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Beekeeping in Western Canada

COVER PHOTO: Honey bee collecting pollen from apple blossom.

Beekeeping in Western Canada

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FOREWORD

Beekeeping in Canada has expanded considerably during the last 20 years, particularly in Western Canada. Alberta, Manitoba, and Saskatchewan annually produce about 70% of Canada's 25–29 million kg honey crop. In 1979 Canada had a record honey crop of 33 million kg (see Table). The value of the honey and wax was more than 47 million dollars.

Western Canada has about 10 000 beekeepers. However, approximately 85% of these keep bees as a hobby or for secondary income. The number of hobby beekeepers has increased dramatically in the last 5 years, as has attendance on field days and at short courses in beekeeping.

This publication is intended as a guide for beekeepers on general management practices. Procedures for registration under the Bee Diseases Act of each province, disease control recommendations, and specific in-depth information can be obtained from provincial departments of agriculture, from the Entomology Department, University of Manitoba, or from the Beaverlodge Research Station.

WORD OF CAUTION Some beekeepers and/or members of their families may be allergic to bee stings, or may in time develop an allergic reaction to them. Immunity enjoyed by most beekeepers is not necessarily permanent. Immediate medical help should be sought if any of the following symptoms are experienced: (1) generalized itching, hives, or swelling; (2) feeling of constriction in chest, or sneezing; (3) abdominal pain, nausea, vomiting, or diarrhea; (4) thickened speech, confusion, collapse, or unconsciousness. For further information contact your doctor.

INTRODUCTION

The beekeeping industry in Western Canada has two primary values to agriculture. The first and most visible is the production of about 25 million kg of honey each year. The second is the pollination provided by the honey bees — estimated to be at least of equal dollar value. In Western Canada, tree fruits and small fruits, legumes, sweetclover, alsike clover, white clover, birdsfoot trefoil, red clover, sainfoin, buckwheat, sunflower, and rapeseed (Polish) are dependent on honey bees for pollination. The number of wintered colonies has increased from 5% to about 37% during the last 5–7 years. With proper management overwintered or package colonies are able to produce an average of 65 kg of honey per colony, but yields as high as 227 kg per colony are known. The fascinating life of bees and the fact that they are the only insects able to communicate the location, quality, and quantity of a food source or of a new home site to other bees, interests many people.

BEGINNING WITH BEES

Sources of information

There are many good books available on beekeeping; here are some of them.

ABC and XYZ of bee culture, 33rd ed. Medina, Ohio: A. I. Root Co.; 1966. 728 pp.

The hive and the honey bee. Hamilton, Ill: Dadant and Sons, Inc.; rev. 1975. 740 pp.

Honey bee pests, predators and diseases by R. A. Morse. Ithaca and London: Cornell Univ. Press; 1978. 430 pp.

Contemporary queen rearing by H. H. Laidlaw Jr. Hamilton, Ill: Dadant and Sons, Inc.; 1979. 199 pp.

The following periodicals are also available:

Canadian Beekeeping. Orono, Ont.

American Bee Journal. Hamilton, Ill: Dadant and Sons, Inc.

Gleanings in Bee Culture. Medina, Ohio: A. I. Root Co.

On request, the provincial apiarist, the supervisor of apiculture, the apiary branch, the district agriculturist, or your local agricultural representative will provide information on beekeeping. The addresses of the provincial apiarists are:

Apiary Branch, 4607 23rd Street, Vernon, B.C. V1T 4K7

Supervisor of Apiculture, Box 415, Falher, Alta. T0H 1M0

Apiary Administrator, 196 9th Street E., Prince Albert, Sask. S6V 0X5

Apiarist, 910 Norquay Bldg., 401 York Avenue, Winnipeg, Man. R3C 0V8

Information may also be obtained from the Research Station, Agriculture Canada, Beaverlodge, Alta. T0H 0C0, and the Entomology Department, University of Manitoba, Winnipeg, Man. R3T 2N2.

Beekeeping courses are offered at Fairview College, Fairview, Alta., T0H 1L0; Lakeland College, Vermilion, Alta. T0B 4M0; Olds Agricultural College, Olds, Alta.; and the Entomology Department, University of Manitoba, Winnipeg, Man. R3T 2N2.

If you intend to make beekeeping your profession, the best way to learn is to work with a successful beekeeper for at least 2 years, and to take short courses in beekeeping when possible.

The honey bee

For the honey bee, the colony is the unit, rather than individual bees. The colony consists of one queen (Fig. 1), as many as 80 000 workers, and a few thousand drones. The queen not only lays up to 2000 eggs a day, but also is responsible for the "colony morale." With good-quality queens colony development is better. The workers are undeveloped females and perform a great variety of activities. They clean the hive, secrete worker jelly to feed the worker

FIGURE 1 Honey bee queen marked with a numbered disk, and attendant workers around her.

larvae, secrete royal jelly to feed the queen larvae, protect the colony from intruders, collect pollen, nectar, and water, make the honey, secrete wax to build combs, regulate the temperature and humidity of the hive, and perform many other complex activities. The drones only function is to fertilize virgin queens.

The length of time in days required for the development of bees is as follows:

Stages	Queen	Worker	Drone
Egg	3	3	3
Larva	6	6	7
Pupa	7	12	14
Total	16	21	24

Honey bees are not native to America; early settlers brought them from Europe. The most important geographical races of bees are the Italian, Carniolan, and Caucasian, and their hybrids. Importation of bees is now permitted only from USA. This regulation is important to avoid the importation of detrimental *Varroa jacobsoni* and *Acarapis woodi* mites.

Honey plants

Honey bees collect nectar, pollen (Fig. 2), and propolis from flowering plants and in return pollinate plants. Important early nectar and pollen sources are willow, fruit trees (cover photo), and dan-

delion for colony buildup. The main nectar flow is obtained from alsike clover, rapeseed, alfalfa, sweetclover, white clover, red clover, fireweed, sunflower, and buckwheat.

