Canadian Association of Professional Apiculturists

Canadian Honey Council

8th National Apiculture Research-Planning Workshop

Langley, British Columbia
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Editor: P. van Westendorp

Contents

1.0 INTRODUCTION

The Canadian Association of Professional Apiculturists and the Canadian Honey Council held an Apiculture Research Planning Workshop on the 26th of January in Langley, British Columbia. The purpose of the research workshop was to assess the current status of the industry and its research infrastructure, to review the objectives of past workshops, to assess the progress that has been made in reaching those objectives and finally, to establish research priorities and recommendations for the next five years.

Many individuals contributed information to the reports presented at this meeting and their involvement helped to make the workshop a success. Summaries of their reports are contained within section 2 of the proceedings. Participants included representatives of industry, extension and research personnel from across Canada. Research priorities that were established during the workshop and the "Emerging Issues and Recommendations" relating to research personnel and funding are highlighted in section 3. Section 4 lists the participants.

The workshop discussions made it evident that the Canadian beekeeping industry will continue to face many challenges in the coming years that need to be addressed through further research. In order to assist in solving these problems, there is an urgent need to strengthen the existing research and extension community. Research priorities and recommendations proposed at this workshop provide a strategic plan to guide the industry in meeting its goals over the next five years.

Paul van Westendorp
Research Committee Chair
Canadian Association of Professional Apiculturists

2.0 REPORTS

2.1 Review Of The Canadian Beekeeping Industry 2001 – 2006 (F. Makki)

Summary
The following summarizes some of the most important issues and events faced by the Canadian honey industry during the period 2001-2006:

- In March 2002, chloramphenicol was detected in imported Chinese honey, which led to a Canadian Food Inspection Agency (CFIA) recall of all products containing Chinese honey. As a result, Argentina became the single largest source of honey imports for that year, exceeding China for the first time.

- In May 2004, the CFIA lifted the ban on the importation of honeybee queens from the continental U.S. which allowed beekeepers in Alberta to import some 10,000 queens from the U.S. in the spring of that year.

- In 2005-2006 lower wholesale honey prices adversely affected the market. In a matter of months, wholesale prices fell from around $1.60 per pound to less than $1 per pound, mainly as a result of a massive influx of low-priced Chinese honey on world markets and particularly on the US market, which accounts for about 85% of our export market.

- The abrupt collapse in wholesale prices led a number of beekeepers associations in Manitoba, Alberta and Saskatchewan to request a “stay of default” under the Advance Payments Program two years in a row, as they were unable to repay their loans during the 2004-2005 and 2005-2006 crop years.

- After a year of fund raising for the registration of oxalic acid, the Canadian Honey council (CHC) submitted an application for registration to the PMRA on January 10, 2005. On October 03, 2005 the PMRA announced that oxalic acid has been approved for the treatment of varroa mites on honeybees.

- Upon industry requests and active lobbying from the CHC, the CFIA recently proposed amendments to the *Honey Regulations* with new requirements for using Canada grade names for honey and minor modifications to the country of origin labeling requirement based on input from industry stakeholders and the results of focus groups conducted in June 2006.

Canadian Honey Bee Population
The Canadian honey bee population peaked at about 700,000 hives in the mid-eighties and dropped to around 500,000 hives in the early nineties. However, in the past decade the number of hives has slowly risen to reach just over 600,000 in 2001. Preliminary estimates indicate that the number of hives was 631,252 in 2006, representing a 2.6% increase from 2005 and a 6.4% increase compared to the 5-year average.

The number of Canadian beekeepers appears to be stabilizing around 8,000 after a continuous downward trend over the last 10 years. This clearly indicates that while there are fewer beekeepers, the average number of hives per beekeeper is on the increase. For 2006, it is estimated that on average there were 79 colonies per beekeeper, up from 65 in 2000. Alberta had the highest average in 2006 with 345 hives per beekeeper, while BC had the lowest average with 24 hives per beekeeper.

Canadian Honey Yields and Prices
The estimated average yield for 2006 was 156 pounds per colony, up 21% from the previous year, and was the second highest yield in the last 10 years. The average yield for the preceding 5-year period was 132 pounds per pound.

The value of the Canadian honey crop reached an all-time high of $161 million in 2002, thanks to a combination of an above average production and almost record-high average wholesale prices of $1.97 per pound in 2002. Average prices peaked in 2003 when they reached $ 2.04 per pound and fell to $1.60/lb in 2004 and around $0.80 in 2005. Lower wholesale prices for honey in 2005 adversely affected the market pushing many beekeepers to rent their hives for pollination purposes rather than to extract the honey. This downward trend in prices was caused by a massive influx of low-priced Chinese honey on world markets and particularly in the US market, which absorbs about 85% of our honey exports. The availability of large amounts of low-priced Chinese and Argentinean honey on the world market in 2005 led most North American honey packers to source an ever-increasing portion of their needs from offshore, particularly China, resulting in an unprecedented build-up of Canadian honey inventory levels. This factor along with a worldwide decrease in honey consumption triggered a rapid decline in honey prices in Canada, as well as in our traditional markets, namely the United States and Europe.

Canadian Honey Imports and Exports

Canada is a net exporter of honey. Canadian honey exports peaked in 2002 when they reached almost 22 million kg with a value of almost $88 million, but have since fallen to around 12 million kg while the value has dropped to around $30 million due to much lower prices on the world market. Imports of honey into Canada peaked at 13.4 million kg in 1996, then leveled off to about 2-3 million kg until 2000 and have been growing steadily since then reaching 8.9 million kg in the calendar year 2004. Total Canadian honey imports for the calendar year 2005 were 8.2 million kg, up 4.5% compared to the 5-year average.

Argentina captured 38% of the Canadian import market for honey, while imports from China represented 30% and Australian honey captured 19% of that market in 2005. Although China and Argentina together account for 70-80% of our imports in the last few years, it appears that since 2002, following the CFIA recall of Chinese honey related to chloramphenicol residues, Argentina has taken the lead from China.

