APICULTURE RESEARCH

WORKSHOP REPORT

1986

SPONSORED BY

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OF

PROFESSIONAL APICULTURISTS

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NOVEMBER 17 AND 18, 1986

C O N T E N T S

F O R E W O R D

The Apiculture Research Workshop was sponsored by the Canadian Association of Professional Apiculturists (C.A.P.A.) in cooperation with the Research Branch of Agriculture Canada. The purpose of the workshop was to review the priorities established at the 1981 Workshop, evaluate progress, review changes in the industry and establish current research priorities and recommendations.

Members of C.A.P.A. (i.e. provincial apiarists, university and Agriculture Canada researchers) and executive members of the Canadian Honey Council (C.H.C.) were present at the Workshop. Forty-seven concerns were identified which were grouped into nine general areas (Stock Improvement, Pests and Diseases, Bee Botany, Marketing Research, Colony Management, Human Health, Pollinator-Pesticide Interaction, Financial Management and Bee Supply). Eleven criteria for evaluating research needs were developed, such as economic impact, cost to do research, urgency, probability of success, industry interest, etc. The participants were then divided into three representative groups and given 3 of the above areas to discuss and to develop the statement of research needs, considerations and recommendations. Then the nine areas were ranked using the developed criteria. Final ranking was in two areas, (A) Apiculture Research and (B) Industry Related Research.

Although this report has not identified future apicultural positions it is essential that adequate support exist for current personnel before new positions be identified.

The well-being of the honey industry's future will depend on the extension and inspection services of each province, the education and training of professional people, and on research in the areas outlined in this report.

The following recommendations should be used as guidelines by agencies that are now or may be involved in research programs aimed at helping Canada's honey industry achieve its full potential.

D.L. Nelson, Coordinator
Research Workshop Report
January, 1987

A C K N O W L E D G E M E N T S

Sincere appreciation is expressed to the Canadian Association of Professional Apiculturists for sponsoring the workshop, Dr. R. Trottier for chairing the workshop, to members of the executive of the Canadian Honey Council, to the participants, and to the following for preparation of reports which are included in the Workshop Report; D. Dixon, S.C. Jay, J. Gruszka and D. Tegart.

RESEARCH PRIORITIES AND RECOMMENDATIONS
NOVEMBER 1986

A. APICULTURE RESEARCH

1. DISEASES AND PESTS

There is need for research on the economic impact and control of the following diseases and pests: chalkbrood, parasitic mites, viruses, wax moth and Africanized bees. These pests are threats to the Canadian beekeeping industry and cause, or have the potential to cause, significant economic losses.

Considerations

Research is in progress in some of these areas but success will be limited if additional resources are not obtained. If additional funding is not forthcoming it will be necessary to priorize the above research areas.

A second federal pathologist position has been promised but the status of the position is uncertain.

Recommendations

That researchers presently working on priority diseases and pests be encouraged to expand their efforts to include economic impact and control studies, and explore or expand co-operative projects on diseases and pests with U.S. researchers.

That the second pathologist when hired, have a diverse background and be capable of working on most, if not all, of the diseases and pests. In addition, that research scientists employed by institutions be provided with appropriate technical assistance.

Consideration should be given to the consolidation of a research team at a university with the aim of developing an integrated approach to disease and pest control in honey bees.

2. BEE SUPPLY

There is a need for research and development involving the future supply of early queens, package bees and nuclei. Because of the unique climate in Canada, replacement bees are required each spring.

Considerations

There is concern in the industry that traditional sources of supply from the U.S.A. could be lost due to the presence there of diseases and pests that are not wanted in Canada.

There is concern about the ready availability of bees from alternate sources of supply. Is the volume required available and at an acceptable cost? Additional concerns include the suitability of stock from new sources and the possibility of bringing new diseases and pests into Canada from such sources.

Canadian beekeepers are also expressing considerable interest in self-sufficiency.

Provincial development and extension personnel are active in technology transfer in queen, package bee and nucleus production. The problem of early queen availability could be solved by a successful, cost effective method of overwintering queens.

Recommendations

Queen overwintering research be conducted at universities, Agriculture Canada and the beekeeper level. Funding - partial federal, provincial and private.

Extension and development personnel in the provinces continue activities in technology transfer in the fields of queen, package bee, and nucleus production.

The beekeeping community continue to explore and evaluate additional alternate sources of bee supply.

Study mating biology and basic bee genetics to facilitate stock development.

3. COLONY MANAGEMENT

There is a continued need for applied and basic colony management research with an aim to improved production efficiency.

Consideration

With our current technology, there is a general feeling that most of the basic information relating to colony management is available, and therefore emphasis should be placed on technology transfer. Future research efforts in the area of colony management should be directed at developing the most cost efficient management systems.

Recommendations

The following aspects of research on colony management should be encouraged at the Agriculture Canada, university, and provincial levels using cooperative and demonstration projects that directly involve beekeepers: e.g., wintering methods, colony management for honey production and pollination, "high tech" beekeeping, queen bee introduction, swarm prevention and population dynamics.

The remaining research priorities that have been identified (e.g. bee nutrition, phagostimulants in pollen, pheromones and their applications etc.) require more fundamental approaches that can be best addressed by researchers at universities and government institutions.

The existing personnel and resources need to be increased to meet these research priorities.

