LOOSE CELL MANAGEMENT OF LEAFCUTTING BEES

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Loose cell management has a number of advantages—more manageable parasite and predator problems, lower chalkbrood rates, and reduced space for winter storage. It takes more time to manage bees in loose cells, and carelessness can result in great losses of the bees.

CONTENTS

THE ALFALFA LEAFCUTTING BEE, *Megachile rotundata*, is very valuable as a pollinator of alfalfa grown for seed in the Northwest. Management of leafcutting bees in the early years was simple, and they multiplied rapidly to fill any available nesting material. Since the bees are not native to the United States, they had no natural enemies, and three- to fivefold increases each year were common.

In the past 25 years, however, several factors have combined to reduce leafcutting bee populations. The favorable growing conditions no longer exist. More than 20 parasites and predators have been found in bee nests, accounting for high bee mortality. Unfavorably high temperatures in field shelters account for additional larval mortality. Insecticides used for controlling alfalfa pests undoubtedly further add to the mortality figures. In the mid-1970s bee management was further complicated with the advent of a fungus disease called chalkbrood. This disease of bee larvae accounts for another 10–50% mortality.

With the combined mortality factors, bee producers can no longer expect an increase of bees each year. In many cases, bee numbers decline in spite of intensive efforts to manage them properly.

As a result, many in the leafcutter industry have moved to the loose cell method to facilitate more frequent cleanup of nesting materials, to eliminate pest insects, and to improve other sanitation measures.

DEVELOPMENT OF LOOSE CELL MANAGEMENT

Loose cell management is not new. The Canadians have used this method successfully for many years. More recently, Montana growers have adopted loose cell methods almost exclusively.

The first take-apart boards for loose cells were developed by Ned Bohart and Bill Nye of the USDA Bee Lab at Logan, Utah. However, the earliest commercial units were the "Mega-nest" produced by Val Barnes of Fillmore, Utah, in the

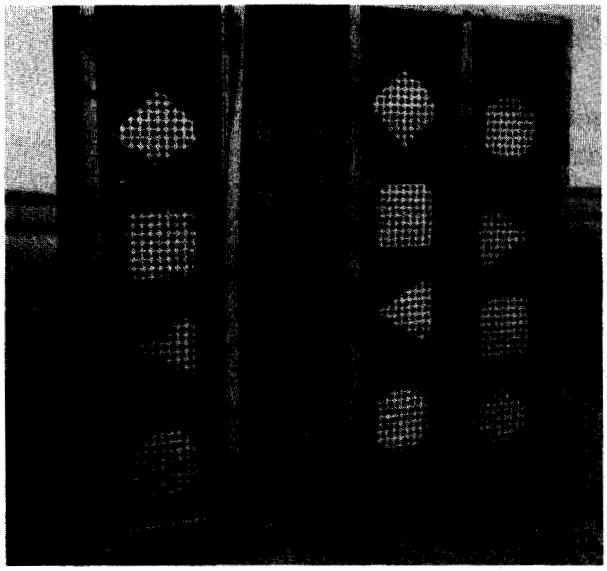

Fig. 1—Wooden laminate nesting material.

