication was printed in November 2000. The revision edition includes additional information on r-AFB, fluvalinate resistance in varroa mites and the small hive beetle. We also managed to correct some glaring errors that had been pointed out by faithful readers over the years. The 3,750 copies of 2nd Edition Revision that were printed should be enough of an inventory to tie us over until Don Dixon and his committee can formulate the all new 3rd Edition that should be available later in 2002. CAPA members should have received a complimentary copy of the 2nd Edition revision earlier in January.
- I have also represented CAPA at the Aerial Application Standards - Insecticides Committee that has been formed to discuss the PMRA/ EPA chlorpyrifos environmental risk assessments, to look for language that we can use to improve the Canadian chlorpyrifos label instructions related to aerial application and to discuss possible label standards, applicator training programs and other approaches that will permit growers to retain the use of aerial application of pesticides to protect their crops while ensuring minimal impact on non-target organisms. I am sure that there will be several more meetings on this issue and it is important that a CAPA representative continue to attend. If I am unable to attend I have asked Chemical Committee Chair - John Gruszka - to be my designate.
- Rob Currie has been busy preparing for the Apicultural Research Review scheduled for Thursday evening. I know that Thursday will be a long day for all of us, but it is an extremely important that remain focused on establishing clear and attainable long-term goals for apiculture research and associated infrastructure in Canada.
- Other issues that have surfaced in 2000 are the increasing incidence of r-AFB in Canada, potential changes to the scheduling of formic acid for use in controlling mites in colonies and proposed changes by the EPA to bee protection label statements on pesticides in the US - which could ultimately effect the situation in Canada if the proposals are adopted by the PMRA.

So that's the past - What is in the future?

- Paul van Westendorp has indicated to me that he will officially step down as CAPA Secretary-Treasurer after this meeting. I know we had a bit of a false farewell last year but he is definitely leaving his post this time. His job is extremely important and he has done an exceptional job. I would like to take this opportunity to thank him for all of his support in the past few years. Now we have to fill his shoes. I know that there are many capable CAPA members that could step in as Secretary-Treasurer, however, one of the main difficulties is the funding to actually attend our annual meetings. We have always struggled with the problem that provinces are only allowed to officially send one representative and this has for sometime limited the input of many capable and dedicated members. I would like to suggest that CAPA consider setting up of some type of travel funding for members in this situation who accept executive positions. As executive members of CAPA it is essential that you attend CAPA meetings on an annual basis. Guaranteed funding or even a partial-travel subsidy for those who would not ordinarily be able to attend would encourage broader member participation in the executive.
- The second item that I think we should consider is a new extension activity. We have been very successful with our printed publications and I am not suggesting that we abandon that format. I strongly believe, however, that there are a lot of other ways that we can disseminate apicultural information to beekeepers throughout Canada and North America for that matter. I suggest that an Ad-hoc Committee be formed to investigate new extension endeavors, markets to focus on and ways of marketing the product.

In closing I would like to thank all of you for your many individuals efforts on behalf of CAPA and the Canadian beekeeping industry. I am really proud of this organization because I know that our success is primarily due, in an altruistic sense, to the willingness of our members to offer their time, knowledge, and skills in a collegial and professional way.

Cynthia D. Scott-Dupree
January 31, 2001

Motion: *It was moved by McRory and seconded by Winston to accept the President's report as presented.* ***Carried***

Financial Report — ***P. van Westendorp***

As the accompanying Financial Statement indicates, our Association remains in good financial health. Highlights of the 2000 fiscal year include:

1. *Publication Sales.* Inventory of the Disease publication was very low at the start of the year and it was expected that remaining inventories of provinces and organizations had to be used to meet demand. A total of $4,618.44 of sales were recorded during the year but CAPA had to back purchase $803.22 from two different commercial sources (AAPA and McCutcheon). Several provinces also provided back up for which non-cash replacement arrangements were made. At the end of the year, the revised Disease publication was completed and printed.
2. *GIC.* During the 99 fiscal year, we retained a GIC of close to $10,000 rolled over monthly. This was done to maintain access to funds as needed to cover the significant expenses of the printing of the French edition of the Disease Manual. The GIC earned $74.31 during the first three months of 2000 (Jan - March 23). Then on March 23, the GIC was cashed in at $10,096.67. A new GIC was purchased with an additional $5,000 transferred from the CAPA bank account raising the opening balance to $15,096.67. The new GIC offered cash-in option after 90 days without penalty and 4.25% interest compounded annually. An interest payment of $641.61 will be received at maturity on March 23, 2001. I recommend that a new GIC will be purchased at the most favorable rates after the current GIC reaches maturity.
3. *GST Rebates.* Ottawa issued rebates on the 1998 and 1999 fiscal years as was submitted. In August, a notice was received with payment of $75.27. This payment referred to the 1992 taxation year where, according to the federal government's own calculations, CAPA had not been refunded enough in the amount of $54.96. An additional payment of $20.31 was made for interest earned since 1992.
4. *API'99 Donation.* The Apimondia '99 Organizing Committee submitted to CAPA an initial payment of $175,000 as part of CAPA's share of the proceeds of the Apimondia Congress. Within days, the same amount was transferred to the Canadian Bee Research Fund as a donation. The few days that these funds were in the bank account amounted to $40.03 of interest earnings. The remaining interest earnings for the year ($1.59) were paid on the funds in our business account. As reported last year, the Business Account offers flexibility and services but virtually no interest earnings. I propose that we retain the same policy by transferring access funds into GIC's depending on projected expenditures for the next FY.
5. *Gift to Ms. Debbie Macdonald.* As recorded in the minutes of the 99 Proceedings, a great deal of time and effort is required to administer the publication sales of CAPA. Ms. Macdonald of Guelph has carried out this responsibility voluntarily for a number of years without even being a member of CAPA. The Executive decided to offer Ms. Macdonald a gift in recognition of her work but no decision was made as to the kind of gift. Instead, CAPA wrote her a letter of appreciation with a payment of $150.
6. *Printing Disease Publication.* Revisions to the Disease booklet were completed during the year and the revised document was printed in late 2000. The total cost for 3,750 copies was $8,499.65 (PST/GST included). The payment was not debited to our account until the new fiscal year.
7. *Unpaid Publication Orders.* Only C$20.79 is owed to CAPA of individuals who ordered books. One unpaid order of US$183.91 (shipping included) involved 50 Disease booklets (French) to Cameroun. It is not expected to ever receive payment.

In the next Fiscal Year, no major expenditures are anticipated and given the health of our Association I propose that the membership dues for 2001 remain unchanged at $40 for Full and $20 for Associate memberships.

2000 Financial Statement

Opening Balance				$11,011.38
Income				
. 2000 membership	- 26 full	@$40	1,040.00	
.	- 6 assoc.	@$20	120.00	
. registration	- 16	@$60 + 4.20	1,027.20	
. publication sales		(1*)	4,618.44	
. interest	- bank account		41.62	
	- GIC	(2*)	74.31	
. GST Rebates		(3*)	1,031.90	
. GIC cash-in			10,096.67	
. API'99 deposit		(4*)	175,000.00	
			193,050.14	193,050.14
				$204,061.52

Expenditures

. Print	- 2000 Proceedings	453.72		
. Student Award	- Adony (99 recipient)	200.00		
	- Pernal (2000 recipient)	200.00		
	- Framing	50.00		
. Gift – D. Macdonald	(5*)	150.00		
. S. Daniels	- refund, overpayment of dues	20.00		
. IBRA Sponsorship		250.00		
. S&H charges (UoG)	- Publication sales	1,068.89		
. Publication Purchase	- McCutcheon & AAPA	803.22		
. Postage & Misc.	- mail, receipt book, etc.	261.74		
. Bank Services	- Package Fee (50) + S/C (53.25)	113.25		
. GIC Purchase	- Mar. 23, 2000	15,096.67		
. API99 donation		175,000.00		
		193,667.49		193,667.49
Closing Balance 31/12/00				**10,394.03**

Motion: *It was moved by Dixon and seconded by Gruszka to accept the 2000 Financial Report as submitted.* ***Carried***

Proposed Budget, FY2001 ***P. van Westendorp***

In preparation of the FY2001 budget, following expenditures and earnings are anticipated;

1. The revised edition of the CAPA Disease booklet was paid in December. The total cost of $8,499.65 was not debited to our account until early January and hence, this expenditure will be part of the 2001 budget.
2. C. Scott-Dupree attended meetings on behalf of CAPA in August 2000. Reimbursement of $387.50 was made in early January 2001 and will be part of the 2001 budget.
3. I had been advised by CHC that this year's meetings at Moncton would incur costs. The exact amount is not known at this time but we should budget $1,000 (meeting rooms + coffee/tea).
4. It has been proposed for CAPA to reimburse the Secretary-Treasurer in the future when the employer does not financially support his/her attendance at the annual meeting. A travel budget of $1,000 may be considered.
5. The tax returns for FY2000 will be submitted shortly. I estimate that we can expect a GST rebate of $602.02 of which $517.37 would come from the printing of the Disease booklet.
6. The GIC will mature on March 23, 2001 and will provide an interest payment of $641.61.

A tentative 2001 Budget is being proposed as follows;

. Opening balance, bank account (01/01/2001)			10,394.03
Income			
. membership	- 25 full @$40	1,000.00	
	- 8 assoc.@$20	160.00	
. registrations	- 16 @60 + 4.20	1,027.20	
. publication sales		5,000.00	
. GST refund (FY2001)		602.02	
. GIC interest		641.61	
		8,430.63	8,430.63
			18,824.66
Expenditures			
. Print	- Proceedings	500.00	
	- Disease booklet	8,499.65	
. S & H, publication sales		1,500.00	

. IBRA sponsorship		250.00	
. Framing Student Award		50.00	
. Student Award, prize		200.00	
. Travel	- President	500.00	
	- Scott-Dupree (08/2000)	387.50	
	- Secretary-Treasurer	1000.00	
. Postage/mail		200.00	
. Bank Service charges		115.00	
. Meeting Rooms, Moncton		1,000.00	
		14,202.15	14,202.15
			4,622.51
GIC			15,096.67
Closing Balance			**19,719.18**

To facilitate the budget matters as discussed, it was suggested to select a new Secretary-Treasurer now. It was agreed that the nomination committee would come forward with a nomination later in the meeting. In preparing a FY2001 budget, the following members were appointed: Dixon, Melathopoulos, Gruszka.

Dixon suggested that based on the documentation submitted by Van Westendorp, the membership moves that the annual membership and registration fee remain the same as in the past: $40-full member, $20-student member, $60 + GST-Registration.

Motion: *It was moved by Dixon and seconded by Gruszka to maintain the annual membership fee at the same levels as before; $40.00 for full membership and $20.00 for associate membership* ***Carried***

Motion: *It was moved by Dixon and seconded by MacKenzie to accept the proposed budget report as presented.* ***Carried***

Discussion

- Outstanding charges, Victoria Meeting, January 1999. The Capital Region Honey Producers (CRHP) claims that CAPA still owes $1,500 for the meeting in Victoria; CAPA members already paid $1,300 together as individual registrations at the time of the meeting. In previous communication between CAPA and the CRHP, CAPA had indicated a willingness to consider payment of these additional expenses if invoices from the hotel are presented; none have been forthcoming. Any future requests for payment will have to come to the CAPA membership for consideration.

- Discussion followed concerning the proposed financial support in ensuring the attendance of the Secretary-Treasurer at future annual meetings. Tuckey asserted that such provision may set a dangerous precedent and has the potential for abuse. On the other hand, it would help a second person from a province to attend (in those provinces with two apicultural staff members) (Gruszka). Furthermore, the provision would reduce the constraints currently felt by many CAPA members to be nominated for executive positions. Otis pointed out that CAPA is sufficiently small and with proper safeguards and accountability the expense approval process could easily be put into place. It was pointed out that this issue relates to all executive positions, and should not be limited to the Secretary/Treasurer.

Motion: *It was moved by Winston and seconded by Kevan to provide funding for up to $1000 for annual meeting expenses, if necessary, to members of the CAPA executive, with the approval of the other executive members.* ***Carried***

Awards Committee: ***J. Gates***

Student Merit Award

An invitation to submit nominations for the Student Award was sent out, but not everyone received it. No eligible nominees were received this year. One US citizen was nominated but was not eligible.

A suggestion was made to change the wording of the student award, to *"Nominees must be a Canadian citizen/permanent resident or a student at a Canadian university".*

Special Awards
The possibility of nominating H. Shimanuki or Bill Wilson as honorary members was discussed. In the past this honour was reserved for former CAPA members. Winston suggested there may be a need for a different category of awards and honorary membership as the current system may not be the best to recognize these individuals (e.g., "Awards of Merit" in our bylaws may be more appropriate). The Awards Committee was directed to return tomorrow with a suggestion for how to best handle this matter. Committee membership includes: Gates, Dixon, McKenna, Prouse, van Westendorp.

In the minutes, the list of honorary members should be amended: Mr. E. Bland, Mr. F. Beauchesne (not Dr.)

Canadian Bee Research Foundation — ***M. Winston***

The Canadian Bee Research Foundation has so far raised approximately $600,000 in research funding to date (from private donations, Garfield-Weston Foundation, and Apimondia profits). The committee is still evolving in its research priorities and in the types of proposals received (multiyear proposals, etc.).

The CBRF is administered through Canadian Honey Council at a low cost; thanks to Heather Clay for handling much of the administration, sending out of letters, issuing cheques, and coordinating the participation of recipients at the annual research symposium. All awards to date have received matching funding. Thanks were also expressed to other directors, President and Research Chair of CAPA and CHC. In the past this consisted of Wink Howland, Merv Malyon, Mark Winston and Rob Currie. Mark has indicated his desire to step down as chair of the CBRF Committee.

Motion: *It was moved by McRory and seconded by Nasr to accept the report as submitted.*

Carried

CAPA Publication Report — ***C. Scott-Dupree***

We had a busy year with CAPA publications. As predicted last year, our disease publication inventory lasted until May 2000. The 2000 inventory report for the Honey Bee Diseases and Pests publication indicates that we sold 877 copies of the 2nd Edition of the disease publication in the passed year and 515 of those sold were borrowed from D. McCutcheon, P. van Westendorp, D. Dixon and J. Gruszka. The understanding with these individuals was that they would be reimbursed with copies of the 2nd Edition Revision when available. During the summer final editorial corrections and additions (rAFB, varroa mite resistance to fluvalinate and small hive beetle) were made to the disease publication. The 2nd Edition Revision was sent to press in late October and by the end of November we had 3,750 copies available for distribution. In last years budget, $8,500.00 was allotted to the publication of the 2nd Edition revision. The actual cost of 3,750 copies was $8,499.65. We have provided all CAPA members with complimentary copies of the 2nd Ed. Revision and have also reimbursed the 515 copies borrowed in 2000. In 2001, we have already sold 300 copies of the disease publication.

On an even more interesting note - CAPA can be proud of the fact that our disease publication is now printed in Flemish. Pierre Varijkel - Secretary of the Belgian Beekeepers Federation (BBF)contacted me in the March 2000 as for permission to translate and print copies of the disease publication. A MOU was established that allowed for maintenance of ownership, editorial input and royalties ($0.10US/unit) for CAPA. To date 500 copies have been printed in Flemish and we have receive a payment of $50.00 US from the BBF.

We have a small inventory of pollination publication on hand. We boosted last years stock by purchasing 40 copies from AAPA through Marla Spivak. All of our regular customers have been informed that the pollination publication is out of print. CAPA needs to consider how to deal with requests from customers to reprint (photocopy) the publication for various requirements. It is my hope that the section on the economics of pollination by honey bees to agriculture, which has been revised by Dave Pearen and Randy Muma - AAFC, can be reprinted as a short extension article, published as a general interest article in a trade journal and/or made available on the CHC-website.

January 1, 2000 - December 6, 2000

A. Disease Booklet (2nd Ed.) - orders filled

1)	January 1, 2000	GloryBee Foods Inc.	72
2)	January 19, 2000	Szkok Istvan	1
3)	January 19, 2000	Mann Lake Supply Ltd. (E. Jurgenson)	62
4)	January 19, 2000	GloryBee Foods Inc.	100
5)	January 19, 2000	Jim Walls	24
6)	February 25, 2000	Brush Mountain Bee Farm (S. Forest)	100
7)	March 1, 2000	Dadant & Sons, Inc. **(borrowed)**	200
8)	March 8, 2000	Cal Madill	1
9)	March 9, 2000	D.A. Schaap	1
10)	March 31, 2000	Monroe Cty. MSU Extension (P.F. Marks)	20
11)	March 31, 2000	Paul Pineo	1
12)	April 6, 2000	MAPAQ-QASA	1
13)	April 10, 2000	Ontario Beekeepers' Association	12
14)	May 9, 2000	Rob Bronsveld	1
15)	May 9, 2000	Cathy Windsor	1
16)	May 31, 2000	Jack Piepenbrok	1
17)	May 31, 2000	Sharon C. Hohner	1
18)	May 31, 2000	Brigitte Reynolds	1
19)	June 28, 2000	Bruce Penfound	1
20)	June 28, 2000	P.E.I. Dept. of Agr. and Forestry (C. Prouse)	30
21)	July 5, 2000	Dadant & Sons, Inc. **(borrowed)**	200
22)	October 23, 2000	Ruhl Bee Supply	25
23)	November 3, 2000	Lynn Hanson	1
24)	December 6, 2000	NGWE Ruben (Delegue)	20
			877

Summary

420	**inventory left over from (1999)**	
877	orders filled in (2000)	
- 457		
+ 85	stock borrowed from D. McCutcheon	
- 372		
+150	stock borrowed from P. VanWestendorp	
- 222		
+100	stock borrowed from D. Dixon	
- 122		
+180	stock borrowed from J. Gruszka	
+ 58		
- 36	complimentary copies given	
22	**inventory left over in (2000)**	**(21 - cupboard; 1 - desk copy)**

Value of remaining inventory: **22 x $3.00/copy = $66.00**

B. Pollination Publications - orders filled

1)	January 19, 2000	Szkok Istvan	1
2)	May 31, 2000	Sharon Hohner	1
3)	May 31, 2000	Bridgitte Reynolds	1
4)	October 19, 2000	Dave Matheson	1
5)	October 19, 2000	Cal Madill	1
6)	October 19, 2000	D.A. Schaap	1
7)	October 19, 2000	Marion Osborne	1
8)	December 6, 2000	Scott McClinchey	1
9)	December 6, 2000	Rob Bronsveld	1
			9

Summary

6	**inventory left over from (1999)**
- 1	(Debbie used)
5	inventory
+40	bought from AAPA - Marla Spivak
45	
- 9	orders in (2000)
36	**inventory left over in (2000)** **(34 - cupboard; 2 - floating)**

Value of remaining inventory: **36 x $2.50/copy = $90.00**

Discussion
CAPA inventory ran out of Disease and Pest publications in May 2000. Replacement copies were borrowed from several CAPA members to meet orders. Once the revised printing was received, those borrowed copies were replaced with copies of the new printing, which included updated information on r-AFB, varroa mite resistance to fluvalinate, and the small hive beetle.

In Quebec, they are working to update information on diseases and pests. The CAPA publication is now available in 3 languages (English, French, and Flemish).

Only a small number of the pollination publications remain (but both Dixon (200), Gruszka (200), Tuckey (100) and Pat Westlake (Ontario) and BC (100) have a number of copies if needed). Some suppliers (e.g., Kelley Co., Dadant) should be contacted to make them aware that copies have been located. The assessment of the economic value of pollination has been revised, and should be published in an accessible format.

About 800 AAPA Varroa mite publications remain (with Scott-Dupree) to be sold. Scott-Dupree raised the matter of looking into other potential ways to extend information on beekeeping (e.g. websites). Currie indicated his students are accessing web info on the US and other countries, but very little relating to Canada. Scott-Dupree suggested forming an ad hoc committee to look into this (Melathopoulos [chair], Scott-Dupree, Tuckey, Currie).

Dixon reported on plans to completely revise the Disease and Pest publication. The plea went out for members to volunteer and contribute to this effort by taking charge of rewriting particular sections. It is planned to publish the revised booklet by the end of 2002. New visual material is also desired to enhance its presentation. Slides and electronic images are acceptable at present.

EAS/AAPA summer meeting ***M. Nasr***

Sixteen members and associate members attended the AAPA meeting. Issues discussed at the meeting:

AAPA Annual Meeting
The AAPA annual meeting will be put back on annual meeting basis. It was decided to rotate the meetings, for example: ABF – AHP – USDA Bee Lab (3 year rotation), or Industry – USDA Bee Lab (2 year rotation). The president will decide on this rotation. For the next two years it was suggested that we meet:
- 2001: with ABF (January)
- 2002: at USDA Bee Lab (Beltsville?), or in Savannah, GA at the Big House on Sapalo Island

Resistance Management. (Discussion leader (M. Ellis)
Factors effect development of resistance were discussed:
1. Resistance dose / timing: how long before fluvalinate can be used in the USA?. In Italy, Varroa has been resistant to fluvalinate for 7 years and Apistan has not been reused in these areas for Varroa control.
2. Mechanisms of resistance: Huang, Hunt, and Ellis are currently researching Apistan resistance mechanisms. It is important to understand the genetics behind the resistance and how to break it down.
3. IPM strategy: Nasr combines use of alternative controls, resistant bee stocks, with registered pesticides.
4. Pesticides use: effects of dose, frequency, and formulation on resistance.

The Small Hive Beetle. (Discussion leader: K. Delplane)
No outbreaks has been reported. The treatments of Checkmite combined with drench treatment of GuardStar seem to have reduced the impacts of the beetles. Beetles are a problem in honey houses. There are no registered chemical to be used against the beetles in honey houses. Beekeepers are using their own chemicals (i.e. methyl bromide and phosphotoxin) to fumigate honey supers to control beetles in honey houses. How effective is this treatment? How much did beekeepers learn about honey house sanitation? Will the beetle have a cycle every 5 years? Can we use beetle attractant tarps? There are no answers to these basic questions. We need research on basic life history and biology.

Bee Stock Importation. (Discussion leader: N. Calderone)
There were several requests from New Zealand, Australia, and Argentina to ship queens to the USA. Also, there was a request from Sue Cobey to make importation of bee stocks open to any researchers. The responsibility of the AAPA to make a stand on importation was discussed. Nasr described the procedure to import various stocks such as Buckfast, French, and Russian bees to Canada. The role of CAPA, CHC, and CFIA in regulating the imports of bees to Canada was explained. Following this procedure reduces the risk of importing new diseases. It was decided to form Ad hoc committee to explore current laws by APHIS and make recommendations to be discussed at a future meeting.

Student Awards
Ann Harman (Eastern Apiculture Society) mentioned that there were no submissions for the Student Research Award in year 2000. The value of the award ($1000) was not clearly stated in the announcement. It was decided to change the title to "Student Research Scholarship" and wording of the announcement to read "encourage new students..." so that it didn't appear to only reward past research.

Final Report, Apimondia'99 | ***D. Dixon***

Over the last year we completed negotiations with the Apimondia executive, and all outstanding matters with the parent organization have been resolved. However there are still some outstanding issues.
(1) We have an obligation to send two representatives to the next Apimondia conference in South Africa
(2) Nelson still needs to complete a publication with photos, etc., as a record of the conference
(3) There are some GST discrepancies that require resolution, and
(4) Fees will be associated with the final audit.