4. STOCK IMPROVEMENT

There is a need for improvement of stock and testing of presently available bee stock. Regional differences occur and must be considered in such programs.

Considerations

There is an increasing incidence of bee diseases and pests and concern over bee poisoning in pollination situations. Development of bee stocks resistant to disease could solve some of these problems. Increases in honey yield may be necessary to increase profitability and provide future stability to the industry.

Breeding programs such as the closed population technique have been developed elsewhere and implemented at Beaverlodge and in B.C. These programs were funded by Agriculture Canada and provincial agencies. Criteria for testing bee stocks are available.

Recommendations

Test currently available stock on a regional basis for honey production, wintering ability and disease resistance. Much of this should be done at the beekeeper level in consultation with apiculturists based on a set of defined criteria.

Selection of stock for resistance to disease and pesticides be conducted by Agriculture Canada.

Future stock development be conducted by queen producers with technical assistance from apiculturists and with limited financial assistance from the federal government.

Importation of queens for stock improvement purposes should be considered from countries with desirable stock. This would likely require the development of quarantine facilities and procedures.

Study mating biology and bee genetics to assist in solving problems of early queen availability.

5. PESTICIDE - POLLINATOR INTERACTIONS

There is a need for research into pesticide - pollinator interactions since a large number of bees are killed when insecticides are applied, especially in large spray programs. There is concern about forager kills, as well as sublethal effects on queens, brood, and overwintering bees. Concern is expressed over the long term effects on native pollinators due to the application of insecticides to the ecosystem.

Considerations

Present information on pesticide toxicity used by Canadians is based on California and Washington tests. Climatic conditions in Canada are considerably different due to the lower temperatures which result in longer residual toxicity. Currently there is little information on methods of repelling honey bees from areas where insecticides are being applied. Insufficient information is available to beekeepers on acceptable methods of confining bees to hives during such applications. Alternate insecticides, less toxic to bees are often available, but are expensive and therefore rarely used by farmers. The National Research Council publication (1981; NRCC No. 18471) on "Pesticide - Pollinator Interactions" provides full justification for this area of research.

Recommendations

Conduct field toxicity tests of insecticides under Canadian conditions at provincial institutions, universities, or Agriculture Canada.

Conduct studies on both chemical and technical methods of repelling bees from areas in which insecticides are being applied.

Develop better methods to protect bees during insecticide application. Research be done by Agriculture Canada, universities and beekeepers.

Study sublethal effects of pesticides on honey bees and other pollinators.

6. BEE BOTANY

Additional information is required to determine the value of bees to agriculture from an economic and ecological viewpoint. In Canada, research on pollination efficiency is fragmented and a more co-ordinated effort is needed in the future to assess and develop baseline pollination data relative to commercially produced crops. This approach will also be valuable in studies on management of bees for pollination of agricultural crops and bee-flower interactions.

Considerations

There is considerable interest in this subject from beekeepers and other commodity groups, but a data base is lacking to determine the economic significance on beekeeping.

Personnel are available in Canada and are researching this topic at present.

Recommendations

Establish a co-ordinated approach to research in this field and obtain continued financial support.

Additional funding and staffing be provided to determine the economic significance of bees to the agricultural sector.

B. INDUSTRY RELATED RESEARCH

1. MARKETING RESEARCH

Because Canada presently (i) produces more honey than we consume, (ii) has recently become dependent on one major export market which presents some hazards to our beekeeping industry, and (iii) recognizes the vast potential that marketing research has in our industry, we believe that there are two major needs in marketing research:

Considerations

There is a need for diversification in our marketing strategy, in both domestic and export markets and there is a need for development of innovative uses of honey and other hive products, including container development and the use of honey in food products.

Marketing research is beyond the scope of our apiculture specialists, but we encourage and strive to facilitate cooperative work with other agencies and departments.

Recommendations

The federal government should make funds available to the beekeeping industry as well as providing access to facilities and expertise so that the industry, as a whole, can pursue new product and market development.

The federal government should assist the beekeeping industry by initiating studies on new techniques for determining floral sources of honey.

2. HUMAN HEALTH

There is a need to determine the cause of medical problems resulting from exposure to dead bees in wintering structures. Human health may also be affected by chemicals used in beekeeping.

Considerations

Beekeepers are suffering from these problems and in extreme cases must give up wintering and/or beekeeping.

Residues or chemicals in honey could have a negative impact on marketing the product.

The medical profession is interested in this type of project and investigation could probably proceed with little cost to the industry.

Recommendations

Alert the medical profession to this problem and actively encourage research on health hazards.

A medical specialist may be essential to this type of project. Agriculture may have to fund the research if professionals are interested and available but lack the financial resources.

3. FINANCIAL MANAGEMENT

As a result of increased costs of production, low honey prices and marketing problems, Canadian beekeepers are experiencing reduced profit margins and therefore, financial hardships.

Considerations

Our apiculture specialists and beekeepers are not usually trained in the area of financial management. We need to work closely with farm management specialists and other specialists to develop these programs and to assist in their transfer to, and use by beekeepers.

Recommendation

Comprehensive financial planning and management systems need to be developed that address the specific and unique needs of Canadian beekeepers.

