APPENDIX F

Nest Material Comparison for Leafcutter and Mason Bees

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Table F.1
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CHARACTERISTICS	STYROFOAM BLOCKS (LOOSE-CELL SYSTEM)	GROOVED LAMINATE BOARDS: WOOD OR STYROFOAM (LOOSE-CELL SYSTEM)	SOLID WOOD BLOCKS (CLOSED-CELL SYSTEM)	REED OR BAMBOO (CLOSED-CELL SYSTEM)	CARDBOARD TUBES (WITH OR WITHOUT PAPER INSERTS)	HYBRID SYSTEM: SOLID WOOD BLOCK WITH REMOVABLE BACK AND PAPER INSERTS
Bee type	Only widely used for leafcutter bees.	Styrofoam laminates used for leafcutter bees. Wood grooved boards used for leafcutters and mason bees.	No longer widely used for leafcutter bees. Small, mason bee versions still used.	Used by some mason bee producers. Not typically used with leafcutters.	Widely used for mason bees. Cardboard and paper tubes historically used for leafcutter bees, no longer common today.	Currently only used for mason bees, but also suitable with leafcutter bees.
Availability	Only produced by a handful of Canadian manufacturers.	Styrofoam laminates only produced by a handful of Canadian manufacturers. Wood laminates commercially produced in small quantities by a few American and Canadian companies; typically they must be homemade.	No longer commercially produced. Older leafcutter blocks occasionally available at farm sales and auctions in western states. Can be made at home.	Bamboo garden stakes are widely available from landscape supply companies and can be cut to length. Phragmities reed is considered invasive in many areas and can be wild collected.	Available from many mason bee suppliers. Custom manufacturing also available from many manufacturers. Sizes for leafcutter bees not commonly available.	Available from several small manufacturers.
Cost	Actual blocks are very low cost; however shipping costs from Canada greatly exceed the cost of the blocks themselves.	Styrofoam laminates are cheap, but like Styrofoam blocks shipping costs from Canada greatly exceed the cost of the boards themselves.	Used leafcutter blocks are moderately priced. Quality lumber to construct new blocks is expensive.	Extremely cheap.	Relatively cheap.	High initial cost to purchase or construct nest block. Low cost for ongoing replacement of paper liners.
Durability	Poor durability. Handling and cell stripping can damage blocks. Rodents and woodpeckers can easily destroy Styrofoam.	Poor durability. Styrofoam laminates have the same problems as Styrofoam blocks. Thin wood laminates easily warp and crack.	Extremely durable. Cracking can be a problem in larger blocks.	Very durable.	Poor durability, prone to crushing, easily damaged by rain, rodents, and birds.	Extremely durable. Cracking can be a problem in larger blocks.
Ability to phaseout nests	Easy to phase out nests since cells are removed annually.	Easy to phase out nests since cells are removed annually.	Difficult; some type of phaseout system is required to prevent bees from nesting in old nest tunnels.	Difficult, some type of phaseout system is required to prevent bees from returning to old nest tunnels.	Easy to do.	Easy to phase out nests since inserts are removed annually.

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Nest Material Comparison for Leafcutter and Mason Bees (continued)

CHARACTERISTICS	STYROFOAM BLOCKS (LOOSE-CELL SYSTEM)	GROOVED LAMINATE BOARDS: WOOD OR STYROFOAM (LOOSE-CELL SYSTEM)	SOLID WOOD BLOCKS (CLOSED-CELL SYSTEM)	REED OR BAMBOO (CLOSED-CELL SYSTEM)	CARDBOARD TUBES (WITH OR WITHOUT PAPER INSERTS)	HYBRID SYSTEM: SOLID WOOD BLOCK WITH REMOVABLE BACK AND PAPER INSERTS
Nest block cleaning	Easy to do, by submerging in bleach-water solution.	Easy to do, by submerging in bleach-water solution.	Difficult to clean. Phased out blocks must be redrilled annually, then submerged in bleach-water solution, or heat sterilized.	Impossible to clean. Old tubes should be disposed of annually.	Impossible to clean. Old tubes should be disposed of annually.	Easy to clean by removing used inserts annually. Other disinfection may also be necessary.
Labor	Minimal manual labor if automated cell removers are used.	Moderate manual labor if automated cell removers are used.	Moderate manual labor associated with redrilling, disinfecting, and phasing out old blocks.	Lots of manual labor due to cutting and sorting individual tubes.	Moderate labor sorting, discarding tubes.	Moderate labor sorting, discarding inserts.
Storage	Bulky nest blocks take up a lot of room. Loose cells take up much less cooler space.	Somewhat easier to store than larger blocks. Grooved boards can be disassembled to fit into boxes. Loose cells take up much less cooler space.	Bulky nest blocks take up a lot of room. Bees not removed from the block so the entire nest may need to be refrigerated.	Easy to store. Unused tubes can be stored in boxes; only filled tubes need refrigeration.	Easy to store. Unused tubes can be stored in boxes; only filled tubes need refrigeration.	Bulky nest blocks take up a lot of room. Filled inserts take up much less cooler space.
Weight	Very lightweight.	Styrofoam laminates are very lightweight. Wood grooved boards are heavy.	Heavy.	Generally lightweight.	Moderate weight.	Heavy.
Insulation properties	Very good.	Good.	Very good.	Poor.	Poor.	Good.
Incubation	Easy to do with loose cells.	Easy to do with loose cells.	Difficult—entire block must be incubated. Blocks may warm unevenly.	Relatively easy; entire tube must be incubated.	Relatively easy; entire tube must be incubated.	Easy; inserts can be incubated, or cocoons can easily be removed and incubated.
Sex ratios	Poor. Higher male ratios.	Poor. Higher male ratios.	Okay, but often high male ratios.	Extremely good if tubes are cut to varying lengths. High female ratios.	Okay depending on tube lengths and diameters.	Okay, but often high male ratios.