The blooming period of plants varies in different areas. At Beaverlodge, Alta. (latitude 55°N) from 1954 to 1977, 72.6% of the total scale colony gain was produced in July, 23% in August, and 5.2% in June. Nectar flow records can aid in management decisions. Colonies may lose 0.45–1.35 kg/day during the fall due to large populations of bees and the absence of nectar.

The quantity of the honey crop is dependent on the population of the colonies and weather for both plant development and bee flight.

Hive and bee equipment

The Standard Langstroth hive is generally used by beekeepers in North America. This is a box (chamber) filled with 9 or 10 frames where the bees build, or draw, the combs.

The box has a removable top, called a hive cover, and a removable bottom, called a bottom board. One end of the bottom board is open and this provides the entrance for the bees. Many beekeepers use an inner cover inside the hive cover. When the colony fills one chamber with brood, bees, honey, and pollen, the beekeeper places another chamber on the first one. These first two boxes are called brood chambers. When they are nearly full, more boxes with nine combs each are placed on the top of the two brood chambers. These boxes are called honey supers. The total number of chambers can go as high as six or eight (Fig. 3).

Hive parts, frames, foundation, wire, and nails are readily available from bee supply houses or you can construct the first two items. For details consult Agric. Can. Publ. 1584 *Beehive construction*. Used equipment may also be purchased, but this must be inspected first by the provincial apiarist.

The beekeeper requires a hive tool (a flat, chisel-like piece of metal used for opening the hive, removing the frames, and scraping), a smoker (used to calm the bees), and a bee veil, coveralls, and gloves (for protection)—all available from bee supply houses.

SEASONAL MANAGEMENT

Obtaining bees

Package bees or established colonies can be purchased in the spring. The package bees should be ordered 3–5 months in advance from breeders in southern U.S. or from bee supply houses, local bee associations, or local beekeepers. The package bees are screened

FIGURE 2 Honey bee worker collecting nectar and pollen from blooming white clover.

FIGURE 3 Commercial bee yard in a red clover field in the Peace River region.

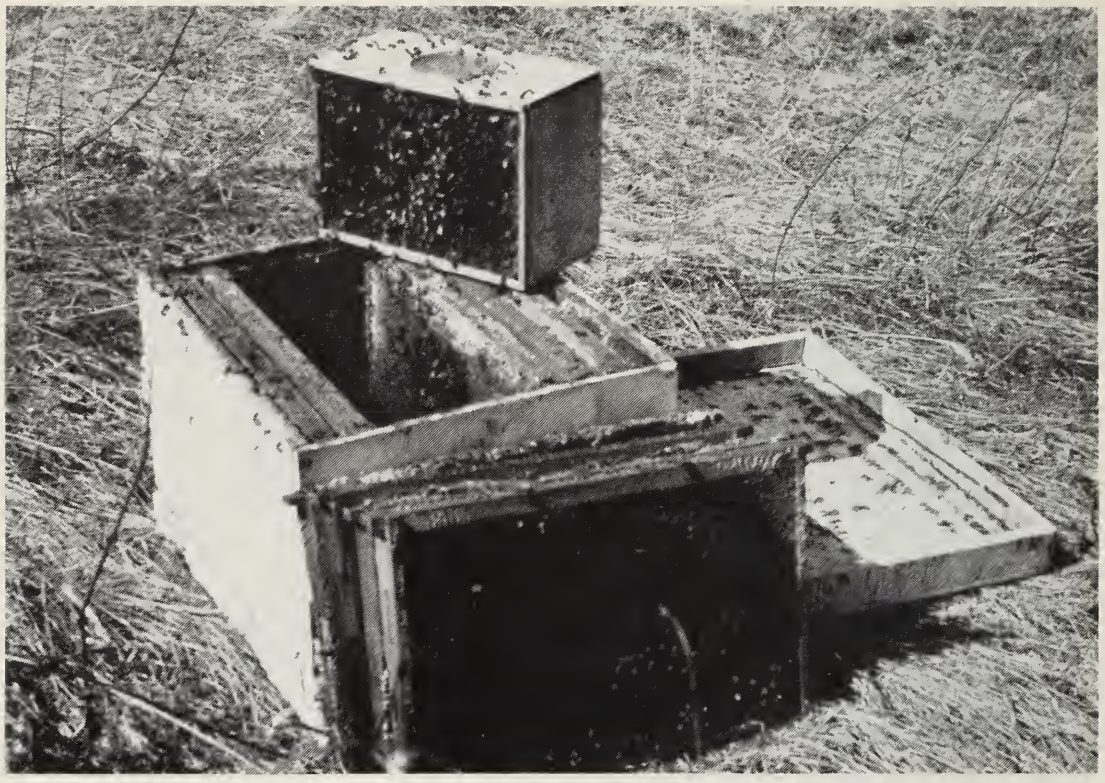

FIGURE 4 Package bees before installation.

cages (Fig. 4) usually containing 0.9 kg of workers, one queen in a cage, and a container with sugar syrup. These are transported from California or southeastern U.S. by special trucks or occasionally by air freight. The best time to receive the packages is about 10–12 weeks before the main flowering period (Fig. 5), from early April until late April. Beginners should order for delivery in late April or early May.

When bees with combs are purchased the colonies must have been inspected previously and a permit must be obtained from the provincial apiarist. The most suitable colony is a strong overwintered one in two brood chambers.