UPDATE INFORMATION

A. THE CANADIAN BEEKEEPING INDUSTRY

The rapid expansion, in the Canadian Beekeeping Industry, that began in the early 1970's and continued into the 1980's appears to be showing signs of levelling off. Total honey bee colonies kept in Canada have settled at approximately 700,000 in the years 1984, 1985 and 1986. Five years ago (1981), the total number of colonies kept was estimated at 633,500 and ten years ago (1976) was 530,930.

The estimated value of the beekeeping industry, based on honey and beeswax sales at the producer level has also leveled off in recent years partly as a result of less then average crops in some of the major producing areas and partly due to a general reduction in the wholesale price for honey. The beekeeping industry also contributes to the agricultural economy through the provision of insect pollination, resulting in increased seed and fruit production of several crops. The monetary result of this pollination is difficult to estimate, but is usually considered to be valued at several times the value of the honey and beeswax produced.

Inputs into the honey bee industry originate from labor, utility services, feed, construction, credit, pharmaceutical, petroleum, machinery and equipment industries. As the honey is prepared for domestic and export markets it supports a number of secondary industries including those involved in processing, packing, marketing and transportation.

Alberta, Saskatchewan and Manitoba continue to be the centers of production in the Canadian Beekeeping Industry. In 1985, the three prairie provinces accounted for approximately 70% of the total Canadian honey crop (see Table 2, Appendix I)

Of the 36,017,000 kg of honey produced in 1985, approximately 17,278,000 kg were exported with approximately 80% going to the United States (see Table 4, Appendix I).

Beekeepers have several potential markets for the honey they harvest:

1. Direct sales to consumers -- Beekeepers may pack honey in consumer containers and sell it directly to the public. This market is particularly important to beekeepers that are located close to large population areas and to beekeepers that harvest relatively small amounts of honey.

2. Direct sales to retail outlets -- Some beekeepers pack honey in approved containers and sell their product directly to food stores.

3. Sales to honey co-operatives -- Some beekeepers have chosen to join and ship their honey to co-operatives that have been established for the purposes of processing, packing and marketing the honey of their members.

This market is particularly important for many beekeepers in the three prairie provinces where approximately 40% of the honey harvested is marketed through the Manitoba Co-operative Honey Producers Ltd. and the Alberta Honey Producers Co-operative Ltd..

4. Sales to other buyers -- There are several independent packers, wholesalers and brokers in Canada, the United States and overseas that purchase honey from beekeepers. This honey is usually packed in 45 gallon drums and shipped in container or semi-trailer lots (approximately 18,000 kg per load).

Regulations pertaining to the packing and grading of honey are set forth in the Canada Agricultural Products Standards Act and the Honey Regulations of this Act. These regulations are administered by the Food, Production and Inspection Branch of Agriculture Canada. The Honey Regulations are effective only in those provinces that have adopted the federal regulations and have authorized the federal government to administer them within that particular province. Honey may move in bulk containers between provinces without being classified and graded provided it is to be repacked or reprocessed in Canada. Honey being exported, however, is subject to the federal regulations and can only be marketed internationally by an individual or firm licenced by Agriculture Canada as a Producer-Grader, Packing or Pasteurizing Plant. As of November 1985, there were 401 Producer-Graders, 75 honey packing plants and 13 pasteurizing plants registered in Canada.

B. REVIEW OF RESEARCH PRIORITIES ESTABLISHED AT 1981 RESEARCH WORKSHOP

In 1981 the CAPA Research Workshop listed research priorities under the following broad areas: Production, Regulations, Utilization, Education and Marketing in descending order of priority.

(1) PRODUCTION:

The first priority of stock selection and breeding was actively pursued with breeding projects at Beaverlodge and in British Columbia. These projects have culminated in the establishment of breeding stocks which are now commercially available. In 1983 CAPA organized a queen and package production workshop which highlighted the necessity and priority of these efforts and which have been followed up by research projects in British Columbia. Since these efforts were initiated, there have been extension efforts across Canada to provide information to beekeepers regarding queen and package production. These efforts have been highly successful in that there are now commercially available packages and queens in Eastern and Western Canada and a large number of commercial beekeepers are beginning to raise their own queens and increase their colony numbers in an attempt to become self-sufficient.

Clearly all of these efforts during the past five years have met the priority, established at the 1981 research workshop, of improving colony management methods.

Diseases and pests were identified as a priority at the 1981 research workshop. During that same year, a CAPA bee diseases workshop was held at Guelph which provided training in the identification of acarine disease. This has become a major preoccupation in Canada since the honey bee tracheal mite was first discovered in the United States in 1984. All provinces have been performing surveys, particularly of imported package bees, for the presence of honey bee tracheal mites.

Recently, two research projects have been established (one by the Saskatchewan Beekeepers Association at La Ronge, Saskatchewan and another by the University of Guelph in New York State) in an attempt to determine the life cycle, biology and the economic impact of the mite under northern climates.

(2) REGULATIONS:

The first priority was identified as a need to evaluate the chemicals presently being used by the beekeeping industry in Canada and to begin the process of having some of these chemicals registered. The CAPA Chemicals Committee has been very diligent in its work to provide as much information to the appropriate regulatory bodies with regard to two particular chemicals ie. ethylene oxide and methyl bromide. As well, research has been done on bee repellents which in the future will provide a basis for sound application recommendations and hopefully for registration of some of these compounds.