All accounts have been condensed into one Canadian fund with $108,200. It has been proposed to transfer $20,000 to CAPA and hold this for outstanding expenses related to Apimondia'99; the remainder would be issued in two cheques each in the amount of $44,100, one to CHC and one to the CBRF. ~~This is actually at odds with a resolution passed at the 2000 CAPA meeting, which directed all remaining funds to go to the CBRF.~~ motion to remove last sentence 30 yes/0 no passed.

Gruszka added that Dixon and the other members of the Apimondia'99 Organizing Committee should be commended for the fact that **$440,000** was raised by Apimondia'99 for the benefit of Canadian apiculture!

Motion: *It was moved by Scott-Dupree, seconded by Gruszka to transfer $20,000 to CAPA from the Apimondia'99 Organizing Committee for paying outstanding financial commitments as determined by the Apimondia'99 Organizing Committee.* ***Carried***

Amendment to Motion:
At the resolution of all Apimondia'99 expenses, any remaining funds should be divided equally between CHC and CAPA. Moved: Currie, seconded by Moran. ***Carried***

Non-Apis Bee Committee | ***K. MacKenzie***

Bombus terrestris is still coming into Mexico and there is no resolution to that matter which is a concern to the USA and Canada. *Osmia lignaria* is being moved around, and there are no regulations to limit its movements within Canada. Manitoba may add *Megachile rotundata* to their *Bee Legislation* as chalkbrood affects leafcutter bees, while Nova Scotia is considering the same. MacKenzie plans to step down as chair, and recommends Kevan to replace her.

Kevan reported that in 1998 there was a major initiative to consider healthy pollinator populations as part of biodiversity concerns. FAO was asked to take on a leadership role in what is now known as the International Pollinators Initiative. This includes honeybees as well as other taxa. In the USA, *The Forgotten Pollinators* book raised awareness of the plight of pollination concerns. A follow-up meeting took place in Logan, Utah in 1998, followed by meetings in Santa Barbara, CA and Washington, DC.

In Canada, honey bees fall under the federal Animal Health Act while other bees fall under the Plant Protection directorate. There seems an *ad hoc* approach to individual requests to import non-*Apis* bees, as there is no designated lab to certify export shipments, etc. Environment Canada with its conservation mandate, may also be a partner in any discussions and agreements. The *Nosema* issue is particularly relevant, because bumblebees have one or more species that are different from *Nosema apis*, with potentially important ramifications to indigenous *Bombus* populations.

Currie reported that there is interest in Manitoba to update the list of native species of bees (and elsewhere in Canada) from private or other collections.

CHC Report — ***M. Malyon***

Research priorities will be considered during the research review. There was a recent meeting in Calgary to consider application of *chloropyrifos*, especially on canola. CHC attended express the concerns of beekeepers, especially on aerial applications of pesticides. One possible solution for consideration was to provide some form of financial compensation to affected beekeepers.

A formal acknowledgement was made to recognize the large contributions of Mark Winston to the establishment and initial success of the CBRF.

With respect to diseases and pests, there are strong concerns relating to r-AFB, fluvalinate-resistant Varroa, and the small hive beetle.

This fall there were some positive tests for antibiotics in honey, which could have been due to the method of testing or problems of application. The matter has been handled discreetly so far.

Marketing: There are two systems being looked at in the USA. The first is a buyback system, with a loan rate set at $0.65/lb, but the buy-back rate has not been set yet. Also, several US groups have lodged anti-dumping suits against Argentina and China. Initially these have been successful, but it could be several months until formal quotas for honey exports from those countries are set. This could lead to increased honey shipments to Canada in an attempt to move the honey from here into the USA.

Ontario has brought forward a recommendation concerning grading of honey: "Canada No. 1" labeling would require that the honey is a product of Canada. There has been concern about unwashed honey drums, which could be a source of terramycin-resistant AFB or even hive beetles into Canada.

Imidachloprid is a concern of CHC, but insufficient information is available to raise valid concerns.

Several years ago there were negotiations to CFIA, etc., about the federal charges applied to imports of bees from Australia and New Zealand. Those remain unresolved.

Heather Clay discussed costs of the annual meeting. Approximate costs are $12,000, which will be largely met through meeting registrations, the NB government, and several other donations. If a profit is made, it will be shared between CHC and the local beekeepers' association.

Hivelights has taken up a large proportion of Heather's job. She is now producing it, and is interested in original articles for the journal. She is also asking CAPA members to promote subscriptions to Hivelights.

Nominations are still being taken for the Fred Rathje award.

There are still many copies of the Apimondia'99 Proceedings available. Gruszka has some sweatshirts, t-shirts, etc., and would like some directions for what to do with these items.
Winston asked whether CHC is planning to take an initiative with respect to managing resistance problems? While research is needed, additional regulatory and extension initiatives are needed to handle these problems. Malyon indicated there have been discussions, but no agreement yet.

Currie offered a brief explanation of what the focus of the research review will be. Such reviews do not seem to influence the federal government much, but it will be helpful in directing the financial contributions from the CBRF. We will review the past 5 years and our progress, then attempt to set priorities for the next 5 years. The background document previously distributed to members covers the various categories of research.

Chemicals Committee Report — *J. Gruszka*

Formic Acid Review

The Chemicals Committee was approached by Dr. M. Farkas of the Pest Management Regulatory Agency of Health Canada to review the use of formic acid. The committee reviewed document C94-05 (proposed scheduling of 65% of formic acid for the detection and control of honey bee mites).

The committee took this as an opportunity to formerly recognize a variety of application methods that have been developed over the last few years since formic was first scheduled. However, PMRA has taken the stance that any product development still needs to be authorized by the agency. Consequently, manufactures and distributors of a number of products have been advised to have their product submitted to PMRA for approval.

The only changes that will take place are that there will be an indication on the labels provided for bee use, that the minimum temperature has been lowered from 10ºC to 7ºC with the additional statement that read as follows: *"Adult bees that come into contact with liquid formic acid will be killed. To minimize bee mortality, use a smoker to drive bees from the bottom board before applying formic acid to the bottom board. Use a smoker to drive bees away from the top bars for upper hive placement and ensure that formic acid will not drip on bees below. "*

Federal-Provincial Task Force

The Federal-Provincial Task Force Committee on Pest Management and Pesticides was recently asked by PMRA to review the aerial application of *chlorpyrifos* (Lorsban). This is a continuation of the organophosphate re-evaluation that PMRA is currently conducting. With the recent addition of Don Dixon to this committee, it has become much more obvious to the committee members that aerial application of insecticides in general and Lorsban in particular have been serious issues within the beekeeping industry.

As a consequence, CAPA and CHC have recently been asked to participate in this committee. These will be very beneficial additions for our industry as this committee tries to find solutions to the issues regarding Lorsban and other insecticides as pertaining to aerial application.

Coumaphous

In the summer of 2000, the Environmental Protection Agency in the United States set tolerances for *coumaphous* in honey and bees wax. The tolerances were set at 0.1 ppm for honey and 100 ppm for bees wax. These tolerances remain in effect until December 31, 2002.

The Section 18 exemptions that were formerly provided to individual states in the United States for the use of *coumaphous* expired at the end of 2000. States that wish to have a Section 18 exemption for the use of *coumaphous* (Check Mite) for 2001 are currently in the process of reapplying.

As for the Canadian situation, a representative of Bayer informed the committee in June that PMRA has decided not to accept any applications for the registration of new organophosphate products before their re-evaluation is completed. Consequently, the only alternative remaining, if resistance to fluvalinate manifests itself in Canada, is to apply for an emergency registration.

Until that time, Bayer will await the results of the organophosphate re-evaluation and continue to seek registration of their product in Canada.

Resistant American Foulbrood (r-AFB)
Resistant AFB has been reported in British Columbia and Alberta. In British Columbia, AFB has been found in widespread locations but at very low levels. Alberta conducted inspections in the fall of 2000 and found that 14 operations (of 45 inspected) have been found with resistant AFB. These beekeepers operate approximately 22,000 colonies.

Research has begun at Beaverlodge on prospective chemicals that have been shown to control the resistant strains. One of the promising antibiotics has been researched in the USA for the past 4 years. Approval for its use has still not been obtained in the United States. The problem with the candidate antibiotics is that they leave prolonged residues. Until a new product is registered, beekeepers should be advised to monitor their operations closely, remove and destroy any foulbrood, particularly that when it does not appear to respond to current antibiotic control methods.

Skunk Control
There has been no agreement reached in registering *strychnine* for the use of skunk control. The discussions with the parties involved seem to have come to a stalemate. Failing to come to some resolution, the problem still remains that skunks are a serious problem for beekeepers and that there is no legitimate control. There is maybe some urgency in Saskatchewan as there have been increasing reports of rabies.

Small Hive Beetle
As a result of discussions held last year, Rheal Lafreniere provided a chapter in the new issue of *The CAPA Disease Publication.* As well, copies of slides were made and distributed to members.

Although Small Hive Beetles have not been reported in Canada to date, the concern still exists that they may appear in the near future. There is no registered product in Canada for the control small hive beetle. *Mite Check* is available for control in those States that have applied for Section 18 from the EPA in the United States.

Discussion
It was noted that several methods of application of formic acid that have been developed in recent years are at odds with the original application method scheduled and have not been approved. The producers of these alternative application methods are strongly encouraged to submit materials to have them officially "scheduled" for beekeeper use.

Coumaphos emergency use is not likely, and the full formal registration process is anticipated should the company decide to move forward on this.

So far none of the colonies in Alberta have been destroyed to control rAFB; some large number of frames have been destroyed. There has not been a wide survey, but the problem is large. Some of the equipment will be irradiated prior to establishing "clean" packages in the spring. Both Alberta and BC allow considerable flexibility in terms of how AFB-positive hives are handled.

It is possible to alter regulations for antibiotic drugs be sold only through prescription. Individual provinces can enact amendments to their regulations. In Quebec, a prescription is normally only obtained once the disease is detected, but it is possible to use the antibiotics for prevention too. In Ontario it has been proposed the requirement for a prescription to treat bees, and that only veterinarians could legally give drug recommendations for disease control. These issues raise several major concerns, both inspection-related and regulatory, which may emerge from the second part of the Chemical Committee Report (Review of Drug Feeding Recommendations). This latter report points out differences in recommendations between different provincial regulations. According to Gruszka's experience, there is widespread disregard of drug application recommendations by beekeepers.

Winston suggested we investigate the possibility of eliminating the use of antibiotics for AFB control. With a restoration of our regulatory agencies, and commitment by beekeepers to make this work, we would ultimately be further ahead in our bee management practices. Gates questioned many beekeepers in New Zealand last summer about their non-antibiotic use in New Zealand, and received unanimous support for their program. We need to recognize that these are industry problems, not individual beekeeper problems (Dixon). Much of the problem stems from some beekeepers not accepting responsibility of proper disease management with regular inspections, and a more responsible approach is needed. Currie noted that New Zealanders have not yet had to manage bee colonies in the presence of the added stress-factor of Varroa mites. We have been fortunate in the length of time that oxytetracycline has been effective. A ban on antibiotics may not be the best approach;

rather a shift in recommendations about when to use antibiotics may be needed. According to Scott-Dupree, the discussions are leading us to adoption of the principles of IPM, where chemical treatments are recommended under certain conditions.

In Canada, both *Tylosin* and *Lincomycin* are registered for veterinary uses. Each of these drugs including oxytetracycline are in different classes of antibiotics. Willie Baumgartner of Medivet (AB) has indicated that registration could be obtained in a period as short as 8 months. At the federal level, there will be the start of a model animal-feed program, and several beekeepers will be selected to try the program in the near future (McCool).

Currie stated that the use of antibiotics for prophylactic purposes should be discouraged. Long-term application methods (e.g., extender patties) also favor the evolution of resistance and should be discouraged.

For r-AFB, what recommendations does CAPA want to make? Spores must be destroyed: removal and burning infected combs or irradiation is the only choice. Implementation of effective programs requires staff, so we should strive to improve inspection programs. The question arose whether r-AFB and AFB have equivalent interactions with the bees? (Question arises because Dixon has observed that honey supers from infected hives do not seem to be a major source of reinfection.) Removal of brood frames followed by oxytetracycline treatment results in about 90% reduction in infection on a year-by-year basis. Would the removal of brood frames alone lead to some solution to this problem?

Scott-Dupree recommended a discussion group that would try to synthesize the discussions and come up with a summary statement for CHC to discuss. The discussion group included Tuckey, Desjardins, Gruszka, Gates, Scott-Dupree, McRory, Colter.

Revised Disease Publication: There is a statement that Varroa mites found in PEI originated from New Zealand, but evidence suggests that this may not be correct (Prouse). There was a suggestion for CAPA to write a letter to the appropriate New Zealand authorities apologizing for this error on our part. The members agreed with this suggestion.

Food Safety Enhancement Program — *J. McCool*

John McCool indicated that the beekeeping industry should be aware that certain products will be tested for in honey, both those registered and those unregistered. Members offered suggestions of possible chemicals to look for.

AAPA Report — *J. Pettis*

There were approximately 25 members present at the recent AAPA meeting in San Diego. APHIS is considering a change to the rules relating to honey bee imports into the USA. Industry is likely to fight the change to allow imports from New Zealand and Australia, but it is not clear how that will play out. Mexico is interested in moving colonies north for pollination of almonds, and Argentina is interested in exporting queen bees to the USA.

Coumaphos is approved for registered use under Section 18 in most states now as an emergency exemption. Another major issue is resistance of AFB to oxytetracycline. USDA is going forward to seek registration for two antibiotics to be used in treatment of infected hives, but not for prophylactic use to prevent infection.

AAPA meets with beekeeping organizations as a means of improving communication between researchers and producers but there is less need to do so than is that case with CAPA. They are proposing the possibility of a joint meeting with CAPA, possibly also AIA, in Niagara Falls two years from now.

New executive:	President	- Jeff Pettis
	Vice President	- John Harbo
	Secretary/Treasurer	- Eric Mussen

Discussion

Winston questioned about the Small Hive Beetle and its impact on bees. The beetle continues to spread within the US. In 1998 there was more damage reported than in 1999/2000. Some of that may relate to improved sanitation in honey processing facilities, where beetles can be a significant problem. Effects on active colonies outside can be large on weak colonies, but apparently not so severe in strong colonies. *Coumaphos* is used on the bottom board near the entrance, but Pettis feels it is not very effective because the beetles seek the warmth of the bees except in the warmest climates. Ground drenches of the apiary with GardStar have proven highly effective. There seems to be less effect of the beetles in areas experiencing droughts. In northern areas there has been very little damage of colonies, but there can be problems in honey houses. Jadczak views the hive beetle much like a wax moth, with a bigger effect on weak or dead colonies than on strong colonies. When he followed colonies with beetles, the numbers seemed to decline over the summer. They do better in sandy soil than in clay soils. SHB likes pollen, and with effective use of queen excluders so honey lacks brood and pollen, there should be no effect of beetles on those honey frames. Jadczak has observed beetles in hives that have come from the southern USA, but in nearby local beekeeping operations in Maine they have not been detected yet. Florida beekeepers have adopted strategies to move the honey through the honey house more quickly, maintain strong colonies, and remove dead colonies from out apiaries and stack then in an apiary with the soil treated with GardStar. McRory pointed out that there are beetles close to the border in New York (near St. Lawrence River and Niagara River).

On the matter of an AAPA/CAPA joint meeting, Dixon moved the creation of a working committee involving members of both associations to work towards that end. Historically CAPA meets with CHC, but if that proves to be impossible in this case, we may want to consider proceeding with this meeting on a one-time basis because of the value to be obtained from a joint meeting.

Motion: *It was moved by Dixon and seconded by Mackenzie that the CAPA executive appoint several members of CAPA to work with AAPA for a joint meeting in fall 2002/winter 2003.* ***Carried***

Volunteers to serve on the Committee: Dixon, Otis, McRory, Scott-Dupree, Pettis, Hanson.

AIA Report ***T. Jadczak***

Much of discussion centered around registration of Tylosin for control of AFB. To get the registration, they must talk about "cure" of infected colonies, but it is more accurately the suppression of the disease. Another big issue was the closing of the Tucson Bee Lab. Checkmite+ (produced by Bayer) may have some problems under cooler temperatures (when bees are clustered) with mortality of bees. In some cases when the packages are opened, a powder on the outer surface of the plastic strips is Coumaphos which may cause some problems. There was brief discussion of the resolutions passed at the AIA annual conference in January, 2001 (hard copy distributed). There was concern about the proposed changes in the labeling of pesticides, but no agreement was reached to result in a formal resolution.

Importation Committee Report ***D. McRory***

The report includes a review of imports of French and Russian stocks in 2000 and a summary of the situation that unfolded with respect to the discovery of Varroa in New Zealand this past year. There are three requests for importation of breeding stocks from USA (Russian and Harbo stocks) and France that the committee supported.

Motion: *It was moved by McRory and seconded by Nelson to support the bee imports as proposed.* ***Carried***

Dr. Brian Jamieson presented an overview of regulations relating to imports. All regulations relating to imports of animals are being reviewed. The proposed changes were published in the Canada Gazette, available for comment, and will go into law in March/April, 2001. With the revised legislation, changes can be made by order rather than requiring official voting, making it possible to make changes very quickly. These changes in regulations will affect some industries extensively, but are expected to have little effect on the beekeeping industry. Website: <www.cfia-acia.agr.ca>.

The Reportable Disease Legislation has been modified, and there are no bee diseases now listed as "reportable". The Immediately and Annually Notifiable Disease Regulations are under review for change, and the Immediately Notifiable "diseases" include fluvalinate-**resistant** Varroa mites and the small hive beetle (fluvalinate-**susceptible** Varroa mites have been removed from this list). The Annually Notifiable diseases are acarine disease, American foulbrood, European foulbrood, and nosematosis. Every province must report these diseases/pests annually, and it was suggested that this could be best handled through CAPA given that these statistics are compiled annually. Revisions to the format of the annual provincial apiarists' reports should be changed to make it easier to report the appropriate information. Jamieson will forward these proposed regulations to McRory and Scott-Dupree as well as CHC for consultation and review.

Jamieson then turned to the situation of Varroa mites in New Zealand. The North Island of NZ has been divided into an "infected zone" to the north and a "buffer zone" to the south, with a 10 km-wide boundary between the two (the extreme southern part of the North Island is considered non-infested). These zones were created in order to meet the needs of the industry, to delay the infection of all apiaries on the island and maintain the Varroa-free status of the South Island. The surveys for mites (311 apiaries of 148 beekeepers) have provided a good picture of infestation, with most of the infested sites in the vicinity of Auckland. The southernmost locality of detection nearest to the Buffer Zone (a single mite from "National Park" from the 10-km boundary) may involve a mix-up of samples rather than a real infestation.

CFIA is proposing that:

(i) the South Island and the southern zone of the North Island would be considered mite-free areas for the coming shipping season. (Proposed wording: "that the honeybees originated from zones that are recognized by Canada as being free of the varroa mite.")

(ii) For the Buffer Zone and the 10 km-boundary, it is proposed that the wording relative to bees originating in these areas would be: "that the honeybees originated from apiaries not known to be infested with the Varroa mite."

It was recognized that most surveys were done in the New Zealand spring and early summer; later in the year (e.g., close to the timing of shipment of bees to Canada) it would be very difficult to survey hives. Importation from a Varroa-infested zone with no additional requirements about treatments to control varroa (pre, during, or post shipment) may set a bad precedent for future situations (Gates). The general impression is that at the beekeeper and MAF level in New Zealand there is a strong willingness to meet concerns of Canadian industry, but the trade negotiators seem less willing to negotiate. Jamieson cautioned that requiring treatment in New Zealand is fairly certain to bring in the trade people with possibly negative ramifications (we could lose the ability to require any reporting or regulation of Varroa). Within New Zealand, the beekeepers are willing to put Apistan strips into hives before movement for pollination and also if moving into the Boundary Zone, but we have no uniform legal requirements across Canada to require similar actions prior to bee movements. In response to a concern raised by Dixon, Jamieson suggested that for all bee permits, because there are provincial requirements relating to importing and reporting, the importers should be directed to contact the appropriate provincial person. There was agreement with the proposed wording for imports of bees from New Zealand for 2001.

Recommendations for Control of AFB — ***J. Gruszka***

After discussions last night, the discussion group came to the conclusion that CAPA's recommendations follow the principles of an IPM program:

1. Extension efforts should be increased, with more emphasis on,
    - Renewed emphasis to control AFB (not mites).
    - To improve the education level of beekeepers with respect to diagnosis of AFB, recognition of symptoms;
    - Differentiate between control and prevention;
    - Antibiotics should no longer be applied as prophylactic.
2. The industry needs to promote the maintenance/initiation/improvement of current inspection activities and implement appropriate regulatory strategies;
3. The foundation of any AFB control strategy is removal of infected equipment.
4. There should be irradiation of equipment at risk (i.e., irradiation has an appropriate place in our control strategy)
5. All CAPA people need to warn beekeepers of the dangers of using non-registered products.

Motion: *It was moved by Dixon, seconded by Mackenzie to accept these recommendations.* **Carried**

Nominations Committee **M. Winston**

The sole nomination for Secretary/Treasurer is Rheal LaFreniere, who was elected by unanimous acclaim.

Awards Committee **D. Dixon**

Motion: *It was moved by Dixon and seconded by Nelson to allow the CAPA Executive discretion to add a budget item in allowing for the issuance of a new Award of Merit within the coming year, based on the recommendations of the Awards Committee.* **Carried**

Apidologie subscriptions

Paul van Westendorp is willing to coordinate discussions with Apidologie to purchase memberships; he is directed to respond to this as quickly as possible.

CAPA Pins

Pins are now available for sale ($5 each)

Committee Members

McKenna is stepping down as chair of the non-*Apis* committee. Peter Kevan has agreed to chair the committee. Other members will remain the same.

There was a round of applause for the high level of service that Paul van Westendorp devoted to CAPA as Secretary/Treasurer over many years.

Adjournment

Scott-Dupree thanked everyone for attending.

Motion: *It was moved by Moran and seconded by Otis to adjourn the meeting.* **Carried**

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PROVINCIAL REPORTS

Provincial Reports, 2000 Production Season

	BC	***AB***	***SK***	***MB***	***ON***	***QC***	***NB***	***NS***	***PEI***	***Totals***
#beekeepers	2,293	738	1,300	860	3,400	1,200	275	442	46	**10,554**
#colonies	47,968	216,259	100,000	95,000	80,000	38,000	8,200	12,000	1,866	**599,293**
Av. Yld. lbs.	83	108	180	140	70	98	70	35	40	**114**
kg.	38	49	82	64	32	45	32	16	18	**52**
Total xK, lbs	3,892	23,000	18,000	13,300	5,600	3,724	574	420	75	**68,585**
kg.	1,769	10,435	8,181	6,033	2,540	1,710	261	191	34	**31,154**
Wint. Cols. 99-00	47,000	214,000	102,000	95,000	80,000	38,000	8,000	19,500	1,500	**605,000**
98-99	45,000	209,600	98,000	91,000	85,000	38,000	7,000	17,500	1,000	**592,100**
#Col.Insp.	2,973	1024	0	6,050	3,703	710	0	328	0	
Inc.% AFB	10	10	0	0	2.3	15	2	1.2	0	
EFB	0	na	0	0	0	3	0	16.5	0	
Chalkbrood	3	na	0	0	2.5	9	0	6	0	
Sacbrood	0	na	0	0	1.5	0	0	0	0	
HBTM Smpls	1,271	na	1,600	220	na	666	0	1300	0	
%Pos.	30	na	50	62	40	5	na	0	0	
VM Cols.Tested	1,470	419	2500	220	na	788	0	3090	0	
%Pos.	15	na	13	44	95	56	na	25	0	

PROVINCIAL REPORTS
2000 Production Season

Comments

British Columbia — ***Paul van Westendorp***

- Average honey production per colony was 83 lbs., slightly above the long-term provincial average of 80 lbs. The industry earnings have been increasing because an estimated 78% of the total honey crop is marketed privately at an average price of $2.16 / Lbs. The total industry earnings of honey sales is estimated at $8 million.
- Crop pollination services continue to increase with the exception of cranberries. A total of 29,000 colonies were used in crop pollination. The total annual agricultural output in BC that can be attributed to honeybee pollination is estimated at $136 million.
- Production of wax has been estimated at 49,100 lbs at an average price of $4.32. Pollen production is estimated at 41,598 lbs at an average price of $12.78. There has been increased interest in the production of high-grade propolis. The last survey data (96) estimated the average price at $33 / Lbs.
- Amercian Foulbrood disease incidence has been on the increase. Although brood disease surveying is biased as inspections are carried out on operations that report disease problems, the same bias is applied equally in any given year.