Outlook for the Canadian Honey Industry

According to preliminary estimates Canada's 2006 honey crop is around 44.6 million kg, which is 26% higher than the 5-year average and the second largest crop in the last 10 years. Prices offered to Canadian beekeepers for raw honey appear to be rising, although this recovery, spurred by the latest developments on the world honey market, is relatively slow.

Honey imports from low-cost producing countries such as China and Argentina which have been a source of concern over the last few years, do not seem to be causing as much downward pressure on prices as last year as the quantities imported from those countries have significantly dropped. This is probably due to a combination of factors including a short honey crop and increased domestic consumption in China, a delay in the 2006 crop in Argentina and pre-selling of the crop in the fall of 2005 and a recent (March 2006) ban on imports of Brazilian honey in the European Union, eliminating 35-50 million pounds of honey from EU import requirements.

In 2006, the New Shipper legislation passed both the House and the Senate in the US closing once and for all the loophole for exporting duty-free honey from China to the US. Passage of this bill has already raised raw honey prices in the US and this trend should continue as long as demand for honey exceeds supply.

2.2 Review of Previous Apiculture Research Workshops

Since 1970 there have been seven Apiculture Research Workshops. The Canadian Food Inspection Agency (formerly Agriculture Canada) and the Canadian Association of Professional Apiculturists (CAPA) jointly sponsored five workshops from 1970 until 1989, while the 1996 workshop was conducted by CAPA. The first Apiculture Research Workshop in Canada was organized by the Dominion Apiarist and held in Banff, Alberta in 1951.

- 2001 - Moncton, New Brunswick
- 1996 - Ottawa, Ontario
- 1989 - Winnipeg, Manitoba
- 1986 - Charlottetown, Prince Edward Island
- 1981 - Toronto, Ontario
- 1977 - Victoria, British Columbia
- 1970 - Ottawa, Ontario

Until the mid-1980s, apiculture research priorities in Canada were focused on wintering and production management. After the introduction of tracheal mites in 1984 and Varroa mites in 1987 in North America, research was focused on disease control. To lower the dependency on honeybee imports, emphasis was also placed at self sufficiency, queen breeding and stock selection for disease and pest resistance. Concerns about potential declines in honeybee populations also demanded research on alternative pollinators and crop pollination.

In 2001, the Canadian Honey Council (CHC) and CAPA ranked research priorities within two major categories, General Apicultural Research and Pollination Research. Continuing industry problems with parasitic mites, despite the availability of registered control products, directed General Apicultural Research towards developing more efficient methods of using "current tools", developing and testing new control methods, preventing mite resistance, bee breeding, studying mite population dynamics and studying disease-pest interactions.

Pollination Research priorities were identified and included;
- Impacts of pesticides on honey bees and hive products,
- Increasing efficiency of honey bees for crop pollination,
- Quantifying the economic contribution of honey bee pollination to the agricultural sector,
- Developing economic thresholds for specific crops, and
- Studying native pollinators.

2.3 Summary of Research Priorities of Previous Workshops

Workshop	Research Priorities	Details
2001, Moncton, NB	A. Apiculture - Diseases, parasites, pests	▪ Improved mite control use ▪ Alternative mite control under Canadian conditions
	- Queen breeding/Stock selection	▪ Selection for mite resistance

1996, Ottawa, ON	A. Apiculture - Diseases, parasites, pests - Stock selection and breeding - Colony management - Impacts of chemical controls	 ▪ Pest/disease interactions, economic impact and control ▪ Improved use of current mite controls ▪ Alternative mite controls ▪ Pheromone-based controls ▪ HBTM build-up, spread / impact ▪ Selection for mite resistance ▪ Mating control ▪ Pheromone-based swarm control
	B. Pollination - Pesticide pollinator interactions - Pollination / plant studies - Native pollinators	▪ Pesticide impact on colonies / potential hive product contamination ▪ Less hazardous agricultural pesticides ▪ Improving honey bee pollination management ▪ Pheremones to enhance pollination ▪ Value of pollinators and crop pollination thresholds ▪ Relative value of honey bees and native pollinators. ▪ Biology, habitat & conservation
1989, Winnipeg, MB	A. Apiculture - Mites - Residues in hive products - Value of bees for pollination - Management of self-sufficiency - Pollination requirements of crops - Chemical and Non-chemical control of diseases	 ▪ Detection (HBTM) ▪ Production/maintenance of mite-free stock (HBTM) ▪ Control products (both mites) ▪ Economic impacts (both mites) ▪ Cultural controls ▪ Integrated pest management

	B. Leafcutter Bees - Pathogens – prevention/control - Parasites and predators – biology and control - Causes of mortality in immature bees - Use of leafcutter bees in other crops - Management studies - Leafcutter bee stock selection	▪ Equipment evaluations ▪ Optimum densities of bees ▪ Sex ratios ▪ Combining honey bees and leafcutter bees
	C.Commodity Specific Pollination - Tree fruits - Field crops - Small fruits - Greenhouse crops - Special crops - Pollination for sustainable agriculture	▪ Oil seeds ▪ Forage legumes
1986 Charlottetown, PEI	A. Apiculture - Diseases and pests - Bee supply - Colony management - Stock Improvement - Pesticide-pollinator interactions - Bee botany	
	B. Industry Related Research - Marketing related research - Human health - Financial management	
1981, Toronto, ON	A. Production - Stock selection and breeding - Diseases and pests - Improved colony management	
	B. Regulations - Chemicals - Evaluation of pesticides	
	C. Utilization	
	D. Marketing	

	E. Education	
1977, Victoria, BC	A. Production - Stock selection and breeding - diseases and pests - Improved colony management	
	B. Utilization - Nectar production and pollination of specific crops - New nectar and pollen sources	
	C Regulations - Chemicals - Evaluation of pesticides	
	D. Marketing	
	E. Education	
1970, Ottawa, ON	A. Marketing and Products Res.	
	B. Management for Honey and Pollen Production	
	C. Wintering	
	D. Pollination	
	E. Honey Producing Plants	
	F. Bee Disease	
1951, Banff, AB (C.A. Jamieson, Dominion Apiarist)	A. Queen breeding	▪ Progeny testing of improved strains by longevity, flight activity and honey production. ▪ Artificial insemination for development of hybrid lines.
	B. Bee Diseases	▪ AFB; control studies with antibiotics and drugs, spore survival tests in soil, disinfectants with lye, fumigation tests with caboxide, irradiation of spore material in scale, wax, capped cells and honey. ▪ Sacbrood, effectiveness of various antibiotics and drugs.

