Extending the Life of Beehives With and Without Preservatives

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ABSTRACT

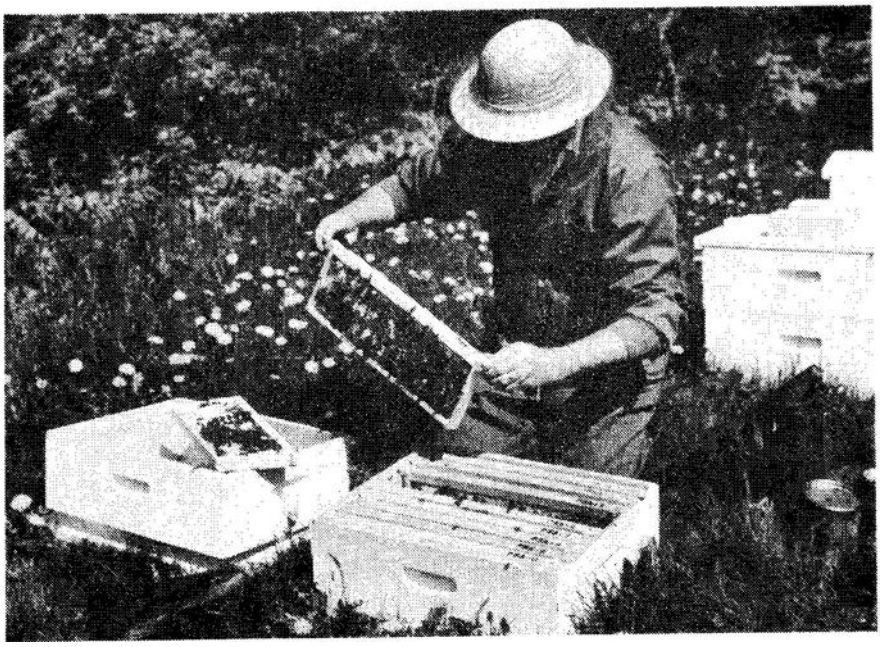
The useful life of beehives may be extended by taking care to prevent decay and insect attack. Several wood preservatives (copper naphthenate. copper-8-quinolinolate, and acid copper chromate) are reported to be harmless to bees or hive products. Others (creosote, chromated copper arsenate (CCA). tributyl tin ozide (TBTO), and pentachlorophenol) are reported to contaminate hive products or harm the bees. Preservatives may beapplied by brush, dip treatment, hot and cold baths, and commercial pressure-treating processes.

INTRODUCTION

The average life of wood beehives in the United States is about 10 years. Microorganisms (principally fungi) decay the wood when it is in contact with soil. In some areas, insects (termites and carpenter ants) are an added problem for beekeepers. Because the investment in hive parts is sizeable, many beekeepers are interested in extending the useful life of their hives.

The lifespan of wood hive parts varies according to the care given the hives. Untreated wood hives that are set directly on moist soil are subject to decay in the bottom boards within 2 years. Untreated hives will last considerably longer if conditions that favor decay and insect attack are avoided. Treating the decay-prone parts with wood preservatives provides the greatest degree of durability. We estimate that treated hives can have a lifespan of more than 20 years if given ordinary care. Each course of action has its cost and benefits; the beekeeper needs to decide which procedure is best for each situation.

Studies were undertaken at Forest Products Laboratory (FPL) at Madison, WI, in May of 1980 to determine which, if any, of the commonly used wood preservatives can be used on beehive parts without hazards to the bees or contamination of hive products. The results of these studies along with the work of others are summarized in this article. Our studies are continuing, and a report on the longevity of our experimental hives that are in contact with the ground will appear in about 2 years.



Examining brood development in hive treated with unsuitable pentachlorophenol wood preservative.