Spring bee yards

A spring yard must be an easily accessible site, at least 100 m from the highway and the nearest inhabited dwelling. The ground should be level and have good drainage. Avoid low areas which usually are damp and cold. Windbreaks on the north and west of the apiary are essential, and direct sunlight is very important for proper colony development. Early nectar and pollen sources such as willow, dandelion, and fruit bloom should be close by. Ensure that there is a water source, e.g., a dugout or slough, near the site or that water is provided for the bees. To minimize drifting use jagged rows

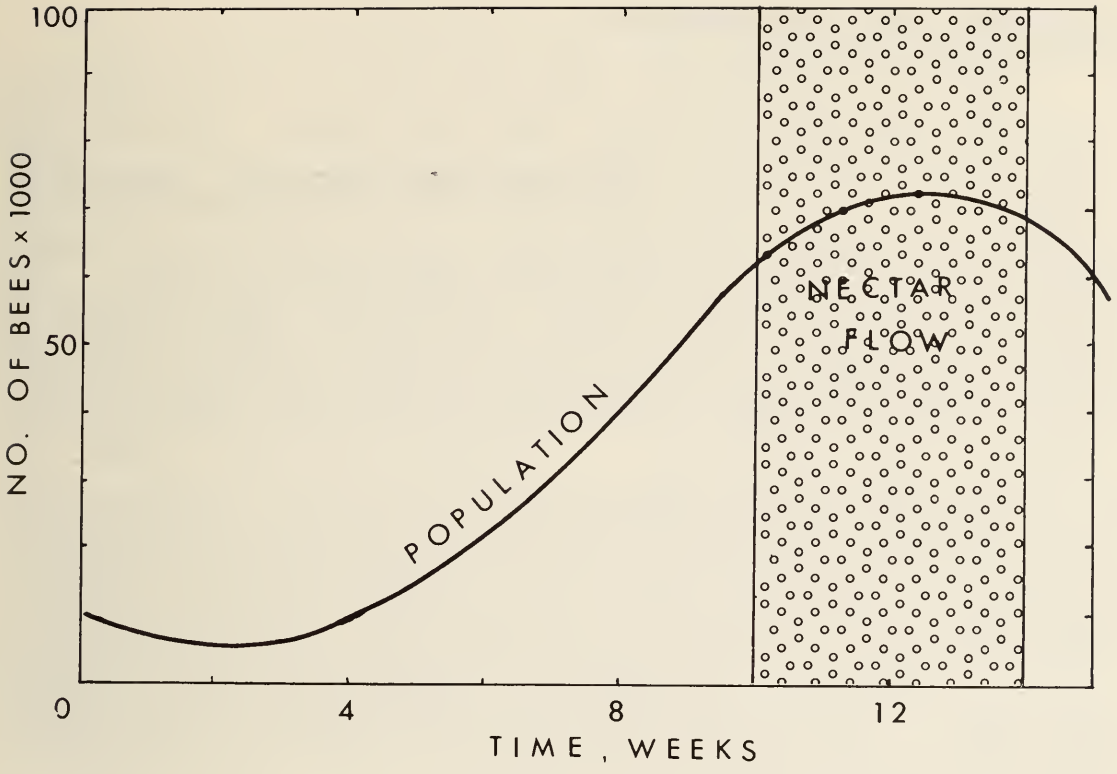

FIGURE 5 Ideal relationship between package colony buildup and nectar flow.

or groups of four hives with various distances between colonies. Face the colonies in different directions, but generally not northerly. The brood chambers may be painted different colors to serve as orientation cues. Avoid locations visited by bears and other predators or, if this is not possible, use an electric fence to discourage such visits.

Preparing brood chambers

Brood chambers with nine frames should be prepared well before the package bees arrive. Some beekeepers prepare them in the fall after they have killed the bees. Combs 1, 2, 8, and 9 should be filled with honey; combs 3 and 7 should be filled with mostly pollen and some honey, and combs 4, 5, and 6 should be three-quarters empty and one-quarter filled with honey and pollen. Each brood chamber should weigh approximately 25–30 kg.

Bring brood chambers stored in cold storage sheds into a warm building for a few days before use. Package bees hived in warm brood chambers develop better. An inner hive cover of burlap, canvas, or tar paper and an insulated top, or hive cover, help conserve heat.

Package bee installation

When the package bees arrive place them in a dark room at 10–16°C. Feed them on arrival, daily, and before installation by spraying the screen side of the packages with warm syrup (50% sugar). Hive the package bees as soon as possible, because with duration of storage the worker and queen mortality increases; nosema infection also increases, since the bees are not able to get rid of their dead and sick. A cool, cloudy day or late afternoon is ideal for installation. This gives the colonies a chance to settle for 15–24 hours before flight. If the weather is very cold, install the bees in their hives in a darkened warehouse and move them as soon as possible to the spring yard.

The direct release method as explained here is recommended for hiving the package bees. The hive entrance should be reduced to 10 x 20 mm. Remove the three center frames. Give the package a severe jar so that the bees fall to the bottom of the cage. Quickly remove the feed can and the cage with the queen, then spray the bees with sugar syrup. If it is cold use only a little syrup, in warm weather use more. In cool temperatures protect the queen from chilling by placing the queen cage in your pocket.

Shake the bees into the bottom of the brood chamber, then replace all but one comb. Place the queen cage into the brood chamber, remove the screen from the cage, and release the queen to the workers (Fig. 6). In warm weather spray the queen with warm

FIGURE 6 Direct release of the queen amongst the workers, during installation of package bees.

syrup before releasing her, to prevent her from flying. Replace the last comb carefully to avoid injury to the queen and replace the hive cover.

Spring inspection of colonies

About 3–4 days after installation check the colony for the presence of eggs. Remove an outside comb and slide combs to that side, so that a middle comb can be removed for inspection. Usually the presence of a large number of uniformly laid eggs means that the queen is there and laying normally. Replace failing or missing queens as soon as possible.

Check the colonies briefly at least every 2 weeks thereafter and replace all missing or nonlaying queens and queens with poor brood patterns. After July 1, it is better to unite a queenless colony with a queen-right colony, rather than attempting to requeen (see Requeening and uniting colonies). During the third check, look for brood diseases (see Honey bee diseases and pests).