	C. Pollination - Legumes	▪ Survey of pollinating insects on cherries and pears in Niagara District ▪ Honey bee population densities for maximum seed set ▪ Efficiency of honeybees vs native pollinators for cross pollination ▪ Weather, soil conditions and inter-actions regarding honeybee floral visitation ▪ Effect of injurious insects of seed set ▪ Toxicity of insecticides to honey bees, nectar concentration and volume as a factor in seed set ▪ Different color marking agents for identification of honey bees in field ▪ Effect of soil, liming, cutting, etc. on growth & nectar secretion of sweet clover.
	D. Management - Wintering - Production	▪ Efficacy testing of insulating materials for wintering bees ▪ Effect of heating on wintering and spring colony development. ▪ Division of colonies for increased production.
	E. Honey - Processing	▪ Factors affecting honey crystallization to improve processing of liquid honey ▪ Factors affecting stability of re-crystallized honey.
	F. Research Recommendations - Processing - Diseases and Controls	▪ Development of heating/cooling equipment for pasteurizing honey ▪ Study of honey fermentation to develop honey wine. ▪ EFB control and studies to determine causal agent of the disease ▪ Efficacy of antibiotics and drugs to control AFB ▪ Determination of stability of sulfa drugs in honey.

2.4 Review Of Research Progress 2001 – Present

Canadian bee-research projects conducted between 1996 and 2000 are listed below with information submitted by all Canadian bee researchers. Research projects are grouped by province and institution.

Simon Fraser University, Burnaby B.C. (Mark L. Winston & Higo)

Year(s)	Investigator(s)	Project
1997-02	S. Pernal S. Baird K. Slessor A. Birmingham	A semiochemical trapping system for varroa mites
1999-02	H. Sabara R. Whittington A. Birmingham N. Rice H. Higo M. Dogterom	Diversified management systems for pollinating greenhouse tomatoes
2000-04	M. Winston S. Hoover K. Slessor H. Higo C.Keeling	Behavioral and pheromonal factors influencing the organization and evolution of highly social insect colonies
2000-04	L. Morandin	Effects of GM crops on bees
2000-02	R. Whittington M. Winston	Nutrition and other factors influencing bumblebee colonies in commercial greenhouses
2000-05	L. Morandin M. Winston	Agroecosystems and wild bees
2000-05	S.E. Hoover M. Winston H. Higo B. Oldroyd	Behavioural and pheromonal factors influencing the organization of social insect colonies
2001-02	H. Higo N. Rice B. Lewis M. Winston	Supplementary pollination of commercial greenhouse tomatoes with honey bees
2001-03	A. Birmingham M. Winston	Bumble bee drift in a greenhouse environment
2001-05	G. Robinson Y. LeConte	From genes to behavior: the mode of action of queen pheromone
2002-03	M. Franklin L. Morandin M. Winston	Effects of clothianidin on Bombus impatiens colony health and foraging ability

2003-04	N. Gervan S.E. Hoover M. Winston H. Higo	The effects of honey bee queen mandibular pheromone on colony defensive behaviour
2003-05	C. Ratti M. Winston	Bee diversity and abundance in berry agriculture
2005-06	H. Higo V. Abbott J. Nadeau M. Winston	Lethal and sublethal effects of imidacloprid and clothianidin on orchard mason and alfalfa leafcutter bees

University of British Columbia (Leonard Foster)

Year(s)	Investigator(s)	Project
2005-10	L. Foster	Proteomic analysis of honey bee response to P. larvae infection

B.C. Agriculture, Province of British Columbia (P. van Westendorp)

Year(s)	Investigator(s)	Project
2003	P. van Westendorp L. Cuthill J. Bunse	Determination of Apistan-resistant Varroa mites in BC.
2003	P. van Westendorp J. Bunse	Efficacy comparison between Apistan, Coumaphos and Follicell to control Varroa mites in honey bee colonies.
2004	P. van Westendorp T. Fredrich	Determination of Apistan-resistant Varroa mites on Vancouver Island.
2004	P. van Westendorp R. Richardson S. Byrne	Detection and monitoring of Kashmir Bee Virus (KBV) in British Columbia.
2004-05	P. van Westendorp	Varroa mite eradication trial on the Sunshine Coast of BC.
2005-06	P. van Westendorp J. Bunse	Efficacy of Oxalic Acid and Acetic Acid as Varroa mite controls.
2005-07	P. van Westendorp J. Bunse	Bumble bee population enhancement in blueberry plantings.

CPC Crop Pollination Systems, Burnaby, B.C. (Margriet Dogterom)

Year(s)	Investigator (s)	Project Title
2001-02	M. Dogterom	Stigma pollen counts used as an effective tool to determine how pollination can be optimized in blueberry and cranberry fields.
2001-03	M. Dogterom	Investigation of the bushy dwarf virus and its effect on raspberry ovule abortion and fruit yield.