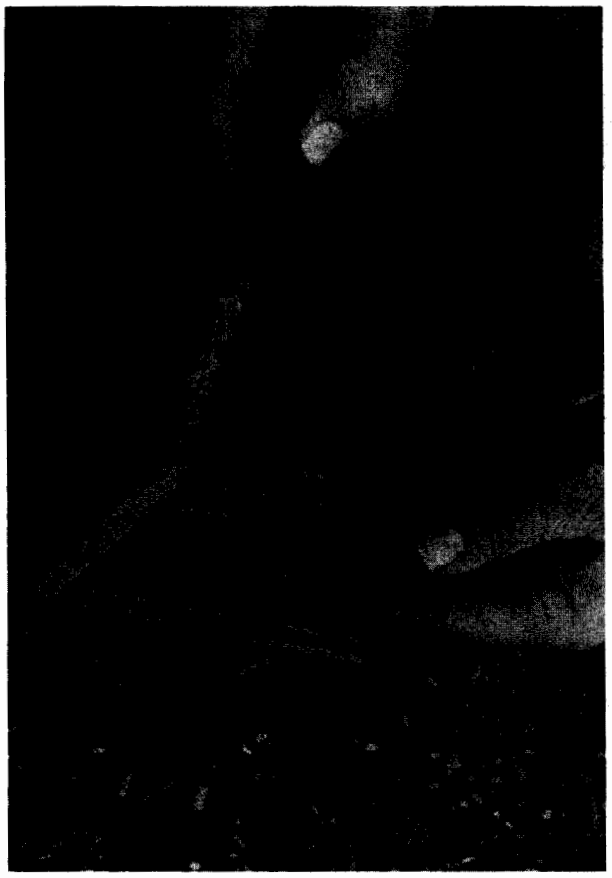

Fig. 2—Closeup of wooden laminate and cells.

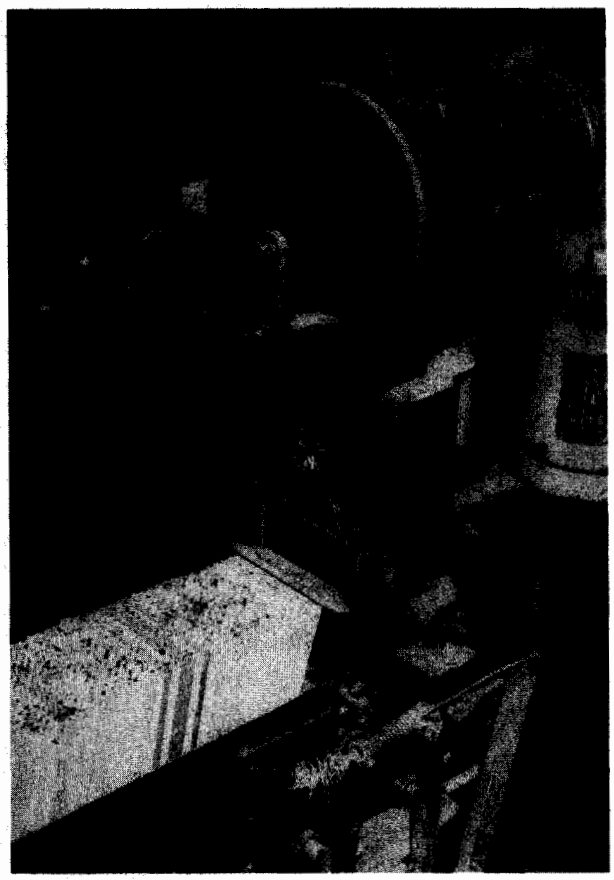

Fig. 3—Equipment used to remove bee cells from wooden laminates.

Fig. 4—Leafcutting bee cells after removal.

early 1960s. Other Northwest seed growers experimented in many ways but had trouble with cell drying and various parasite and predator problems. By the late 1960s, Gordon Hobbs began developing equipment and techniques that resulted in the efficient loose cell system used today.

The advantages of loose cell management include better parasite and predator control, lower chalkbrood mortality, and reduced winter requirements. The disadvantages include higher initial costs for nest material and cell stripping equipment. Also, more time is required to manage bees in loose cells. Carelessness can result in greater losses than in conventional solid board management.

Serious bee producers realize that the days of putting bees in the field and letting them "do their thing" are past. More intensive management efforts must be made. Loose cell management is one such method.

MATERIALS

The following types of nesting material are available for loose cell management:

Laminated wood boards (grooved boards). Sections of specially constructed wood plates are secured together to form a block with ¼-inch holes for bee nesting (Fig. 1). They can be easily disassembled for stripping out bee cells and for cleaning. (Figs. 2–4.)

Laminated styrofoam. Similar to wood laminates except these are molded from styrofoam (Fig. 5).

Punch-out solid boards. These are similar to regular solid boards except the holes are drilled completely through. The back is covered with foil or a thin wood backing. The back is removed after the nesting season and the cells are punched out with a special machine.