The second priority was to begin evaluation of pesticides under Canadian conditions. To this end, some research projects have been initiated and data has been collected to establish the extent of pesticide poisoning to honey bee colonies across Canada. Further, CAPA has expressed a desire both to Agriculture Canada and to the Canadian Honey Council that this issue be properly addressed with the establishment of a research position, however, this now seems unlikely to materialize.

(3) UTILIZATION:

This research priority dealt primarily with the need to initiate studies on nectar production and pollination of specific field crops and new nectar and pollen sources. During the past five years there has been a significant amount of research conducted on specific field crops which are important to beekeeping in Western Canada in particular as well as studies of native plants to determine their value of nectar and pollen sources to honey bee colonies during the spring and summer.

(4) EDUCATION:

The research workshop in 1981 estimated the needs for trained apiculturists in Canada up to 1986. Fortunately, Canadian needs have been more than adequately met with graduates from University of Guelph, Manitoba and Simon Fraser as well as the excellent training that has been provided at Fairview College both to students of beekeeping in Canada and overseas.

A problem has developed in recent years for a number of qualified apiculture graduates who have not been able to find employment opportunities. This has occurred in spite of the fact that several apiculture positions have become vacant due to deaths and retirements and in spite of the fact that there appears to be a need for more apiculture research in Canada (eg. mites, genetics, pesticides and pollination).

(5) MARKETING:

This was designated as the last priority not because of need but rather recognizing the limitations in this field of the members of CAPA. The recommendations which were forwarded to the Canadian Honey Council did result in the establishment of a promotion committee which has been active during the past five years in promoting honey in Canada.

C. INDUSTRY REVIEW AND COMMENTS

The priorities and recommendations of the 1981 workshop were reviewed and the following comments are offered by the Canadian Honey Industry. In a time of changing needs general progress has been good and consistent with the recommendations of the last workshop.

It is felt that federal research provides the most input to the industry especially in the areas of pathology, breeding and management. The important role of the research component at universities is also recognized as well as the need to train new people to work in the industry. Inspection and extension services of the provincial apiarists provide a very valuable component to our industry. There has also been considerable effort by CAPA and provincial apiarists to learn the methods of analysing bee samples for the tracheal mite. Each province now inspect imported packages for this mite. All of the above areas need sustained or greater emphasis over the long term.

Areas where progress was meager or lacking include, new methods of tracheal mite detection, a work transfer for someone to become familiar with the biology and behavior of the varroa mite and the Africanized bee, stock evaluation especially at the producer level, and research toward the registration of chemicals used in the beekeeping industry. There is also an increasing need for research on problems of chemical hazards to bees under Canadian conditions.

There is a continual need to make scientific information available in a form that beekeepers will read.

LOOKING AHEAD

Since there are several diseases and pests that are threatening our industry and will continue to cause problems, we feel the federal government should strengthen its commitment to apiculture research, in particular, in the area of bee diseases and pests. The industry is now faced with tracheal mites, chalkbrood disease, and apparently some new viruses about which very little is known for Canadian conditions. As well there is a future threat of Varroa disease and the Africanized bee and research should be initiated on these as soon as possible.

At no other time in the history of Canadian beekeeping has the industry faced tougher problems which need an intensified and concerted research effort in disease and pests, colony management, pollination, insecticide damage, etc. Research in these areas is and will become even more important for our industry to remain competitive on the world market. With a unified effort by Agriculture Canada, universities, and provincial extention people the problems will be solved or minimized and the industry will remain viable.

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TABLE 1

BEEKEEPING STATISTICS FOR CANADA[1]

YEAR	NO. OF BEEKEEPERS	NO. OF COLONIES	PRODUCTION PER COLONY (kg)	TOTAL PRODUCTION '000 kg	VALUE OF HONEY & WAX $'000
1976	15,300	530,930	48	25,444	25,927
1977	15,510	541,470	51	27,747	32,070
1978	17,470	566,900	54	30,585	39,803
1979	18,550	581,200	57	32,996	47,603
1980	19,500	607,800	48	29,235	44,276
1981	19,980	633,500	55	34,769	61,360
1982	20,650	663,450	46	30,528	50,640
1983	21,110	684,850	57	38,770	61,294
1984	20,810	704,650	61	43,297	63,212
1985	19,625	691,575	52	36,017	--
1986[2]	20,289	702,375	49	34,239	--

1. Source - Statistics Canada
2. Preliminary Estimate - Source: Provincial Apiarists

TABLE 2

BEEKEEPING STATISTICS BY PROVINCE

BRITISH COLUMBIA

YEAR	NO. OF BEEKEEPERS	NO. OF COLONIES	PRODUCTION PER COLONY (kg)	TOTAL PRODUCTION ('000 kg)
1976	4,500	50,000	24	1,202
1977	4,500	47,000	54	2,516
1978	5,200	50,000	38	1,882
1979	5,250	51,000	46	2,336
1980	5,400	49,000	36	1,756
1981	5,600	50,500	42	2,107
1982	6,000	56,000	41	2,286
1983	5,900	56,500	41	2,332
1984	5,500	59,400	51	3,045
1985	5,450	55,000	37	2,046
1986	5,000	55,000	38	2,090