Alberta Agriculture and Food Research Program (M. Nasr)

Date(s)	Investigator(s)	Project
2004-06	M. Nasr D. Noot T. Thmposon S. Muirhead	On-Farm honey safety study: Chemical residues in honey produced in Alberta
2004-06	M. Nasr S. Muirhead R. Panasiuk	Determining Varroa economic thresholds in Alberta
2003-07	M. Nasr S. Muirhead R. Panasiuk	Development of oxalic acid sublimation applicator: Optimization of oxalic acid treatments for varroa control
2002-08	M. Nasr S. Muirhead R. Panasiuk	Development of an Integrated Pest Management (IPM) Program to Control Honey Bee Parasitic Mites
2004-07	M. Nasr S. Muirhead R. Panasiuk	Determination of
2005- 07	M. Nasr S. Muirhead R. Panasiuk	Evaluation of commercially available pollen supplementary diets for feeding honey bees
2006- 08	M. Nasr S. Muirhead R. Panasiuk	Efficacy studies of Exomite, Apilife var, formic acid and oxalic acid on Varroa and tracheal mites under Alberta conditions.
2005-06	M. Nasr S. Muirhead R. Panasiuk	Eco-sources of antibiotics in honey

Agriculture and Agri-food Canada, Beaverlodge, AB (Don Nelson)

Year(s)	Investigator(s)	Project
2001-03	D. Nelson A. Melathopoulos D. Colter D. Noot K. Manninen P. Sporns	Management of oxytetracycline resistant American Foulbrood disease in honey bees.
2001-02	P. Mills D. Nelson	Bee degree day programming

Agriculture and Agri-Food Canada, Beaverlodge, AB (S. Pernal)

Date(s)	Investigator(s)	Project
2002-06	D. Noot T. Thompson K. Manninen A. Misko W. Walter M. Lunam C. White D. Munro P. Mills A. Melathopoulos D. Nelson S. Pernal (P.I.)	Integrated Management of Oxytetracycline-Resistant American Foulbrood (AFB) Disease in Honey Bees
2003-07	P. Mills S. Pernal (P.I.)	RFID Hive Management and Traceability
2005-07	J. Zhang A. Van Haga D. Munro A. Melathopoulos S. Pernal (P.I.)	Management of Honey Bee Diseases Using Lysozyme

University of Saskatchewan, Saskatoon, Sask.: (A.R. Davis)

Year(s)	Investigator(s)	Project
2000-04	K. Lew N. Low A.R. Davis	Nectar-carbohydrate composition of canola and borage in Western Canada
2001-03	M. Taylor A.R. Davis	Studies of floral characteristics indicative of high nectar carbohydrate production in canola
2003-06	T.J. Wist A.R. Davis	Pollination biology of Narrow Leaved Purple Coneflower (*Echinacea angustifolia*)
2003-06	T.J. Wist A.R. Davis	Nectar secretion studies in two *Echinacea* spp.
2005-08	W.D. Caswell A.R. Davis	Pollination biology of purple loosestrife (*Lythrum salicaria*)
2005-08	W.D. Caswell A.R. Davis	Nectar secretion studies in two *Lythrum* spp.
2005-08	A.R. Davis D. Bikey A. Mirakhur	Damage caused to Varroa mites caused by three ant species.
2006-09	A.R. Davis D. Bikey A. Mirakhur	Studies of the filtering functions of the honey bee proventriculus.

2006-09	J. Stolar A.R. Davis	Pollination biology of the Western Red Lily (*Lilium philadelphicum*).
2006-09	J. Stolar A.R. Davis	Nectar secretion studies in two *Lilium* spp.

Saskatchewan Beekeepers Association, Sask.: (A. Robertson - J. Gruszka)

Year(s)	Investigator(s)	Project
2004-05	A. Robertson	Genetic marker determination
2006-08	A. Robertson J. Gruszka	Saskatchewan beekeepers honey bee breeding program – "Saskatraz"

University of Manitoba, Winnipeg, Manitoba (R.W. Currie)

Year(s)	Investigator(s)	Project
1999-01	D. Ostermann R. Currie	Interactions of between varroa, chalkbrood, Nosema, and the environment in colonies treated with formic acid.
2001-06	R. Underwood R. Currie	The use of formic acid for control of *Varroa destructor* Anderson and Trueman and other pests in overwintering honey bee *Apis mellifera* L. colonies.
1994-96	P. Kozak R. Currie	Relationship of winter brood rearing to reproduction of varroa and efficacy of winter formic acid treatments
1995-98	S. Desai R. Currie	Mechanism of resistance to honey bee parasites and disease interactions.
1996-02	R. Currie	Factors associated with bee mortality in Off-spec corn syrup fed to honey bees
1995-96	R. Currie E. Smirl P. Kozak	Fumigation of Package bees with formic and oxalic acid to control varroa
1996-98	R. Currie S. Bahreini	Integrating chemical control, host resistance and the wintering environment to increase treatment thresholds for *Varroa destructor*

University of Guelph, Guelph Ontario, OMAF: (E. Guzman)

Date(s)	Investigator(s)	Project
2005-08	E. Guzman H. Gashout B. Emsen P.G. Kelly	Delivery methods of organic pesticides for the control of varroa mites
2006-08	E. Guzman M. Taylor P.G. Kelly	Diluents and cryoprotectants to preserve honeybee spermatozoa

2006-10	E. Guzman P. Unger P.G. Kelly F. Becerra	Genetic effects on traits of evolutionary and economic importance in honeybees
2004-07	E. Guzman L. Espinoza H. Montaldo	Heritability of mechanisms of resistance against varroa mites in honeybees
2004-08	E. Guzman J.L. Uribe G.J. Hunt M. Arechavaleta C. Vazquez	Genetic basis of honeybee defensive behaviour

Ontario Beekeeper's Association Tech-Transfer Program and OMAFRA (Nasr/McRory/Skinner)