Water-soluble cardboard. This cardboard is especially made for leafcutting bee nesting. It provides holes approximately ¼ inch in diameter and about 4 inches deep (Fig. 6). The cardboard is available in large sheets and can be cut to any desired size. After the nesting season, the cardboard section is submerged in water, allowing the

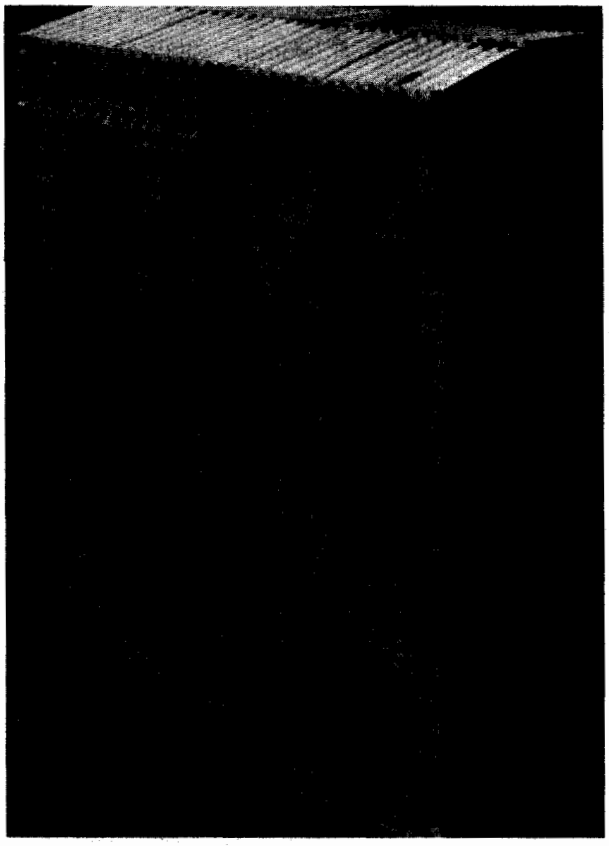

Fig. 5—Polystyrene nesting material.

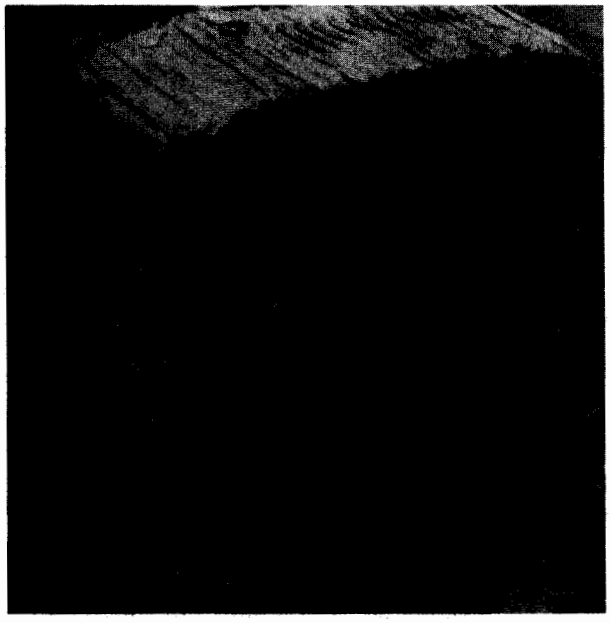

Fig. 6—Cardboard nesting material.

cardboard to separate and the bee cells to float to the top. The cells must be immediately skimmed off and air dried. The cardboard is used one time only.

Wood or styrofoam laminates must be kept in good condition for a tight fit. This is necessary to prevent pest insect entry into the boards. Backing for punch-out boards must also be tightly fitted.

SPRING MANAGEMENT

Sanitation

If chalkbrood is present, the loose cells should be dipped in a 1% calcium hypochlorite solution (swimming pool/spa treatment) and allowed to air dry. This aids significantly in reducing chalkbrood incidence.

Dipping containers can be prepared to suit individual conditions. Most growers use plastic buckets perforated with ⅛-inch holes or wire buckets constructed of ⅛-inch mesh hardware cloth.

The dipping bucket should be filled with cells and submerged in the hypochlorite solution for 3 minutes. To remove trapped air and ensure fresh solution on each cell, the bucket should be lifted out and resubmerged several times during the 3-minute period.