Parasite control during nesting	Poor. Backing material often fails, allowing parasite entry.	Extremely poor. Backing material often fails, allowing parasite entry. In addition, spaces between boards allow easy access for chalcid wasps.	Very good. Parasites can only enter through nest entrance.	Very good. Parasites can only enter through nest entrance.	Good to poor—depends on how tube backs are sealed and wall thickness.	Good to poor—depends on how tunnel backs are sealed.
Parasite control during storage and incubation	Very poor. Loose cells must be refrigerated to prevent parasite activity. During incubation light traps and other methods must be used to control chalcid wasps.	Very poor. Loose cells must be refrigerated to prevent parasite activity. During incubation light traps and other methods must be used to control chalcid wasps.	Very good. Blocks can also be covered with sawdust or vermiculite during storage.	Very good. Tubes can also be covered with sawdust or vermiculite during storage.	Moderate, tubes should be refrigerated and covered with sawdust or vermiculite during storage.	Poor. Inserts must be refrigerated to prevent parasite activity. During incubation light traps and other methods must be used to control chalcid wasps.
Disease control	Moderate. Nest blocks are cleaned annually, but chalkbrood spores can easily be spread in containers of loose cocoons.	Moderate. Boards are cleaned annually, but chalkbrood spores can easily be spread in containers of loose cocoons.	Very poor. Even with redrilling, and disinfection, it is difficult to kill all chalkbrood spores in wood nests. Second generation leafcutter bees also encourage disease spread in solid block nests.	Good if tubes are phased out annually. Poor if tubes are reused.	Good if tubes are phased out annually. Poor if tubes are reused.	Very good if blocks and backing material are disinfected annually in addition to replacing inserts.
Cocoon inspection	Easy to do with loose cells.	Easy to do with loose cells.	Very difficult. Special probes must be created to remove larvae from nests.	Easy to do by splitting tubes lengthwise using a sharp blade. Tubes can also be X-rayed.	Easy if paper inserts are used inside cardboard. Moderately easy to take apart cardboard tubes if no inserts are used. Tubes can also be X-rayed.	Easy to take apart paper inserts.
Drying of cells and pollen	Poor drying ability. Wet pollen, leaf tissue, and cocoons subject to mold growth.	Poor drying ability in Styrofoam laminates. Wet pollen, leaf tissue, and cocoons subject to mold growth. Wood boards are fine.	Very good. Wood porosity reduces mold growth. Overdrying of pollen provisions can be a problem in new lumber.	Good. Porosity reduces mold growth. Tubes may become too dry in some areas however.	Okay. Cardboard and paper tend to dry quickly, and may wick moisture from pollen. Paraffin-coated straws solve this problem. Plastic straws should not be used.	Okay. Paper inserts tend to dry quickly, and may wick moisture from pollen. Paraffin-coated straws solve this problem. Plastic straws should not be used.

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Processing damage to cocoons	Potentially high if cell strippers are not properly adjusted.	Potentially high if cell strippers are not properly adjusted.	No damage to bees.	No damage to bees.	No damage to bees.	No damage to bees unless inserts are shaken during development, or crushed.
Bee appeal	Low.	Low appeal for Styrofoam laminates. Higher appeal for wood boards.	Relatively high appeal to bees.	Very appealing to bees—bamboo more so than reed.	Moderately appealing.	Moderately appealing.
Bee orientation	Poor. Few orientation marks for returning foragers. Especially when blocks are not painted, and do not have raised orientation patterns.	Okay. Better when boards are painted with orientation patterns.	Okay. Better when blocks are painted with orientation patterns.	Excellent. Irregular tube lengths and sizes provide many orientation "landmarks" for bees returning to nest.	Poor. Better when tubes are painted different colors, or vary in size and length.	Okay. Better when blocks are painted with orientation patterns.
Scalability	High. Large numbers of bees can be managed and produced using this system. Limiting factors will be parasite control—especially chalcid wasps. Bee health and sex ratios will never be optimal. Other necessary loose-cell equipment such as cell strippers add significantly to the cost.	High. Large numbers of bees can be managed and produced using this system. Limiting factors will be parasite control—especially chalcid wasps. Bee health and sex ratios will never be optimal. Other necessary loose-cell equipment such as cell strippers add significantly to the cost.	Moderate. Equipment is easy to manage and maintain. Limiting factors will be disease control—especially chalkbrood. Short-term results may be good, but long-term prospects are poor. Expect annual losses after several seasons.	Low. Smaller numbers of very healthy bees, with good female to male ratios can be produced this way. Limiting factors will involve management labor—especially sorting, cutting, and phasing out tubes.	Moderate. Medium-sized populations of bees can be produced this way. Limiting factors will be management labor associated with sorting, and phasing out tubes, and controlling parasites, especially chalcid wasps.	Moderate. This system can produce medium-sized populations of healthy bees. Labor associated with storing and sorting paper inserts, controlling chalcid wasps during storage and incubation, and nest block cleaning will be limiting factors.