Date(s)	Investigator(s)	Project
2000-02	G. Wilson M. Nasr P. Kevan	Evaluation of Russian bee resistance to varroa mites and their economic traits (G. Wilson's M. Sc. Project)
2000-02	G. Wilson M. Nasr	Study of population dynamics of varroa mites in honey bees in Ontario
2001-06	A. Skinner	Breeding and Maintaining Parasitic Mite Resistant Honey Bee Stocks
2001-06	A. Skinner	Integrated Pest Management (IPM) Program to Control Honey Bee Parasitic Mites
2001	A. Skinner	Management Practices to Reduce Pesticide Damage in Corn
2006	A. Skinner	Maintaining Food Safety in the Honey Bee Industry. Studies in contaminants and residues

M.A.P.A.Q. Deschambeault, Quebec (P. Giovenazzo)

Year (s)	Investigator (s)	Project
2005-06	P. Giovenazzo E. Houle	Comparison of the performance of selected bee stocks available in Quebec and Ontario

Agriculture and Agrifood Canada, Kentville Nova Scotia (Kenna MacKenzie)

Year(s)	Investigator(s)	Project
1999-02	K.E. MacKenzie K. Burgher L. Eaton M. Myra	Genetics and wild blueberry pollination
2000-03	S.K. Javorek K.E. MacKenzie	Development of a Maritime-specific management system for alfalfa leafcutting bees used for wild blueberry pollination

2.5 Apiculture Research and Extension Personnel

The following tables summarize the number of personnel available to teach or conduct apicultural research and/or communicate research results to the Canadian beekeeping industry (Prepared by C. Scott-Dupree).

Personnel – Provincial Government

Province	Provincial Apiarist (PPY / #)	Apiary Specialist (PPY / #)	Inspectors (TPY / #)	No. Positions Currently Available	No. Positions Available 2007-2012	Total PPY - TPYs Present/Past Review Period
BC	1.0 / 1	0	2.0 / 8	0	0	3.0 / 5.5
Alberta	0.6 / 1	0	0.25 / 1	0	0	0.85 / 2.0
Sask.	1.0 / 1	0	0.5 / 2	0	1	1.5 / 1.5
Manitoba	1.0 / 1	1.0 / 1	0.7 / 5	0	0	2.7 / 3.1
Ontario	1.0 / 1	0	2.9 / 20	0	0	3.9 / 3.9
Quebec	0.3 / 1	0	1 / 8* 1 / 8**	0	0	1.3 / 2.3
Nova Scotia	0.1 / 1	0	0.5 / 1	0	0	0.6 / 1
NB	0.3 / 1	0.2 / 1	0.5 / 9	0	0	1 / 0.5
PEI	0.2 / 2	0.2 / 1	0.1 / 1	0	0	0.5 / 0.5
NFLD	0	0.1 / 1	0	0	0	0.1 / 0.1
Totals	**5.5 / 10**	**1.5 / 4**	**8.0 / 63**	**0**	**1**	**15.45 / 20.4**

* - Eight inspectors trained for bee inspections but not dedicated to this job
** - Eight veterinarians in charge of provincial bee health programs throughout Quebec

Federal and Provincial Research Institutions

Research Institutions	Scientists (PPY / #)	Technical Pos'n (TPY / #)	Positions Currently Available	No. Positions 2007 – 2012	Total PPY-TPYs Present/Past Review Period
Beaverlodge – AAFC	1.0 / 1	1.6 / 2	0	0	2.6 / 2.0
Lethbridge – AAFC	0	0	0	0	0 / 0.7
Kentville – AAFC	0.5 / 2	0	0	0	0.5 / 1.8
Alberta Ag-Research	0.4 / 1	2.0 / 2*	0	0	2.4 / 3
Dechambeault - Laval	0.3 / 1	2.2 / 3	0	0	2.5 / 2.5
Totals	**2.2 / 5**	**3.8 / 7**	**0**	**0**	**8.0 / 10.0**

* one salaried technical person

Personnel - Universities

University	Academic Pos'n (PPY / #)	Technical Pos'n (TPY / #)	Grad Students (2001 - 2006)	Grad Student Pos'n Available (2007-2012)	Academic Pos'n Available (2007-2012)	Total PPY - TPYs Present/Past Review Period
S.F.U.	0	0	10	0	0	0 / 2.0
U of SASK.	1.0 / 1	0.25 / 1	5	5	0	1.25 / 1.25
U of MAN.	1.0 / 1	0.25 / 1	5	0	0	1.25 / 1.25
U of Guelph	1.4 / 3	1.0 / 1	9	4.5	0	2.4 / 1.95
U de Montreal	0.5 / 2	0	1*	0	0	0.5 / 0.5
U.B.C.	0.5 / 1	0.75 / 2	1	2	0	1.25 / 1.25
Totals	**4.4 / 8**	**2.25 / 5**	**31**	**11.5**	**0**	**6.65 / 8.2**

* Part time – P. Giovenazzo

Personnel - Provincial Beekeeping Associations

Association	Tech Specialist (TPY / #)	Research Assistants (TPY / #)	Positions Currently Available	Positions 2007 – 2012	Total (TPY's) Present/Past Review Period
Ontario Beekeepers' Assoc.	1.0 / 1	2.0 / 2	0	0	3.0/ 1.7
La Fédération des apiculteurs du Québec	1.0 / 1	0	0	0	1.0 / 0
Totals	**2.0 / 2**	**2.0 / 2**	**0**	**0**	**4.0 / 1.7**

2.6 Apiculture Research Funding
Amounts x $1,000 (GROSS)

Unless indicated otherwise, funding amounts are GROSS and include project materials, supplies, and operating expenses. Funds do **not** include salaries of university staff, student scholarships, bursaries, awards and operational costs of facilities.

Projected funding figures reflect committed funds. Actual funding levels may rise in the next few years as more projects may be approved.

