



PARAFORMALDEHYDE FUMIGATION OF ALFALFA LEAFCUTTING BEE NEST MATERIAL

ISBN 0-88656-556-1

A registration has been obtained for use of the fumigant paraformaldehyde to decontaminate leafcutting bee nest material. Paraformaldehyde is a toxic substance and it is important to follow the fumigation method outlined in this publication. Because problems may occur with persistence of formaldehyde vapor under certain conditions, treatment of nest material should only be undertaken in a building set aside specifically for paraformaldehyde fumigation and not used for any other purpose.

Surveys of populations of the alfalfa leafcutting bee (*Megachile rotundata*), an important pollinator of alfalfa for seed production, have indicated that a number of mould, yeast, and bacterial species (microflora) commonly associated with domestic leafcutting bees can spoil nectar and pollen provisions and contribute to bee mortality. As well, the build-up of microflora in bee populations poses a health hazard to alfalfa seed producers, who may be exposed to high levels of mould spores.

EFFICACY OF PARAFORMALDEHYDE AS A FUMIGANT

Research undertaken to develop a fumigation technique for control of moulds, yeasts, and bacteria in leafcutting bee nest material has led to the identification of paraformaldehyde (prills, 91-93%) as a fumigant which is highly efficacious as a decontaminant. Paraformaldehyde is a white, crystalline substance with the characteristic formaldehyde odor. When formulated as a prill, paraformaldehyde is free-flowing and relatively dust-free. It has a melting range of 120-170 °C and gives off formaldehyde gas when heated. Data on control of microflora obtained by paraformaldehyde fumigation of leafcutting bee nest material are given in the accompanying table. These data indicate that paraformaldehyde fumigation at a rate of 20 g/m³ is highly efficacious for control of microflora in all nest materials tested, with overall control levels ranging from 86.5% to 99.1%.

Common foliar mould species, including *Alternaria*, *Aspergillus*, *Eurotium*, *Penicillium*, and *Rhizopus* spp., were virtually eliminated from polystyrene laminate nest material by paraformaldehyde fumigation. In polystyrene block and wood laminate nest material, overall control was also good.

Efficacy of paraformaldehyde fumigation of leafcutting bee nest material.

Type of material	Microflora	Percent control
Polystyrene Laminate	Moulds	97.3
	Yeasts	99.9
	Bacteria	96.3
	Overall	99.1
Polystyrene Block	Moulds	75.6
	Yeasts	93.3
	Bacteria	99.0
	Overall	96.7
Wood Laminate	Moulds	76.5
	Yeasts	96.9
	Bacteria	67.3
	Overall	86.5

Observations made in the field on bee activity in paraformaldehyde-treated and untreated control nest material indicated that fumigated nest material was clearly acceptable to leafcutting bees. No unusual adult bee mortality was observed and analysis of developing leafcutting bee larvae indicated that larvae reared in paraformaldehyde-treated nest material were healthy. X-ray evaluation of leafcutting bee cocoon samples harvested from fumigated nest material showed that cocoon quality was high, with no indication of prepupal mortality related to paraformaldehyde treatment of nest material. The proportion of healthy prepupae was often significantly higher in paraformaldehyde-treated nest material than in untreated control nest material.

Adult emergence data was similar between groups of incubated prepupae from fumigated and control nest material. Mean emergence time profiles for males, females, and combined sexes were uniform between fumigated and control nest material groups.

Fumigation with paraformaldehyde may be carried out in spring prior to deployment of nest material in the field or in fall once harvesting of nest material is completed. The cost of paraformaldehyde fumigation (estimated to be less than \$0.10 per nest box) is significantly lower than the cost of bleach dipping (calculated to be \$0.50 per nest box). A low cost and simple paraformaldehyde fumigation technique may present an attractive alternative to alfalfa seed producers who are hesitant to set up bleach dipping facilities.

The method developed for fumigating nest material with paraformaldehyde is outlined below. Note that extreme care should be taken in the handling and use of paraformaldehyde; adequate ventilation following its use is essential. **Under no circumstances should paraformaldehyde be exposed to open flame.**

PARAFORMALDEHYDE FUMIGATION METHOD FOR LEAFCUTTING BEE NEST MATERIAL

1. Place field-ready nest material units in well-sealed fumigation chamber (**BUILDING USED ONLY FOR PARAFORMALDEHYDE FUMIGATION**) and condition room for 48 hours at 20-25°C with a relative humidity of 60-70%. Nest material should be stacked loosely (e.g. cross-piled with several inches between boxes) to allow for air movement through the material.

2. Fumigate nest material with paraformaldehyde prills (91-93% formulation), at a rate of 20 grams of product per cubic metre of fumigation chamber area (20g/m³ or 0.5 g/ft³ or 1.1 lb/1000 ft³), by placing product in a heat generation unit (e.g. electric frying pan) attached to an electric timer. Paraformaldehyde prills should be handled with caution; the use of gloves, eye protection, and a dust mask or respirator is advised.

3. To begin the fumigation process, set heat generation unit to maximum heat setting, set electric timer to provide power for 4.0 hours, then seal and **lock** the chamber and **post** a warning sign. **UNDER NO CIRCUMSTANCES SHOULD THE CHAMBER BE RE-ENTERED AFTER ONSET OF FUMIGATION.**

4. From onset of fumigation, allow a 24 hour period for formaldehyde gas treatment. After this 24 hour period, begin continuous ventilation by exhausting from the top of the chamber for a 48-72 hour period. If an odor of formaldehyde gas is still detectable, ventilate for an additional 24-48 hours. Ensure that there is an adequate incoming flow of fresh air during ventilation.

5. **OPEN AND RE-ENTER CHAMBER ONLY AFTER COMPLETION OF ADEQUATE VENTILATION.** Use a full-face NIOSH approved respirator with formaldehyde or acid gas cartridge and particulate filter; coveralls and gloves should also be worn.

6. Following spring fumigation, deploy fumigated nest material directly into field shelters. If possible, allow 7-10 days for paraformaldehyde residue to dissipate prior to field release of bees. When fumigation is carried out at the end of the field season, fumigated nest material may be stored in the fumigation chamber structure until the following spring and moved directly into the field at that time.

NOTE: Paraformaldehyde prills, 91-93% (manufactured by Hoechst Celanese) are available in 50 lb. bags; they should be stored apart from other combustibles in a cool, dry place with adequate ventilation. Before handling, user should be familiar with safety information contained on the paraformaldehyde label and in the MSDS (material safety data sheet) for paraformaldehyde.

SUMMARY

Research on the use of paraformaldehyde as an agent for the control of moulds, yeasts, and bacteria associated with alfalfa leafcutting bee populations has indicated that paraformaldehyde fumigation is highly efficacious for control of these microflora in leafcutting bee nest material.

Leafcutting bees will readily accept paraformaldehyde treated nest material in the field and leafcutting bee prepupae harvested from fumigated nest material are as viable as those harvested from untreated control nest material. Incorporation of foliar mould control techniques is essential in leafcutting bee operations. More comprehensive use of foliar mould control techniques by producers will reduce levels of microflora in leafcutting bee populations and result in increased viability of alfalfa leafcutting bee populations.

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S7N 0X2
February, 1992

This research was funded by the Saskatchewan Agriculture Development Fund (ADF) and by the Minor Use Funding Initiative of Agriculture Canada/Special Programs Division.