AVOIDING CONDITIONS THAT FAVOR DECAY AND INSECT ATTACK

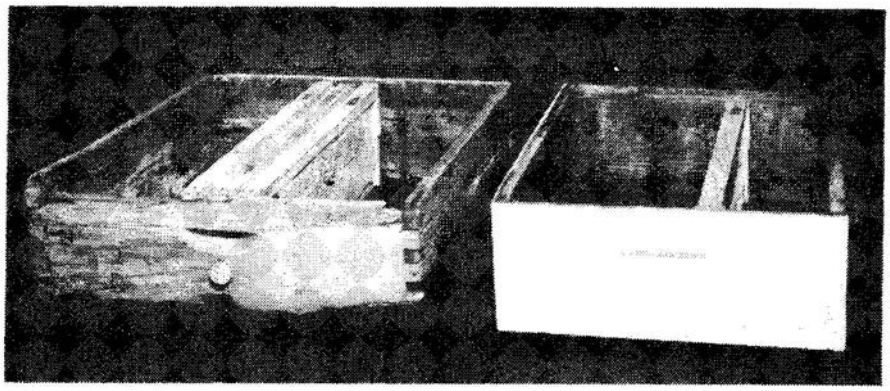
Water Absorption

Wood is subject to decay when its moisture content is above the fiber sat-

uration point, which averages about 30 percent water by weight (USDA Wood Handbook, 1979). This level is often reached in wood that rests on the ground because the wood readily absorbs water from the soil. In addition, soil has an abundance of microorganisms, some of which soon attack the wood. Therefore. it is important not to place beehives directly on the ground. In durability studies by FPL, 2- by 4-inch untreated southern pine sapwood stakes were placed in the ground in Wisconsin and Mississippi. In Wisconsin, the stakes failed from decay in 4 to 6 years (on average); in Mississippi the stakes failed in 1.8 to 3.6 years due to decay and termites (Gjovik and Gutzmer, 1983). Similarly, untreated pine fenceposts failed in 2 to 10 years (Gjovik and Davidson, 1975). A beehive with a pine bottom board resting on moist soil (without a hive stand) will usually show severe decay or destruction within 5 years. The bottom board will last longer if it is elevated above ground, preferably by at least 8 inches.

The heartwood of some tree species, such as black locust, cedar, crypress (old growth), Osage-orange, redwood, and white oak. is naturally resistant to decay. The high-risk parts of a hive, such as the bottom boards and the hive stands, may be fabricated from these more durable types of wood if available.

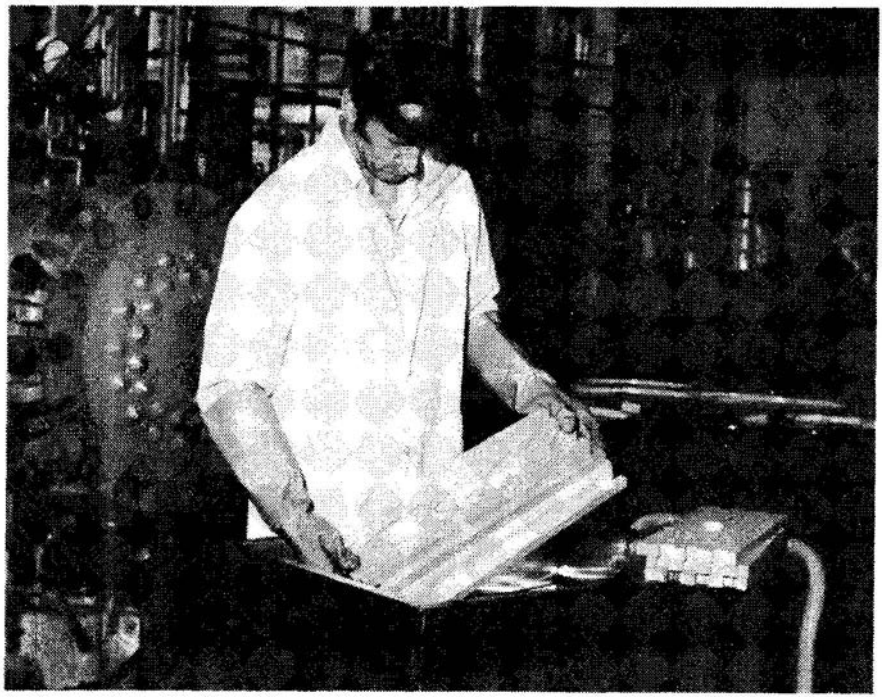
Hive bodies tend to absorb water from rain and snow and from the moisture given off by bees, especially in the winter. Water is absorbed more readily by end grain (corners of hive bodies). The hive body can be protected by painting the exposed end-grain (or the entire hive body): first with a paintable water repellent or water-repellent preservative (Feist and Mraz. 1978), and then (after several days of drying) with two coats of high-quality latex house paint (on beehives latex paint is less apt to blister or peel than oil-based paint). In cold climates. moisture given off by bees can condense (or freeze) on the interior surfaces of the hive and raise the moisture content of the wood. It is not uncommon to find decay in the top rovers and in hive bodies well above ground. Adequate insulation and ventilation and use of roofing material on the outer cover can help prevent decay.



Average life of untreated hives (left) is about 10 years. Hive body on the right was pressure-treated with copper naphthenate and then painted; it will resist decay for a long time.