	Currie *1	Pernal *2	Winston Higo	Foster	Davis *3	Scott-Dupree	Otis	MacKenzie	Giovenazzo Dubreuil	Guzman	OBA	Nasr	S.B.A.	Total Funding
Year	**MB**	**AB**	**BC**	**BC**	**SK**	**ON**	**ON**	**NS**	**QC**	**ON**	**ON**	**AB**	**SK**	
Actual														
2001-02	41.5		185.0		44.0	140.0	32.5	40.0					30.0	**513.0**
2002-03	61.5	134.0	185.0		26.0	80.0	28.0	50.0			17.7	15.0	5.0	**602.2**
2003-04	35.0	144.5	185.0		28.5	80.0	19.0	50.0	56.0		56.9	75.0	13.8	**743.7**
2004-05	67.0	120.5	165.0		40.0	240.0	15.0	0.0	43.0		42.1	75.0	30.2	**837.8**
2005-06	56.3	103.4	165.0	34.0	44.0	200.0	0.0	0.0	153.0	43.5	82.3	85.0	42.7	**1,009.2**
Projected														
2006-07	65.3	102.4		34.0	38.5	25.0	0.0	5.0	135.0	64.0	76.8	75.0	45.0	**666.0**
2007-08	50.0	101.4		34.0	36.0	25.0	0.0	5.0	110.0	64.0	63.0		45.0	**533.4**
2008-09	30.0	165.0		34.0	36.0	25.0	0.0	5.0	100.0	31.0	70.0		45.0	**541.0**

*1 University Fellowships for student (@$16K/year) included. Infrastructure support and salaries not included.
*2 Internal and external sources of cash funding.
*3 Grad student scholarships and salaries not included.

2.7 Research Funding Sources

Apiculture research today is funded through many different organizations, both public and private. Traditional public funding sources include NSERC, federal and provincial governmental organizations. There are also various corporate entities that have made research funds available including BEE MAID, Medivet Pharmaceuticals, Burt's Bees and others. Across Canada, there are a variety of trust funds and endowments established through provincial producer groups that make modest funds available annually to support research and producer education.

A notable funding source is the Canadian Bee Research Fund (CBRF) which was established following the Apimondia conference in Vancouver in 1999. The residual of funds from the conference made it possible to

establish an endowment of approximately $450,000 of which the annual interest earnings are made available for apiculture research in Canada.

Canadian Bee Research Fund – CBRF R. Currie & R. Lafreniere

The Canadian Bee Research Fund is an independent charitable organization that is headed by a board of directors composed of representatives from the Canadian Honey Council and Canadian Association of Professional Apiculturists. The Fund has been set up as a long-term endowment fund, where the interest generated by the fund is made available for annual grants. In most years, the CBRF has been able to contribute $20,000 to $25,000 a year toward apiculture research projects. The board of directors consists of four voting members, two from CAPA and two from CHC and the secretary of the CHC, Heather Clay. The board makes decisions about investments, fund raising, as well as disbursement of research grant funds. A grant selection committee is established each year that consists of CAPA members (whom are not submitting a research grant in the current competition) as well as two appointees from the Canadian Honey Council and the CHC secretary, Heather Clay. Industry research priorities are used as the primary selection criteria for determining which projects receive funding.

The CBRF has recently appointed new managers to oversee the investment of the endowment. Last year investments were moved from CIBC and split between the Royal Bank ($218,803.00) and McLean Budden ($230,253), with those institutions produced yields of approximately 15% and 12% respectively. Grant disbursements are based upon an allocation based upon capitol and an allocation associated with incoming donations each year. It is estimated that approximately $25,000 will be available to fund research grants in the upcoming year.

Six grant applications were received for the 2007 competition and the total value of all funding requests was $81,700. Decisions on the exact amount of money allocated and the number of grants funded will not be made until the CBRF board and Grant selection committee meet in conjunction with the CHC meeting in British Columbia.

3.0 RESEARCH PRIORITIES AND RECOMMENDATIONS

3.1 Research Recommendations - Canadian Honey Council

Directors of the Canadian Honey Council indentified key areas of apicultural research as follows:

- **Low risk pesticides for Varroa mite control.**
  The persistent impact of the Varroa mite on the beekeeping industry has necessitated the ongoing use of pesticides. Varroa mites developed resistance to some previously-introduced products which caused beekeepers to resort to other chemicals that pose greater risk in toxicity or persistence. At the same time, food safety and quality issues have become increasingly important in the public's mind. Canadian producers need to have ongoing access to effective mite control products while ensuring that their hive products remain of the highest quality and purity.
- **Low risk drugs for AFB**
  American Foulbrood disease has probably been responsible for greater colony and production loss than any other honeybee disease. Since the 19th century, many countries of the world enacted legislation to control this disease and protect honeybees. While the causative agent, *Paenibacillus larvae* has only recently acquired resistance to oxytetracycline, the CHC views the development of low risk drugs and management controls of AFB a high priority.
- **Nutritional value of Canadian honey**
  In North America, honey has long been viewed as nothing more than a fancy sugar substitute. In Europe and many other parts of the world, honey has traditionally been recognized for its food value and medicinal qualities. CHC has identified the need for greater research about the nutritional value of honey and Canadian honey in particular. Research findings may enable Canadian beekeepers to promote their honey more successfully and increase per capita consumption in Canada.

- **Pollination and its effect on bee nutrition**
  Crop pollination has rapidly become a primary management component of commercial beekeepers. The placement of colonies on specific crops limits the access that bees have on a wider variety of floral sources. With the successive placement of colonies on a specific number of crops during the production season, are colonies being deprived of essential nutrients they would have otherwise accessed? In light of the Colony Collapse Disorder phenomenon in the US, the CHC has identified crop pollination and bee nutrition as high priority research issues.
- **Wintering bees in erratic fall/winter conditions**
  Canada's winter climate poses unique challenges to honeybee colonies. Many of its northern areas offer among the best honey-producing conditions in the world but on the other hand, winter duration constitutes a severe stress factor. While predictable fall and winter conditions allows for standardized winter preparation and management, erratic fall and winter conditions make winter management far riskier and more costly. CHC would like to see more research in the factors that influence colony responses to changing climatic conditions and the development of management strategies to mitigate their impact.

