Danger of Using Arsenic-treated Timber for Beehives

By D. L. HARRISON, Senior Scientific Officer, T. PALMER-JONES, Principal Scientific Officer, and R. G. NAIRN, Technician, all of the Department of Agriculture Animal Research Station, Wallaceville

TESTS carried out at Wallaceville have shown that wood preservatives containing arsenic are poisonous to bees and lead to serious reduction of the honey crop. Arsenic-treated timber should on no account be used in beehive construction if serious losses are to be avoided.

THE common practice among apiarists is to seal and paint the outsides of beehives and leave the inner surfaces untouched. It is obvious that when treated timber is used for building hives bees will be continually exposed to the chemicals remaining on wood surfaces after treatment or contained in the hive dust and condensed surface moisture. The effect of these chemicals on bee health and possible contamination of the honey are two factors of primary importance to the beekeeper. Field tests in which three commonly available wood preservatives containing arsenic were used were designed to study these problems at Wallaceville Animal Research Station, and the results obtained are discussed in this article.

WALLACEVILLE TRIAL

PRE-CUT hive parts of *Pinus radiata* sufficient for four 3-storey hives were treated with preservatives, dried thoroughly, and assembled (see table at right). The outsides only were sealed with primer and two coats of lead-free paint. The hives were set up in line along the edge of the main apiary and strong colonies and brood headed by young queens installed in each. Four hives chosen at random from the general apiary were used as controls.

TREATMENT OF HIVES

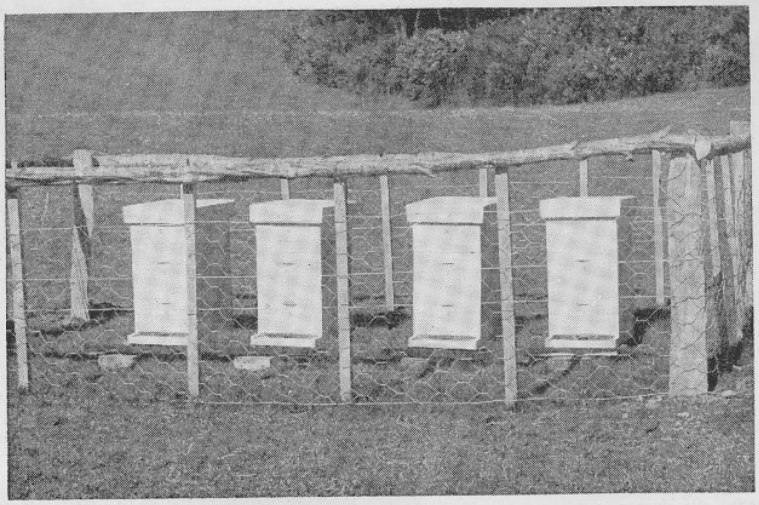
Hive number	Preservative	Composition
1, 2 ..	Tanalith U	Fluor-chrome-arsenate with dinitrophenol
3, 4 ..	Boliden S 25	Zinc, copper, chrome-arsenate
32A, 32B 33, 34	Untreated controls	

The trial was begun in December 1954 at the beginning of a honey flow. Mortalities in the Boliden-treated hives were not excessive until the honey flow tapered off late in February. From then on the numbers of dead and dying bees which accumulated at the entrances of hives 3 and 4 were abnormally high.

The Tanalith-treated hives 1 and 2 did not show excessive mortalities compared with the controls. Unfortunately robbing was particularly severe early in the new year. Hive 2 was almost completely lost and was removed from the experiment to prevent further attack; hive 4 suffered considerable loss of honey from the same cause.

The dead and dying bees ejected daily from all hives were counted for one month beginning in May. Counts showed that abnormally high mortalities were still occurring in the Boliden-treated hives 6 months after establishment. Losses from the Tanalith hives were no greater than from the controls.

Chemical analyses for arsenic were made through May and June on weekly collections of dead bees from the four random controls, the hives treated with preservatives, and the four untreated hives nearest the latter in the apiary. The level of arsenic in bees from treated hives 1, 3, and 4 was high and consistent with death from arsenic poisoning. Bees from all control hives contained more than the normal content of arsenic, which showed that considerable robbing of stores and drifting of bees had taken place between the treated hives and the controls.



An isolated group of beehives under observation at Wallaceville after treatment with an arsenic wood preservative.

Analysis of Live Bees

During the removal of the season's honey crop bees in individual hives were anaesthetised, washed free from surface dust, and analysed for arsenic. The results showed clearly that all bees in every hive built of arsenic-treated wood were still ingesting considerable quantities of preservative 6 months after the trial started.

Analysis of the Honey Crop

Four core samples were taken from every frame with a 1 in. cork borer along a diagonal and perpendicular to the foundation comb. Weighed portions for analysis were taken after all the cores from each hive had been pooled, melted, and homogenised. These samples included cappings, honey, pollen, foundation comb, cell wax, and the occasional bee. The main honey crop and cappings honey were extracted as in normal commercial practice, the burr and brace combs being included in the cappings.

The only significant amount of arsenic found was in the cappings honey from hive 4 (Boliden), which contained 0.13 parts per million of arsenic trioxide. All other samples contained 0.05 parts per million of arsenic trioxide or less, with traces only in the controls. These levels are well below the tolerance of 1.5 parts per million of arsenic trioxide permitted in foodstuffs under the New Zealand Foods and Drugs Act.