Check overwintered colonies by the middle or end of April. Southern areas should be checked approximately 2 weeks earlier than northern areas. Look for normal egg laying, for the presence of brood diseases, and for adequate quantities of honey and pollen. A colony should have a minimum of 10 kg of honey and about 0.5 kg of stored pollen. If disease is detected or the colony's food supply is inadequate the bees should be fed (see Feeding bees).

During the first check of wintered colonies scrape all the dead bees and other waste from the bottom board. If in some colonies the bees occupy only the second brood chamber, remove the first chamber but make sure there is adequate pollen and honey. Close the top entrance and leave a reduced bottom entrance.

Requeening and uniting colonies

Queen loss of 5% is common, but occasionally the loss is as high as 25%. Extra queens in their cages can be stored between the middle combs of a brood chamber after attendant workers have been removed. These extra queens can then be used as required for replacements in queenless colonies.

When a package or overwintered colony is to be requeened, remove the failing queen and destroy all the queen cells. The colony must be queenless. Remove the cork from the candy side of the mailing cage (this cage should have a queen without attendant workers), then push a nail into the candy in order to provide an opening. Place the cage between two frames (candy end up) in the middle of the cluster so that the bees have access to the screen side of the cage. The bees will eat out the candy and release the queen in a few days. Check the colony 10–14 days later for acceptance of the new queen.

With strong overwintered colonies an extra precaution is warranted. Use a large push-in cage. This cage is made of 3-mm mesh wire, like a shallow upside-down tray pushed into the comb. A short tunnel entrance is blocked with soft candy (a mixture of icing sugar and invert sugar). This cage placed over the new queen and emerging brood provides space for young attendant workers, for the queen to lay eggs, and for a slow release of the queen (for more details see Queen introduction, Canadex, Bees 616).

If no extra queens are available or the queenless colonies are weak and have nonlaying or drone-laying queens, the best way to save these bees is to unite them with a queen-right colony. To do this place a sheet of newspaper on the top of the normal colony. Punch a few small holes in the paper with a pencil and place the queenless unit on top of the paper, above the queen-right colony. The bees will gradually chew through the paper and unite without fighting.

Feeding bees

As a regular management practice, both package and overwintered colonies need feeding. The purpose of feeding is to provide an adequate quantity of food, and to stimulate brood rearing. Medicated feed serves to prevent or eliminate some diseases.

The most effective feeder is the hive top feeder (Fig. 7), which fits on top of the super. The bees can reach the syrup through a

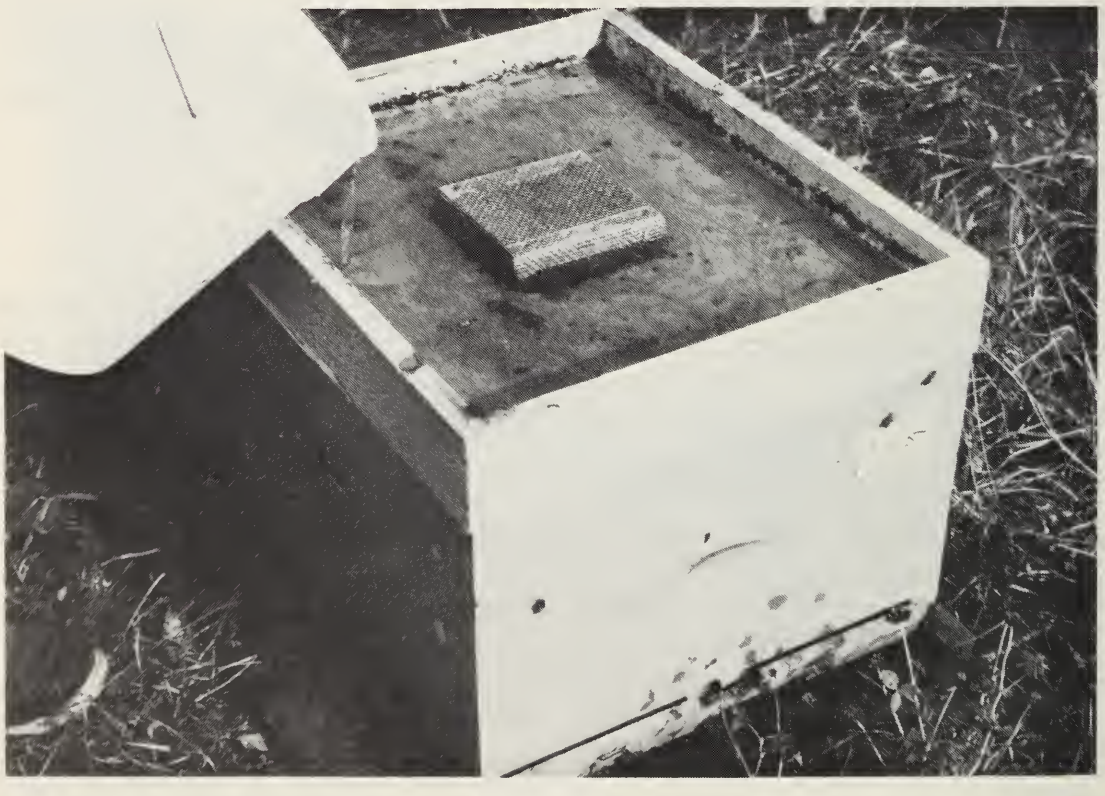

FIGURE 7 A hive top feeder.

small opening right above their nest. It is practical to construct this feeder to hold about 8–10 L of syrup. The feeder can be used any time of the year.

