glossy or cellophene-like. Some of the dead larvae remain white, but others usually become dark grey to black. Cells containing such larvae are fragile and collapse easily.

(4) Methods of larval infection

Only larvae are infected by chalkbrood. A healthy larva is infected when it eats pollen that is contaminated with chalkbrood spores. These spores germinate and the fungus grows inside the gut of the larva, and in later stages moves through the wall of the gut and into the body cavity. The fungus eventually forms black spore cysts under the skin of the larva. At maturity the cysts shatter and disperse a large number of spores. The continued growth of the fungus results in the death of the larva.

(5) Contamination of pollen provisions with chalkbrood spores

If emerging leafcutting bees crawl through infected leaf material or chew through infected larva to emerge, they become covered with massive numbers of spores that adhereto their body hairs. These adults then contaminate their mates, eggs and pollen provisions. Adult bees are carriers of chalkbrood spores.

(6) Possible prevention of entry of chalkbrood infected material into an area

a) Ensure that each consignment of cells purchased has been screened for the presence of chalkbrood.

b) If cells are brought into an area from an outside location, run the consignment separately and isolate the offspring until they are screened for chalkbrood.

(c) Disinfect all nesting material, equipment and storage facilities annually. See No. (8).

(d) Use the loose cell management system. Tumble cells to break into individual cells. Chalkbrood cadavers are light and a large percentage can be removed during tumbling. Breaking up the cells will ensure that the emerging bees do not have to chew through chalkbrood cadavers to emerge. An emerging bee can be dusted with up to 300 million spores when it chews through an infected cadaver.

(e) If equipment has to be shared, ensure that it is properly disinfected before and after use. See No. (8). The sharing of equipment should be avoided where possible.

(f) After bee emergence is complete, incinerate all leaf debris from incubation trays.

(g) Relocate shelters in fields each year to prevent buildup of fungal spores around shelters. Spray shelters and surrounding ground with a 5% sodium hypochlorite solution (household bleach) after nesting boxes are taken indoors.

(7) <u>For control and possible eradication of chalkbrood use the following in conjunction with prevention methods</u>

a) Remove infected cells, nesting material and incubation trays from area.

b) Disinfect storage facilities and all equipment that cannot be moved from area. See No. (8).

c) In the early spring burn top growth in all fields where infected

bees were used for pollination in the previous growing season.

d) If possible, do not use leafcutting bees or other pollinators in the above fields forthe following growing season.

e) If (d) above is implemented, then lcoate trap nests in the field to ascertain whether bees are still present in the area and screen samples of their offspring, if present in these trap nests, for chalkbrood.

f) If 'clean" leafcutting bees have to be introduced into a field where chalkbrood-infected cells were found in the previous growing season, follow procedures recommended for prevention of chalkbrood. See No. (6).

g) If the offspring of the above are disease free, sterilize cells before use as an added precaution. See No. (8). If offsprings are infected, then remove from area.

(8) Disinfection of leafcutting bee cells and equipment for the prevention and control of chalkbrood

Chalkbrood is caused by a fungus or mold and any practice used to control mold will also help to control chalkbrood.

a) Disinfection of leafcutting bee cells

Leafcutting bee cells can be surface sterilized by immersing them in a 3% sodium hypochlorite (household bleach) solution for 1 to 2 minutes. The cells should then be dried away from direct sunlight or excessive heat. This should be done prior to incubation.

b) Disinfection of nesting material

It is preferable to incinerate all nesting material that is known to have contained chalkbrood-infected cells. If this is not possible then disinfect nesting material.

Wood nesting material can be disinfected by placing in an oven at 110°C for 24 hours. Both wood and polystyrene nesting materials can be disinfected by dipping nesting boards in a 5% sodium hypochlorite solution, or a 3 to 5% solution of stabilized dry chlorine (sodium dichloro-s-triazinetrione dihydrate) to which a wetting agent like Tween is added. The nesting boards should be disinfected in the spring and dried completely before use. Some loss of nesting material due to cracking or warping is inevitable.

c) Disinfection of shelters, equipment (e.g., strippers and tumblers) and storage facilities

A mist spraying of a 5% sodium hypochlorite solution is recommended.

To date, there is no cure for chalkbrood. The above information is based on the presently available data on the control or possible eradication of this disease.

The chalcids are the most common parasites of the leafcutting bee. Surveys of parasites in bee populations in northern Alberta show that Dibrachys confusus was the species most commonly found until the mid 1970's when it appeared to be gradually but not completely displaced by Pteromalus venustrus. Both species are similar in size and shape. Adult

females are (2.5 mm) 1/10" long and males (2.0 mm) 1/2" long. Both males and females are black in color. On the main segments of the legs, Pteromalus has a dark brown to green coloration, while Dibrachys has a reddish yellow coloration.

Both species overwinter as mature larvae in leafcutting bee cells. Nine to seven days after the cells are placed in incubation rooms at 30°C, these chalcids are fully developed and start chewing their way out of infected cells through a single hole. The males emerge first. Mating occurs soon after the females emerge. These mated females immediately proceed to parasitise the surrounding healthy cells. The females pierce bee cells with their ovi-positors and sting the bee larva with a paralyzing fluid. The eggs hatch and feed off the bee larva and complete their development within 15 days. Hence, one batch of leafcutting bee cells can be parasitised by two generations of these chalcids.

Pteromalus has the potential to cause greater damage than Dibrachys. The average number of eggs laid by the latter species is 25; of these 10 to 12 develop into adults with a 2:1 male to female ratio. On the other hand, an average of 60 eggs are laid by Pteromalus in a bee cell; of these 20-25 develop into adults with a 1:3 male to female ratio. Thus, a 3 percent infestation with Pteromalus implies that 3 cells in every 100 or up to 60 adult parasites could be present (3 x 20, the latter being the average adult parasite per cell). Thus, in one reported case in the Literature, an initial 3 percent parasitism in 100 gallons of bees resulted in a loss of 40 percent of the bees before they reached the field when proper control measures were not taken.