Year	#Col. Inspected	AFB Pos.	Incidence %
1995	3,859	136	3.5
1996	3,066	181	5.9
1997	2,438	72	2.9
1998	2,583	252	9.7
1999	2,913	252	8.6
2000	2,973	300	10.1

- In 2000, extensive surveying has been carried out to determine the incidence and distribution of antibiotic-resistant American Foulbrood (r-AFB). Results have indicated that r-AFB is geographically widespread but its incidence remains low. In all cases where r-AFB has been confirmed, an association exists with colonies from Alberta. BC is reviewing its AFB control recommendations with emphasis on reduced use of antibiotics and in consultations with the industry, may apply changes to the regulations concerning the import and movement of colonies.

Alberta — ***Kenn Tuckey***

Bee & Crop Conditions
A number of beekeepers experienced heavy wintering losses as a result of inadequate mite control during 199. A cool damp spring slowed colony development. Drought in the south and wet weather in the north reduced honey crops in those areas. The 48,000 colonies on hybrid canola pollination contributed to reduce the per colony average honey crop.

Brood Disease
Normally inspections for brood disease are only done on request but during 2000 some rAFB was.identifiued and further testing was carried out. By year end, rAFB had been detected in 14 operations that operate 22,000 colonies.

Parasitic Mites
Varroa mites have not yet been reported in the NE part of the province but tracheal mites were identified in one operation on the edge of the area. Varroa continues to be reported by more beekeepers. The current tally is 160 operations with 162,000 colonies being positive for varroa.

Saskatchewan — John Gruszka

Foulbrood
Routine inspections for AFB are not conducted. Inspections were performed and 10 "Permits to Sell" were issued to beekeepers selling equipment. Three of these had low level of AFB. At the request of the industry, AFB inspections will be reinstated for 2001 to determine if any r-AFB is present in Sask. hives.

Tracheal mites
Beekeepers continued to submit samples to the lab in Prince Albert for analysis of tracheal mites. Just over 1600 apiary samples were analyzed. Infection levels continue to be low indicating that controls are working. Two commercial operations reported winter losses in excess of 30% during the winter of 99-00, which were attributed to lack of tracheal mite controls. The latest area of new infestation is around Saskatoon.

A commercial beekeeper reported that he conducted an experiment comparing menthol grease boards with the use of an oil evaporator to control tracheal mites. Menthol reduced mite levels, the oil did not. In fact, the mite levels rose dramatically in the oil treated hives.

Varroa mites
The department does not conduct surveys for Varroa mite. However, sticky boards for surveys are provided and sold by the beekeepers' association and the boards are sent to the office of the Provincial Apiculturist for analysis. Two new Varroa infestations were reported in 2000. There are currently 20 known Varroa infestations, all commercial beekeepers and under quarantine and movement restrictions. These operations have approx. 14,000 hives and are located in the northeast of the province.

Three colonies were smuggled into Sask. from the Calgary area in the spring. The hives were found to contain Varroa mites and the bees were killed and buried. The location of the bees was somewhat isolated and they had not developed to have large populations. It is believed that the infestation did not become established in the area.

2000 crop
The honey crop was less than the record crop of the previous two years. The provincial average is just below the 10-year average of 185 lb/hive. Colony development was hampered by cool weather in the spring and the honey flow was hindered by cool rainy weather. Honey prices increased at the end of the year with bulk honey reported to sell in the 80-83 cent range.

Pollination
The acreage of hybrid canola production remained constant at about 1500 acres and involved about 4500 colonies being paid a pollination fee. Bioriginals, a Saskatoon company, did not contract any borage production acres during the summer of 2000 since the market price has fallen and the company has large stocks on hand from a record production during 1999. It is anticipated that the situation will not change for the coming year.

Leaf cutting bees and alfalfa seed production
The summer of 2000 was a dismal year for alfalfa seed production in Sask. Most producers reported less than average production resulting from too much rain, disease problems (botrytis and sclerotinia), late frost in early July and early frost in late August and hail in early July in the major growing area around Nipawin.

Seed prices have dived to 50 cents/pound because of surplus supplies in the USA and bee prices have followed with less demand from the growers in the northwest USA.

Manitoba — Don Dixon

Manitoba experienced another unusually mild winter for 1999/2000 with beekeepers reporting variable mortality and spring build up. Tracheal mite infestations have continued to increase across the province resulting in increased colony mortality in some operations. Due to the short and mild winter, Nosema levels appeared to be very low throughout the province.

Beekeepers increased colony numbers by about 4 % from 1999.

Weather conditions were generally good during spring build up but were only fair to poor during the first part of the honey flow in June. The balance of the season was fair to good resulting in slightly less than average honey production.

Varroa continues to be found throughout the province but most beekeepers appear to be doing an excellent job of keeping this parasite under control.

Ontario — ***Doug McRory***

This year has not been a particularly good one for honey production. The Ontario crop will be in the 70-90 pound range. This is down considerably from the last two seasons. The price of bulk honey also has not recovered from last years low and currently is in the $.70-75 per pound range. The honey that has been produced is of excellent quality. Due to the carryover of honey from the past two seasons, there will be sufficient supplies of honey to meet the demand. As the price is low, beekeepers will try to maximize their returns by adding value to the bulk product by packaging it and selling it through a variety of sales outlets.

The Varroa mites continue to spread to all areas of Ontario except Thunder Bay and Manitoulin Island. For those beekeepers that have been following all the recommended treatments and are re-queening their bees with hygienic bees, the Varroa populations have remained surprisingly low through this season. No resistance to Apistan has been detected in Ontario. Beeswax and honey samples sent to Germany showed exceptionally low residues of Fluivalinate from the use of Apistan in the wax and only one sample with any in the honey.

Honeybee Tracheal Mites (HBTM) continue to spread slowly over Ontario with about 40% of the bees now infested with both Varroa and HBTM. The spring application of Formic Acid in the single application pads along with the use of HBTM resistant queenbees is doing an excellent job of keeping this disease below economic levels.

Resistant American Foulbrood (AFB) has not been detected in Ontario. It has been found in bee operations in Alberta and British Columbia. Because of the AFB resistance in BC and Alberta, no permits to bring live bees from those provinces will be issued. Equipment can be brought in if it is irradiated. To reduce the risk of developing resistant AFB in Ontario, it is recommended that beekeepers kill all bees in colonies that are positive for AFB. Do not shake the bees onto the foundation as previously recommended. All bees should be killed and the combs either burned or irradiated. Ontario beekeepers need to be very vigilant for the first signs of AFB and destroy these colonies by fire or have the equipment irradiated.

Sweet Corn Spray problems have not been reported by beekeepers this season. The next two seasons will be important to see if this year's results can be consistently maintained.

Small Hive Beetles (SHB) have not been detected in Ontario. We have been working with the bee inspectors in New York and the SHB is right across the border from Ontario, both in the Niagara Region and along the St. Lawrence River area. The interesting thing in New York is that the SHB are in the migratory bees from Florida but so far have not been detected in bees on permanent location in New York.

Residues of chemicals not found registered in Canada have been found in foundation from other countries. It is advised that beekeepers use the unsprayed plastic foundation and check out where their foundation wax originated. Some beekeepers are arranging to have their own wax rolled into foundation.

"What is happening about the African Bees?" is a question that is always asked of beekeepers. Currently they are located from Texas across the southwest to California. We do not expect that African Bees will survive this far north, as they are tropical bees that tum all of their honey resources into bees that swarm. They will starve in our climate.

Quebec — ***France Desjardins***

Production
La récolte de miel au Québec en 2000 a été affectée par un début de saison relativement chaud suivi d'une température froide et pluvieuse.

Pollinisation
Des colonies ont été louées essentiellement pour la pollinisation des bleuets, concombres, fraises, pommes et framboises. Des recherches sont à venir en ce qui concerne le canola et la fraise. La pollinisation des pommiers prend de plus en plus d'importance notamment quant à l'amélioration de la qualité des fruits.

Maladies
En 2000, le ministère de l'Agriculture, des Pêcheries et de l'Alimentation (MAPAQ) a poursuivi ses activités dans le domaine de l'inspection sanitaire des ruchers québécois. Les résultats de l'inspection et des activités de dépistage, appuyés par les résultats des analyses effectuées dans les laboratoires de pathologie animale du MAPAQ, ont révélé qu'en 2000, la varroase a poursuivi sa migration d'ouest en est et vers le nord et qu'elle est maintenant entrée dans la région du Bas-Saint-Laurent. De plus, toujours en 2000, un cas d'acariose a été diagnostiqué chez un apiculteur dans la région de la Montérégie. (http ://www.agr.gouv.qc.ca/qasa/desa/accueil.html).

En mars 2000, un bulletin du Réseau d'alerte et d'information zoosanitaire (RAIZO) du MAPAQ, décrivant la situation des maladies en apiculture au Québec, a été expédié aux apiculteurs et autres intervenants en apiculture. Près de 300 producteurs apicoles ont assisté à une dizaine de cliniques organisées par le MAPAQ et portant notamment sur les maladies apicoles un peu partout à travers la province. En juillet 2000, le MAPAQ et le Centre de références en agriculture et en agroalimentaire du Québec (CRAAQ) ont organisé conjointement une journée d'information destinée aux apiculteurs au Centre de recherches en Sciences animales de Deschambault.

Au cours de l'année 2000, les activités de la Filière apicole québécoise se sont poursuivies, alors que le plan de développement stratégique pour les 3 prochaines années est en voie d'être actualisé (http://www.agr.gouv.qc.ca/dgpar/apicult/filiere/fapicole.htm).

Finalement, l'Assemblée nationale du Québec a adopté le projet de loi 120 visant à fusionner la Loi sur les abeilles (L.R.Q. c.A-1) et la Loi sur la protection sanitaire des animaux (L.R.Q. c.P-42). Les intervenants du milieu apicole ont été consultés tout au long de ce processus de révision.

New Brunswick — ***Paul Vautour***

~ No Comments

Nova Scotia — ***Joanne Moran***

~ No Comments

Prince Edward Island — ***Chris Prouse***

Varroa mites were discovered for the first time in Prince Edward Island. The mites were discovered during the spring inspections in four apiaries belonging to the same operation. This operation accounts for 50% of the hives in the province and 75% of the province's pollination capacity. A further survey in the fall showed that the mites had spread to four additional operations. Over half the colonies in the province are now in apiaries know to have been infected.

No special efforts were made to quarantine or eradicate infected colonies, instead efforts were made to provide beekeepers with information on monitoring and control.

Tracheal mite samples have been collected but at this time they have not been processed.

Brood diseases were not monitored however beekeepers reported a high incidence of EFB.

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COMMITTEE REPORTS

Review of Drug Feeding Recommendations **_J. Gruszka_**

This document is prepared and presented for discussion at the 2000 annual CAPA meeting. It is initiated because of recent reports of resistant foulbrood in some jurisdictions and the potential of this occurring across Canada. It is not meant to serve as a directive but rather to indicate some of the issues that we face in order to control American foulbrood disease. Recognizing that Canada is a geographically and climatically diverse country it should be recognized that one universal recommendation may not be appropriate for all regions of the country. Generally speaking, the recommendations are more similar than they are diverse. Some of the issues that do suggest discussion are the following:

Timing of Application
The issue here is when should the last application of medication be applied in the summer active season. This ranges from recommendations of 2 weeks, 6 weeks, and the first week in June. Similarly there is a variation in timing for fall application with recommendations of 1, 2 & 3-week intervals between two feedings using icing sugar in the fall.

Icing Sugar or Sugar Syrup
Some jurisdictions recommend only feeding oxytetracycline in icing sugar while others suggest both icing sugar and sugar syrup (depending on circumstances) in the spring and the option of icing sugar or sugar syrup in the fall.

Antibiotic Extender Patties
There is perhaps more diverse opinion here than anywhere else. Depending on the jurisdiction there is either no mention of antibiotic exterderpaties at all, a warning not to use, a recommendation not to use, or a caution about using extender patties with recommended recipes.

There is speculation that the use of extender patties may be the cause of resistance manifesting itself. Although this has never been proven, one has to wonder whether this method of use should no longer be promoted and, in fact, whether this should be actively discouraged.

Warnings
Across the jurisdictions there are a number of warnings about the use of oxytetracycline that appear in the recommendations. The following are the ones of note and one or all of them might be in any particular recommendations:

1. Exposure to sunlight. Indicating that sunlight will deteriorate the product.
2. Temperature used in sugar syrup. Too warm as sugar syrup will render the antibiotic useless within hours.
3. Expiry date and storage. Often there is no warning about checking the expiry date and not using antibiotic beyond the expiry date. Many jurisdictions indicate that storage should be refrigerated to ensure the longevity of the antibiotic.
4. Combining with fumagillin. Those jurisdictions that provide this warning indicate that this can safely been done if the current dosage for both is used.
5. Rate when using TM25. Most, but not all jurisdictions do indicate to be careful to use the right rate and the right dosage of product.

Removal of Infected Equipment
It must be pointed out that the information provided was specific to drug feeding recommendations. However, some jurisdictions include the drug feeding recommendations with an overall strategy for the control of foulbrood diseases while others do not. It is assumed that those that do not make mention in their drug feeding recommendations do take the opportunity elsewhere to indicate that foulbrood control begins with examination and removal of infected equipment.

Only one jurisdiction indicated that the response to finding any active foulbrood in a hive should result in destruction of the complete hive immediately (including bees, frames, boxes, tops and bottoms). Most of the jurisdictions indicate that inspection should be conducted on stored material and all infected material should be removed and that drug application should be made after infected material has been removed.

Control Versus Prevention
This is not articulated equally across the country. Many jurisdictions do not make a differentiation in the rate of application of antibiotic whether it is being used to control a known infestation or being fed as a prophylactic treatment.

Most recommendations indicate 3 treatments for spring application for the prevention of foulbrood however, the rates of application vary from 5 - 10 - 15 day intervals.

For control of known infestations is it appropriate to suggest weekly applications of antibiotic during the spring feeding period?

There are a number of issues that are brought to mind as a result of the change in beekeeping practices in the last 25 years.

Feeding Change
One of the major changes in beekeeping in the last 25 years in western Canada has been the change from package bees to wintering. With this change has come a large change in feeding habits of honey bee colonies both for fall feeding and for feeding of stronger colonies in the spring. More recently, industry has switched from using sugar and sugar syrup to corn syrup.

In western Canada it has been the practice of most commercial beekeepers to feed antibiotic with sugar syrup both spring and fall. This situation needs to be addressed in terms of efficacy and in terms of residues in honey.

What About Rob Feeding
Open feeding has become fashionable in some areas in the last few years particularly with large-scale commercial beekeepers who find that it is a time saving operation. However, with the advent of resistant foulbrood one has to question whether this practice is not promoting the spread of foulbrood and whether it should be allowed to continue.

What is the Appropriate Control Strategy
Before the advent of Sulfa drugs and antibiotics to assist in the control of American foulbrood the conventional treatment was to: (a) inspect everything (b) Remove any sign of infection which was then burned or rendered. With the advent of antibiotics, there was an expectation that the antibiotics would control and prevent foulbrood from reappearing within an infested operation and that it would save the industry money in the long run.

In the late 70's and early 80's there was a move toward fumigation and more recently consideration of radiation as a method of sterilizing of hive equipment so that it could be reused. This was also thought to be beneficial in keeping costs down and helping to eliminate foulbrood.

There are, however, problems with both of these methods in that any spores under any significant amount of honey are not killed. Consequently, experience has shown, particularly with severely infested operations, that neither of these methods is 100% field safe and foulbrood does reappear in a short time.

In dealing with foulbrood that is now resistant to drugs, it seems that the conventional protocol needs to be followed in terms of (a) inspections (b) removing all diseased equipment. The question then is, what now?

In initial and small infestations, burning of the infected material may go along way to clearing up the disease. In spite of the large financial loss, this is likely the most appropriate approach for a large-scale operations as well.

The industry is in dire need of a new product to take the place of oxytetracycline for those areas where infested foulbrood is now found. However, if the proven first steps of inspection and removal of all infected equipment does not occur first, and there is no change in use patterns such as extended patties and rob feeding, it is only a question of time before this new product is also rendered useless.

Resistant Foulbrood can become THE serious pest of the next decade. Our industry needs to take a serious look and consider as to whether the New Zealand model of foulbrood control should not be emulated and many of its practices adopted quickly. I say this giving full consideration to the fact that the public's perception and concern with the use of drugs, resistance by pathogenic organisms effecting human health, and antibiotic residues in food products are becoming a serious consumer and public health issue.

Canadian Bee Research Fund Annual Report: 2001 ***M. Winston***

The Canadian Bee Research Fund is now in its fourth year of operation, and by February 2001 we had raised $600,000 towards supporting bee research in Canada (figures approximate; audited financial reports will be available in February, 2001). From these funds, grants have been awarded to support research important for the survival and prosperity of the Canadian beekeeping industry. Additional grants will be awarded at the February 2001 Annual Meeting, and annually thereafter. Expenses have been minimal (about $2000 over four years for mailing, printing, registration costs, bank charges, etc.), and the remaining funds have been used to establish a long-term endowment that is now generating income to fund future projects.

To date, the following projects have been funded:

Melathopoulos, Adony (Alberta): Field evaluation of the microbial acaricide *Hirsutella thompsonii* for the control of the honey bee mite parasite *Varroa jacobsoni.*, (2000) $10,000

Winston, Mark (British Columbia) Integrated pest management for Varroa mites, (2000) $10,000

Daniels, R. Scott (Saskatchewan): Membrane-gel delivery of formic acid vapours, and a new, alternate treatment for honey bee mites with an environmentally friendly approach using menthyl formate, (1999)$9200

Otis, Gard (Ontario): Evaluation of the efficacy and residues of Apiguard, a potential product for the control of parasitic mites of honey bees, (1999) $12,000

Kevan, Peter (Ontario): Botanicals for mite control and novel means of administering them for greater efficacy and safety, (1999) $8800

Clark, Kerry (British Columbia): Evaluation of mesh bottom boards for the management of Varroa mites, (1998) $6400 (declined due to a job change)

Nelson, Don (Alberta): Evaluation of indoor winter treatments on bee colonies using oxalic acid, lactic acid, thymol, and formic acid, (1998) $7000

Winston, Mark (British Columbia) A semiochemical trapping system for the parasitic mite *Varroa jacobsoni*, (1998) $15,000

The Canadian Bee Research Fund (CBRF) was established to counteract the problems caused by severe reductions in federal and provincial funding for honeybee research. The Fund has been set up as a long-term endowment to support bee research, with interest generated by the CBRF available for annual grants. The current policy of the CBRF is to award approximately 75% of annual interest and beekeepers' donations towards research projects, and apply 25% of interest and any special donations towards increasing the endowment.

The CBRF is administered by the Canadian Honey Council, and decisions concerning what projects to support are determined according to the priorities set by the Canadian beekeeping community. With the grants awarded to date, the CBRF is fulfilling its mandate to stimulate and support research important for the beekeeping community. Our reach and impact are both national in scope and significant in attracting matching funding for projects. Grants have been directed towards projects identified as high priority by the beekeeping industry, and the partnership between beekeepers and researchers that is at the core of the CBRF has become a functioning reality.

Another noteworthy aspect of the CBRF grants is that all recipients are required to submit a "beekeeper-friendly" report in the fall, to be published in *Hive Lights*, provincial newsletters, and other appropriate outlets. In addition, grant recipients must attend the annual CHC meeting to report on their projects.

The success of the CBRF has been due to a generous donation from the W. Garfield Weston Foundation, to funds generated by the 1999 Apimondia meeting held in Vancouver, and especially to the generosity of beekeepers across Canada who have banded together to build a legacy for our industry.

We can all be proud of what we have built to date, but there is still a long way to go. The financial support for the CBRF needs to grow if the fund is to reach its goal of self-sufficient, beekeeper-directed support for Canadian bee research. Our objective is to raise $1 million over a ten-year period. To reach that goal, we suggest that each beekeeper donate $0.25 per hive annually, and that each provincial association contribute 10-50% of funds raised annually to support research within each province.

I am pleased to recognize the dedicated service of the CBRF's Board of Directors, including Wink Howland, Merv Malyon, and Rob Currie. They have each spent countless hours evaluating grants, developing and overseeing responsible financial management, and promoting the goals of the Fund. In addition, I deeply appreciate the assistance of Heather Clay, Executive Secretary for the Canadian Honey Council, who has administered the Fund. Her professionalism, discretion, organization, and sound advice have been an integral part of the Fund's success, and it is a pleasure to personally acknowledge the important role she has played in the development and implementation of the Canadian Bee Research Fund.

We deeply appreciate and need the support of the entire beekeeping industry. With your continued support, the CBRF will continue to grow and maintain its presence as an important instrument for bee research in Canada.

The Use Of Formic Acid To Control Mites In Honey Bee Colonies — ***M. Nasr***

The Provincial Apiculturists and researchers across Canada were asked to review document C94-05 "Proposed Scheduling of 65 Percent Formic Acid for the Detection and Control of Honey bee Mites", with a view to ensure that the recommendations were still valid or if there should be some changes made to more accurately reflect the current knowledge and use patterns.

The following issues were identified:

Temperature

It is recognized that formic acid efficacy is related to temperature and volatility. It has been suggested that the temperature regime at the lower end of the scale, as suggested for the "Secondary Display Panel" on pg. 8, should read " Use when outside temperatures are 7 C. to 30 C. and leave hive entrances fully open." Experience over the last 6 years has indicated that formic will work at this lower temperature so that the recommendation could be lowered from 10 to 7.

Perhaps this line should also be inserted into the "Proposed uses and use pattern" after the first paragraph on pg. 2.

Contact With Bees

Those beekeepers who used liquid formic acid, applied to the bottom board, quickly realized that if the adult bees came into contact with the formic acid, the bees would be killed. The same would happen of any formic acid that would leak from a top application. It is suggested that the following wording of caution be considered:

"Adult bees that come in contact with liquid formic acid will be killed. To avoid bee mortality, use a smoker to drive bees from the bottom board before applying liquid formic acid to the bottom board. Use a smoker to drive bees away from the top bars for upper hive placement and ensure that formic acid will not drip onto the bees below."