Another popular feeder is the 13.6-kg honeypail feeder. In the middle of the lid a 75 x 75-mm piece of 16 mesh/cm brass screen is melted (with a hot iron) over 1-cm holes. This feeder is used upside down over a 5-cm opening in the inner cover, if there is one, or in the hive cover and is recommended for rapid fall feeding only. About 7.5 kg of sugar can be provided at one time with this feeder.

Honey is not recommended for feeding bees because it is generally more expensive than sugar and some honey crystallizes so fast that the bees have difficulty consuming it. Honey can also spread bee diseases. Clean sugar mixed with water to 60–64% by weight is recommended as a bee food (i.e., 2 parts sugar and 1 part water by weight).

Pollen is an important protein source for bees and is essential for brood rearing. In northern apiaries the bees are not able to collect pollen until the middle of April or as late as the beginning of May. For healthy colony development feeding of a protein source is essential. Pollen supplement consists of a protein source (e.g., soybean flour) mixed with natural pollen. Pollen substitute is a protein source used to replace pollen.

Pollen supplements and substitutes should have 23% protein because this is the optimum protein level in natural pollen. The following formulas are recommended. For pollen supplements, use 1 kg of natural pollen, 5 kg of brewers' yeast (45% protein) or soybean flour (expeller processed, low fat with 42% protein), 4 kg of granulated sugar, and approximately 2 L of water.

Mix the pollen in warm water, then add the sugar and stir until it dissolves. Next add the brewers' yeast or soybean flour until a thick dough is formed. The consistency of the supplement can be regulated with the amount of liquid used. Medication can be mixed with the pollen supplement to avoid any risk of spreading American foulbrood disease. About 0.5–1 kg of pollen supplement should be placed on the frames above the brood nest of each colony.

For pollen substitute, replace the natural pollen with 0.5 kg of brewers' yeast. This substitute is not as attractive to bees and they consume it slowly.

Dividing and boosting colonies

Colony development depends on the quality of the queen, the prevention or control of disease, the drifting of bees, the weather, and many other factors. Package and overwintered colonies show large deviations of colony population. For this reason it is a good practice to check the colony strength during inspection and shake bees from extra packages in front of the weak colonies. In this way most colonies will be able to build up their population within 10–12 weeks before the start of the main nectar flow (Fig. 5).

Overwintered colonies can cover 20 combs by the middle of May, and would reach their peak population before the main nectar flow. These colonies should be divided. First locate the queen and place her with the comb she is on outside the hive. Select 2–3 combs of emerging brood from each populous colony. Place six of these into each prepared hive containing four frames of honey and pollen. A new queen can be introduced by means of a push-in cage (see Requeening and uniting colonies). The new hive should be placed in a new location. Place the comb with the queen into the original hive and put empty combs into the hive in place of those removed.

A weak colony can be boosted by exchanging its position with that of a populous colony. The weak colony receives most of the foragers from the strong colony. The strong colony retains the young population.

Another method of boosting weak colonies is to add 1–2 frames of brood, or shake bees in front of the hive. The young bees will stay with the new hive and the old ones will fly home.

Supersedure and swarming

Both package and wintered colonies may replace their small, inferior, or nosema-infected queens. A colony usually builds one queen cell in the upper part of the brood comb. The newly emerged queen mates and starts egg laying and the two queens often lay eggs together in the same colony until the old queen dies.

The colony that is preparing to swarm builds 10–30 queen cells on the lower part of the brood combs. Before the first queen emerges the old queen leaves the hive with approximately half of the colony population. The swarm settles close to the hive on a tree or other suitable place (Fig. 8), then the scout bees search for a new home. As soon as they find one the swarm flies to this new home. Swarming of a colony is not desirable. This tendency can be minimized by providing sufficient space for the bees, brood, and honey at all times.

Summer bee yards

Since nectar-producing areas change with the season, spring yards will usually not be suitable during the main nectar flow.

Summer yards should be in the immediate vicinity of major nectar sources (Fig. 3), and the location should be sunny and have wind protection, especially at ground level. Beekeepers usually place 20–40 colonies in one yard. In good areas the bee yards are about 0.8 km apart.

FIGURE 8 A swarm of honey bees settled on a tree.

Moving colonies

The best time to move colonies from the spring yard to the summer yard is before the second brood chamber is provided. To minimize losses of bees move the colonies before or after their flight activity: early morning or late evening. Smoke the entrance and place the hives on the truck. If the motor is kept running while loading the bees, flight will be reduced. It is not necessary to close the entrances. With populous colonies this could be detrimental because an excited colony can die in a few minutes due to lack of oxygen and overheating. In the new location place the colonies randomly, in groups of four, facing different directions.

Supering for the main nectar flow

When the bees cover 7-8 combs the second super is placed on the colony. This should contain nine dark combs with some honey. Some beekeepers place the second brood chamber under the first one and a few weeks later reverse them.

Overwintered colonies usually have bees in two brood chambers and these are reversed during the first or second inspection. As soon as the two brood chambers are full of bees the first empty honey super should be provided. During a good nectar flow,

provide two empty supers at a time for each colony. As the population increases and the flow intensifies place the fourth, fifth, and sixth supers on the colony. It is a good practice to remove honey supers and add empty supers during the same visit to the bee yard. When the honey is ripe (i.e., less than 18.6% moisture) the supers can be replaced weekly with extracted ones.

Removing the crop

When the bees start to cap the cells filled with honey in many areas, it is time to remove the honey. In areas where the air moisture is high, wait until one third or two thirds of the cells are capped. Honey is graded according to its moisture content and color. The water content of honey can be measured with a refractometer. No. 1 grade must be less than 17.8% moisture, No. 2 grade 17.8–18.6%, and No. 3 grade 18.6–20%. Honey containing more than 20% moisture will ferment in storage. Western Canadian honey is white or water white, except dandelion honey and sunflower honey, which are both golden, and buckwheat honey, which is amber.