Source of Arsenic

By feeding bees the honey in full combs removed from the Boliden-treated hives it was shown that though the arsenic level of the bees was raised above normal, the arsenic in the combs was not the major cause of the high mortalities in the experimental hives.

In a further test the inside surfaces of a disassembled Boliden hive were sprayed with water and the washings collected, evaporated, and fed to bees in sugar syrup. Bee mortality was higher in this test and the arsenic content of the live colony bees was approximately five times that reached in the first test over the same period. This indicates that hive dust and condensed moisture are the main source of poison within the hives.

KAITOKE TRIAL

A second and more comprehensive trial over a 2-year period was made in which 12 hives constructed from timber treated with Tanalith U, Tanalith C (a copper chrome-arsenate), and Boliden S 25 were used. Whereas in the Wallaceville trial treatment with chemicals was done on the pre-cut hive parts, in this trial the timber was treated in the rough-sawn state, dried, machine dressed, and then cut into the various hive components and assembled. The outsides were sealed with primer and given two coats of lead-free paint; the inner surfaces were left unsealed as previously. Four hives treated with the same preservative were grouped together and the three groups placed several hundred feet apart.

Colonies and brood were introduced into the Tanalith U and Boliden hives in July 1956, and into the Tanalith C groups in October. The soil near the hives was tested and found to be free from arsenic. No arsenic compounds to our knowledge were used during these tests in the areas visited by the bees.

Abnormal numbers of deaths soon occurred in both the Tanalith U and Boliden hives. Dead bees collected during the first fortnight from both groups had very high arsenic contents. The main symptoms shown by the affected bees were weakness and incoordination, which are typical of poisoning by arsenic.

Colony strength was so depleted in the Boliden group that one hive did not survive and the complete honey crop from the other three was lost. The Tanalith U group, after the initial mortalities, built up steadily and the first season's honey crop removed in autumn was satisfactory. The Tanalith C hives, which were started in late spring, appeared quite normal during the first season, though one hive was lost through robbing.

As in the Wallaceville tests, only traces of arsenic were found in the main honey crops; the cappings honey from Tanalith U and Tanalith C groups contained 0.10 and 0.05 parts per million of arsenic trioxide respectively.

The second season proved disastrous for all hives, though every effort was made to help them to survive. Throughout the year heavy losses of bees occurred in all hives, especially during the cold winter months. Mortalities were so severe that the hives could not defend themselves and they were continually under attack by bees from other areas. The three remaining Boliden hives had ceased to function by March 1958.

Throughout the trial analyses of the collected dead bees from all treated hives showed conclusively that mortalities were due to poisoning by arsenic derived from the hive timbers.

By August only one Tanalith C and two Tanalith U hives had survived, all in a weakened condition. Chemical analysis of live bees from these three of the original 12 which survived the 2 years of the trial showed their arsenic content to be abnormally high.

Though the total effect in the Tanalith C hives was the least severe, both live and dead bees from this group contained considerably more than the normal level of arsenic. In the absence of other common causes the dying out of this group can be due either directly or indirectly only to arsenic poisoning.

It is clear that machine dressing of the treated timber was not effective in preventing losses in any of the three groups.

CONCLUSIONS

When treated with wood preservatives containing arsenic both pre-cut timber and timber subsequently machine dressed has been shown to be toxic to bees and to reduce honey yield seriously. The ingestion by bees of arsenic compounds from the inner-hive surfaces continues for at least 2 years after treatment. Contamination of honey with arsenic is negligible. Bee mortality, however, is severe, especially during the cold months of the year, when moisture condensation on the inner-hive surfaces is greatest. The consequent demoralisation within the hives leaves them open to attack by robber bees, and this was a feature in both trials.

Reduction in hive strength might be overlooked for a time in commercial apiaries particularly if the hives were surrounded by long grass and weeds. Such hives when inspected would be found in a weakened condition with depleted stores of honey. Hives could be in a similar plight through poisoning with agricultural chemicals or through the effect of certain bee diseases. The only means by which poisoning by arsenic can be definitely established is by chemical analysis.

Whether hives are decimated by poisoning in a single season (as in the Boliden group) or whether they are weakened to such an extent through the effects of the poison that they are subsequently robbed of all their honey (as in the Tanalith groups) the end result in both cases is the same as far as the beekeeper is concerned.

While the decay resistance qualities under field conditions were excellent, it is considered on the evidence presented that wood treated with arsenic preservatives should on no account be used in beehive construction.

Safe Preservatives for Beehives

Pentachlorophenol is safe for use in beehives according to Dyce (1951) provided the bottom boards and other hive parts with which the bees come into contact are piled outdoors and adequately ventilated for at least a week or two. This allows the volatile solvents to evaporate. Another writer (1954) states that pentachlorophenol is satisfactory for treatment of hive timber provided the timber is thoroughly aired before use; otherwise there is a danger of injuring the bees.

Copper naphthenate, copper chromate, and boric acid should also be satisfactory provided the hives are thoroughly dried and ventilated before use. Creosote should not be used, as it causes honey taint.

Acknowledgments

The authors wish to record their thanks to Hickson's Timber Impregnation Co. (N.Z.) Ltd., Auckland, and to the New Zealand Forest Service's Forest Research Institute, Rotorua, for their cooperation and for supplying the treated timbers.

References

"Treating New Beehives", "Gleanings in Bee Culture", vol. 82, p. 238, 1954.

E. J. Dyce, "Wood Preservatives and their Application", "American Bee Journal", vol. 91, p. 192, 1951.