This paragraph could be inserted in the "Proposed uses and Use patterns" section on pg.3 before the paragraph that begins "To control mites....". It might also be prudent to include this paragraph on pg.8 under "Directions for Use" as the first paragraph after "For Two-Story Colonies".

Material

Prior to 1994, the amount of research into suitable material to deliver formic acid to a hive for use in the upper hive position was limited. The current wording in the "Proposed uses and use pattern" on pg. 3 and the "Directions for use" suggest "absorbent paper or paper towels (three 15 cm. square napkins). It is suggested that these references be changed to read as follows, "...onto absorbent material placed...".

The current application method suggested depositing the appropriate amount of liquid formic acid onto the paper once it has been positioned on the top bars. This method has been effectively changed by practical use in the apiary with a variety of absorbent materials that have had the appropriate amount of formic acid already absorbed into them. This reduces the risk to operator safety by handling and minimizes or eliminates any inadvertent spillage onto the bees and resultant bee mortality.

This change or wording would legitimize the use of a variety of delivery products that have been developed and proven to be effective. First developed in Ontario, and currently being used in other provinces as well, "Mite Wipes " and "Mite Away" are such products of absorbent material, other than paper toweling, that are suitable delivery systems for formic acid. Two other, European, commercial delivery products, the Nassenheider and the Universal evaporators are also available. Both are plastic devices with reservoirs for formic acid that are adjustable to regulate the release of formic acid.

Other absorbent materials have also been tried such as boot felt and florists foam among others. These are usually used to absorb an appropriate amount of formic acid and placed into some form of plastic holder (such as vegetable baggies with perforations) to avoid contact, minimize or eliminate the dripping of formic acid onto the bees and slow the release of the formic acid fumes into the hive.

Would the suggested change in wording from paper toweling to absorbent material allow for the variety of application methods that have evolved over the past 7 years and proven to be efficacious and perhaps safer to handle and deliver? We would suggest it does and is appropriate.

Single Application Methods
When formic acid was first used, the majority of applications were for the control of tracheal mites. To control this mite, three applications of formic acid are required. Beekeepers have found that this is a problem because of inclement weather, and a source of added expense for the repeated travel to distant apiaries. When it comes to the control of Varroa mites, six treatments are required and this is onerous.

To offset this reality, research into one application, slow release methods has been initiated and continues in hopes of finding an appropriate one application method. The Ontario product, "Mite-Away" is one such product and others will be developed.

Should we find the appropriate wording for the document to ensure that these methods are included? Perhaps this would mean a change from the current dosage rates of 30-40 ml. per application to one that indicates that the evaporation rate of the method is 10 ml. per day. This seems to be what is implied and has proven to be an effective rate of evaporation for control. Perhaps a statement that says 30-40 ml per application and/or an evaporation rate of 10 ml. per day is the approach to take.

Reducing Operator Risk / Increasing Safety
Recently, in an effort to find a single application, slow release product and to increase the safety of using formic acid, two products have been developed. One is a gel formulation of formic acid that has been developed in the USA and the other a membrane delivery system developed in Canada. Both have the benefits of being one-application methods and increasing operator safety.

Beekeepers in Canada are awaiting both products. Can they be incorporated under C94-05 with the appropriate language changes or do they need to apply for registration or for exemption?

The industry is looking for a good single application method of applying formic acid so that they can control Varroa mites without the current hassle of 6 applications. This would allow the industry to have confidence in using formic as an alternate year control with the current method (Apistan) which, hopefully, would double (or more) the life expectancy of Apistan.

Non-Apis Pollinators Committee Report — ***K. MacKenzie***

The committee has been rather quiet this year. However, interest in bees other than honey bees is evident as shown by a number of initiatives and popular press articles. Some particular issues to consider are as follows:

Bee Movement
Bombus terrestris is still being imported into Mexico. The possibility of escape and establishment of this aggressive European species in North America is a distinct possiblity as is the introduction of bumble bee pests. *Nosema* has been found in colonies sent to Mexico.

Within North America, bee species continue to be moved into areas where they are not naturally present. *Osmia* species including *O. lignaria* and *Bombus* species are of concern. It appears that this movement falls through the regulatory cracks as Provincial and/or State jurisdiction holds. Yet, there is little legislation to deal with these bees. CFIA has jurisdiction for the movement into Canada of bees other than honey bees.

Alfalfa Leafcutting Bees
Price of ALB's is very low currently which has had negative impacts on the industry. Manitoba is likely to include chalkbrood (ALB species: *Ascosphaera aggregata*) in its Bee Act. This has also been included in the revisions of other Bee Acts (eg Nova Scotia), but none have yet become legislation.

International Initiatives on Pollinator Conservation ***(Reported by Peter Kevan)***
Meetings were held in Sao Paulo, Brazil in 1998 and in Rome, Italy in 2000 addressed the issue of pollinator conservation. FAO has the leadership role on this issue. The influence of the book, The Forgotten Pollinators (Buchman and Naban) has brought the issue to the forefront in the U.S.A. and several meeting have been held to discuss pollinator protection and conservation. Honey bees and non-Apis bees are included in these initiatives.

As of this meeting, I am stepping down as chair of this committee and recommend Peter Kevan as my replacement.

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RESEARCH REPORTS

The Small Hive Beetle: Aethina tumida Murray (Coleoptera:Nitidulidae) ***R. Lafreniere***

Introduction

The small hive beetle, *Aethina tumida* Murray was recently introduced into North America. Prior to its introduction into the United States, this beetle was only known to inhabit honey bee hives in Africa. Very little information existed on *A. tumida* in African apicultural literature, the most detailed study was done by A.E. Lundie, Ph.D. from South Africa in 1940. Dr. Lundie described the life history as well as control options of *A. tumida*, which later proved to be the foundation for much of the literature available on the small hive beetle today. This review will attempt to bring together information on small hive beetles, pertaining to its biology and life history; distribution, with specific reference to its current distribution in North America; damage that it causes; its impact on the North American beekeeping industry; and detection and control of this pest. Because the invasion of the small hive beetle in North America is so recent, most of the research relating to this pest is still being done. Over the next several years it is expected that our knowledge of the biology and control of this insect will improve dramatically. Currently, most published information has been reported in non-refereed publications, or in some cases, anecdotal references such as reports, fact sheets and personal communication. Caution should therefore be used when interpreting this type of information.

Biology And Life History

Aethina tumida belongs to the family Nitidulidae. The nitidulid beetles are sometimes referred to as "sap beetles" because some of the species feed on sap, while others are referred to as "pollen beetles" because they feed on pollen [26]. In any case, the majority of the species in this family are considered scavengers and most of them would be considered secondary or tertiary successional scavengers, feeding on the remnants left behind by the previous groups of scavengers [25, 26]. Similar to *A.tumida*, several other species of nitidulids have been reported to be associated with other species of social insects such as bumble bees and ants [26]. Lundie (1940), reported finding information about several species of Brachypeplus (*B.autitus*, *B. planus*, and *B.meyricki*) associated with Trigona, the stingless bee of Australia. Although similarities can be drawn between the Australian Brachypeplus species and the small hive beetle, *Aethina tumida*: the differences in the ability of honey bees to immediately remove *B. planus* beetles from the hive as opposed to the difficulty they have when attempting to eject *A.tumida* beetles would suggest that the pest host relationship is very different [25].

Adult

The adult small hive beetle has been described as being from reddish brown to black in colour because the beetles often leave their puparia during the teneral phase, (i.e. before full pigmentation), the colour variation in adults can be from light brown to black [25]. Similar to other nitidulids, *A. tumida* has clubbed antennae, its body is broad and flattened dorsally, its elytra are covered with fine hair and like many beetle species it will play dead when disturbed [20, 24, 25]. *A. tumida* adults can also be distinguished from other nitidulids based on several anatomical characteristics such as the lateral tuft of setae on the eyes, the legs are broad and flattened, and the base of the pygydium has a transverse row of fovea [42]. The adult beetle range in size from 5 to 7 mm long and 3 to 4.5 mm wide. The beetles that mature first are typically larger than the beetles that mature much more slowly. In Dr. Lundie's study, the developmental rate from egg to adult ranged anywhere between 38 to 81 days and the small hive beetle may have up to five generations per year. Although young adult beetles are considered good flyers, newly eclosed adults are not very active until they have reached a high degree of pigmentation. Adult beetles generally take flight at dusk, but recent reports indicate that significant flight activity occurs before sundown [43]. Once the adults are one or two weeks old, they will rarely use their wings again [25].

Very little information on the mating behaviour of this beetle has been reported in the literature. Newly emerged adults seek out hives and the females generally begin laying eggs about a week after emerging from the soil [17, 25]. Although some reports have indicated that newly emerged adults readily orientated toward light [25, 34], very few adult beetles were collected using light-traps [3]. Olfactory cues appear to be the way the beetles navigate to the hive [9, 24]. The males are the first to leave the soil puparia and are suspected to be responsible for attracting females using aggregation pheromones [43]. Like most nitidulids, the small hive beetle's pheromone attraction is highly species specific [13]. Elzen et. al. (1999b) reported that adult beetles are most attracted to the combination of adult bees, honey, and pollen, while not very attracted to the individual parts. Beekeepers in Florida and Georgia have also noted that small hive beetles respond to hive odours released during hive manipulation by homing towards hives that have either been recently inspected or have had their honey pulled [6, 11]. The sex ratio of male to female is estimated to be approximately 1:1 [37]. Adult beetles have been reported to live for up to six months, but the majority generally only live for approximately two months [25]. Beetles winter in the adult stage and beetles have been found in the cluster of bees of wintered bee hives [9, 13, 30].

Eggs
The eggs are described as similar in appearance to honey bee eggs but smaller, 1.4 mm long and .26 mm wide. Adult females typically lay their eggs in irregular egg masses along crevices and cavities on or near beeswax combs [25]. A small number of beetles in a hive can generate serious problems because the beetles typically lay all their eggs in a very short period of time [33]. Dr. Lundie indicated that "the number of eggs which a single female can lay in her lifetime was not ascertained, but practical experience has taught that two or three beetles in a pile of supers can cause a heavy infestation of "worms" due not only to the reproductive capacity of the females, but also to their great longevity" [25]. Stanghellini et. al. (2000) estimated that a single female could lay between 200 and 400 eggs, but that this is likely dependent on the availability of food resources. Small hive beetle eggs typically hatch in 2 to 4 days [25].

Larvae
The larvae are generally described as cream coloured grubs with numerous protuberances over their bodies. The larvae are similar in appearance to young wax moth larvae except they only have three sets of legs. Wax moth larvae, like all moth and butterfly larvae, have three sets of legs behind the head but also have a series of paired prolegs that run the length of the body. The small hive beetle larvae also do not produce silk when feeding [25]. Dr. Lundie demonstrated that under laboratory conditions, the majority of the larvae were able to complete their larval development in 10 to 16 days, but approximately 30% of the beetles required an additional week. Most of the slow maturing larvae entered their final moult between day 20 and day 24. Dr. Lundie also reported that the late maturing larvae tended to be smaller and many of them died prior to pupation.

Pupa
Once the larvae are fully developed, they leave the feeding area to pupate in the soil [25]. The larvae make smooth-walled earthen cells in which to pupate. The cells are sometimes connected by tunnels, which allow the larvae to return to the surface before pupating [25, 34]. The pupae are described as pearly white in colour but as the beetles mature the colour will change from white to brown. The body is characterised by a series of projections on the thorax and abdomen. The time spent in the soil can vary from 15 to 60 days but the majority of the beetles will emerge as adults after approximately 3-4 weeks. Dr. Lundie reported that in his laboratory study most of the larvae that entered the soil to pupate, emerge as adults and the ones that did not emerge appeared to have been killed by a fungus [25].

Evans et. al. (2000) reported that virtually all of the beetle developmental stages found in the soil are located within 20cm of soil profile and within 90 cm from the hive entrance. They also found that the majority, over 80%, of the beetles collected were located within the first 10 cm of the sandy soil profile and within the first 30 cm from the hive entrance, therefore it would appear that the beetle larvae do not travel very far from the hive to pupate.

Ecology
Like most insects, the small hive beetle requires a specific set of conditions relating to nutrition and environmental factors, such as temperature and soil humidity in order to successfully complete its development. The nutritional requirements of the small hive beetle consist of pollen, honey, and wax but they are also reported to eat honey bee eggs and brood [9, 11, 14]. Elzen et. al. (1999b) reported that in the laboratory, adult beetles consumed all bee eggs presented to them even in the presence of excess honey and pollen. The protein in bee brood is very important to the successful completion of the life cycle [11, 23, 25]. An experiment limiting the larvae to a diet of honey and pollen had very few successive generations compared to larvae that had bee brood added to the diet [23]. Stanghellini et al. (2000), observed a small hive beetle larva feeding on the inside of the abdomen on a dead adult bumble bee and hypothesised that in the absence of honey and pollen small hive beetle larvae will feed on bee corpses. Small hive beetle larvae have also been reported to feed on dead adult honey bees in the hive [11]. Although honey bees and bee products are the small hive beetle's preferred food, they have been reported to be capable of developing on fruit such as avocado, banana cantaloupe, grape, grapefruit, mango, orange, papaya, pineapple, and strawberry [9] and other bee species such as bumble bees [37]. The presence of an abundant food source other than honey bee hives may serve as a refuge for beetles and a source of further infestations [6, 9, 18]. Dr. Lundie also noted that certain apiaries were always infested with small hive beetles, whereas other apiaries a few kilometres away were relatively free of the beetles. The presence of some abundant food source other than bee hives may be the reason for the difference between the locations [25].

The influence of environmental conditions such as climate and soil conditions on small hive beetle development have been referred to in the literature, but very little information detailing their relationship has been published. Dr. Lundie reported that in South Africa, the beekeepers most familiar with small hive beetle were from the warmer areas of the country and generally along the coast. The majority of beekeepers from the cooler, Western Province and Midlands were not familiar with the beetles at all. "Perhaps the climate and nature of the soil mitigate against a rapid development of the beetle in these areas" [25]. Dr. Lundie also reported that because of the rapid work of scavengers such as *G. mellonella* and *A. tumida* in the warm tropics, the incidence of American foulbrood in South Africa is far less prevalent that in the Northern part of the country where scavenger activity is much less. Reports from American beekeepers indicate that the most serious hive losses have been in Florida, Georgia and South Carolina, where the sandy coastal soils provide suitable habitat for beetle pupation [6, 19].

Beetle reproduction is restricted to the warmest months of the year. Dr. Lundie reported that in South Africa, the beetles do not reproduce during the four coldest months of the year, from mid-April to mid-August [25]. A beetle survey in South Carolina, Georgia and Florida revealed that during the month of February, reproductive development stops in South Carolina and Georgia, but continues in Florida [30].

The development rate of the beetles is also directly influenced by temperature, in that the hottest months of the year are associated with dramatic increases in beetle populations [11]. An unpublished report indicates that at 30ºC, the beetles will start to emerge after spending 13 days in the soil, whereas at 20ºC, the beetles only start to emerge after 24 days and the survivorship is only 46% as opposed to 98%. At 10ºC the beetles require 100 days in the soil before they will start to emerge and the survival rate is very low [29].

The seasonal movement of bee hives from infested areas has resulted in the spread of the pest beyond its natural range and *A. tumida* is currently found in some northern States, which experience temperatures below 0°C for several months such as Minnesota and Michigan [9, 24]. It is clear that the beetle is capable of surviving the winter in bee hives, but it is unlikely that it would be capable of surviving the winter in unheated honey houses or outside the hive in this type of climate [24, 43].

The small hive beetle requires certain soil conditions in order to complete its development. Dr. Lundie wrote, "the nature of the soil on which an apiary stands must play a very important role in determining the relative abundance of *Aethina tumida* in the hive". He also reported that larvae reared in a honey house situation typically did not complete their development because they were unable to find a suitable place on the hard concrete floor in which they could pupate [25]. In beetle infested states such as Georgia, the areas with heavy clay soils continue to have relatively low beetle populations [6]. Pettis and Shimanuki (2000), indicated that loose sandy or sandy-loam soils are the most suitable for beetle development. Soil moisture should not be too wet or too dry [25]. James Baxter, entomologist at the ARS, Subtropical Agriculture Research Center in Weslaco, Texas suggested that soil moisture between 15% to 20% is considered suitable for pupation [2].

DISTRIBUTION

Small hive beetle distribution in Africa

Aethina tumida was first described by Andrew Murray in Nigeria in 1867, but at the time there was no mention of the beetles being associated with honey bees [27]. The first record of *A. tumida* being associated with honey bees was in 1920, submitted by Mr. R.H.T.P. Harris from Durban, South Africa. It was given the common name of small hive beetle to help differentiate it from a larger beetle, *Hyplostonia fuligineus*, which is also associated with bee hives in Africa [18, 25]. While finding small numbers of *A. tumida* in honey bee hives in South Africa is not uncommon, they are rarely considered a pest and generally considered a sign of sloppy beekeeping practices[18, 25, 32]. Mutsaers (1991) reported that in Nigeria, the small hive beetle and wax moth, are generally only considered important pests during the rainy season from May to July, when food is scarce. Although in Uganda the greater wax moth, *Galleria mellonella* is considered the more serious pest, reference to *A. tumida* at least in the environs of Kampala would suggest that it may be considered an occasional pest in some areas [31]. The distribution of the small hive beetle in Africa is primarily in the tropical and subtropical areas [25]. Several papers refer to the range of the small hive beetle as sub-Saharan, which would include a wider range of climatic zones then simply tropical and subtropical [1, 34]. The Sub-Sahara would include the Warm Temperate Zone as well as all the transitional zones between them [1]. Anecdotal reports indicate that although the beetles are most commonly found in the warmer regions of South Africa, they have been found near the Amalola mountains, which for several weeks during the year have snow on the ground and the hives experience periods of zero brood rearing activity. The beetles have also been reported in the southern Cape, which climatically is similar to mid-California [5].

Small hive beetle distribution in the United States of America

The small hive beetle was first identified in the United States in Florida in the spring of 1998. The beetles were brought to the attention of the Florida Department of Agriculture and Consumer Services and were subsequently identified as *Aethina tumida* Murray by Dr. Michael Thomas, Division of Plant Industry, Florida Department of Agriculture and Consumer Services on June 1, 1998 and confirmed by Dr. Dale Habeck, Department of

Entomology University of Florida, Gainesville, Florida, USA and Dr. Alexander Kirejtshuk of Russia, a nitidulid specialist [1, 34, 41]. The initial small hive beetle adults and larvae were collected from colonies in four beekeeping operations in the Fort Pierce area, which is a major wintering area for many migratory beekeepers [18]. After the detection of the small hive beetle, Florida implemented a movement moratorium [14, 18, 33, 41]. Colonies could be relocated after being cleared by a Florida Department of Agriculture and Consumer Services inspector [14, 32, 33]. In July 1998, the presence of small hive beetle was confirmed in Georgia [7] and South Carolina [39]. In Georgia, the beetle specimens were collected from bee hives near Atlanta [7]. In South Carolina the beetles were collected from a weak honey bee colony in Charleston County [39]. Once the information and description of the small hive beetle had been publicised, several beekeepers in Florida, South Carolina and Georgia began reporting that they had seen beetles in colonies and extracting rooms as far back as a couple of years ago [18, 22, 42]. For example, a sample submitted in South Carolina in1997 was only identified to the family level because no one suspected the small hive beetle to be in North America [22]. Some beekeepers mistook the beetle larvae as wax moth larvae, *G. mellonella* [32, 34], which is suspected to be one of the reasons why the small hive beetle is not considered a major pest in its homeland of Africa. To add to the confusion, bee hives are often infested with both species at the same time [25]. Other beekeepers simply never reported it because the beetles did not appear to be causing any problems [6].

In November 1998, the small hive beetle was discovered in Laurinburg, North Carolina. The beetles were discovered by the State Apiary inspector, Bill Sheppard, who at the time estimated the beetle population in the infested hive to be approximately 50 beetles. Upon later investigation, the estimated number of beetles in the hive was much higher than originally reported as more than 100 adult beetles were found on a single frame [23].

There appears to be some confusion as to which U.S. states have reported finding the small hive beetle. As of December 1999, the small hive beetle was found in Florida, Georgia, Iowa, Maine, Massachusetts, Minnesota, New Jersey, North Carolina, Ohio, Pennsylvania, South Carolina, and Wisconsin [30]. As of January 2000, the beetle was reported found in Florida, Georgia, Michigan, Minnesota, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, and Wisconsin [43].

There appears to be a correlation between the infested climatic zones in Africa and the climatic zones in the eastern United States. The counties most affected by the small hive beetles in Florida and many of the other eastern States are in a transition zone similar to the infested Subtropical and Warm Temperate zone in South Africa [1].

Behavioural and biological comparisons of small hive beetles in North America and South Africa indicate that there are very few differences between the two populations [12]. Evans et. al. (2000), studied the genetic material from 26 specimens of *A. tumida* collected from Florida, Georgia, South Carolina and North Carolina, and 14 beetles collected from seven sites in South Africa. Their tests revealed that the mitochondrial DNA variation between all small hive beetle samples was within the range expected for a single species. This would suggest that small hive beetles found in the United States are the same species as those found in South Africa. However, the degree of heterogeneity in the U.S. beetle specimens appears to indicate two distinct haplotypes. There was also significant heterogeneity in haplotype frequencies, to possibly suggesting that the distribution of the small hive beetle in the United States may be the results of multiple introductions.

How *A. tumida* found its way to North America is not certain. Some reports speculate that it came in a shipment of fruit or some other possible food source such as pollen from South Africa [18, 19]. Others suspect that it was transported with a feral colony or contaminated soil aboard a ship [21, 41]. Whatever the case, it is another example of the dangers of global trade and the uncontrolled international movement of biological material [33].

The primary vectors for spreading the pest have been through the shipment of package bees from infected areas [3, 34], movement of infested bee hives [6, 13] and swarming of managed or feral colonies [9]. For example, a report out of Florida indicated small hive beetle eggs were found on the backs of some honey bees [13]. There were also some reports of small hive beetles being found in supers of honey sent north from Florida [19]. There is also speculation that the beetle can be spread via shipments of fruit from infested areas [6, 9].

The adult small hive beetles also appear to be good fliers, capable of dispersing over long distances [16]. Some reports indicated that the adult beetles are capable of flying up to 24 km (15 miles) to find food [24]. Beetles have been found in apiaries that have never been moved, therefore the beetle must have migrated in [6]. This would suggest that establishing quarantine zones will likely not eliminate the possibility of dispersal [16].

Given the fact that migratory beekeeping is such a common practice in the United States, the spread of the small hive beetle across the country will likely occur very quickly. It will soon be apparent whether or not this beetle will become a widespread pest [13, 14, 19]. In response to the anticipated movement of bee across the country, some states such as Pennsylvania have issued restrictions on bees and equipment from U.S. states that currently have been identified as having small hive beetles. "If small hive beetles are found, all colonies within that beekeeping operation have to be treated with coumaphos before the colonies can return to Pennsylvania. In the case of shipment of nucs and packages, any states where the small hive beetle is currently found, the parent colonies must be treated with coumaphos before making up nucs and packages destined for Pennsylvania" [19].