The dipping bucket should then be removed and the contents drained of excess solution. The cells should be spread over ⅛-inch hardware cloth and air dried for several hours. They can also be spread in 1-inch thick layers on a floor surface and allowed to air dry. The cells must not be exposed to direct sunlight.

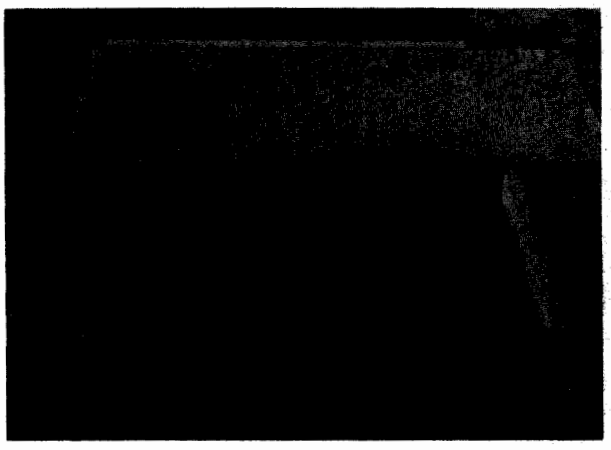

Fig. 7—Loose cell tray used during incubation and also for transport to field shelters.

Prepare fresh solution when the concentration of chlorine in the dipping vat drops to 5000 parts per million. Commercial bleach concentration test kits are available from Taylor Chemical Company, 7300 York Road, Baltimore, MD 21204. Old solution will not disinfect the cells properly and many chalkbrood spores will survive.

Incubation

After the cells have dried, place them in incubation trays and begin incubation (Fig. 7). Removable lids should be placed on the trays when the male bees begin to emerge. The incubator should be constructed to allow 1½ inches between trays for air circulation. Humidity must be maintained between 40–60%. Temperature should be maintained at 82–85°F. High temperatures (over 95°F.) will kill bees. Uneven circulation, temperature, or humidity may cause uneven bee development and emergence. It is important to have well-regulated conditions throughout the entire incubation period.

Parasite Control During Incubation

Several species of tiny gnat-like wasps parasitize bee larvae and cause high mortality if not controlled. Before incubation begins, the cells should be checked for the presence of these chalcid wasps. If more than 2% of the cells are parasitized, the following control measures should be taken.

1. An ultraviolet light (black light) with a pan of water beneath it should be placed in the incubator. Many of the emerging parasites are attracted to the light and fall in the water.
2. A layer of fine sawdust 1–2 inches thick should be placed over the cells in each tray. This allows bees and parasites to emerge; however, the parasites are prevented from returning through the sawdust to reinfest new cells.

3. Use a vacuum cleaner to clean the walls and floor of the incubation room to catch as many parasites as possible.

4. Sticky flypaper tapes should be placed near a light in the incubator. This traps many harmful insects thus preventing injury to the bee cells.

5. Vapona "No-Pest" strips have been recommended by some researchers for use in incubators to control parasites. They are not registered for this use and are, therefore, illegal. If growers insist on using Vapona strips, they must accept the risks. In no instance should strips be placed in the incubator prior to the sixth day nor after the sixteenth day. They must not be left in the incubator for more than 12 hours at one time. Do not use more than half a pest strip in an incubator.

Other insect predators and nest destroyers may have developed in loose cells during winter storage. Therefore, prior to dipping and incubation, the cells should be tumbled and screened to remove harmful insects. This will reduce serious damage during the development period.

Bee Development and Emergence Patterns

Incubation at 85°F. will cause development as follows:

Day 1. Incubation begins. Bees are a worm-like larva, totally white in color.

Day 9. Larvae begin to change to white pupae.

Day 10. *Pteromalus* and *Tetrastichus* parasites begin to emerge.

Day 14. *Monodontomerus* parasites begin to emerge.

Day 15. Pupae are totally black in color.

Day 17. Adult bees are fully formed in the cells.

Day 18. The first male bees emerge. Lids should be on the trays to prevent escape.

Day 20. The first female bees emerge.

Day 22. Incubation trays should go to the field and bees should be allowed to escape. By this time, 30–50% of the females should have emerged.

Day 32. All bees should have emerged.