3.2 Apiculture Research Operating Conditions (P. van Westendorp)

Future apiculture research activities in Canada will be dictated by several key factors. These include:

- Funding availability
- Emergence of new issues with national/international scope,
- Support and availability of existing and new research facilities,
- Availability of expertise to carry out the research.

3.2.1 Funding Availability and Accessibility

Many different endowments and organizations, both private and public, exist to support agriculture research including apiculture research. Corporate research support is also widely available even though the research focus may be restricted to issues associated with the corporate sponsor. Different levels of government have supported various programs and initiatives for many years and are expected to do so in the future. In addition, several provincial beekeeper associations have established trust funds in support of apiculture research. These funding sources may be limited and subject to constitutions that prescribe the type of research or require that the research be carried out within the province from which the funds are issued.

As mentioned before, various corporate research funding sources have been established. Since these funds are from the private sector and are considered "industry money", they play a key role as seed money to secure funding from other sources notably public agencies and governments.

The general feature of research funding today compared to the past is the requirement of funding partnerships. In the past, many research projects secured funding from single sources such as governments directly, or their funding agencies and research support programs. Today researchers must seek financial support from both public and private sources. This requirement enhances the credibility and justification of research projects since the approval process involves all funding partners. Furthermore, in recent years governments have increasingly demanded direct monetary involvement of the beekeeping industry. Recognizing the limited financial and organizational abilities of some provincial beekeeper organizations, provinces have assisted in creating "Commissions" or "Industry Councils", while others made funds available through development trust funds. The purpose of these organizations is to enable industry groups to manage and direct funds for research and industry development. Generally, the funds placed in trust can only be released when matched with industry money.

In conclusion, the new funding environment has had a significant impact on the type of research being carried out and the demands placed on all parties involved:

1. Publicly funded research funds can no longer be accessible unless industry groups commit their own funds, even when such funds are nominal money;
2. The increased involvement of industry greatly influence the type of research being carried out. Generally, industry supported projects tend to have a greater practical component and involve technology transfer.
3. Multi-party funding arrangements demand researchers to spend far greater time and resources on the application process to secure funding. Researchers are also expected to prepare interim reports in greater detail and at greater frequency.

3.2.2 Emergence of New Issues

Funding support of apiculture research is dictated as much by the actual money available as it is by the nature of the research. Research with high public exposure or projects that carry a popular theme are generally easier to secure funding for than research proposal that appear to have marginal relevance to the interests of the beekeeping industry. The downside of this situation is that “hot button” issues and those currently visible in the public domain have a better chance of securing funding than less-visible issues that may harbour equal or greater scientific merit. To overcome this challenge, researchers need to place greater efforts of explaining the purpose and relevance of their proposed research to industry and prospective funders.

3.2.3 Ongoing support and availability of research facilities

Financial and infrastructural support of apiculture research in Canada has been declining during the last few decades. The loss of apiculture research positions coincide with the loss of laboratory and facility space. Financial support of high profile research areas such as genomics, food quality and safety, and conservation studies poses a serious competitive threat to maintaining facilities dedicated to apiculture and pollinator research. Apiculture researchers are encouraged to present their research proposals in the environmental conservation studies category to secure ongoing recognition and institutional support.

3.2.4 Availability of expertise to carry out the research

Dedicated positions in apiculture research and extension in Canada have steadily declined since the 1980s. Most positions have been lost as a result of attrition or through re-assignment of research direction. The most significant loss was the closure of the Bee Lab at Simon Fraser University with the departure of Dr. Mark Winston. From 1996 to 2001, the number of research scientists declined by 38% percent, while the number of professional extension personnel declined by 15% and apiary inspectors by 23%. Since the 2001 Apiculture Research Workshop, positions of researchers, extension specialists and apiary inspectors declined by a further 20 – 25%. Only two provincial organizations, in Quebec and Ontario, established technical positions to provide extension services and technology transfer to their industries. During this period of reductions, Canadian beekeepers have been confronted with more challenges than ever before, from parasitic mites and viruses to cheap imported honeys, while there has been an increase in the demand of bee-related research involving non-Apis pollinators, crop pollination, botanical studies, pollinator conservation studies, etc. The Canadian apiculture research and extension community has been experiencing increased difficulties in meeting the industry’s research demands. It is imperative that all sectors of the Canadian beekeeping industry and members of CAPA continue to press governments and universities of the need for ongoing support of apiculture research and extension positions.

3.3 Categorized Research Priorities

3.3.1 Diseases, Parasites & Pests

- Chemical-free Varroa mite controls including mite pheromones; mite trapping devices; mite-resistant bee stock; mite pathogens; cultural/management strategies that prevent or reduce mite populations.
- Research in the identification of honeybee viruses and their association with parasitic mites.
- AFB disease poses a renewed threat to beekeeping with the development and spread of antibiotic-resistant strains of *Paenibacillus larvae* in parts of Canada. Research needs to be directed towards breeding resistant bee strains and the development of drug-free control strategies.
- Research of the impact of Nosema species on honey bee colonies and its role on the Colony Collapse Disorder phenomenon.
- Effects and mitigation of invasive alien species.

3.3.2 Stock Selection and Breeding:

- Selection for varroa resistance.
- Selection for disease and tracheal mite resistance.
- Maintenance of gentleness, winter-hardiness and high productivity characters.
- Development and application of techniques for screening Africanized genetics.
- Research in pollinating behaviour.

3.3.3 Colony Management:

- Improved colony nutrition.
- Non-chemical colony management strategies to mitigate diseases.
- Improved fall management and wintering.

3.3.4 Pesticides and Antibiotics Utilized in Honey Bee Management:

- Alternative, high efficacy acaricides for treating varroa mites.
- Alternative antibiotic therapies for treating honey bee diseases.
- Resistance management strategies.
- Mitigation of deposition of antibiotic and pesticide residues in honey.
- Development of food-safe treatments for disease and mites treatments in honey bees.
- Determination of environmental sources of contaminants in honey.
- Elucidation of metabolites and pathways of antibiotics and pesticides used in bee management.