ALBERTA

YEAR	NO. OF BEEKEEPERS	NO. OF COLONIES	PRODUCTION PER COLONY (kg)	TOTAL PRODUCTION ('000 kg)
1976	2,000	160,000	58	9,290
1977	1,800	165,000	59	9,730
1978	1,800	160,000	57	9,072
1979	1,700	150,000	68	10,251
1980	1,800	160,000	64	10,306
1981	1,700	170,000	62	10,478
1982	1,650	174,000	47	8,210
1983	1,610	172,000	66	11,391
1984	1,650	180,000	70	12,542
1985	1,700	175,500	48	8,391
1986	1,689	190,000	61	11,590

SASKATCHEWAN

YEAR	NO. OF BEEKEEPERS	NO. OF COLONIES	PRODUCTION PER COLONY (kg)	TOTAL PRODUCTION ('000 kg)
1976	950	60,000	67	4,028
1977	900	60,300	63	3,774
1978	950	68,000	76	5,182
1979	1,550	74,000	73	5,371
1980	1,700	80,000	71	5,697
1981	1,700	83,000	72	5,948
1982	1,700	86,000	68	5,812
1983	1,700	102,000	79	8,097
1984	1.650	105,000	82	8,373
1985	1,650	105,000	70	7,382
1986	1,800	120,000	55	6,600

MANITOBA

YEAR	NO. OF BEEKEEPERS	NO. OF COLONIES	PRODUCTION PER COLONY (kg)	TOTAL PRODUCTION ('000 kg)
1976	1,100	80,000	68	5,479
1977	1,050	81,000	64	5,180
1978	1,200	85,000	81	6,863
1979	1,300	93,000	76	7,087
1980	1,400	99,000	70	6,960
1981	1,550	103,000	73	7,569
1982	1,600	108,000	72	7,789
1983	1,700	111,000	66	7,301
1984	1,750	116,000	68	7,893
1985	1,350	120,000	73	8,727
1986	1,300	110,000	73	8,030

ONTARIO

YEAR	NO. OF BEEKEEPERS	NO. OF COLONIES	PRODUCTION PER COLONY (kg)	TOTAL PRODUCTION ('000 kg)
1976	3,200	106,000	31	3,269
1977	3,500	106,000	34	3,606
1978	4,300	112,000	35	3,963
1979	4,300	112,000	33	3,709
1980	4,300	110,000	23	2,495
1981	4,300	110,000	30	3,343
1982	4,200	112,000	24	2,642
1983	4,500	110,000	41	4,491
1984	4,500	110,000	40	4,391
1985	4,500	113,000	38	4,305
1986	6,000	115,000	23	2,645

QUEBEC

YEAR	NO. OF BEEKEEPERS	NO. OF COLONIES	PRODUCTION PER COLONY (kg)	TOTAL PRODUCTION ('000 kg)
1976	2,400	67,000	28	1,884
1977	2,600	73,700	36	2,634
1978	2,750	82,000	40	3,289
1979	3,050	90,000	43	3,878
1980	3,420	98,000	17	1,647
1981	3,600	105,000	46	4,792
1982	4,000	115,000	29	3,376
1983	4,200	120,000	39	4,638
1984	4,200	120,000	53	6,400
1985	3,600	110,000	43	4,740
1986	3,400	100,000	30	3,000

NEW BRUNSWICK

YEAR	NO. OF BEEKEEPERS	NO. OF COLONIES	PRODUCTION PER COLONY (kg)	TOTAL PRODUCTION ('000 kg)
1976	470	2,700	36	98
1977	440	2,940	31	91
1978	500	3,200	30	97
1979	600	3,800	35	134
1980	650	3,900	29	115
1981	680	4,000	44	178
1982	600	4,100	32	132
1983	600	5,000	42	211
1984	550	5,000	36	181
1985	440	4,200	36	152
1986	420	5,000	23	115

NOVA SCOTIA

YEAR	NO. OF BEEKEEPERS	NO. OF COLONIES	PRODUCTION PER COLONY (kg)	TOTAL PRODUCTION ('000 kg)
1976	520	4,350	37	160
1977	520	4,580	37	171
1978	550	5,500	33	180
1979	590	6,100	29	174
1980	630	6,600	32	210
1981	650	6,700	43	288
1982	690	7,000	32	222
1983	690	7,000	36	254
1984	800	7,900	27	215
1985	800	8,000	29	236
1986	550	6,300	21	137

PRINCE EDWARD ISLAND

YEAR	NO. OF BEEKEEPERS	NO. OF COLONIES	PRODUCTION PER COLONY (kg)	TOTAL PRODUCTION ('000 kg)
1976	160	880	39	34
1977	200	950	48	45
1978	220	1,200	48	57
1979	210	1,300	43	56
1980	200	1,300	37	49
1981	200	1,300	51	66
1982	210	1,350	43	58
1983	210	1,350	42	56
1984	210	1,350	43	58
1985	135	875	43	38
1986	130	875	36	32

TABLE 3

HONEY IMPORTS (kg)

	FROM U.S.	TOTAL
1979	154,000	235,000
1980	181,000	276,000
1981	317,000	446,000
1982	162,570	239,341
1983	162,870	283,740
1984	102,349	196,492
1985	116,331	246,159

TABLE 4

HONEY EXPORTS (kg)