SUMMER MANAGEMENT

Field Management Methods

Field shelters and landing areas should be sprayed with chlorine bleach solution before bees are placed in the field. Nest materials should be dipped in chlorine bleach solution or heat-treated at 250°F. for four hours before use.

On the fifth day after bee emergence begins, place the incubation trays in the field shelters and release the bees. If field incubators are not available, the trays should be returned to the incubator each night. Direct sunlight must not contact the cells or high bee mortality will result. To prevent renesting of old cells, cover the cells with fine sawdust or have the bees emerge through an excluder trap attached to the field incubator.

Newly emerged bees must feed immediately; thus it is important to have alfalfa bloom readily available as the bees come out. Bees should be timed to emerge in warm, dry conditions. If the weather turns cool (below 75°F.) during the emergence period, return the trays containing the bees to the incubator. Turn off the heat and maintain the bees and remaining cells at 60°F. This will retard development of the cells and lower bee metabolism to conserve their energy. Adult bees can be held at these temperatures up to 10 days. The trays should be taken to the field again when field temperatures reach 75°F. and the weather improves.

Bees should be checked often during the incubation and post-emergence periods.

Bloom Timing

The crop should be managed to come into bloom at the time most likely to have favorable weather (75°F. temperatures during the day, no rain, etc.). The bees should then be incubated to emerge at that time. Bloom delay (setback) can be accomplished mechanically or chemically. Depending on conditions, four to six weeks are required for bloom to reappear after the crop has been delayed.

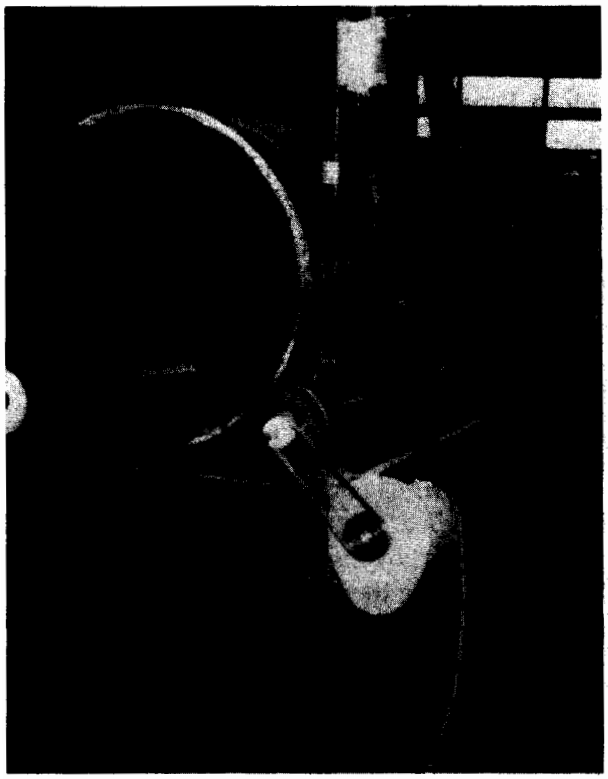

Fig. 8—Loose cell tumbler used to remove excess leaf pieces, trash, and various stages of parasites and predators.

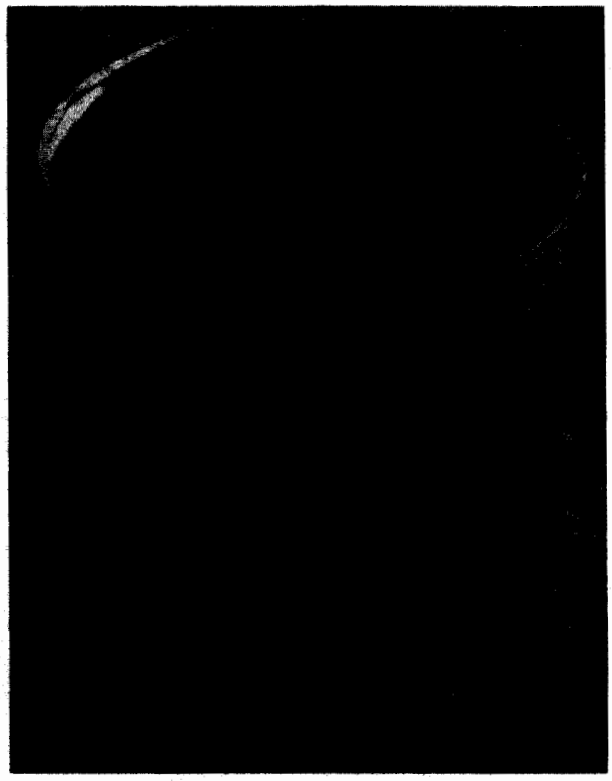

Fig. 9—Winter storage container, holding enough bee cells to potentially pollinate 15 acres. Lid must also be used.