Damage

Both the adult and larva of the small hive beetle cause damage to honey bee hives [18]. Similar to wax moth, it is the larval stage of the small hive beetle that causes the greatest amount of damage [34]. The larvae pierce the cappings, side walls and mid-rib as they tunnel through the comb as they feed. Damage to comb can be quite extensive, especially in newly manufactured comb, however brood comb generally remains intact especially old comb with several layers of pupal skins [25, 32]. Reports of comb damage in bumble bee colonies indicate that with an initial infestations of 20 adult beetles, a bumble bee colony can be reduced to a layer of wax fragments and beetle faeces in a matter of two months [37].

As the beetles feed, they defecate on the honey causing it to ferment and leak out of the combs [25]. The fermented honey has a very characteristic odour, it is reported to smell like decaying oranges. As this mixture of fermented honey, beetle secretions and excrement dries, it becomes a sticky slime, which can be difficult to remove from the equipment [25, 33]. The comb can be washed to remove the beetle faeces and fermented honey, but there are still concerns regarding its acceptance by the bees [9]. Honey bee hives heavily infested with small hive beetles are characteristically covered with the slime, even on the outside of the hive. When small hive beetle infestations are heavy, even in strong colonies, queens will stop laying eggs and the bees may abscond. In addition to consuming the resources of the colony (wax, honey, pollen, bee eggs and brood), adult beetles have been observed eating their own eggs and larval cannibalism has also been reported [42].

Impact

The impact of the small hive beetle on the North American honey bee industry has been very different from what has been previously documented. For example, a survey in South Africa reported that only 30% of 185 beekeepers responding to the survey, listed the small hive beetle as a pest of honey bees. Of the respondents that listed the small hive beetle as a pest, 68% of them indicated that it was not a serious pest [4]. Where as in North America, it is estimated that within the first year of its introduction, the small hive beetle had been responsible for the destruction of over 20,000 bee hives [37]. In Africa it is also reported that similar to wax moth, small hive beetles are generally only problematic in weak colonies or colonies where the ratio of bee population to comb surface is insufficient to protect the comb [25]. Queen rearing operations are especially vulnerable to beetle attacks because of the large number of small hives in one area. In North America, the beetles appear to be able to readily take over even strong colonies with little resistance by the bees [9]. In South Africa, due to the lack of beekeeper concern for the presence of the small hive beetle in honey bee hives, the beetles are typically regarded as incidental pests which associate with the bees for shelter and warmth. The U.S. experience to date would suggest that it has the potential to be a pest of significant economic importance, in at least some areas [9, 13, 19]. Whether or not it proves to be a widespread pest is not yet known [34].

One reason why the damage caused by *A. tumida* has been more severe in the United States than in Africa may have to do with differences between the two nations honey bee stocks [12, 13, 16, 22, 32, 33, 34]. Observations of the pest-host relationship of the Cape honey bee, *A. mellifera capensis* in South Africa indicated that it responds to the beetle in an aggressive manner, grasping the beetles and attempting to sting them. The bees chased the adult beetles, corralling them into areas were they could not lay eggs [12]. The bees also consume any exposed beetle eggs and are capable of removing the larvae from the hive [12, 33, 34]. The African honey bee, *A. mellifera scutellata* also exhibits different behaviour from that of the European *A. mellifera* bees typically found in North America. They readily abscond in the presence of predation or perturbation of the hive [32]; they propolize entrances to protect the hive from beetle entry and keep the bottom boards clean, thus providing the beetles with few places to hide [33]. None of these behaviours have been observed in European honey bees in the United States [12]. However several cooperative studies have been started to study hygienic behaviour traits in U.S. bee stocks and how they can be used to help manage small hive beetle infestations [39]. A study on the effects of *A. tumida* on bumble bee colonies revealed that *Bombus impatiens* also is susceptible to beetle invasions and that the bees did not show any aggression towards the adult beetles or their larvae [37].

Although there have been major differences between the two nations with regard to the level of impact the small hive beetle has had on honey bee hives, the similarity is that the most vulnerable part of the beekeeping operation is equipment in storage and products containing wax, honey and/or pollen [11, 20]. In beetle infested areas, full honey supers stored in the honey house or on hives above bee escapes are most vulnerable to attack because there are no or fewer bees to protect the stores [20, 25]. Environmental conditions generally associated with honey houses such as high temperature and humidity provide optimal conditions for beetle development. This fact alone underscores the need for the protection of supers in the honey house both before and after extraction [11]. Severe beetle infestation in the honey house can also quickly result in beetle infestations in the bee yards through the transportation of contaminated equipment [33].

Detection

To reduce the spread and damage caused by the small hive beetle, beekeepers are encouraged to regularly inspect their bee hives to detect early infestations [18, 25, 34]. Currently, the best way to monitor for the presence of *A. tumida* is to pay close attention during hive inspections for signs of beetles or the damage they cause [13]. Begin monitoring when temperatures are warm enough that colonies are no longer clustered during the day and when the bees are using their bottom hive entrance [22]. Adult beetles are typically found under the top cover or on the bottom board of the hives. If an infestation is heavy, both adults and masses of larvae may be seen on the combs and bottom board. When opening a hive containing beetles, they can be seen running across the combs trying to find hiding places [25]. Adult beetles can also be detected at night by shining an amber light, which causes them to move on the frames. Varroa mite sticky boards are reported ineffective for use in detecting adult beetles. The beetles move easily across the sticky material even if the boards are coated with a stickier material such as Tangle Foot® [22, 42]. Corrugated cardboard with the paper removed from one side, placed on the bottom board at the rear of the hive, has been successfully used in detecting adult beetles. The beetles appear to seek shelter in the corrugations [19, 34]. Sanford (2000a) reported that a young hobby beekeeper in Florida collected adult beetle in the hive using the pitfall trap concept. A hole was cut into the bottom board and jar that was 1/3 filled with honey was attached to the bottom of the hole. Over the opening, was a Plexiglas cover that was bolted to the bottom board with screws and a couple of washers for spacers. The spacers provide enough room to allow the beetle to crawl under the Plexiglas but not the bees [33]. Fermented honey exuding from full supers in storage, waiting to be extracted, or on active colonies, is a sign that hive beetles may be present. In addition to the leaking of fermented honey, the characteristic odour given during fermentation can be used to detect the presence of the small hive beetle [25].

Control

Prevention through sanitation in the bee yards and honey house is the first line of defence against small hive beetle infestations [42]. In South Africa, beekeepers typically only have problems with the small hive beetle when combs of honey are leftunprotected by the bees such as sitting the honey house or above a bee escape board for several days. Honey supers should therefore be promptly extracted after they have been pulled from the bee hives and put back onto the hives as soon as possible. During the beetle breeding season, comb in storage should be examined at least once every three weeks for the presence of larvae. In the apiary, weak colonies should be either combined with other colonies, requeened, strengthened, or the comb surface reduced in order to maintain enough bees to adequately protect the comb. Honey should be stored in tightly sealed drums and wax cappings should be quickly processed into cakes of wax. The honey house and extracting equipment have to be kept clean [25]. In South Africa, beekeepers also use cold rooms for storing filled and extracted honey supers in order to avoid problems associated with either wax moth or small hive beetle [33].

The problem of honey contamination causes additional problems when considering control options in bee hives and equipment [9]. In order to minimise the risk of contaminating the honey, many cultural or non-chemical control techniques have been used to control small hive beetle populations. Freezing the equipment at -12°C (10°F) for 24 hours is reported to kill all life stages of the beetle [22]. In the honey house beetle larvae can be trapped using florescent lights and then swept up and disposed of [33]. The fact that the small hive beetle is reported to be attracted to the combination odour of honey, pollen, and live adult bees [13, 14], some beekeepers have reported that adult beetles can be trapped using nucleus hives placed near the honey house. The nucleus hives are then subsequently treated to control the beetles or destroyed [34]. In Florida, some beekeepers choose to destroy heavy infested equipment in order to control beetle populations [9].

The close genetic similarities between small hive beetles in North America and Africa would suggest that investigations into biological and cultural controls in South Africa would have direct bearing on beetle control in North America [12, 16]. Lundie (1940), reported that a fungal disease was suspected of causing mortality of some of the beetles during his study. He also reported the predation of the beetles by fire ants and the possibility of parasitism, but no species were identified. Experimentation with *Bracon brevicornis* Wesm. (ref. *Microbracon brevicornis*) a parasite of *G. mellonella* failed to successfully parasitize *Aethina tumida* [25]. Unlike wax moth, because the small hive beetle is not easily ejected from the hive, it is not recommended that infested supers be placed on strong bee hives for pest control or clean up [18]. As far as cultural control techniques used to minimise the risk of beetle infestations, Dr. Lundie reported that stationary hives were more vulnerable than hives that were moved on a regular basis. The theory being that the hives that have been moved will break the cycle of the beetles [25]. Another suggested cultural control technique that targets disrupting the beetle developmental cycle would be to place an impenetrable substrate around the hive that intercepts the movement of the larvae into the soil to pupate, thereby interrupting the developmental cycle of the beetle [6, 38]. Another way to interrupt the beetle's developmental cycle would be to treat the immature beetles with a compound that would arrest their development. Currently research is being done to investigate the effects of inhibiting the conversion of dietary sterol to cholesterol on small hive beetle development. Preliminary results indicate a strong potential for the development of environmentally safe compounds for control the small hive beetle [29].

Chemical control options that have been tested for their efficacy in controlling the small hive beetle include fumigation of equipment using carbon bisulphide [25]; naphthalene and para- dichlorobenzene. These will kill all beetle stages except the eggs [19]. Eischen et. al. (1999) was unsuccessful in controlling beetles with naphthalene, paradichlorobenzene, or carbon dioxide with a 48 hour exposure treatment. The Florida Beekeepers Association is attempting to get a Section 18 registration for methyl bromide fumigation of supers, but it is unlikely that they will be successful in getting this registered [11]. Lundie (1940), reported that when using carbolic acid to remove honey from a hive, the small hive beetle seemed to respond more quickly to the fumes than did honey bees.

Wilson et. al. (1998) conducted a laboratory screening trial of eight unidentified insecticides; 3 pyrethroids, 3 organophosphates, 1 formamidine, and 1 neurotransmitter agonist for their toxicological effect on small hive beetle adults and larvae. In this study, the three pyrethroids as well as two of the organophosphates were highly toxic to small hive beetles, killing 100% of the adults and larvae. The formamidine, neurotransmitter agonist, and one of the organophosphates showed low toxicity on either the adults or larvae or both, based on tested dosages. Further investigations identified that one of the investigated organophosphates was effective at controlling small hive beetles in the hive, while showing little toxicity to the bees [13, 14, 15]. Apistan®, (10% fluvalinate) did not control small hive beetle adults or larvae [13]. Elzen et. al. (1999b), demonstrated that a plastic strip impregnated with 10% coumaphos stapled under a cardboard trap was effective at controlling small hive beetle adults and larvae on the bottom board within a 48 hour exposure treatment, but that a longer treatment would be required to control all the developmental stages in the hive.

In the United States, CheckMite+™ (10% coumaphos strips) are recommended for the control of Varroa mites and small hive beetles in several U.S. States under a Section 18 (exemption registration) [14, 40]. The + in CheckMite+™ was added to indicate the label expansion to include the small hive beetle [40]. This product is registered for non-food use and therefore there is no allowance for any coumaphos residue in honey or wax [36]. Coumaphos has been reported to have an affinity for beeswax and therefore there is a real possibility of contaminating honey if not properly used, although these reports were associated with the application of liquid coumaphos (Perizen) and may not necessarily apply to the impregnated plastic strip formulation [40]. All surplus honey supers must be removed before treatment and not be replaced until 14 days after the treatment has been ended. There can be no sale of comb honey from hives that have been treated with coumaphos for the control of either Varroa mites or small hive beetles [36].

The Bayer Corporation, USA is working toward getting a Section 3 (general use) registration for the CheckMite+™ strips. If the Section 3 registration is not approved, then an application for renewal of the section 18 registration will have to be made [15, 19]. In the meantime, The Environmental Protection Agency, through state pesticide agencies, will monitor the use of these strips [19, 36]. Bayer Corp. and Mann Lake Ltd, the sole distributor of the CheckMite+™ strips are responsible for recording the number of strips sold in the U.S.[19]. For the control of the small hive beetle, the label indicates that the coumaphos strips must be in the hive for a minimum of three days and a maximum of 45 days. The strips must also not be reused and the maximum number of treatments per year is four. Any deviations from the label requirements could be considered a direct violation of the product registration, which may be grounds for revoking the registration [36].

To use the strips, prepare a piece of corrugated cardboard 15 cm x 15cm by removing the paper from one side. Cut the strip in half crosswise and staple both pieces to the corrugated side of the cardboard. The cardboard should then be placed in the centre of the bottom board with the strips facing down [3, 13, 19, 22]. Small hive beetle may be controlled in package bees by stapling a Bayer Bee pest strip inside the package so that it hangs down into the bees. This treatment does not control small adults that can escape through the wire screen of the packages. In order to ensure beetle-free packages, control measures should occur in the hives from which the packages are being taken [3]. During the non-reproductive periods when the adults are in the cluster of bees, hanging a strip in the broodnest may be successful in controlling both Varroa mites and small hive beetles [9]. This method does not work during the beetle reproductive period, because the beetles, (larvae and adults) are not necessarily located in the bee cluster or on the brood [9].

Soil Treatment

Wilson et. al. (1998) identified that one of the pyrethroids in their screening trail showed great potential as a soil treatment to control the beetles outside the hive. A pesticide used outside the hive would help reduce the risk of contamination of the honey as well as damage to the bees in the hive [6, 9]. The ground drench insecticide permethrin used for the control of fire ants was successful at controlling small hive beetle larvae, pupae and adults in the soil [9, 13]. Y-Tex Gardstar® 40% permethrin EC insecticide has been approved for controlling the small hive beetle around honey bee colonies [19, 22, 34]. Permethrin is highly toxic to bees, therefore extreme caution must be taken to avoid contact by spray or spray drift with the bees, hive, or any other surfaces that bees may contact [19]. Other soil treatment pesticides such as Diazinon® or Dursban® for fire ant or Japanese beetle control were also mentioned as possible site treatment for small hive beetle control in some areas. Granular insecticides may need to be watered in order to become effective [22]. Pettis and Shiminuki (2000) reported that the vast majority of the beetles in the soil are found within 90 cm from the hive entrance, therefore soil treatment applied in a band extending out 90 to 180 cm in all directions from the hive should provide very good control. For treatment of existing infestations, apply as soon as beetles or larvae are observed in or around the hive. When hives are present, applications should be done with a sprinkler can. A hand pump sprayer can be used to treat an entire apiary 24-48 hours prior to moving the hives on to the site. It is best to apply the treatment during the evening or when the bees are going to be the least active. Do not apply during windy conditions. For better soil penetration and improved efficacy, cut grass around hive prior to application [19]. Beekeepers are strongly encouraged not to experiment with illegal non registered pesticide treatments for small hive beetle control [22].

SUMMARY

In summary, although the small hive beetle found in North America appears to be the same as the one found in South Africa, the impact this beetle has had on the North American beekeeping industry has been very different. While this beetle is considered a minor pest in South Africa, losses in North America have been estimated to be as high as $3 million [34]. This difference may be due to the differences in host/pest response between the African honey bees and the European bee stocks found in North America [12, 13, 16, 22, 32, 33, 34]. Another reason may be related to the absence of the beetle's natural enemies in North America [7]. It is also suspected that due to the increased stresses caused by mites and antibiotic resistant disease, the honey bee colonies have become more susceptible to beetle attacks [33]. It is possible that it may be a combination of all of the above.

Thanks to Dr. Lundie's research on the small hive beetle in South Africa, North American researchers were quickly able to respond to the pest outbreak by developing insecticide treatments to control the beetles in the hives as well as in the soil. Due to the risk of residue contamination and the obstacles of registering hazardous compounds in the food production industry, chemical controls are generally considered a last resort. Controlling the beetles outside the hives, bait trapping and using environmentally friendly controls are all considered better options [33, 32, 35]. In order to improve our ability to control this pest, we must continue to find out more about this beetle. Research into its ecology relating to its environmental and nutritional requirements, alternative hosts, and natural enemy complex are all key to our understanding and ability to predict future outbreaks and potential geographical distribution of this pest. It is also important to investigate the possibilities of improving the bees ability to survive beetle infestations, through breeding and selection programs.

The impact of this pest on Canadian beekeeping is still unknown. Due to current pesticide regulations, it may be very difficult to obtain registration for the insecticide coumaphos in Canada. It is therefore important that the Canadian beekeeping industry support every effort to improve the general knowledge of this insect and the continued development of alternative chemical, cultural, and biological controls for the management of this pest.

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Kentville AAFC Research — ***Kenna MacKenzie***

Honey Bee Health

Controlled Delivery Device for Formic Acid.

An improved delivery device and analyses on formic acid residues in honey were studied by Dr. Scott Daniels, University of Regina. Dr. Daniels moved to an industrial position in early fall and R. Rogers and Dr. K. MacKenzie took over as co-project leaders. Trials were run in the fall of 2000 in Alberta (Dr. D. Nelson), Nova Scotia (R. Rogers and Dr. K. MacKenzie), and Tennessee (Drs. J. Skinner and P. Parkman). Formic acid delivery rate and control of Varroa mite was not acceptable. Thus, research development work is required. This project was partially funded by CBRF, and results will be presented at the CHC research session. Further funding is required for this project to continue.

Pollination and Other Bees

Development of a Maritime Management System for Alfalfa Leafcutting Bees for Wild Blueberry Pollination.

S. Javorek is leading this research. Parasitism, second generation and poor bee return are problems associated with alfalfa leafcutting bee production in the Maritimes. Methods to reduce these problems and to fit bee management into the wild blueberry crop cycle are being investigated. The goal of this research is to develop a Maritime/Wild Blueberry specific alfalfa leafcutting bee management system.

Wild Blueberry Reproduction and Genetics.

Research into the genetic diversity and reproductive strategies of the wild blueberry is being carried out by M. Myra, Masters Student, Acadia University (Collaborators: K. Burgher, AAFC; and Dr. S. Vander Kloet and M. Synder, Acadia University). Pollinator influence on reproduction is also being addressed.

Indigenous Bees in Wild Blueberry.

In collaboration with S. Javorek, the diversity and abundance of bees foraging on wild blueberry and how habitat on a landscape scale affects these bee populations are being studied. In addition, field trapping of Osmiine bees is continuing.

Other Publications

MacKenzie, K. 2000. Cranberry pollination. Proceedings of the Atlantic Cranberry Management Course 2000. 4 pp.

Funding

2000-2002: Agriculture and Agri-Food Matching Investment Initiative, with Bragg Lumber Company, the Wild Blueberry Producers Association of Nova Scotia, and Eaton Research Associates, "Site Specific Management of Wild Blueberries: Phase Two", $238,140.00.

2000-2003: Agriculture and Agri-Food Matching Investment Initiative, with Wild Blueberry Producers Association of Nova Scotia, Mapleton Enterprises Ltd., Hoeg Farms, Ltd., Bruce Mowatt Farms, Ltd., Diversified Pollination Services, and Percy Eggerman Farms, Ltd., "Development of a Maritime-Specific Management System for Alfalfa Leafcutting Bees (*M. rotundata*) used for Wild Blueberry Pollination", $353,570.00

Development of an IPM Program to Control Bee Parasitic Mites in Ontario — ***M. Nasr***

The following research projects were conducted during the 2000 season. Research team members included Geoff Wilson, Janet Tam, Shannon Melin, Rachel Bannister, David Servos, and Alison Skinner.

1.0.0 BREEDING PARASITIC MITE RESISTANT HONEY BEE STOCKS

1.1.0 Development and Marketing of Parasitic Mite-Resistant Honey Bee Stocks in Ontario

1.1.1 Maintenance of tracheal mite-resistant honey bee stocks

Ontario bee breeders selected potential breeder queens from the 1999 generation. The offspring of 175 queens were evaluated for tracheal mite resistance using the tracheal mite resistance bioassay. The 25% of bee colonies which had the lowest abundance and prevalence of tracheal mites in the resistance bioassay, were selected as the mite resistant stock. These colonies were recommended as the source of breeder queens. These selected queens were used to produce the 2001 generation of the Tracheal Mite Resistant-Hygienic stock.

1.1.2 Breeding and amalgamation of the hygienic trait into the Tracheal Mite-Resistant honey bee stocks

Over 200 colonies from the 1999 Tracheal Mite Resistant-Hygienic bees in Ontario were evaluated for hygienic behaviour in 2000. The liquid nitrogen freeze-killed pupae assay was used. Honey bee colonies which removed more than 50% of the freeze killed pupae, were recommended for use to produce hygienic bee stocks. Thus, the amalgamation of the hygienic trait with the tracheal mite resistance has been continued for 4 generations in Ontario.

1.1.3 Augmentation and marketing of mite resistant bee queens in Ontario and other countries

An estimated 15 000 queens were produced from Tracheal Mite Resistant-Hygienic bee stocks in 2000. Most of these queens were used for requeening bee colonies across Ontario but about 2500 queens were exported to beekeepers in the USA.

1.2.0 Evaluation of Quality of Honey Bee Queens Produced in Ontario

To follow up the 1999 evaluation of the quality of honey bee queens in Ontario, we continued to evaluate queens from Ontario queen producers in 2000. Four queen producers sent a total of 23 queens for evaluation. Queens and attendant workers were examined for tracheal mite infestation and nosema infection. Results showed that no queens or workers were infected with tracheal mites or nosema. The average number of sperm per queen was 6.54 ± 0.41 million (Mean ±std error). The number of sperm in the examined queens ranged from 3.6-9.6 million. In general the number of sperm was significantly higher in comparison to the number of sperm in 1999 queens. These results showed that queen producers in Ontario produced healthy queens and followed recommendations to improve queen mating and quality.

1.3.0 Importation and Evaluation of the Russian Honey Bee Stock for Varroa Resistance and Economic Traits in Ontario

Permits for the importation of eggs and semen from Russian honey bee stocks in the USA were granted by the Canadian Food Inspection Agency. Eggs were imported from Corfu, NY to a certified bee quarantine facility in Smithville, Ontario. 176 queen cells were grafted and 96 queens were produced from the grafted cells. Russian honey bee semen was imported to the Townsend Bee Facility at the University of Guelph, Guelph, Ontario. The semen was used to inseminate Russian and Ontario bee queens. 17 pure Russian queens, 45 Russian queens open mated with Ontario drones, and 14 Ontario queens inseminated with Russian semen were successfully introduced to bee colonies. Thus, the total number of Russian bee colonies wintered in Ontario was 76. The evaluation of this Russian bee stock will commence in Spring 2001.

2.0 DEVELOPMENT OF AN INTEGRATED PEST MANAGEMENT (IPM) PROGRAM TO CONTROL HONEY BEE PARASITIC MITES

2.1.0 Development of IPM Tools for Mite Management

2.1.1 Re-evaluation of Mite-Away formic acid pad size, hole size and formic acid volume to improve efficacy

To improve the efficacy of Mite-Away formic acid pads in controlling varroa mites in honey bee colonies, pad size, hole size and the volume of formic acid applied per pad were investigated. Two sizes of the pads (20 x 21.5 cm and 20 x 19.5 cm) were tested. Five different bags were evaluated. Two volumes of formic acid (250 and 300 ml/ pad) were tested. Thus, 12 treatments were tested. For each treatment, 8 colonies were used. Test colonies were located in 6 apiaries in the Simcoe area, Ontario. Bee samples (100 bees/colony) were collected to determine the tracheal mite prevalence in each colony before treatment. Sticky traps were used to collect dead varroa mites. The traps were replaced weekly and all dead mites were counted. Mite-Away formic acid pads were weighed every 2 days for a period of 21 days to determine the formic acid evaporation rates. After applied treatments were removed all colonies were treated with Apistan® to kill the remaining varroa mites in order to determine the relative efficacy of formic acid treatments to Apistan®. The Apistan® strips were left in bee colonies for 21 days. Bee colonies were sampled again in late August to determine the tracheal mite prevalence and calculate the efficacy of formic acid on tracheal mites.