One way to remove bees from the honey comb is with a bee-escape board. The board, which has two 2-cm diameter holes with one-way passages, is placed between the super containing the honey to be removed and the rest of the colony. The bees leave the super through the holes and enter the brood chamber. The super is usually empty within 24 hours. This method is recommended for hobby beekeepers.

Another method of removing bees from honey supers is to use a bee blower. The super with honey combs and bees is placed on a stand in front of the hive. High velocity air is directed into each passage between the combs and blows the bees onto the ground where they can walk back into the hive. The bee blower works well when conditions are cool and cloudy, whereas chemicals do not.

Chemicals such as carbolic acid (phenol), benzaldehyde, or butyric anyhydride are also used to repel the bees from honey supers. These repellants are applied to an acid board (similar to a hive cover), which is lined with a thick cloth on the inside. When this is placed on a honey super the bees move down into the brood chambers. Care must be taken by the beekeeper in the handling of these chemicals as they can be hazardous to humans and can contaminate the honey if used carelessly or in excessive amounts. Upon request your local provincial apiarist will provide recommendations for this procedure.

Extracting honey and separating the wax

In some years the overwintered colonies are able to produce surplus honey from willow and dandelion. If a super per colony is stored it is a good idea to extract the dandelion honey as soon as

possible because it crystallizes rapidly. During the main nectar flow the situation is similar with rapeseed honey. After removal, the honey supers are transported into a hot room where the temperature is maintained at approximately 25°C. Then, in the extracting room the cappings are removed from the honey combs with a capping scratcher or an uncapping machine. The combs are then placed in an extractor and the centrifugal force removes the honey from the combs. The honey is collected and strained and then stored or packed.

The wax cappings also contain honey which should be removed. With the spin-dry method the wax and honey are separated by centrifugal force. The wax stays inside a perforated drum and the honey is forced outside.

With the Brand melter method, the wax and honey are melted by a heat source, such as overhead radiant heat. The wax, which is lighter, will float on the honey. The wax and honey are drained off by separate valves from the top and bottom of the melter, respectively. Prolonged high temperature will damage the honey and should be avoided.

Beeswax from cappings, culled combs, and scrapings of burr comb should be saved for rendering. However, rendering old combs is difficult and it is advisable to send them to a wax processing plant.

About 0.5–2 kg of wax is obtained from cappings for each 100 kg of extracted honey. Cappings and white combs are easily melted with a solar wax extractor.

Queen rearing

Queens should be replaced in overwintered colonies on an annual basis. This offers insurance against unexpected queen losses during the winter and poor colony development.

SMALL-SCALE QUEEN PRODUCTION Choose a breeder colony containing bees that are docile, are good honey producers, and have good wintering ability. These are the most favorable characteristics. Place an empty, light-colored comb in the center of the brood nest. The queen will lay eggs in this comb. After about 3 days, when the eggs start to hatch, remove the comb and place it in a cell-builder colony. Prepare the cell-builder colony from a colony with a large population from which you have removed the colony queen and destroyed all the queen cells. Nine days after removing the queen, introduce the comb from the breeder colony. Two days after introducing this comb, carefully check it for queen cells. Mark the queen cells present by pushing 2.5-cm nails above each cell in such a way that the cells will not be damaged, and about 6–7 days later destroy all the unmarked queen cells. In this way queens will be produced from the younger larvae and will be the best-quality queens. About 9 days after the introduction of the comb to the cell-builder

colony cut these cells out of the comb very carefully and place them in nuclei, or colonies, that have been prepared for requeening. The new queen will start egg laying on an average of 14 days after emergence.

COMMERCIAL QUEEN REARING The Doolittle system of queen rearing involves the transferring of small larvae (Fig. 9) into artificial queen cells. These cells are placed into queenless or cell-builder colonies. Then the ripe queen cells or the emerged queens are placed in mating nuclei. For details consult the recommended references on page 7.

Comb building

During the honey flow, 3–6 foundation frames are easily built by the bees; however, the supering of the colonies with foundation frames could significantly reduce the honey yield. An alternative is to use these colonies for comb building after the honey flow period. Remove all combs from a colony and replace them with foundation frames. Then the bees with the queen should be shaken, blown, or brushed from the old combs onto the new frames. Feed the colony with 60% sugar syrup. A colony is able to build 15–20 combs during every 6–8 days (Fig. 10). As the bees draw out these foundations, replace them with frames of new foundation. The same colony can be used repeatedly. See Comb-building for colony increase, Canadex, Bees 616.

Wintering honey bee colonies

In the past, the wintering of honey bee colonies in the Prairie Provinces has been limited. During the last 5–7 years the number of colonies being wintered increased from approximately 5% to 37%. Indoor and outdoor wintering are both successful. The same preparation is usually necessary for both types of wintering.

By about mid-August the colonies are reduced to two brood chambers. This is the time to replace the old colony queens with locally reared ones. The queens should be replaced every year. At present there is no easy way to do this. For instructions on requeening see Requeening and uniting colonies. Colonies with newly introduced queens will have more brood and more young bees for wintering.

Reduce each colony's bottom entrance to a 1 x 5-cm opening and equip it with a nail grid to exclude mice. Also place rodent poison under the hives.

The robbing of colonies by bees could be a serious problem during the wintering preparation period. Never expose combs to bees for any length of time, and make all necessary manipulations

FIGURE 9 A less than 1 day old larva being grafted into an artificial queen cap.

FIGURE 10 After nectar flow a colony can be provided with foundation frames and fed sugar syrup to build 15–20 combs every 6–8 days.

as quickly as possible. Robbing usually starts when the bees have access to honey. They then try to invade other colonies. When this happens reduce the entrances and manage the bees before or after they fly.