Insect Attack

Insect attack on untreated wood is not easily prevented in areas where insects such as termites and carpenter ants are abundant. It is a good practice to clear wood debris, which may house insects, away from the vicinity of the hive. Around dwellings, termites are controlled by treating subsoil with termiticides. However, significant bee mortality may occur if termiticicles are used around beehives (Erickson and Erickson, 1983).



Dip-treatment of precut hive parts offers some protection from decay. Cylinders in the background are used for pressure treatment.

USING WOOD PRESERVATIVES

Wood preservatives have been used on beehives for a number of years with varying results (Cross, 1983; Kalnins and Detroy, 1984). High levels of bee mortality have resulted from the use of certain preservative chemicals: some of these are as toxic 10 bees as some of the more hazardous pesticides applied to crops. A few wood preservatives are absorbed by beeswax where. like other pesticides. they persist for several months or years (Erickson and Erickson, 1983; Kalnins and Detroy, 1984).

TYPES OF PRESERVATIVES

Unsuitable Preservatives

Several wood preservatives are unsuitable for treating beehives and should be avoided. Moreover, wooden bee equipment or wax combs should nor be stored in buildings where these materials have been used.

Creosote. Creosote (a distillate of coal tar) can affect the flavor of honey and is harmful to bees (Vorwohl, 1968).

Pentachlorophenol. Once popular among beekeepers in some areas, pentachlorophenol contaminates beeswax, bees, and to a lesser extent, honey. It can also contribute to winter kill (Kalnins and Detroy, 1984). We found that in hive bodies treated with pentachlorophenol (to a level of 6.4 kg/m^3 or 0.4 lb/ft^3) the beeswax averaged 39.8 parts per million of pentachlorophenol; 5.2 and 0.14 parts per million of the preservative were found in the bees and the honey, respectively (Kalnins and Detroy, 1984). The assumption that pentachlorophenol is harmless to bees if theequipment is first “aired out” is unsubstantiated by research. Pentachlorophenol is hazardous regardless of the solvent that is used. Note that solvents that do not evaporate easily, such as fuel oil. can themselves be hazardous to bees and should not be used.

Arsenic-Containing Preservatives. Inorganic arsenical wood preservatives such as chromated copper arsenate (CCA) may weaken colonies, kill significant numbers of bees that come in

contact with newly treated wood, and contribute to winter kill (Harrison, Palmer-Jones, and Nairn, 1959; Kalnins and Detroy, 1984). Although these inorganic salt preservatives do not evaporate (unlike creosote and pentachlorophenol), bees evidently ingest enough preservative from the treated wood surfaces to be weakened or killed. In FPL studies, approximately one part per million arsenic was found in bees from hives treated with 4 kg/m^3 or 0.25 lb/ft^3 of CCA (Kalnins and Detroy, 1984). The safety of using CCA on hive parts that do not come in contact with bees (such as hive stands) has not been tested. In July 1984, the Environmental Protection Agency (Environmental Protection Agency, 1984) mandated that labels on pentachlorophenol, inorganic arsenicals, or creosote warn consumers not to treat wood intended for those portions of beehives which may come in contact with the honey. According to our results (Kalnins and Detroy, 1984), this precaution ought to extend to portions of beehives that come in contact with bees as well.

Other Preservatives. Tributyl tin oxide (TBTO), another nonvolatile preservative, was found to be unsuitable because of winter bee kill and the presence of tin in both bees and beeswax (Kalnins and Detroy, 1984).

A water-repellent dip treatment (solvent, varnish, and paraffin wax) was harmless to bees, but added very little decay resistance to bottom boards in ground contact (Kalnins and Detroy. 1984).

Suitable Preservatives

In FPL experiments (Kalnins and Detroy, 1984), treating wood hive parts with copper naphthenate, copper-8-quinolinolate, and acid copper chromate not harm bees or result in significant levels of hive product contamination.

Copper Naphthenate. Copper naphthenate is sold as a concentrate or as a solution ready for use. The concentrate, 8 percent copper, is a viscous green liquid. For dip, soak, or brush application, it is usally diluted with mineral spirits or paint thinner to a concentration of 1 percent copper (for temperate zones) or 2 percent copper (for subtropical areas). A more dilute solution is used for pressure treatment. Copper naphthenate is also available as a concentrate that can be diluted with water; we did not evaluate this formulation. It has a moderate nonpersistent odor familiar to many because of its common use in preserving canvas. Copper naphthenate itself is nonvolatile, only very slightly soluble in water. and therefore not easily lost from treated wood.