Results showed that the size of the pads, the volume of formic acid and the whole size did not significantly effect the evaporation rates of formic acid. However, we found that during a cold spring making three 5" slits in the perforated bags helped to increase the formic acid evaporation rates and achieve high varroa mite kill. The average (mean ± std error) efficacy of Mite-Away formic acid pads on tracheal mites and varroa mites was 94.9% ± 4.8% and 81.3 %± 9.2, respectively. These finding will help to improve the efficacy of formic acid treatment on varroa mites and will also help to improve the packaging of Mite-Away formic acid pads when sold in small numbers

2.1.2 Impacts of tracheal mites (Acarapis woodi) on the respiration and thermoregulation of overwintering honey bees in a temperate climate

In partial fulfilment of requirements for the degree of Master of Sciences, A. Skinner conducted a research projects which fitted in the objectives of the Tech-Transfer program.
The summary of the M. Sc. thesis is included.

Summary

The impact of the tracheal mite (*Acarapis woodi*) on the respiration, thermo-regulation and wintering of honey bees was investigated. The oxygen consumption rate (ml O_2/bee/hr) after acclimatizing to15^{0}C was significantly lower for individual tracheal mite infested bees (8.93±0.07) than for non-infested bees (9.82±0.07). Bees with sealed spiracles had the lowest oxygen consumption rate (8.33±0.09). The oxygen consumption rate after acclimatization to 24^{0}C and to 5^{0}C was significantly lower for clusters (200 bees) of tracheal mite infested bees than for non-infested bees. Tracheal mite infested colonies had significantly lower core cluster temperatures in comparison to non-infested colonies. For winter protection of bee colonies, the indoor wintering facility and the Davies system offered more protection than did the waxed cardboard boxes and the tar paper wrap. A spring application of formic acid reduced tracheal mite infestation by 93%. Microencapsulated menthol (MEM) reduced mite infestation by 50%. Neither treatment significantly effected bee and colony mortality nor the number of bees and the amount of brood. Lowering tracheal mite prevalence prior to winter and providing an efficient wintering system reduced the negative effects that tracheal mites have on the oxygen consumption rates of honey bees thus improving their thermoregulatory ability and their survivorship.

2.1.3 Evaluation of Efficacy of Oxalic Acid, Apilife var, Formic Acid and Apistan® on varroa and tracheal mites in fall

This project was conducted to determine the efficacy of several miticides applied in the fall on varroa and tracheal mites. Four products were examined; formic acid (Mite-Away pads), Apistan®, Apilife Var, as well as two concentrations of oxalic acid. Oxalic acid and Apilife Var are commonly used for varroa control in Europe, but very little is know about their efficacy in North American conditions.

Honey bee colonies infected with varroa mites were located near Guelph, Ontario. Bee colonies were examined before applying the treatments. The size of the cluster was determined and the number of brood chambers (single or double) was also taken into consideration. The fallen mites in 24 h on sticky boards were counted. On the basis of the number of brood chambers, the bee cluster size and the number of fallen mites, bee colonies were divided into groups of 8. A randomized block design was used to test the treatments. On 20 October 2000, miticides were applied according to the instructions on the label. For oxalic acid, 28 g were dissolved in 1L of sugar syrup (50:50) (w:w) to make the 2.8% oxalic acid concentration. The second concentration tested was 3.5%. 40-50 ml of oxalic acid (5 ml/ bee way) were applied by trickling the solution on the bees between the frames. For Apilife Var, each block was divided into 2 pieces which were placed on the periphery of the cluster at opposite sides of the cluster. Apistan® and formic acid were applied as recommended. Sticky traps were placed under the colonies on the bottom board, and were replaced every week to collect dead mites. All mites on the sticky traps were counted After two weeks the formic acid pads were removed from the vegetable bags, and Apilife VAR was reapplied, as per recommendations. After the treatment period of 21 days, every colony was treated with Apistan®. Sticky traps were again used to collect the remaining dead mites for 20 days. The relative efficacy of each tested miticide was calculated in relation to Apistan®.

Apistan® proved to be the most effective treatment, on average killing 96.961±0.89% (mean± std error) of varroa mites. This was followed by formic acid at 90.80±4.27% effective, 3.5 % Oxalic Acid at 88.43±4.08%, Apilife Var 67.98±6.74%, and 2.8% Oxalic Acid 60.35±6.47%. One colony in the formic acid group was particularly weak, and high levels of moisture built up on the top of the hive, can negatively effect the evaporation of formic acid. If the results from this colony are not included in calculation the efficacy, the efficacy of the formic acid treatment increases to 94.75±1.88%. Furthermore, if the 3.5% Oxalic Acid treatment is examined with regard to the number of brood chambers, it was found that the efficacy was 94.42±1.64% in single brood chamber colonies, and 82.45±7.14% in double brood chamber colonies.

These results suggest that while the varroa treatments currently recommended in Ontario are effective, oxalic acid could become a viable alternative. Before this is determined, future studies will need to investigate various methods of application, single vs double brood chamber effects, as well as the efficacy of treatment with different concentrations and volumes of the acid.

2.2.0 Improving Honey Bee Hive Product Quality: Preliminary Determination of Miticide Residues in Honey and Beeswax Executive Summary of the Final Report (M. Nasr and K. Wallner)

Samples of honey and wax from Ontario were analyzed for the residues of 9 miticides (Fluvalinate-tau (Apistan®), Coumaphos, Bromopropylate, Flumethrine, Acarinathrin, Chlorfenvinphos, Tetradifon, Vinclozolin, Phos-ester) which have been used around the world to control varroa mites. In general, the honey and the wax produced in Ontario were found to be safe for food consumption. Residues of miticides were not found in most of the samples and when found they were below the allowable limits.

Residues of Fluvalinate-tau, Coumaphos, and Phos-ester were found in some honey and beeswax samples. Residues of the other 6 miticides were not detected in analyzed samples. The following levels of residues were reported:

- Apistan® was not found in any honey samples that were taken from honey for sale to consumers.
- There was 5 ppb of Apistan® in one honey sample extracted from combs used in the brood chamber. This is 20 times less than the allowed level of 1 ppm in honey.
- An average of 1.04 ppm of Apistan® was found in 38.46% of the wax samples, which were collected from honey super combs. This is 5 times less that the allowed level of 5 ppm in wax.
- An average of 2.41 ppm of Apistan® was found in 91.7% of the wax samples collected from the brood chamber.
- One sample of wax from the brood chamber contained Coumaphos residues (0.7 ppm).
- An average of 4.56 ppm of Apistan® was found in 66.67% of the samples, which represented the cocoon and wax residues (slum gum) after extracting wax from the brood chamber combs.
- 1.5 ppm of Apistan® was found in 15.38% of the samples which represented residues (Slum gum) from the honey super combs.
- Apistan® residues were not found in wax samples of virgin wax from cut comb honey and cappings.

These results showed that beekeepers are using the recommended miticides for varroa control. Using the miticides as a part of the Ontario Integrated Pest Management program has helped to keep the residues at very low levels in comparison to European countries.

2.3.0 Evaluation of Practices of IPM Program by Ontario Beekeepers

A survey was mailed to 250 beekeepers who have 50 colonies or more, to determine the mite presence in their operations. Any IPM practices which were used to control tracheal and varroa mites were assessed. 25% of the beekeepers who received surveys replied.

2.3.1 Mite presence

Varroa mites occur throughout most of Ontario. 61.29% of the beekeepers sampled for varroa mites. 85.48% of beekeepers know that they have varroa mites and only 4.84% of beekeepers have no varroa mites. Less than half (46.77%) of the beekeepers sampled for tracheal mites. Tracheal mites were reported in 41.93% of the beekeeping operations.

2.3.2 Parasitic mite control

Mites are controlled in Ontario using two registered chemicals, Apistan® and formic acid. Because of the gradual spread of varroa mites across Ontario, Apistan® has been applied for different lengths of times in different areas. The average time of use is 4.3 years ± 1.2 (mean ± std), with about 50% of beekeepers having used it for 5 to 10 years.

The application of formic acid and Apistan® depends on management practices and the type of mites present. Beekeepers use Apistan® for varroa mites, while formic acid is used for both varroa and tracheal mites. Presently Apistan® is used by 96.8% of the beekeepers and formic acid is used by 77.9% of beekeepers in Ontario. 18.3% of the beekeepers use Apistan® in both spring and fall for varroa mite control. 76.3% of the beekeepers use only one treatment of Apistan® in the fall. Most beekeepers in this group also use formic acid treatments.

Beekeepers using only Apistan® do not have tracheal mites or are using genetic resistance to control tracheal mite infestations (6.5% of total beekeepers). Alternating the use of formic acid and Apistan® is common for controlling both varroa and tracheal mites. A rotation of MiteAway (single application formic acid treatment) and Apistan® is used by 67.7% of the beekeepers. 9.8% of the beekeepers use 3 Mite-Wipe applications in the spring to control both tracheal and varroa mites, and Apistan® in the fall for Varroa control. Two Mite-Wipe applications and Apistan® are used in 6.5% of beekeeping operations to control both mites. However, using only 2 applications of Mite-Wipe has been proven to be insufficient for mite control.

3.0 INNOVATIVE QUALITY ASSURANCE: HONEY BEE POLLINATION IN AGRICULTURE: EXECUTIVE SUMMARY OF THE FINAL REPORT

The research project Innovative Quality Assurance for Honey Bee Pollination in Rural Ontario was conducted in 1999. To develop preliminary standards to obtain a seal of quality for an efficient pollination unit, a field survey of honey bee colonies rented for pollination was completed in the spring and summer of 1999. Results from examining honey bee colonies were reported in 1999.

In order to determine the effects of pollination on the quality of produced apples, 1344 randomly chosen Ida Red and Red Delicious apples were evaluated in 2000. These apples were harvested from two well-pollinated and two poorly pollinated apple orchards. Results showed a significant increase in fruit weight, volume, height, width, breadth and the number of viable seeds. A significant correlation was found between seed number and apple weight. Apples from well-pollinated orchards also had a significantly higher percentage of apples with large width. In poorly pollinated orchards, a significantly large percentage of apples with small widths were found. The average weight was significantly correlated to the volume, width, breadth, height, number of seeds and average radial distance across the carpels (Table 11). For each increase by 1 seed, the weight of each Ida Red apple increased by 4 g and the average weight for Red Delicious apple increased by 7 g.

Pollination practices by beekeepers and farmers were surveyed in 1999. Data were analyzed in 2000. Many apple and cucumber growers rent colonies for pollination, but most growers rent fewer (25-50%) colonies than the recommended number per acre. A wide range of prices was reported and most the pollination contracts were verbal. Colony strength was of concern to most growers, but many of them did not check rented colonies for strength. 45% of growers are willing to hire a beekeeper to check colony strength and health.

Bee Management Research Report – Beaverlodge **D. Nelson**

Equipment and Pollen Irradiation (Nelson, Clark, Melathopoulos, Colter, Gates, lotron)
The feasibility of high velocity electron beam irradiation as a method to decontaminate hive equipment and pollen of disease was investigated through 1999 and 2000. Irradiation with powerful electron beams does not involve radioactive materials or chemicals and has been used extensively in the sterilization of medical supplies, spices and other materials. The study focussed on two diseases; the fungus causing chalkbrood (*Ascopheara apis*) and the bacterial causing American Foulbrood (AFB) (*Paenibacilus larvae larvae*).

Laboratory tests conducted in 1999 and 2000 determined the amount of radiation required to render *A. apis* and *P. l. larvae* spores unviable. Two experiments were conducted. The first involved irradiating chalkbrood mummies at different depths within packages of pollen. The second directly exposed chalkbrood mummies and AFB scales to 5 different doses (4-12 kGy) of radiation. Tests indicated that doses of at least 6kGy were required to sterilize *A. apis* and *P. l. larvae* spores and that beams are able to penetrate up to 10 cm of pollen for chalkbrood control.

Tests in 2000 investigated the abilities of electron beams to penetration full-depth supers of comb. Three frames in each of 2 supers were equipped with dosemeters capable of detecting the levels of exposed radiation. Dosemeters were fastened to; 1) the tops of frames, 2) the centre of the comb and 3) the bottom of the frame. Frames contained no honey. Two supers were irradiated from the top surface and 1 super was irradiated from both the top and bottom. Results indicate the a sufficient dose (>8 kGy) of radiation was delivered to sterilize the entire comb of disease spores, when irradiated from the top only. Irradiation from the top and bottom resulted in very high exposure to irradiation (>15kGy). A second experiment compared the penetration of electron beams through 6 frames of: 1) empty comb, 2) comb with fresh honey and 3) comb with crystalized honey. All six frames of empty comb received doses exceeding 7kGy, whereas the beam was not able to penetrate more than 1 comb containing fresh or crystalized honey. The results suggest that high velocity electron beam irradiation is a viable method to sterilize pollen and empty comb of disease spores.

Pollination Studies *(Nelson and Westcott)*

Ninety-six honey bee colonies were moved to each of two hybrid canola certified seed production fields near Coaldale, AB in the summer of 2000. Two treatment groups were used to evaluate the foraging activity of bees from different strength colonies at the hive entrance and on male and female canola flowers. The number of colonies placed at each field was 3 hive/acre stocking density, both fields were approximately 30 acres. Nectar production (volume and sugar concentration) was evaluated in male and female lines and also in developmental parental lines.

Certified Fields - The bloom period at one research field began in late June and finished in late July, but blooming began a week later at the second research field. Bees at both certified fields remained devoted to pollen collection from canola flowers throughout the bloom period; canola pollen accounted for 85 % to 100% of pollen trap samples from both fields. Pollen collecting activity at both certified fields peaked during morning and early afternoon (1100 - 1300 h) while non-pollen foraging peaked in late afternoon (1700 h). A bee density gradient related to distance from hives was observed at both certified fields; greater distance between the colonies and the sample plots resulted in lower numbers of bee visits. The number of bee visits was not different between the inside and the outer margins of female bays at either field. Bee visits to sample plots at both fields peaked in late morning (1130 h). Nectar volume and sugar concentration was higher from male plants than female plants, though these differences may not be of biological significance; i.e. the differences may not be large enough to influence honey bee foraging preference.

Membrane-gel formic acid trials *(S. Daniels, D. Nelson, K. MacKenzie, D. Rogers)*

In 1999 and 2000 cooperative studies were carried out on the evaporation rates and effectiveness of membrane-gel packs placed on colonies for Varroa control in Saskatchewan, Nova Scotia and Alberta. Results both years indicate that although the method provides evaporation over the entire 28 day application period the desired level of 10 g per day is seldom reached. On average the level is between 6-8 g, which is felt to be inadequate for good Varroa control. The data for the two years is being summarised for publication.

Antibiotic Trials *(Melathopoulos & Nelson)*

The rapid spread of oxytetracycline resistant American Foulbrood (AFB) in Alberta and British Columbia prompted the evaluation of three antibiotics, tylosin tartrate, lincomycin hydrochloride and erythromycin phosphate, for efficacy and negative effects to colonies. Two experiments are underway. The first involved feeding colonies with high levels of oxytetracycline resistant AFB with treated syrup. Treatments were applied in September 2000. The results are summarized below:

Treatment	No. Colonies	Application Method	Concentration (mg ai/colony)	Scales/Frame of Brood ($\pm$SE) October 2000
Untreated	*10*	-	-	498 $\pm$ 337
Oxytetracycline	*10*	*Syrup*	*800*	732 $\pm$ 467
Erythromycin	*10*	*Syrup*	*600*	254 $\pm$ 128
Tylosin	*10*	*Syrup*	*600*	0.64 $\pm$ 0.64
Lincomycin	*10*	*Syrup*	*600*	4.71 $\pm$ 3.09

A separate set of colonies without disease were treated with antibiotic and half were wintered indoors and half wintered outdoors. Samples of honey were obtained before winter and samples will be obtained after winter to determine the persistence of the antibiotics in honey.

Thymol Trials *(Melathopoulos & Gates)*

Two commercial Varroa acaricides that have thymol as their active ingredients, Apiguard and Apilife VAR, were compared to treatment with Apistan in trials underway in Vernon, British Columbia. Colonies were treated in mid-September 2001 and evaluated by counting the number of Varroa found on adhesive bottom boards before treatment and on a weekly basis after treatment. The thymol products appear to provide similar levels of control as that observed using Apistan. Varroa levels will again be evaluated in April 2002.

Treatment	Dose	No. Colonies	Mortality during treatment / before (Varroa / day $\pm$ SE)
Apiguard	1 dispenser	15	6.24 $\pm$ 2.02
Apilife VAR	2 dispensers	7	3.18 $\pm$ 0.89
Apilife VAR	3 dispensers	8	5.47 $\pm$ 1.30
Apistan	As recommended	15	3.88 $\pm$ 0.52

Comb Replacement Study (Melathopoulos)

The objective of the experiment was to determine the costs and benefits of spring comb renewal for prairie beekeepers. Two-pound packages were established on frames with either; 1) new or 2) old drawn comb or 3-5) one of 3 different brands of plastic foundation (Pierco black, Premadent White, Permadent Black). Colony populations, the amount of comb drawn, honey production and disease levels were measured throughout the experiment. The results showed that colonies established on older drawn comb had significantly higher levels of chalkbrood in early-spring (June) compared to the other treatments, although the difference disappeared by summer (July). More significantly however, colonies established on drawn comb made twice as much honey compared to colonies on foundation. Colonies on foundations drew approximately 8 combs of foundations by September.

AFB Antibiotic Trials on Colonies with Oxytetracycline Resistance ***Nelson, Melathopoulus***

Introduction

Widespread colony loss to AFB in Canada is prevented by prophylactic treatment of colonies with antibiotics, coupled with routine colony inspection and destruction of infected bees and equipment. Presently one antibiotic is registered for use in Canada, oxytetracycline hydrochloride (OTC). OTC has been used for the successful prevention of AFB since the early 1950s (Shimanuki and Knox 1994), however recent widespread resistance to OTC by *P. l. larvae* has occurred throughout the Americas (Alippi 1996, Miyagi 2000), including Alberta and British Columbia (CAPA 2000, Colter 2000). The size of the industry impacted by OTC-resistant AFB in Canada not only includes the $93 million generated by Canadian bees from the sale of honey (Statistics Canada 1998), but more importantly the $420 million generated from the pollination of oilseeds, tree fruit, berries, and cucurbits (CAPA 1995).

Proposed Project

Immediate and severe losses to AFB, particularly in Alberta and British Columbia, cannot be overcome without the development and registration of new antibiotics. Consequently, an objective of this project will be to evaluate 3 new antibiotic products for their ability to control rAFB (resistant AFB) with minimal undesirable side-effects.

An alternative strategy of managing AFB that may address the problems associated with relying on antibiotics would involve integrating a variety of non-antibiotic disease management tactics with reduced antibiotic use. The aim of an integrated disease management strategy would be to reduce the risk of bee disease outbreak by monitoring disease hazard and responding to the hazard with a combination of disease management tactics most appropriate to the hazard.

Three elements are required for an integrated AFB management strategy: 1) sensitive, precise and cost-effective surveillance of AFB hazard, 2) a diversity in control tactics that manage AFB at multiple stages of the disease cycle and 3) thresholds and guidelines to direct appropriate control tactics. The major objective of this proposal is to develop each of the three elements of an integrated AFB management strategy and integrate them into a simple, effective and efficient system that can be used by beekeepers to manage AFB with reduced levels of antibiotic.

Research Summary, Guelph ***Gard Otis***

1. Reports of possible Varroa mite-resistant honey bees in France led to a collaborative evaluation of that stock with Dr. Y. LeConte (Bee Research Unit, INRA, Avignon, France). Permits were secured and French and Ontario queens were exchanged in June, 2000. Parallel experiments have been established to compare the development of Varroa mite populations in colonies headed by queens of the two geographic stocks. Initial results from Ontario suggest that some other factor (e.g., a less virulent strain of mite or a localized interactions between French bees and French mites) may be responsible for the reduction in problems caused by mites in France. The evaluations are continuing.
2. We undertook an investigation of the basic biology of drone bees that followed up on previous studies of drones. Drones of two sizes, large (from drone cells) and small (from worker cells) were obtained from individual colonies. They were marked and introduced into queenless colonies in order to quantify differences in traits that would affect the relative fitness of large and small drones. In one hive large drones lived significantly longer than small drones; in the other colony there was no difference. Flight characteristics (number of flights per day, duration of mating flights) did not differ between large and small drones except at cool temperatures when a larger proportion of large drones took mating flights. Sperm

numbers were positively correlated with drone size (dry weight). Together these results demonstrate a fitness advantage of being a large drone. (This was an undergraduate student project of Jitka Jarolimek which required minor contribution from OMAFRA resources).

3. We attempted to further document the effects of tracheal mites on individual bee longevity. Young newly-emerged bees were marked and divided equally between heavily infested colonies and uninfested colonies. However, a subsequent check showed that the mite populations in the "heavily infested" colonies had crashed. The low mite infestions (~4% of the bees infested) led us to terminate the study. If heavily infested colonies can be located in spring 2001 we will repeat this study.
4. During sabbatical leave at the USDA Honey Bee Lab in Tucson, Arizona, I completed writing of many overdue publications.

Contributions to Education, Training and Technology Transfer

Education and Training: G. W. Otis

- May-August: Training in beekeeping and research of undergraduate students David Servos and Jitka Jarolimek at Apiculture Field Lab.
- July 8: Ontario Beekeepers' Association Summer Meeting, Napanee: "Importation of 'Varroa-resistant' bees from France"
- Aug. 4: Eastern Apicultural Society, Salisbury, MD: "Importation of 'Varroa-resistant' bees from France."
- Sept. 11: Toronto District Beekeepers' Ass'n.: "Varroa resistant bees from France."
- Nov. 18: Ontario Beekeepers' Association Annual Convention, Ottawa: "Breeding Varroa resistance: French bees and beyond."

Education, Training, and Technology Transfer: Paul G. Kelly

- Presentations to six groups (local beekeepers' associations, bee inspectors, bee breeders)
- Member of Board of Directors, Ontario Beekeepers' Association (as chair of "Commercial Club," made arrangements for two meetings)
- Royal Ontario Museum: assistance with observation bee hive
- Royal Winter Fair: provision of observation bee hive for educational booth; assisted with display of the OBA's booth (banner and backdrop) and set-up.
- Tours of 5 groups of children at U. of Guelph apiculture field lab

Publications

A. Peer-Reviewed publications

Hepburn, H. R., S. E. Radloff, G. W. Otis, and D. R. Smith. In Press. Infraspecific categories of *Apis cerana*. Apidologie.

Mattila, H. and G.W. Otis. 2000. The efficacy of Apiguard against varroa and tracheal mites, and it effect on honey production: 1999 trial. Am. Bee J. 140: 969-973.