At the beginning of September feed the colonies with a 60–64% sugar syrup. Use large-capacity feeders (see Feeding bees), and provide 8–10 L of syrup at a time. Continue the feeding until each colony has reached a total weight of about 63 kg. Medicated feed for disease control should be administered with the syrup (see Feeding bees). After feeding, provide a top entrance of 1 x 5 cm by reversing an inner cover which has a notch cut in the rim.

In late fall (end of October) the colonies should be moved into a wintering facility or prepared for outdoor wintering. For outdoor preparation move four colonies into one group. Ensure that all colonies touch each other tightly, with two facing east or south and two facing the opposite direction. Wrap the colonies with R7, 58.4 cm rolled fiber glass insulation with double insulation on the top. Cut the entrance holes in the insulation (Fig. 11), and cover the fiber glass with building paper. Fold the paper in over the colonies and cover the top with a 122 x 122-cm building paper or plywood (Fig. 12). Fasten the paper and the plywood covers twice with baler twine, then nail four 10 cm x 15 cm x 8 mm plywood pieces, with approximately a 2 x 6-cm opening in the middle, to the top entrances (Fig. 12). They should have been previously painted in different colors.

If indoor wintering is preferred, instead of packing the colonies move them into a room with controlled temperature and humidity. For populous colonies a temperature of 4°C, approximately 60% relative humidity, and a slow air exchange is satisfactory. The wintering of honey bee colonies is successful using both methods.

HONEY BEE DISEASES AND PESTS

The provincial apiarists are responsible for regulations concerning bee diseases and their control. Their recommendations should be followed for disease prevention, feeding dosage, number of treatments, and when treatment should be suspended to prevent contamination of honey.

American foulbrood *(Bacillus larvae)* (AFB) and European foulbrood *(Streptococcus pluton)* (EFB) are bacterial diseases that destroy honey bee larvae (Figs. 13 and 14). AFB is the most destructive of the brood diseases and is highly infectious. It is spread by diseased package colonies; by bees robbing colonies that are weak or dead due to disease; or by the beekeeper using the same equipment for both healthy and diseased colonies or by feeding pollen collected from diseased colonies. Oxytetracycline and tetracycline are effective against both diseases. Sodium sulfathiazole controls AFB only.

FIGURE 11 Colonies in a group of four wrapped with fiber glass for wintering.

FIGURE 12 Outdoor wintering of honey bee colonies.

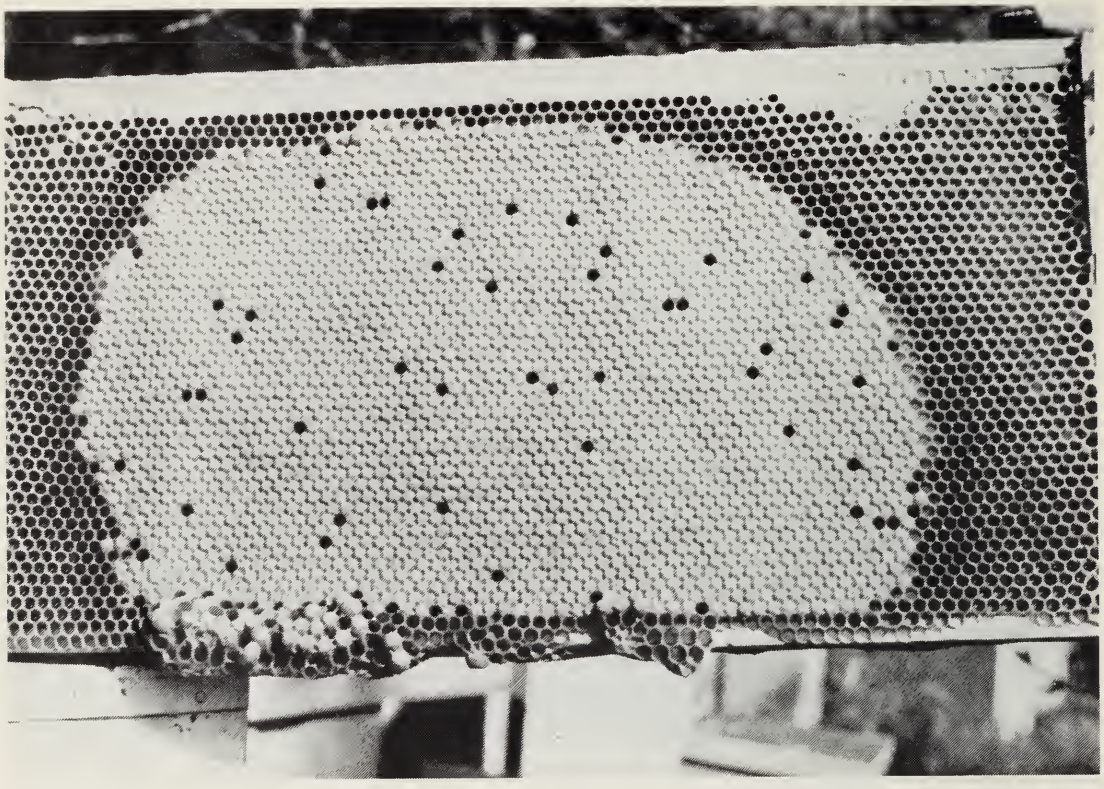

FIGURE 13 Healthy, capped brood indicating a good queen and a disease-free colony.