Number of Pollinators Required

Each female bee can set ¼ pound of seed. Based on this figure, most researchers recommend releasing about 7,000 female bees (20,000 live bees) per acre. The following steps will help you to determine how many cells must be incubated for your operation.

1. Determine the number of live larvae in one pound of cells. This can be done by opening or X-raying several 1-ounce samples (about 250 cells) and counting the live larvae. Multiply the average of these samples by 16 to get an average number of live larvae per pound.

2. Multiply the number of live larvae per pound by the percentage of females (about 35%) to determine the number of females per pound.

3. Divide the number of females per pound of cells into 7,000. This will give you the number of pounds of loose cells required to give you 7,000 females at bloom time.

Example. Three 1-ounce samples have 220, 200, and 180 live larvae. The average is 200 live larvae per *ounce* of cells. Multiply 200 by 16 to get the number of live larvae per *pound* of cells. In this example, it is 3,200 live larvae. Multiply this by 35% (the percentage of females) to get 1,120 females per pound of cells. Divide 1,120 into 7,000 (the number of females desired per acre) to get the pounds of loose cells required per acre. In this case, it is 6.25 pounds of cells per acre.

Using 7,000 females per acre can set a field in a short time, perhaps 10–14 days, under ideal conditions. If this happens, move the bees to another field in bloom to maintain their pollen source for bee increase. The foraging bees must have a constant pollen source to continue making more cells for the following year. Allow sufficient nesting

material for at least one hole per nesting female.

Loose cells are commonly marketed in gallons (10,000 cells approximately). It is good policy to sample the cells for live bees to know what you are getting.

FALL AND WINTER MANAGEMENT

Filled nesting materials must not be left in the field too long. In many areas, they can be left until mid-September. However, where checkered flower beetles and other bee predators are prevalent, the nesting material should be removed from field shelters by mid- to late August to prevent predator damage.

Cell Extraction

After taking the filled nest material from the shelters, allow the bees to develop to the cocoon stage before extracting the cells. This usually takes about two weeks. However, do not delay the cell extraction for more than three to four weeks or allow the cells to remain in the nest boards overwinter since this nullifies the advantages of the loose cell system.

Remove the cells and roll them over screened shaker tables or screened drums (Fig. 8). This removes excess leaf materials, predator insects, and many pollen balls. After tumbling, run the cells over a belt for inspection and to break up the cell strings. Hand sort the cells for predators and damaged cells.

Cell Storage

The sorted loose cells are ready for storage. Metal or hard plastic containers with holes for air circulation can be used (Fig. 9). Lids should be tightly secured to prevent mouse damage. Store the containers at 35–38°F. Check frequently during the fall and winter to insure that insects, mold, or mice do not damage the cells.

Cold storage is a must for the loose cell system. Do not allow filled nesting media or extracted loose cells to remain unrefrigerated through the fall months. Extract cells early and get them into cold storage.

X-Ray Analysis

One advantage of the loose cell system is that cells can be inspected for damage, disease, or pest insects. The most efficient method is to X-ray a sample of extracted cells to determine the percentage of live bees present. Chalkbrood cadavers, pollen balls, and many bee predators and parasites can be readily identified with this tool. Thus, bee producers can assess the bee mortality factors more accurately and take corrective action with greater confidence than in the past.

X-ray services are available from the following: Gary Jensen, Lewis Hall, Montana State University, Bozeman, MT 59717; Ron Bitner, Pollination and Pest Management Consulting Services, Caldwell, ID 83605; William Stephen, Department of Entomology, Oregon State University, Corvallis, OR 97330; Harold Arnett, University of Nevada, Reno, NV 89500.