Mattila, H. R., J. L. Harris, and G. W. Otis. In Press. Timing and rate of production of winter bees in temperate honey bee (*Apis mellifera*) colonies. Insectes Sociaux

Nasr, M.E.; G.W. Otis; and C.S. Scott-Dupree. In Press. Divergent selection for tracheal mite resistance in honey bees (Hymenoptera, Apidae). Journal of Economic Entomology 93:

Otis, G. W., S. Hadisoesilo, and Sugiyani. In Press. Using social bees to assess habitat quality in Sulawesi. Proceedings, 7th IBRA Conference on Tropical Bees: Management and Diversity.

Otis, G. W., N. Koeniger, T. E. Rinderer, S. Hadisoesilo, T. Yoshida, S. Tingek, S. Wongsiri, and M. Mardan. In Press. Comparative drone mating flight times of Asian honey bees. Proceedings, 7th IBRA Conference on Tropical Bees: Management and Diversity.

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Smith, D. R., L. Villafuerte, G. Otis, and M. R. Palmer. In Press.. Biogeography of *Apis cerana* and *A. nigrocincta*: insights from mtDNA sequence studies. Proceedings, 7th IBRA Conference on Tropical Bees: Management and Diversity,

Smith, D. R., L. Villafuerte, G. Otis, and M. R. Palmer. 2000. Biogeography of *Apis cerana* F. and *Apis nigrocincta* Smith: insights from mtDNA studies. Apidologie 31: 265-279.

van Engelsdorp, D. and G. W. Otis. In Press. Application of a modified selection index for honey bees. Journal of Economic Entomology.

van Engelsdorp, D. and G. W. Otis. In Press. Comparison of spring pollen collection by honey bee (*Apis mellifera*) colonies of Buckfast and Canadian stocks. Proc. Entomological Society of Ontario.

van Engelsdorp, D. and G. W. Otis. In Press. Field evaluation of nine families of honey bees for resistance to tracheal mites. Can. Entomol.

van Engelsdorp, D. and G. W. Otis. Reviewed, under revision. The role of cuticular compounds in the resistance of honey bees to tracheal mites. Experimental and Applied Acarology.

B. Books and Reports

Otis, G.W. and J. Kralj. 2001. Parasitic mites of honey bees not present in North America. In: Webster, T. and K.S. Delaplane, (eds.) Mites of the Honey Bee. Hamilton, IL: Dadant & Sons.

C. Conference Proceedings or Abstracts

Otis, G. W., O. R. Taylor, and M. L. Winston. In Press. Colony size affects reproductive attributes of African honey bees. Proceedings, 2nd Internat. Conference on Africanized honey bees and bee mites. Tucson, Arizona, April 2000.

Smith, D. R., L. Villafuerte, G. Otis, and M. R. Palmer. In Press. Coevoluiton between honey bees and Varroa mites. Proceedings, 2nd Internat. Conference on Africanized honey bees and bee mites. Tucson, Arizona, April 2000.

D. Popular Press Articles

Otis, G. W. 2000. Importation of potentially "varroa-resistant" honey bees from France. Hivelights 13 (3): 6-7, 9.

Otis, G. W. In Press. Managing the small hive beetle. The Sting 18 (6): 31-32.

Otis, G. W. 2000. Africanized honey bees: the tenth anniversary. The Sting 18 (5): 17-19.

Otis, G. W. 2000. Successful wintering of honeybee colonies infested with mites. The Sting 18 (4): 20-22.

Otis, G. W. 2000. The OMAFRA/University of Guelph bee research program. The Sting 18 (3): 20-21.

Otis, G. W. 2000. Recent activities (February-March, 2000). The Sting 18 (2): 8-9.

Otis, G. W., S. Hadisoesilo, and G. Wardell. 2000. Homemade queen cages in Sulawesi, Indonesia. Beekeeping and Development, No. 56: 4-5.

*Note: The Sting is published by the Ontario Beekeepers' Association

Scientific Presentations

Otis, G. W., S. Madvandi-Nejad, H. Mattila, and H. K. Moghadam. 2000. Effects of queenlessness and queen mandubular pheromone (QMP) on comb construction by honey bees (*Apis mellifera* L.), Entomological Society of America/Entomological Society of Canada, 3 December, 2000, Montreal, Quebec, Canada.

H. Mattila, J. Harris, and G. Otis. 2000. Timing and rate of production of winter bees in temperate honey bee (*Apis mellifera* L.) colonies. Entomological Society of America/Entomological Society of Canada, 3 December, 2000, Montreal, Quebec, Canada.

Otis, G. W. 2000. Facilitated reproductive character displacement as an evolutionary force in insects. Entomological Society of Ontario, 28 October, 2000, Sault Ste. Marie, Ontario.

Otis, G. W., O. R. Taylor, Jr., and M. L. Winston. 2000. Colony size affects reproductive attributes of Africanized honey bees. 2nd International Conference on Africanized Honey Bees and Bee Mites, 10-12 April, 2000, Tucson, Arizona.

Keeling, C. I., G. W. Otis, S. Hadisoesilo, and K. N. Slessor. 2000. Mandibular gland components in head extracts of *Apis cerana* and *Apis nigrocincta*. 7th IBRA Conference on Tropical Bees: Management and Diversity, March 19-25, 2000, Chiang Mai, Thailand.

Otis, G. W. 2000. Comparative drone mating flight times of Asian honey bees. 7th IBRA Conference on Tropical Bees: Management and Diversity, March 19-25, 2000, Chiang Mai, Thailand.

Otis, G. W., S. Hadisoesilo, and Sugiyani. 2000. Using social bees to assess habitat quality in Sulawesi. 7th IBRA Conference on Tropical Bees: Management and Diversity, March 19-25, 2000, Chiang Mai, Thailand.

Radloff, S. E., H. R. Hepburn, and G. W. Otis. 2000. Flight machinery of honeybees (Hymenoptera: Apidae, *Apis*). 7th IBRA Conference on Tropical Bees: Management and Diversity, March 19-15, 2000, Chiang Mai, Thailand.

Smith, D. R., G. Otis, L. Villafuerte, and M. R. Palmer. 2000. Coevolution of parasites and hosts? *Apis cerana* and *Varroa*. 2nd International Conference on Africanized Honey Bees and Bee Mites, 10-12 April, 2000, Tucson, Arizona.

Sustainable Pollination & Biocontrol Services with Bees ***P. Kevan***

Introduction: Pollination

Our research has focussed on pollination of crops (see below) and has promoted collaboration between scientists and crop production specialists at University of Guelph, Agriculture and AgriFood Canada, Ontario Ministry of Agriculture, Food, and Rural Affairs, University of Western Ontario, and many growers and grower associations. Beekeeper, grower, and ministry priorities addressed by this proposal include the need for enhanced support of research in pollination as noted in previous years by the Apiculture and Pollination subcommittee, and as generally noted by a number of other subcommittees concerned with such crops as orchard fruits, tender fruits, and seed production. The need for pollination research for various agricultural commodity groups tends to be ranked as a priority three or lower, resulting in the no one group having it as one of their highest priorities, but the across-agriculture need is well recognized. The need for research on bumble bee pollination in greenhouses is recognized by the industry. A major injection of funds for 1998 and 1999 came from the Ontario Research Enhancement Project (OREP) that, for the first time has allowed issues of modern pollination technology to be applied to problems facing agriculture in Ontario. In 1999 and 2000 grower funding was applied to a successful grant submitted to The Natural Sciences and Engineering Research Council and Agriculture and Agri-Food Canada. Thus, we have integrated our activities across production and food quality improvement. Industry support was given in-kind by grower generosity, and some financial support from the Ontario Beekeepers' Association, during this project. In 1999 and 2000, financial support has been given from the Canadian Honey Council, Ontario Apple Marketing Commission, Ontario Vegetable Growers' Marketing Board, Ontario Fruit and Vegetable Growers' Association, Ontario Beekeepers' Association, and private industry (Bick's Pickles, Enviroquest Ltd., Blaindale Farms, individual growers) to continue. The projects from 1998 to 2000 have rejuvenated interest and has rebuilt research into applied pollination biology in agriculture, an area which had been all but ignored in Ontario for several decades.

Pollination is a highly valuable eco-process for agriculture. For most crops, reliance has been placed with honeybees and honey beekeeping ,or on chance. The dollar value of honeybees to agriculture has been placed at about 10 fold that of hive products (ca.$ half a billion for Canada (CAPA 1995)). Use of honeybees realizes from $41 to $192 per $1 spent on pollination on some crops (CAPA 1995), and about 700% profit on money spent on pollinating apples in Ontario (Kevan 1997). In greenhouse tomato production, bumblebees are pollinators of choice. The value of greenhouse crops in Ontario rose to $112 M in 1996 and large markets are expanding in the NE USA. Given those figures, it is surprising that more effort is not placed into pollination technology, especially on crops which are poorly understood.

Reliance on honeybees will continue for most crops. However, given the reduced numbers of colonies and beekeepers (CAPA 1995), coupled with the increasing incidence of devastating mite diseases of honeybees, and the increased cost of maintaining healthy colonies with improved genetic stock and chemical controls of diseases and parasites, priority must be paid to using honeybees more effectively and diversifying the array of pollinating insects which can be used in agriculture (Agriculture Canada 1989). Nevertheless, the lessons from bumble bee culture confirm the potential for more imaginative and holistic approaches to crop pollination, as do older examples of alkali bee, alfalfa leafcutting bee, and orchard bee cultures.

Problems facing pollination of crops have been recognized in Canada and Ontario for many years. In 1989, the PI attended the Canadian National Workshop on Bee and Pollination Research (Ag. Canada, 1989) when future potential difficulties were discussed. Since that time most of the predictions for adversity in pollination have come true in the USA and are held at bay in Canada and Ontario only through vigilance in apiculture and agriculture. Eventually, the problems of tracheal mites and *Varroa* mites which have created havoc with crop pollination services and caused crop reductions in the USA will likely afflict Canada. However, excellent progress in honeybee breeding in Ontario provides some real hope that the same levels of severe honeybee losses as in the USA are not as serious in Canada. Nevertheless, it is widely recognized that alternative pollinators must be considered and wild pollinators protected and their habitats preserved or created in agricultural settings (Kevan 1991, 1994, 1995, 1999; Kevan et al. 1990; Buchmann & Nabhan 1996). Already the values of alternative pollinators has been proven for many years through the encouragement of alkali bees, culture of alfalfa leafcutting bees, and more recently through bumblebee culture for greenhouse crop pollination (Kevan et al. 1992), and orchard bees for orchard fruit pollination (Torchio 1987). Despite those proven successes, much needs to be done to remove pollination services of crops from dependence on single species (e.g. honeybees for many crops, alfalfa leafcutting bees for alfalfa, and *Bombus* in greenhouses, etc.) and to expand the diversity of crop pollinators.

The rationale and objectives of this program have been and continue to be to establish a basis for reliably sustainable pollination services to agriculture in Ontario. Existing technologies must be further refined to make better use of what we have (e.g. honeybees on various crops, including high density apple orchards and bumblebees in tomato greenhouses) and new potentials must be explored to encourage diversification of pollinators (e.g. blueberry bees, bumblebees for cranberries, blueberries, red clover seed, and squash bees for pumpkin and squash). Thus, the objectives of the research programme have been, and continue to be, to improve existing technologies and to explore potential diversification.

This project focussed on a few, model crops which bloom asynchronously but with various pollination requirements (to allow most efficient use of the season) in the following order:

- Greenhouse tomatoes and bumblebees,
- High density apple orchards and honeybees and later management of orchard and other wild bees,
- Highbush blueberries and encouragement of native bees,
- Red-clover seed production with bumblebees and honeybees,
- Field cucumbers and honeybee pollination,
- Studies on *Echinacea* as a pollen and nectar source for honeybees
- Squash and pumpkin and the biology and potential for management of it as a specialist pollinator hoary squash bee.

Another phase of the research accomplished over the last three years has been the use of botanical (essential oils) as potential medicaments for protecting honeybees from the ravages of mite diseases. Novel application of microencapsulation technology has resulted in two patents granted to a Canadian collaborating company (Enviroquest Ltd.) for administering orally medicaments to honeybees. Already, the technology using menthol is in the process of commercialization. Thus, this report includes advances in this area to date.

A novel use of pollinators was pioneered at the University of Guelph by Profs. John Sutton and Peter Kevan. That is the delivery on the bodies of pollinating bees (honeybees and bumblebees) of biocontrol agents that have the potential to suppress plant pathogens (such as gray mold and schlerotinia) and infect pest insects (such as tarnished plant bugs and weevils) to the flowers where the pest organisms initially affect the crop plant. Over the last two years, we have concentrated our efforts of tarnished plant bugs as a pest of canola.

Lygus bugs (tarnished plant bugs) have become a major pest affecting canola, especially in Alberta, Saskatchewan, and Manitoba. Major crop losses were experienced in 1998 and extensive pesticide spray programmes were initiated to bring about control. Although outbreaks in 1999 were not as severe, problems persisted in the Peace River area and it is anticipated that the problem will recur throughout the prairies during summers favourable to *Lygus* population growth (warm, dry, spring weather). A complication to pest management is the increasing presence of the eastern tarnished plant bug in the west, in conjunction with the western species. Biocontrol methodologies for *Lygus* have not been developed on canola so far. We propose to apply a novel biocontrol technology to the *Lygus* problem on canola.

With the recognition by international agencies that pollination services are in jeopardy in various parts of the world, special attention is being paid to ways to assess the extent of the problem from ecological and economic points of view. Peter Kevan has been involved such considerations in Ontario, Canada, North America, and the world over the past several years.

Bumble Bees and Greenhouse Tomato Pollination

The use of bumble bees to pollinate greenhouse crops has become increasingly common. Traditionally, pollination was accomplished through the use of hand held electronic vibrators. Because of expense, risk of damage to the flowers and developing fruit, and the time consuming nature of this method, there has been interest in developing alternative methods of pollination. The value of greenhouse tomato crops in southern Ontario was estimated at $78 million in 1996. Before 1992 virtually all greenhouse tomato crop pollination in Ontario was done by hand vibration. As of 1994, all commercial growers in southern Ontario began to use bumble bees as their sole means of pollination, creating a new multi-million dollar supply business.

Bumblebee keeping in greenhouses has encountered some problems because of the escape of the bees (value ca. $10 - $20 per bee!) through open vents in late winter and early spring. The bees freeze outside and so are lost (Khosla and Shipp pers. comm.). Determining the activity patterns of bumblebees under various conditions of temperature, humidity, and light in greenhouses made with different plastic coverings is important to understanding how to best manage pollination. New understandings in insect colour vision (Backhaus 1991) have suggested ways by which the visual target of the open vents (daylight with UV) versus the greenhouse roof and walls (attenuated UV) can be disguised by coloured transparent flaps or blocked by screening so that the bees are not attracted and can not escape. The former would be easier and cheaper. UV light encourages the germination of spores of grey mould (*Botrytis*), so UV opaque plastics are favoured. Thus, trials have been made to determine the minimum UV transmission to permit bumblebee activity in the greenhouse, with mechanisms to prevent their escape, while suppressing grey mould spore germination.

Although the use of bumble bees as greenhouse pollinators has spread rapidly, very little basic research has been conducted to answer many important questions. Some of the main problems encountered by growers have been bee loss through ventilation systems, and inadequate levels of pollination. It is suspected that varying levels of bee loss and activity between greenhouses may result from the kind of plastics used.

The objectives of our research have been to address how different greenhouse plastic types affect colony activity levels and resulting pollination levels, to determine the number of bumble bee visits required to produce the highest quality tomato, to assess daily activity patterns, and to quantify bee loss based on plastic type. This information will ultimately be used to create a standard bumble bee pollination methodology, based on individual greenhouse specifications, for greenhouse tomatoes which can be used by growers and bee suppliers as a procedural guide.

During the growing season of 1998 and 1999, we conducted research in commercial tomato greenhouses in Leamington, Ontario. The studies conducted have shown that greenhouses using one of the less common plastic types (CT plastic) experience less bee loss and greater bee activity than greenhouses with the other plastic types. Greater activity of bees correlated with higher levels of pollination per bee.

Ms. Morandin has since conducted laboratory studies to determine if tomato quality is affected by various levels of pollination. The goal of this experiment was to determine the optimal number of bee visits to a tomato flower, which will produce the highest quality tomato. Laboratory studies have also been done to look at bee activity under various commonly used greenhouse plastic types in a controlled setting. Additional field studies have been done in the Leamington greenhouses, including research on levels of bee loss and activity levels under different plastic types. In the future, it will be important to study additional greenhouses that use CT and other plastics. The information on activity levels, bee loss, pollination levels, and tomato quality are under analysis and the results will be used; 1. To make recommendations on the plastic types which are most conducive to bumble bees, and, 2. To determine the fewest number of colonies required to pollinate a certain area of greenhouse tomatoes based on the plastic type being used.

The results of the research conducted from 1998 through 1999 are being analysed and have been reported in the M. Sc. dissertation of Ms. L. Morandin, and several papers stemming from that work are now in press or have been submitted.

Honey bees and High Density Apple Orchard Pollination

Although much is known about apple pollination (Free 1996) and the values of honeybees and mason bees (Torchio 1987), little information is available on the size of the pollinator forces (Kevan et al. 1986) required to effect economically profitable levels of pollination, especially in modern orchards with high density plantings using dwarfing root-stocks. The tendency of honeybees to work the trees by row suggests that pollinizer plantings are different from those recommended in standard orchards, but detailed recommendations need further research. Additionally, the relative blossom density for different varieties of apples have not been examined and must influence what levels of pollinator populations are needed (Heimstra pers. comm.). The whole issue of the value of pollinators in apple orchards has been often misrepresented through the erroneous view that over-pollination is a major problem which results in the need for thinning. The value of orchard bees (*Osmia lignaria*) has been demonstrated in parts of the USA, but rigorous and scientific appraisals of these bees, and other wild pollinators in Ontario has not been undertaken.

Experiments from 1998 to 2000 used 7 apple varieties (Red Delicious, Empire, Mutsu, Jonagold, McIntosh, Fuji and Gala) in 4 orchards in Lambeth, Ontario. Bee behaviour affects fruit quality by amount and variety of pollen deposited on the stigmata. Experiments were conducted to determine how honey bees foraging behaviour (i.e. pollen deposition) is affected by floral morphology, distance from bee hives and bloom density. Field work resulted in > 1000 bee observations and over 3000 hand pollinations in each of years 1998 and 1999. The success of different varieties as pollenizers within apple orchards has been determined by genetic markers (electrophoresis), but the detailed analyses are still in progress. Results from 1999 and 2000 had to await fall when apples have matured. Thus, analyses are in progress and the first scientific papers have been submitted (Kron et al.).

Studies on honeybee movements in the orchards have shown some interesting trends. It seems that most bees do tend to restrict their movements to within rows, and on only a few trees in a row. On the trees, there appear to be bees that work the top, middle, or bottom of blooming apple trees, and others that are lest fastidious in their foraging activity. There are other bees that cross rows, but these are a small minority. They are impossible to follow for more than two rows. It seems that honey bee foraging is not affected by apple variety. However, bee activity is influenced by bloom density and distance from the hives. There is more activity on trees with high bloom density, but activity decreases with increasing distance from bee hives.

Combining the information on gene dispersal and bee movements, it appears that the latter is not a good indicator of the former. The genes move more than the bees. This finding is somewhat consistent with the idea that pollen transfer between bees back at the hive is important. However, if that were of tantamount importance, gene flow would be expected to be much greater that it seems to be. Detailed modelling of the movements of bees and genes must be undertaken to determine how the dynamics of the system are working to bring about apple pollination.

There was too little time and insufficient money to investigate the importance of native bees, especially orchard bees, for apple pollination in Ontario during the exceptionally short bloom periods of 1998, 1999, and 2000. We noted that some orchards had large numbers of native bees present during bloom, but that others did not. We intend to address the issues of native bees, their distribution, abundance, and nesting behaviours in the future..

Highbush Blueberry Pollination

Highbush blueberries are not well understood from the viewpoint of their breeding system (incompatibility is used to refer to inter-varietal and intra-varietal incompatibility, and to self-incompatibility proper) (Eck and Childers 1966). The varieties grown in Ontario are no exception. Further, the value of honeybees in pollination of highbush blueberries varies from low to nil with variety and floral structure. Populations of native pollinators, including bumblebees and solitary bees, for highbush blueberries is high on some farms and low on others. Thus, there is much to learn about what pollinates this crop, how reliably, the habitat requirements for the best pollinators, encouragement to nest in the vicinity of the fields, and so on. In various places, specialist pollinators have been advocated and encouraged for various blueberry crops (see Kevan et al. 1990), an approach which would serve well in Ontario.

Pollination success by pollinators of highbush blueberries varies from variety to variety. To begin addressing that issue, flowers from the 10 main varieties grown in Ontario were collected (Berkeley, BlueCrop, BlueJay, BlueRay, Duke, Elliot, Jersey, NorthBlue, NorthLand, and Patriot) to study their forms in regard to pollination. were gathered and their morphology measured. Highbush blueberry flowers are variable in the depths of their corollas and the width of the aperture. Thus, for some longer-tongued bees, especially bumblebees, are the effective pollinators more so than honeybees, with tongues only about 6 mm long, which can not obtain nectar from the flowers of some varieties. The floral samples have all been measured, but the data have yet to be analysed in detail.

Once fruit has matured, electrophoresis can be used to begin investigating aspects of the crop's breeding systems in those varieties. Because the early spring resulted in blueberries flowering at the same time as apples in both 1998 and 1999, only small collections of native pollinators were made. In the next year, 2000, efforts were concentrated on pollinators and how they forage. The results are awaiting analysis.

Pickling Cucumber Pollination

There are a number of problems related to pollination that affect pickling (field) cucumber production. Little research has been conducted in Ontario on managing pollination for field cucumbers. It has been found that inter-plant cross-pollination maximizes crop yields. It is understood from George Pape (Bick's Pickles) that various research projects are underway in the U.S. to address this problem and contacts with US resaerchers have been made Through isozyme analysis, the pollinizer (pollen-donor) variety's genes present in the seeds can be identified in crops. These techniques have been used to examine the movement of pollen in agricultural crops, such as apples (Husband and Kevan, 1999) and mangoes (Dag, 1999) and in 1999, we were able to identify genetic variability among several varieties of pickling cucmbers as provided by Bick's Pickles.

Issues associated with the increasing importance of machine harvesting pickling cucumbers include a narrower temporal window for flowering and pollination to make for greater uniformity of cucumber size at harvest time, and associated with that the constraints on the time and intesity of pollination.

Field sites near Simcoe, Ontario were selected in 1998, 1999, and 2000 to be used for pollination studies. Experiments on bee foraging behavior and pollination success with increasing distance away from bee hives have been made.

Honey bee pollination experiments were conducted on two (1998) three (1999) and four (2000) cucumber fields near Simcoe, Ontario in July of each year. Female cucumber flowers require up to 15 bee visitations to produce commercially acceptable cucumbers. In a series of experiments in 1998, 1999, and 2000 we found that bee foraging behavior decreased with increasing distance from bee hives through the day. Although bee activity was greatest within 75 meters from the hive, comparisons of fruit set and quality revealed no differences in plants located up to 250 meters away (the length of the fields) from hives. In 1999, the same patterns were not observed and the bees seemed to be dispersed more evenly across the fields. In 2000, our results were more similar to those of 1998 than of 1999.