3.3.5 Pollination:

- Enhanced management of bees improve the effectiveness and efficiency of commercial pollination.
- Determination of the effects of agricultural chemicals and their metabolites to which pollinators may be exposed in conventional and genetically modified cropping systems.
- Comparative efficiency of crop pollination between honey bees and non-Apis pollinators.
- Crop requirements for pollination and evaluation of characters affecting pollinator performance (i.e. nectar secretion, pollen availability/nutrition, floral morphology etc.).

3.3.6 Non-Apis Pollinators:

- Population dynamics of wild pollinators and development of pollinator preservation techniques.
- Determination of the contributions of wild pollinators to the agro-ecosystem.

3.3.7 Emerging Disease Issues:

- Research of the impact of Nosema species on honey bee colonies and their role in wintering losses.
- Investigations into possible contributing factors to Colony Collapse Disorder.

3.4 Emerging Issues and Recommendations:

Beekeeping has become a far-more complex enterprise of animal husbandry than it was 25 years ago. Beekeepers are confronted with an array of challenges that can only be addressed through further research. To ensure the ongoing sustainability of the Canadian beekeeping industry, apiculture research priorities for the next 5 – 10 years include:

3.4.1 Research in Disease Control and Management:

- **Varroa mite controls**
  The Varroa mite remains the single greatest disease threat to beekeeping in North America since its introduction in 1987. Research is urgently needed to mitigate the threat of resistant mites to several chemical controls. Food safety concerns dictate that such research is directed to the development of non-chemical controls. This will include the development of integrated pest management strategies, alternative chemicals and an understanding of how to delay the development of pesticide and antibiotic resistance in honey bee pests and diseases.

- **Antibiotic-resistant American Foulbrood (r-AFB)**
  AFB has been successfully controlled with oxytetracycline for about 50 years in North America. The incessant use of antibiotics invariably led to the development of antibiotic resistant strains of *Paenibacillus larvae,* the causative agent of AFB. Many producers responded by applying different antibiotics including tylosin. Accepting the fact that the use of antibiotics is a short-term solution before resistance develops, research is urgently needed towards the development of alternative AFB controls including resistant bee stock and improved management practices.

- **Colony Collapse Disorder and the Effects of Stress**
  A number of organisms have been identified in association with the CCD phenomenon but none has been proven to be the causal agent. It is hypothesized that other factors including external stresses brought about by management practices and climate may play a key role in the onset of CCD. Research is needed to identify the nature of these stress factors and quantify their impact on honey bee colonies.

- **Honey Bee Genetics**
  The CCD phenomenon of 2006 and the subsequent search of causal agents has raised the question whether the narrow scope of selection criteria used in commercial queen rearing has led to a loss of genetic diversity of the North American honey bee population. Research is required to determine whether a decline of genetic diversity has increased the population's vulnerability to CCD-like phenomena and pathogens.

- **Threat of Invasive Species**
  The inadvertent introduction of invasive species including the African Honey Bee (AHB) and *Tropilaelaps clarae* continue to pose a serious threat to the Canadian honey bee population. Research is required in assessing the impact such introductions would have on Canadian beekeeping. Furthermore, strategic response strategies need to be developed that would encompass management controls, regulatory provisions, communication protocols and producer training.

3.4.2 Research in Crop Pollination

- **GM Crops**
  Modern agriculture has become more dependent on insect pollinators in recent decades than ever before. New high-yielding cultivars are released every year. Some of these cultivars are genetically modified to include insecticidal activity that may be harmful to bees. The impact of these developments on the beekeeping industry needs to be closely monitored and researched.

- **Crop-Pollinator Interactions**
  High-yielding crop cultivars today often involve high-density plantings. Foraging behaviour of pollinators is greatly affected by the cultivar's growth habits and the lay-out of crop plantings. Research is needed to better understand the interactions between crop and pollinator.

3.4.3 Research on the Impact of Pesticides on Honey Bees

- While modern agriculture has increased its dependency on pollinators, honey bee colonies and wild pollinator continue to be affected by pesticides used to control crop pests and vectors of human disease (such as West Nile Virus). The latest generation of pesticides include broad-spectrum chloronicotinal insecticides that may have sub-lethal effects on pollinators or affect their foraging behaviour. Furthermore, the impact of aerial applications of pesticides on pollinators needs to be investigated.

3.4.4 Improvement in Colony Management

- **Comb Replacement**
  The application of mite control products, antibiotics and other disease-control products has increased the risk of residues in hive equipment including comb, honey and pollen. To lower the risk of honey contamination, some control products are applied in fat-soluble formulas. The repeated use of such products may cause its migration and subsequent build-up in brood comb. Research is needed to determine whether these substances reach sub-lethal levels to bee brood and assess the value of comb replacement.

- **Colony Nutrition**
  Proper nutrition plays a key role in general honey bee health. With increased crop pollination management where colonies are placed from one pollination contract to the next, bees may obtain their principal nutrients from only a few floral sources. Research is needed to determine whether honey bee colonies are impacted by the reduced diversity of nutrient sources and whether this compromises their immune system.

3.4.5 Recommendations for Research and Extension Infrastructure

- **Research Collaboration**
  Given the large number of research priorities and the limited resources available, it is recommended that researchers and extension specialists collaborate with each other, within Canada and the United States. It is imperative provincial and national producer organizations contact their respective governments to emphasize the urgent need for continued support of apiculture research.

- **Collaboration of Extension Services**

  There has been a critical decline in the infrastructure necessary for effective extension and regulatory activities in most provinces. The reduction of resources has reached the point where it threatens the ability of industry to respond effectively to emerging issues. Some provinces have no personnel or supporting resources to carry out extension and regulatory activities. There is an urgent need to strengthen extension services and collaborate more closely among provinces in the delivery of extension and inspection programs.

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