	TO U.S.	TOTAL
1979	4,132,000	8,163,000
1980	7,477,000	10,838,000
1981	4,902,000	8,200,000
1982	6,496,995	9,751,810
1983	6,872,090	9,521,553
1984	15,607,593	18,871,176
1985	13,998,543	17,278,234

TABLE 5

PACKAGE BEE IMPORTS

YEAR	NO. OF PACKAGES
1976	330,246
1977	314,439
1978	321,006
1979	323,102
1980	315,683
1981	331,261
1982	345,331
1983	323,012
1984	317,984
1985	249,036
1986	232,147

RESEARCH PROJECTS

The following is a listing of apicultural-related projects in Canada from about 1981 to the present. Two previous Research Workshop Reports (Victoria, B.C., Nov. 1977 and Toronto, Ontario, Nov. 1981) list earlier projects. The projects are arbitrarily listed under the headings of Agriculture Canada, Universities and Provinces. The chronological listing that follows may not be complete as submissions were not received from all apicultural researchers in Canada.

Year	Name	Title
AGRICULTURE CANADA		
(a) **Beaverlodge Research Station**		
1978-1983	D. Nelson S.C. Jay	The effect of apiary relocation on the orientation of honey bees.
1981	R.E. Salmon T.I. Szabo	Dried bee meal as a feedstuff for growing turkeys.
1981-1982	B.G. Fingler W.T. Nash T.I. Szabo	A comparison of two techniques for the measurement of nosema disease.
1981-1985	T.I. Szabo	Nectar secretion of canola.
1981-1982	T.I. Szabo	Phenotypic correlations between colony traits.
1981-1982	T.I. Szabo	Requeening colonies with queen cells.
1981-1983	T.I. Szabo	Outdoor wintering and colony entrances.
1981-1986	T.I. Szabo	Alberta nucleus hive.
1981-1986	T.I. Szabo	Various combs and weight gain.
1981-1984	J.R. Harbo T.I. Szabo	Comparison of I.I. and N.M. queens.
1981-1984	T.I. Szabo	Nectar secretion of dandelion.
1981-1985	T.I. Szabo	Thermology of wintering.
1981-1985	D. Nelson	Evaluation of canola species and varieties for bee forage.
1981-1982	T.I. Szabo	Phacelia tanacelifolia.
1981	T.P. Liu	Growth and development of protozoan pathozens of the honey bee and host-parasite relationships.

1981-1983	T.I. Szabo S.D. Neilson	A modified hive top feeder.
1981	T.I. Szabo	Selection and breeding of honey bees.
1982-1985	T.I. Szabo H.G. Najda	Flowering, nectar secretion and pollen production of some legumes.
1982	T.P. Liu	Fine structure and morphological studies of Varroa jacobsoni and Acatapic woodi.
1983-1985	D. Nelson D. McKenna E. Zumwalt	The effect of continuous pollen trapping on sealed brood, honey production and gross income.
1983-1986	T.I. Szabo D.T. Heikel	Solar pollen substitute feeder.
1984-1985	D. Nelson	The effect of short term storage methods on queen weight.
1984-1985	S. Liu D. Nelson M. Collins	Amoeba and Nosema-infected honey bee queens and worker attendants shipped in mailing cages to Western Canada.
1984-1985	D. Nelson	Evaluation of pollination requirements of canola species.
1985	T.P. Liu	Fine structure of hypopharyngeal glands from honey bees with and without tracheal mite infection.
1986	T.P. Liu	Testing Tioconazole and related compounds against both Ascophaera apis and Nosema apis.
1986	D. McKenna D. Nelson	Evaluation of nuclei wintered indoors with new and old queens and fed or not fed pollen supplement.

(b) **Saint-Jean-sur-Richelieu**

1986	C. Vincent	The effect of pesticides on foraging behaviour of strawberry pollinators.

(c) **Ottawa Research Station**

1980-1981	R. Boch R.A. Morse	Artifical odors and pheromones on queen discrimination.
1980-1981	T.A. Gochnauer	Distribution of AFB spores in and around infected colonies.
1980-1981	T.A. Gochnauer B. Furgala	Chemotherapy of Nosema disease.
1980	T.A. Gochnauer	Use of ETO to decontaminate larvae previously killed by chalkbrood.
1980-1981	T.A. Gochnauer U.J. Margetts	Volatile sulphide from residues of diseased honey bee larvae.
1980-1981	T.A. Gochnauer D.A. Shearer	Volatile acids from honey bee larvae infected with AFB.
1982	R. Boch	Attractiveness of different pollens to honey bees.
1982	R. Boch R.A. Morse	Genetic factor in queen recognition odors of honey bees.
1980-1982	R. Boch D.A. Shearer	Fatty acids in the heads of worker honey bees of various ages.
1982	T.A. Gochnauer V.J. Maragetts	Production of hydrogen sulphide in AFB in Vitro.
1984	T.A. Gochnauer	Improved methods of AFB and chalkbrood disease detection.