Copper naphtenate is an effective preservative. For example, test stakes (nominal 2 x 4's in the ground) preserved with a 0.57 percent copper solution had a 27.2-year average lifetime in Mississippi and a longer lifespan in Wisconsin (Gjovik and Gutzmer, 1983). In our study, copper naphthenate was applied by pressure treatment. Although more preservative is absorbed when pressure treatment is used, copper naphthenate is usually applied with a brush or by dipping or soaking the wood. Nevertheless, brushing or dipping wood in this preservative definitely extends the life of the wood compared to untreated wood (Scheffer, Verrall, and Harvey, 1971; Verrall, 1963). Southern pine sapwood test stakes (nominal 2 x 4's) in the ground brush or dip treated with copper naphthenate solution (2% copper) had average lifetimes of 3.7 to 5.2 years in Mississippi and 8.6 to 9.8 years in Wisconsin (Gjovik and Gutzmer, 1983). By contrast, the lifetime of untreated stakes averaged 1.8 years in Mississippi and 4.9 years in Wisconsin. Average lifetime for brush-or dip-treated pine bottom boards placed on the ground is likely to be longer than that of similarly treated stakes.

Copper naphthenate may have a tendency to bleed through some paints, especially the solvent type. After the preservative has thoroughly dried (possibly several weeks), the hive parts can be painted with latex paint.

Copper-8-quinolinolate. Although copper-8-quinolinolate is less effective than copper naphthenate for preserving wood in ground contact, it is also less hazardous and can be used to preserve wood that may contact foodstuffs (such as refrigerator cars, food-processing plants, warehouses, containers for storing fruit, vegetables, and grain, etc.).

Copper-8-quinolinolate can be obtained as a water- or solvent-soluble concentrate, or already diluted (i.e., ready to use). A solvent-type solution of approximately 0.045 percent copper is commonly used for brush and dip treatments.

In Mississippi, test stakes pressure treated with 0.12 lb/ft^3 of copper-8-quinolinolate in light solvent averaged 7.8 years in the ground before failure, compared to 2.2 years without treatment (Gjovik and Gutzmer, 1983). How much longer the hive parts will last when brush- or dip-treated with this or with the other preservatives and placed in service above ground is not yet known.

Acid Copper Chromate. Wood commercially treated with this waterborne preservative is available in some areas. Acid copper chromate may be applied by brushing. dipping. or soaking, but the wood will be more durable when pressure treated to specified retention of preservative. For example. southern pine stakes treated to 0.26 lb/ft^3 had an average life of 11.6 years in the ground in Mississippi compared to 3.2 years for untreated stakes (Gjovik and Gutzmer, 1983). while stakes at 0.75-lb/ft^3 retention were performing well alter 36 years. The durability of dip- or brush-treated hive parts above ground is not yet known.

If acid copper chromate treatment is desired, we suggest that commercially treated wood be purchased. Such wood is more durable than brush- or dip-treated wood. Copper oxide or copper sulfate, chromic acid, or potassium or sodium dichromate may be difficult to obtain, and the chemicals pose hazards for handling and disposal. Dust masks should be worn when sawing or machining treated wood, and leftover treated wood should not be burned but disposed with other solid waste in a landfill.

METHODS OF APPLICATION

Beekeepers who wish to treat wood hive parts with preservatives can consider brush application. dip treatment, cold soak, or hot and cold bath methods of application.

Brush Application

This method is fairly effective, especially in treating end grain and wood joints. If hive parts are not painted, the treatment can be repeated in a few years; regular application will result in longer service life. Hive parts that are painted after treatment last longer than treated, unpainted hive parts. Wood treated with preservative should be allowed to dry for at least several days (longer if copper naphtenate or copper-8-quinolinolate is used) before painting with a high-quality latex exterior paint.

Dip Treatment

Dipping for approximately 3 minutes is as effective and faster than brush application, although more liquid is needed in order to submerge the wooden parts. Leftover chemicals should be disposed of only according to state regulations (DeGroot and Johnson, 1979). It may be more practical to brush the leftover liquid on other wood in need of protection.

Cold Soak

Wood is usually cold soaked for about 2 days. The penetration of preservative depends on the kind of wood and its moisture content. This process works well on dry pine and results in greater absorption of the preservative than dipping.

Hot and Cold Baths

Wood is submerged in heated treating solution in an open tank for several hours. When bubbling has ceased, the wood is quickly submerged in a cold tank for several hours. Cooling reduces air pressure within the wood, and the preservative is drawn into the wood. Penetration is better than that obtained by the cold-soak method, especially for wood that resists absorption of preservative.

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