These observations were constant within years for 4 different cucumber varieties (Fancy Pak, Fancy Pak - M, Vlasset and Score). Bee foraging activity was greatest between 12:30 and 1:00 in both years Observations of bee behavior with regards to choice of male or female flowers, amount of time spent on a flower, and direction of flight indicate that behavior remained relatively constant throughout the day. Statistical analysis of the results is being conducted. These experiments will allow cucumber growers to more effectively use honey bees for pollination of cucumber crops.

Cucurbit (Squash and Pumpkin) Pollination

Squash and pumpkin are pollinated in southern Ontario by a specialist bee, *Peponapis pruinosa*. This solitary bee nests in dense aggregations. The females emerge in summer co-incidentally as the crop blooms and they forage on the flowers, which last about half a day, early in the moming and well before honeybees have become active. These bees lend themselves to consideration as encouragable pollinators in the vicinity of pumpkin and squash growing operations (Willis and Kevan 1995). It should be possible to establish nesting beds, similar to those used for alkali bees, once more is known about the bees requirements for soil texture, moisture, pH, and so on (see Kevan et al. 1990). To this end, a survey of over farms throughout southem and central Ontario in 1998,1999, and 2000 showed that the bee is widespread throughout those parts of the province, but probably absent in the north. Morse (Cornell University, personal communication) has suggested that in New York State, this bee may be responsible for about 90% of squash and pumpkin pollination.

Field sites have been selected for studies on the nesting biology of these bees and once the pumpkins and squash began to flower, intensive surveys of the native squash bee and its nesting habitats were made. Basic information on bee requirements for soil texture, moisture, pH etc. are required to establish nesting beds. We have determined that the uppermost cells that these bees make in the soil are about 8 to 12 cm down. Thus, shallow chisel ploughing of fields in which these bees are to be encouraged should be minimally damaging to them.

Bumblebees, Red-Clover and other Crops

Bumblebee biology in Canada is well developed, but populations of bumblebees on crops well serviced by them (e.g. cranberry (Kevan et al. 1984, Mohr and Kevan 1988), red clover (Free 1996), blueberries (Mohr and Kevan 1988; Usui and Kevan in prep.) fluctuate from year to year. The reasons for that are not understood, but numbers of nesting sites and cold and rainy spring weather are thought to be important limiting factors. Bumblebees can easily be induced to occupy artificial domiciles which, if placed in the field and equipped with feeding mechanisms, could provide easily managed domiciles to be occupied by a reliably high population of bumblebees. We have developed a design for protective domiciles and this is awaiting implementation in 2001.

The research conducted in 1999 was on a red clover seed production field near Caledonia, Ontario. The experiment included ten colonies of bumblebees, ten colonies of honeybees, experimental plots of red clover in which the numbers of flowers were counted and from which seeds have been harvested. These plots were also monitored for pollinator activity over the blooming period. The data from the project have been analysed, and it appears that the supplemental pollination by bumblebees and by honeybees had a beneficial effect on seed yields in the experimentally monitored plots within the field.

Honeybees and Echinacea

There is little information on the value of *Echinacea* to beekeeping, nor on the importance of honeybees for pollination in obtaining *Echinacea* seeds. Experiments were set up near Simcoe, Ontario in 1999 to determine if *Echinacea* is a good nectar and pollen source for honeybees. We determined that it is both. Seed heads from the experimental plants have been examined and the seed production assessed from flowering heads that were bagged versus those open to pollination. *Echinacea* appears to be self-pollinating and self-fertile. Pollen and honey-crop contents from honeybees foraging on *Echinacea* have been collected for more detailed analysis for potential herbal value. The samples are presently being analysed.

Essential Oils for Mite Control In Honeybee Colonies - Review in Brief

Essential oils are secondary plant compounds that are used for the natural protection of these plants from pests and pathogens. This protection is provided through anti-feedant and toxic properties. Several research reports show that essential oils have antimicrobial, fungitoxic, insecticidal and miticidal effects on various pathogens and pests under laboratory and field conditions.

In honeybees essential oils have been used for treating disorders, including parasitic mite infections and American Foulbrood. Laboratory and field tests have shown that they are 50% to 95% effective against *Varroa* mites and tracheal mites. They also show minimal contamination of wax and honey in field trials. They are usually used in bee hives as fumigants, or mixed with sugar syrup for ingestion by bees. The most common formulation used against tracheal mites is menthol crystals (50g/hive). Microencapsulated menthol is a new formulation, which can be added to honey bee feed. It showed promising results for protecting bees from tracheal mites. For *Varroa* control, the most commonly used essential oils are thymol, eucalyptus, and wintergreen. These oils are applied singly or as a mixture of different compounds to improve efficacy. Applied as fumigants, the effectiveness of thymol and other essential oils against *Varroa* mites depends greatly on temperature, time of the year, colony strength, and brood area. Because of the inconsistency and unreliability of essential oils for mite control, they cannot be used alone. However, their use does fit well into Integrated Pest Management (IPM) programs for alternating use with other control measures. New efficient methods for applying these oils and finding the right time of the year for application to bee colonies are required to produce reliable effective control of mites.

In this review, over 40 published scientific papers were examined. The complete review was published in *HiveLights* in a beekeeper friendly format for publication. This is especially important because of the recent body of information published since the review was completed.

Our research on the toxicity of various ingested botanicals to honeybees has been presented previously, as well (CAPA 2000). It is repeated here for the sake of completeness.

Essential Oils and their Toxicity to Honeybees - Research Results 1999

The following oils were hand fed to honey bees to determine their toxicity to honeybees: pinene, oil of wintergreen, thymol, clove oil, cinnamon oil and Neem oil. Neem oil underwent preliminary testing but more work needs to be done, and was planned, with this material.

Results

Control cages that were fed sugar syrup had an average of 2 dead bees over 72 hours. Bees fed the ethyl alcohol sandwich without any oils had an average of 3.5 dead bees over 72 hours. Thus, the physical effects of force feeding were minimal and the ethyl alcohol we used had little toxicity for the bees.

The following is a list of the approximate LD_{50}'s for each of the oils tested together with menthol from a previous experiment.

Menthol - unable to cause mortality with highest doses administerable (see Kevan et al.1999, Canadian Entomologist)

- Cinnamon - 150 ppm
- Clove oil - 200 ppm
- Pinene - 1500 ppm
- Thymol - 100 ppm
- Oil of wintergreen - 500 ppm.
- Neem oil - from 100 ppm to 1000 ppm (bees did not take well to being fed neem oil)

Conclusions

Establishing the toxicity of these potentially useful botanicals is an important step to understanding dosage response, and the risks of administering these materials orally to bees for their protection against mites. Although a given compound may be efficacious against mites, if its toxicity to bees is high then there is great risk in using it. Materials such as thymol may continue to be useful as fumigants and in topical application, but would have to be used with care as an oral medicament. Pinene, on the other hand, may be valuable in killing mites on and in the bodies of honeybees by its relatively low toxicity to bees when they ingest it. In Phase I of this research we were unable to proceed with toxicity trials against mites and microencapsulation because matching funds have not been granted. In Phase II of this research we expected continue our work on the toxicity of the botanicals to mites and investigate the potential for microencapsulated formulations being used as medicaments, but funding was not available.

Funding from Canadian Honey Council allowed us to initiate this work in 1999, but those funds were deemed inelligible for the NSERC-AAFC proposal (1999 - 2001). Thus, the projected amount of work valued at over $24,000 per year could not be completed. The project was terminated when further funding from CHC was not forthcoming either. We understand the disappointment of CAPA and CHC in our inability to complete the work proposed, but point out in the strongest manner that the work that was completed (major literature review and ingested toxicity studies on six essential oils) more than matched the amount of CHC funding ($8,000) made available. Another review of the subject is in preparation.

Biocontrol of Lygus Infestations by entomomopathogenic fungi delivered by Pollinators to Canola
Lygus species are susceptible to various entomopathogens, including the fungus *Beauveria bassiana* (Bidochka et al. 1993; J. econ. Ent. 115: 313-317). Formulations (e.g. Mycotrol WP, Naturalis RL) of this fungus have been tried against tarnished plant bugs on cotton in the southern USA with some success, especially if combined with chemical insecticides (Steinkraus & Tugwell 1997; J. ent. Sci 32:79-90). Steinkraus & Tugwell were able to show field persistence of conidia of *Beauveria* on cotton for up to 4 days and continued infection of Lygus. Other fungal entomopathogens may also hold potential for use, e.g. *Metarhizium*. That *Beauveria* can be produced in commercially available amounts for agriculture and shows efficacy in killing Lygus suggests that a novel means of vectoring the fungus directly to the flowers of canola, and other crops, where Lygus are known to feed could be useful. *Lygus lineolaris* is easily reared in the laboratory and a culture suitable to our needs is available at the AAFC laboratory in London, Ontario (Broadbent).

At the University of Guelph, a novel technology for the delivery of microbial biocontrol agents against plant pathogens been developed. It uses a special dispenser attached to hives of honeybees so that the honeybees, when exiting the hive, pick up a body dose of the agent which they then disperse to flowers. The first trials with *Gleocladium* against grey mould on strawberries, and then raspberries, showed control equivalent to that obtained by the recommended applications of the fungicide, Captan (Peng, Sutton and Kevan 1992; Can. J. Plant Path. 14: 117-129). Potential biocontrol agents against sclerotinia on canola have also been successfully disseminated to canola flowers under experimental situations at the University of Guelph (Boland unpublished).The technology has been used in experimental situations in the Carolinas on soft fruit, and in the Northwest states on orchard trees against fire blight (Johnson et al. 1993; Phytopathology 83: 478-484: Thompson et al. 1992; Plant Disease 76:1052-1056). More recently, however, the same technological principle has been used to disseminate biocontrol agents against insect pests on crops. Gross et al. (1994; Environ. Ent. 23: 492-501) developed a honeybee hive dispenser that delivered nuclear polyhedrosis virus infections to caterpillars on field crops. More recently, Butt and co-workers (1998 Biocontrol Science & Technol. 8: 533-538) at Rothamsted, England have sucessfully delivered fungal biocontrol agents (*Metarhizium*) against pollen beetles on canola using honeybees as the vetors.

Neither *Beauveria* nor *Metarhizum* seem to be detrimental to honeybees (Butt et al. op cit. and other references). Our results on *Beauveria* from 1999 confirm those findings.

Canola benefits from insect pollination. Depending on species, variety, and breeding system (incompatibility), canola requires insect pollination to greater or lesser extents for seed-set (Free 1993; Insect Pollination of Crop Plants) and for seed quality (Kevan and Eisikowitch 1990; Euphytica 45: 39-41). Hybrid seed production fields require pollinators, and hybrid varieties grown for oil variously depend on insects for pollination. The preferred pollinators are honeybees and leafcutting bees (*Megachile rotundata*). The former is well proven as a vector of biocontrol agents (above), but the latter needs more study with respect to this potential. The technology we propose to investigate and develop should bring about the benefit of more and better pollination on canola fields while effecting control of the pest.

Thus, we are confident that we have a bio-delivery system for microbial/fungal biocontrol agents against a serious pest, the tamished plant bug. We have potential biocontrol agents in commercial formulations and strains that can be obtained from nature in Canada (e.g. *Beauveria*). We know that the bio-delivery system works on canola from studies on *Sclerotinia* biocontrol agents delivered to the anthoplane (flower surfaces) by honeybees (Boland et al.. unpublished, University of Guelph). Recent research in U.K. has also confirmed this and developments are in progress to use the technology for control of pollen beetle pests on oilseed rape (canola) (Butt et al. 1998 op. cit.; Williams personal communication). We propose to test the bio-delivery system on canola, using potentially efficacious biocontrol agents, notably fungi, against tarnished plant bugs. The additional benefit of increased pollination will also eventuate from the project

The results to date have been highly encouraging. In 1998 we asked for only one year of funding because of various uncertainties intrinsic to this novel approach to biocontrol of *Lygus* bugs on canola. We were concerned that the entomopathogenic fungi might prove to fatal to the proposed vectors, honey bees. We were also concerned that honey bees might, in tum, diminish thè germinability of the spores. In the 1999 season in the laboratory we determined that honey bees are capable of vectoring tens of millions of spores of entomopathogenic fungi, especially *Beauveria,* we have used We have determined that various inert additives (e.g. talc, corn starch, corn meal, rice flour, potato strach, and kaolin) can be to improve the efficiency of spore delivery. We have no indication that the germinability of the spores is adversely affected by contact with honey bees, and there is no evidence that honey bees dusted with spores suffer any mortality. Temperature studies in brood chamber of the honey bee colonies indicate that it is too hot there for larvae and pupae to become infected because the spores would be killed. A dispenser for formulations of spores of entomopathogenic fungi and additives has been designed and prototypes will be constructed in winter 1999 - 2000 preparatory to the field season 2000. Research at the laboratory in London, Ontario has demonstrated the efficacy of *Beauvaria* in killing *Lygus.* At AAFC, London [SCPFRC] Dr. Broadbent completed 10 successful experiments of *Beauveria* vs. *Lygus* [second instar nymphs and adults] in lab studies. High mortality of *Lygus* has been observed using an airbrush sprayer which delivered 1-6 x 10superscript7 spores/ml *Beauveria* [from naturally occuring strain grown on PDA] in 0.03% Tween 20 on to *Lygus* cuticle. [A typical field rate of *Beauveria* in a vegetable crop would be around 2.5×10^{13} spores/ha in 30 US gals/acre which is equivalent to 9×10^{7} spores/ml]. So we are working with a typical field rate. We have consistently seen higher mortality of adults than nymphs. Typically first mortality of *Lygus* is observed at 4 days after treatment and accumulative mortality reaches 80-90% by day 8 after treatment at concentrations in the region of millions of spores per ml (such as are delivered by honeybees).

Pollinator Declines, Ecology, Sustainable Productivity, and Economics
Research on pollinator declines started in Canada in the late 1940s with the realization that crop yields were not meeting potential because of pollinator shortages. The earliest work was on alfalfa and the changing face of agriculture on the prairies. Subsequent research focussed on pesticide poisonings, primarily of honeybees. In the early 1970s problems surfaced in New Brunswick on blueberry lands on which native pollinators were severely and adversely affected by Fenitrothion. Since then, interest in protecting pollinators has been a central theme in the anthecology laboratory at the University of Guelph.

With the launching of the Forgotten Pollinators Campaign at the Desert Museum, Tucson, AZ and the publication of Buchmann and Nabhan's highly influential book, The Forgotten Pollinators, there has been a major world interest in pollinator conservation and sustainablity of agricultural and natural productivity through healthy pollinator assemblages. Kevan has been involved in recent initiatives (The Forgotten Pollinators Campaign, The North American Pollinator Protection Campaign, The Convention on Biodiversity's workshops and publications in Brazil and elsewhere, The Food and Agriculture Organization's initiatives in protection of beneficial insects (INTID) (Chair of workshop, Rome, December 1999) and its pollinators in agroecosystems initiative (Rome, November 2000), meetings and symposia in USA (Tucson, AZ; Logan, UT; Las Vegas, NV; Burlington, VT; Washington, DC; Santa Barbara, CA; Edmonton, AB (Session organizer); Quebec City (Session organizer); Montreal (Session organizer); Chiang Mai, Thailand (Chair of Session); Sao Paulo, Brazil; Riberao Preto, Brazil; and others). Kevan has edited one book, with another in the works, that stem from these activities. His publications in the area are exemplified by his paper (1999) *"Pollinators as bioindicators of the state of the environment; species, activity and diversity"*, which makes reference to many other works. More recently, he has teamed up with Prof. Truman Phillips to explore the ramifications of pollinator declines in agricultural economics. Their paper (in press in *Conservation Ecology*) points out that pollinator shortages have been an agricultural problem for thousands of years, and that although some areas of the modern economy may profit from pollinator shortages, others suffer, and the consumer always loses.

Anticipated Benefits for Agriculture
The anticipated benefits of the research programme described above to industry are tremendous. The profit levels already enjoyed by growers employing managed pollinators in apple orchards (Kevan 1997), other crops (CAPA 1995, 1999), and greenhouse tomatoes in Ontario are already high. With greater reliability of pollination, harvests can be more readily predicted, the crops will be of higher quality, farm gate profits will be higher, competitive ability against imports enhanced, and planning for the future less uncertain. Additional means of protecting honeybee colonies are now more important than ever with recorded incidence of pesiticide resistant mites and other diseases in Europe and USA. The novel technology of delivery of biocontrol agents by pollinators has the double benefit of enhanced crop pollination and crop protection.

Specifically, the programme will provide the following benefits:
1. to the plastic industry, guides for manufacture of new formulation(s) of plastic film which will allow bumble bee foraging in greenhouses while suppressing grey mould spore germination.
2. allow the greenhouse industry to continue using bumble bee pollination in winter and early spring for tomatoes, green and bell peppers, etc.
3. allow the Ontario greenhouse industry to expand its market competitively into the NE USA with high quality, pesticide free produce.

4. allow the modern apple and orchard industry to more effectively use pollination services provided by beekeepers, and to diversify the pollinator community to increase assurance of greater and higher quality crops.
5. allow the beekeeping industry to diversify its financial basis through provision of pollination services to modern, high density, orchards and to diversify its bee husbandry through diversification into managed orchard bees (managed similarly to alfalfa leafcutting bees).
6. allow the small fruit industry (as exemplified by highbush blueberries) to be more assured of effective pollination as a first biological step to crop production by encouraging assemblages of native (including bumble) bees
7. allow the squash and pumpkin growers greater assurances effective pollination by encouraging and providing nesting beds for the specialized pollinating squash bees.
8. allow greater assurance of pollination of certain crops, cranberries, blueberries, and especially red clover by providing protected and manageable domiciles for bumble bee pollinators on the production fields themselves.
9. provide the apicultural industry with a greater diversity of tools to protect its micro-livestock in the forthcoming period as Integrated Pest Management becomes more and more part of managing honeybees for hive products and for pollination.

provide protection and pollination for canola, especially in high-value hybrid seed production fields, and an additional opportunity for the beekeeping industry.

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BYLAWS

CANADIAN ASSOCIATION OF PROFESSIONAL APICULTURISTS
L'ASSOCIATION CANADIENNE DE PROFESSIONELS DE L'APICULTURE

BYLAWS

Objectives of the Association

1. To promote, develop and maintain good fellowship and cooperation among professional apiculturists.
2. To create a meeting of administrative and research apiculturists for the purpose of discussing common interests and effectively coordinating, where possible, their respective apicultural activities.
3. To aid in the dissemination of information regarding the beekeeping industry.
4. To maintain a consultative rapport with the Canadian Honey Council.
5. To maintain a rapport with professional apiculturists in other countries.

ARTICLE I - <u>Membership</u>

I (1): Full membership, with voting privileges is open to personnel employed by Canadian Federal and Provincial governments, universities or colleges who are in employed in the field of apiculture as:

- federal apiculturist
- provincial apiculturist
- full-time extension apiculturist
- full-time teaching and/or research apiculturist
- full-time apiary inspectors
- full-time apicultural technicians,

and, that the term "full-time" signifies a permanent position.

I(2): Non-voting, associate membership in the association may, upon receipt of an application, beg granted to persons who are:

- Part or full-time graduate students involved in apicultural projects
- Part-time technicians associated with apicultural personnel or apicultural projects
- Part-time disease inspection staff
- Representatives of appropriate Agriculture Canada branches
- The representative of the Canadian Honey Council
- Members of the American Association of Professional Apiculturists
- Members of the Apiary Inspectors of America.

I(3): Membership or associate membership may be extended to persons other than those defined in Clauses I and II upon ratification by a majority of the membership.

I(4): The priveleges of membership in the Association shall terminate when a current member resigns or retires from the position which established his/her eligibility.

I(5): Membership fees shall be prescribed by the members in general meeting.

I(6): Every member shall receive a copy of the bylaws annually.

I(7): Priveleges of membership shall be restricted to those holding current membership.

I(8): The decision to grant life memberships, honorary memberships, and awards of merit shall be made by a 75% majority of the members at the general meeting.

ARTICLE II - <u>General Meeting</u>

II(1): The annual meeting shall be held at a time and place designated by the executive.

II(2): The secretary shall send all members a notice of a general meeting sixty (60) days in advance of the date of such a meeting unless a majority of the members waive the sixty day requirement.

II(3): A quorum of a duly called general meeting shall be six (6) members.

II(4): Attendance at the Association's meeting shall be limited to members and guests invited by the executive.

II(5): Minutes of the general meeting shall, when printed, be of a confidential nature and permission to use the information presented must be obtained from the executive.

ARTICLE III - <u>Finances</u>

III(1): The fiscal year of the Association shall be from January 01 to December 31 of the calendar year.

III(2): All monies and securities held by the Association shall be in the name of the Canadian Association of Professional Apiculturists.

III(3): All money transactions made by the Association shall be made by cheque signed by the secretary-treasurer and the president.

ARTICLE IV - Officers of the Association

IV(1): The members shall, at the general meeting, elect a president, vice-president and secretary- treasurer and the executive may appoint such other officers and committee members as may be required.

IV(2): All officers shall be elected for a two year term of office.

IV(3): The president shall preside over all meetings of the Association and shall be ex-officio, a member of all committees.

IV(4): The vice-president shall perform the duties of the president in his/her absence or inability to act.

IV(5): The secretary-treasurer shall:

1. Record the minutes of all meetings of the Association and distribute copies of these minutes to the membership sometime during the sixty (60) days following a meeting, and,
2. Send information and notices of motions and meetings etc. to the membership as required, and,
3. Collect the annual fees from each member and maintain an up-to-date membership list, and,
4. Look after all financial matters of the Association and maintain accurate records relating to same.

ARTICLE V - Amendments of Bylaws

V(1): Bylaws may be amended only by a recognized quorum at a general meeting and all members must be notified by the secretary-treasurer of any proposed changes in the thirty (30) days in advance of the meeting date.

The foregoing are the Bylaws of the Canadian Association of Professional Apiculturists as amended at the annual meeting held in Victoria, British Columbia, November 19th, 20th, and 21st, 1977.

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2001 CAPA EXECUTIVE & COMMITTEES

Executive		Cynthia Scott-Dupree	President
		Rob Currie	Vice-Pres.
		Rheal Lafreniere	Secretary/Treas
Standing Committees	**Chemical**	John Gruszka	Chair
		Doug McRory	
		Medhat Nasr	
		Rheal Lafreniere	
		Steve Pernal	
	Importation	Doug McRory	Chair
		Gard Otis	
		John Gruszka	
		Kenn Tuckey	
		John Gates	
	Research	Rob Currie	Chair
		Don Nelson	
		Kenna MacKenzie	
		Medhat Nasr	
	Awards	John Gates	Chair
		Don Dixon	
		Paul van Westendorp	
	CBRF Directors	Rob Currie	
		Mark Winston	
Ad-Hoc Committees	**Publications**	Cynthia Scott-Dupree	Chair
		Don Dixon	
		Paul Kelly	
	Archives	Don Nelson	Chair
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Hello CAPA members,

According to my records, which is basically the list from the 2001 proceedings and any additional new members that joined after the 2001 meetings in New Brunswick, the following is a list of members and their contact information. If you see any errors or omissions in the contacts info, please let me know ASAP. I will also send this message via the CAPA membership list under the subject heading " List of CAPA members and associate members via CAPA membership listing, therefore if you only receive one copy of this message, please notify me and we will make the necessary changes to either list. Thank you for your cooperation.

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