UNIVERSITIES

(a) Simon Fraser University

1982-1984	M.L. Winston C.D. Scott-Dupree G.C. Grant G.G.S. King K.N. Slessor	The biology and pheromone-based monitoring of the dried fruit moth.
1983-1986	M.L. Winston C.D. Scott-Dupree E.N. Punnett S.R. Mitchell	The feasibility of package honey bee production in British Columbia.
1984	M.L. Winston K.E. MacKenzie C.D. Scott-Dupree	Diversity and abundance of native bee pollinators on berry and fruit crops compared to natural vegetation.
1984	M.L. Winston K.E. Mackenzie M.J. Smirle	The effect of sublethal pesticide exposure on temporal division of labour and longevity.
1984-1985	K.J. Clark	A review of, and survey for, parasitic mites of honey bees in British Columbia.
1985-1986	M.L. Winston L.A. Ferguson	The effects of worker loss and amount of brood on temporal caste structure in honey bee colonies.
1985	M.L. Winston P.C. Lee	The effect of swarm size on brood production, emergent worker weight, and comb construction in newly-founded honey bee colonies.
1986	M.L. Winston S.A. Kolmes	A quantitative study of the division of labour among worker honey bees in demographically manipulated colonies.
1986	M.L. Winston M.J. Smirle	Inter-colony variation in pesticide detoxication by the honey bee.

(b) University of Alberta

1986	P. Sporns	Analysis of sulfur and major elements in honey.

(c) University of Manitoba

1981-1982	S. Malaipan S.C. Jay	Pollination studies of faba beans.

1981-1982	D.J. Dyer S.C. Jay	Effects of malathion on the behaviour and cholinesterase enzymes of honey bees.
1981-1982	R. Graham S.C. Jay	Rearing and mating of queen honey bees in Manitoba.
1981-1982	J.L. Harris S.C. Jay	A population model and its application to the study of honey bee colonies.
1981-1986	R.W. Currie S.C. Jay	Factors affecting the orientation of drone honey bees.
1982-1986	T. Pankiw D. Dixon S.C. Jay	Effect of aerial application of Malathion on honey bee colonies.
1983	S.C. Jay	Disorientation studies of honey bees.
1983-1985	S.C. Jay D. Nelson	Effect of apiary relocation on the orientation of honey bees.
1983	S.C. Jay D. Jay	Pollination studies of kiwifruit.
1983-1985	N. Mohr S.C. Jay	Foraging behaviour of honey bees on Canola.
1983	S.C. Jay	Disorientation studies of bees in New Zealand relative to the sun's position.
1984-1986	S.C. Jay D. Dixon	Management strategies for use with palletized honey bee colonies.
1984-1986	S.C. Jay R. Currie	Pollination studies of faba beans.
1985-1986	S.C. Jay D. Dixon	Nectar secretion studies of selected crops in Manitoba.

(d) **University of Guelph**

1962-1983	R.W. Shuel S.E. Dixon	Nutrition of the larval honeybee. Development of an artificial diet for laboratory rearing of honeybees.
1980-1982	D.S. Dietlein R.W. Shuel	Remote monitoring of activity of honeybee colonies by sound analysis. Measurement of carbon dioxide in honeybee colonies.
1981-1985	R.W. Shuel B.R. Christie	Selection for ease of tripping and high nectar in alfalfa.

1981-1985	R.W. Shuel D. Murrell	Physiological indices of nectar potential in forage legumes.
1981-1985	R.W. Shuel	Selection for high nectar potential in some agricultural honey plants.
1981	C.P. Milne	Laboratory measurement of honey production in the honey bee.
1981	M.V. Smith C.P. Milne	Increasing the efficiency of queen mating nuclei.
1981	G.W. Otis O.R. Taylor M.L. Winston	Studies in Africanized bees.
1982	P.G. Kevan	Cranberry pollination in Ontario.
1982	P.G. Kevan	Training honey bees to recognize microscopic textures of flower petals.
1982	P.G. Kevan	The pollination and oil yield in canola.
1982	P.G. Kevan	Pollination of milkweeds.
1982-1983	P.G. Kevan	Hazards of formulations of Carbaryl to honey bees.
1982	P.G. Kevan	Pollination of various crops.
1982	P.G. Kevan G.W. Otis	Evaluation of hazards of Sevin® to bees
1982	C.P. Milne	Laboratory measurement of brood disease resistance in the honey bee.
1982	G.W. Otis	Characteristics of feral honey bee colonies in Ontario.
1982-1985	A.R. Davis R.W. Shuel	The secretion of systemic insecticides in nectar and some effects on honey bee development.
1983-1986	G.W. Otis	Effects of worker bee size on behaviour, honey production, and pollination.
1983	C.P. Milne	Honey bee hygienic behaviour and resistance to chalkbrood.
1983	C.P. Milne W.C. Rothenbuhler	Polarization of the honey bee gynandrormorphic blastoderm.