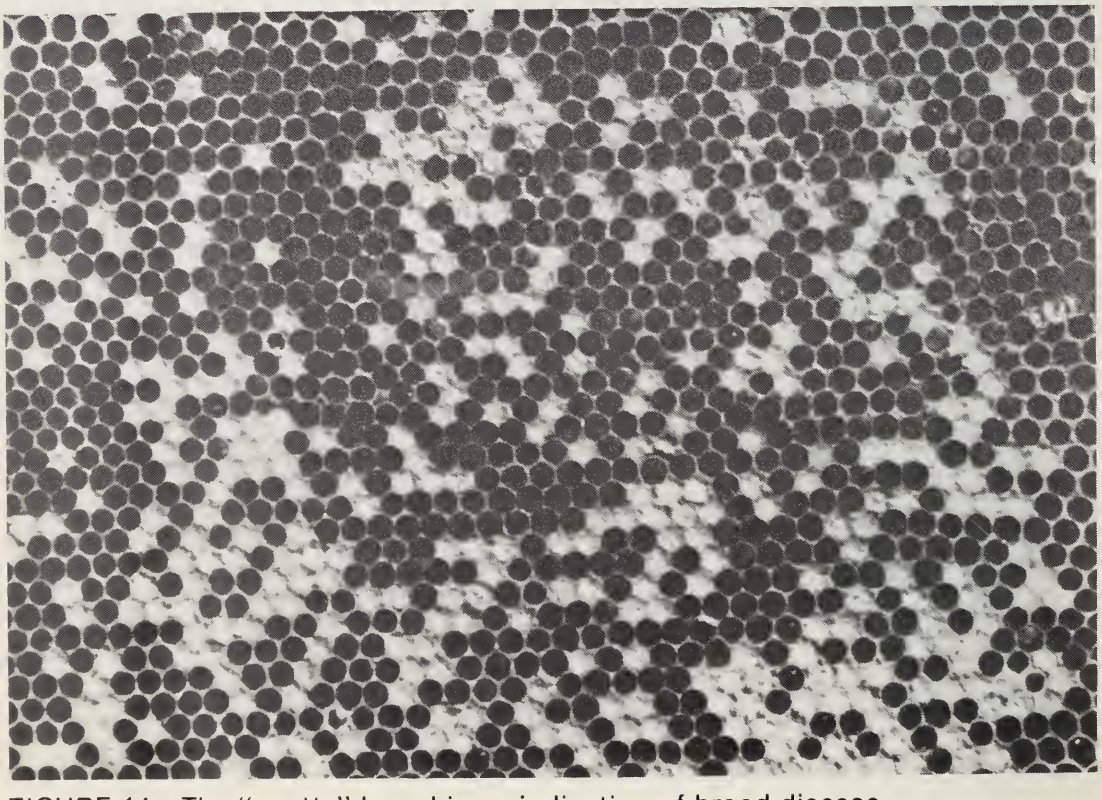

FIGURE 14 The "spotty" brood is an indication of brood disease.

Sacbrood is caused by a virus, which kills the larvae. There is no known cure, but in severe or prolonged instances requeening is sometimes recommended. A new queen will provide a change in genetic base and increase colony vigor.

Chalkbrood *(Ascophaera apis)* is a fungus disease which kills the larvae and pupae. When these become dry, they are known as mummies. No control of this disease is known; however, apiary sites with good air drainage and a sunny exposure are recommended. In severe cases requeening is also an option.

Nosema disease *(Nosema apis)* is caused by an intestinal protozoan. The spores of this disease are ingested by the adult bee, germinate, and multiply in the gut. This is a serious disease of adult bees because it shortens their life. Fumagillin controls this disease.

Bears are the most common and most notable bee pests in Western Canada. The black bear *(Ursus americanus)* causes extensive damage to honey bee colonies and losses in honey production (Fig. 15).

Electric fences offer good protection against bears, and the portable ones can be moved easily with the colonies to a new location (Fig. 16). Bee yards should be protected from early spring until late fall in locations surrounded by woodlot or forest.

Skunks eat adult bees from the hive entrance and they may return to the hives nightly. The first indication of skunk attacks are scratches on the front of the hive chambers or on the entrance boards. Contact your local wildlife officer for assistance in the control of skunks or bears.

FIGURE 15 A bee hive damaged by a black bear.

FIGURE 16 Portable electric fence.

Other small animals such as mice, ants, and wax moths can be a serious problem. Mice can damage overwintering colonies, packing material, or stored equipment. Mouse poison or traps will reduce the damage. Ants build nests under the hives and often attack the colonies. Insecticides applied carefully under the hive eliminate the problem. Wax moths destroy stored and unprotected combs in hives in the southern parts of the western provinces. Contact your provincial apiarist or local bee inspector for advice and recommendations for the control of this problem.

Beekeeping statistics 1979 (from provincial reports)

Province	No. of beekeepers	No. of honey bee colonies in 1000s	Honey yield		No. of colonies wintered in 1000s	
			Total in 1000 kg	Per colony kg	1978–79	1979–80
British Columbia	5 250	51.0	2 197	43	32	34
Alberta	1 700	155.0	9 979	64	35	40
Saskatchewan	1 600	78.9	5 476	69	30	33
Manitoba	1 300	93.0	6 985	75	27	33
Western Canada	9 850	377.9	24 637	65	124	140
Canada	18 550	581.2	33 017	56	—	—

CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
AREA		
square centimetre (cm^2)	x 0.15	square inch
square metre (m^2)	x 1.2	square yard
square kilometre (km^2)	x 0.39	square mile
hectare (ha)	x 2.5	acres
VOLUME		
cubic centimetre (cm^3)	x 0.06	cubic inch
cubic metre (m^3)	x 35.31	cubic feet
	x 1.31	cubic yard
CAPACITY		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2.5	bushels
WEIGHT		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
AGRICULTURAL		
litres per hectare (L/ha)	x 0.089	gallons per acre
	x 0.357	quarts per acre
	x 0.71	pints per acre
millilitres per hectare (mL/ha)	x 0.014	fl. oz per acre
tonnes per hectare (t/ha)	x 0.45	tons per acre
kilograms per hectare (kg/ha)	x 0.89	lb per acre
grams per hectare (g/ha)	x 0.014	oz avdp per acre
plants per hectare (plants/ha)	x 0.405	plants per acre