1984	P.G. Kevan	Lowbush blueberry pollination.
1984-1985	G.W. Otis G.M. Grant	Effects of inner cover design on winter honey consumption.
1984-1986	P.G. Kevan	A survey of pollinator services.
1984 -	P.G. Kevan	Foraging behaviour of bees.
1984-1985	G. Morales G.W. Otis	Effects of hive size on colony demography.
1984-1985	G.W. Otis G.M. Grant	Evaluation of Canadian honey bee stocks.
1984	C.P. Milne K.J. Pries	Honey bee corbicular size and honey production.
1984	C.P. Milne G.W. Friars	An estimate of the heritability of honey bee pupal weight.
1984-	Z.Y. Huang	Activation of hypopharyngeal glands.
1985	A.R. Davis R.W. Shuel	Movement of systematic insecticides into pollen?
1985	A.R. Davis D.F. Boyes G.W. Otis G.M. Grant	Transport of mature queen cells in a portable incubator.
1985	G.W. Otis D. Randall	The influence of genetic relatedness on worker visitation to honey bee larvae.
1985	C.P. Milne	Laboratory tests of honey bee hygienic behaviour and resistance to E.F.B.
1985-1986	C.P. Milne	An estimate of the heritability of the corbicular area of the honey bee.
1985	C.P. Milne	An estimate of the heritability of worker longevity or length of life in the honey bee.
1985	C.P. Milne	A heritability estimate of honey bee hoarding behaviour.
1985-1986	G.W. Otis	Effects of tracheal mites on overwintered colonies of honey bees.
1985-1986	G.W. Otis	Studies on the biology of the honey bee tracheal mite during winter.

1986	G.W. Otis P.E.A. Teal M.H. Carter	Gas chromatographic analysis of honey bees infested by tracheal mites.
1986	W. Ramirez G.W. Otis	Developmental phases in the life cycle of Varroa jacobsoni.
1986	G.W. Otis W. Ramirez J. Bath	Have Africanized bees brought tracheal mites to Costa Rica?
1986	C.P. Milne	Honey bees with larger corbiculae carry larger pollen pellets.
1986	A.R. Davis R.W. Shuel	Distribution of ^{14}C-labelled systemic insecticides in royal jelly, queen larvae and nurse honey bees.
1986-	C.D. Scott-Dupree	The impact of Acarapis woodi on overwintering honey bee colonies.

PROVINCES

(a) **British Columbia**

1981-1983	J. Corner	Using pollen inserts to accomplish cross pollination in a solid block of Spartan apples.
1981-1985	D.M. McCutcheon D. Bates	Overwintering honey bee queens for commercial use.
1981-1985	J. Corner J. Gates F. Calvert	Development of queen rearing techniques.
1981-1985	J. Corner J. Gates F. Calvert	Honey bee stock selection using closed population techniques.
1982-1983	J. Corner J. Gates D.M. McCutcheon M. Wyborn F. Calvert	Production of package bees.
1984-1985	J. Gates	Comparative testing of B.C. developed stock.
1985	M. Wyborn D.M. McCutcheon	Applying fumagillan in dry baker's fondant sugar.
1985-1986	D.M. McCutcheon	Alternate method of depopulating hives.

1986	J. Gates	Using the Jentner queen rearing device.
1986	J. Gates	Pollination survey in Okanagan area of B.C.

(b) **Alberta**

1984	D. Colter	Indoor wintering of five-frame nuclei hives in Peace River, Alberta.
1985	D. Colter	Pesticide degradation rates for Furadan, Decis, Lorsban, and Larvin.

(c) **Saskatchewan**

1982 -	J. Gruszka	Analysis for the presence of oxytetracycline residues in Saskatchewan honey.
1983 -	D. Murrell	The effect of fall and spring protein supplementation on honey bee colonies.
1983-1985	T. Taylor S. Clifford	The feasibility of utilizing Saskatchewan reared honey bee queens in commercial honey production.
1985-	J. Gruszka D. Peer	Honey bee tracheal mite project, La Ronge, Saskatchewan.
1986-	J. Gruszka	Wintering nucleus hives indoors.

(d) **Manitoba**

1981	D. Dixon B. Fingler	The effects of the 1981 Manitoba emergency mosquito control program on honey bees.
1982	D. Dixon S.C. Jay	Nosema disease in package bees, queens and attendant workers shipped to Western Canada.
1984	D. Dixon B. Fingler	Environmental monitoring program for the 1983 aerial spraying of malathion to combat Western Equine Encephalitis.
1984	D. Dixon S.C. Jay	Infertile and Nosema infected queen honey bees shipped to Western Canada.
1986	D. Dixon J. Borsa T.A. Gochnauer	Sterilization of comb with gamma radiation.

(e) **Ontario**

1986	D.G. McRory A.R. Davis	Investigation of Africanized bees in Ontario.
1986	D.G. McRory A.R. Davis	Survey of mite fauna in hives in Ontario.

(f) **Quebec**

1986	A. Methot	Possibility of controlling A.F.B. using gamma radiation from Cobalt 60.
1984-1986	A. Methot	Efficiency of transferring bees from colonies infected with A.F.B. into disinfected equipment.
1984-1987	J.-L. Villeneuve	Measure foraging activity and relate to colony population.
1983-1986	J.-L. Villeneuve	Queen selection.
1984-1986	J.-L. Villeneuve	Methods to reduce turbidity in honey due to handling.
1985-1986	J.-L. Villeneuve	Methods of moisture determination in dried pollen.
1984-1986	B. Levac	Queen selection for honey production.
1985-1986	B. Levac	Effect of temperature, speed, moisture, etc. on pumping honey.
1983-1986	B. Levac	Queen rearing for high quality

(g) **Nova Scotia**

1982	L. Crozier	Outdoor wintering of nuclei.
1986	E. Nickerson H. Specht L. Crozier	Indoor wintering of honey bee colonies in Nova Scotia.