Bulletin No. 158 - The Use of Calcium Cyanide in the Apiary

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UNIVERSITY OF WYOMING
AGRICULTURAL
EXPERIMENT STATION

THE USE OF CALCIUM CYANIDE
IN THE APIARY

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/*In cooperation with the U. S. Department of Agriculture.
The Use of Calcium Cyanide in the Apiary

By C. L. Corkins

INTRODUCTION

The burning of colonies of bees infected with American foulbrood caused by Bacillus larvae White is universally recognized as the most positive method of control of this most disastrous of all brood diseases of the apiary. It is especially recommended as the treatment to be used by the apiarist who has had little or no experience in the treatment of this disease. Moreover, it is being adopted as the standard practice, fixed by law, by many apiary inspection departments of the United States and the provinces of Canada.

As general in adoption as this method has become, there is a great possibility of the spread of the disease in its use, especially by the novice. The complete destruction by fire of the diseased bees and all of the infected parts of the hive most certainly is effective. The danger lies in the improper handling of the diseased colony in preparation for burning. To make the treatment absolutely safe, all bees carrying infected honey must go into the fire. This means that they must be killed prior to burning, so that none can take flight and enter a healthy colony.

Hence, the first step in the burning treatment is the killing of all of the bees within their hives, making sure that not one escapes alive. Unfortunately, this primary requisite to the success of the treatment has not always been practiced and in such cases the danger in the spread of the disease is greater than if other and more difficult means of control were applied. The old methods of killing the bees prior to burning have been by the use of sulphur smoke or formaldehyde.

There are serious objections to the use of either of these chemicals. In the first place, their killing action is slow. With sulphur smoke there is always the unavoidable chance that live bees will escape, no matter when applied. If the hives are tight, formaldehyde could be used at night when the bees were all in and the entrance immediately blocked. To have to return to the apiary at night requires unnecessary time. Finally, both of these chemicals are inconvenient and disagreeable to use.
"G" grade calcium cyanide, \( \text{Ca}(\text{Cn})_2 \) meets all the rigid requirements of the initial step in the burning treatment. It kills quickly, most of the bees being overcome in a few seconds, and all are dead in five minutes. Any bees which are outside of the hive or may get out during treatment are not repelled by it when they return to the hive and so enter normally and are quickly overcome. There is no danger to the operator in handling this chemical in the open air. It is not disagreeable to most people, though some find it slightly nauseating and productive of headaches when constantly using it. When used infrequently, even this slight disadvantage is not apparent. The convenience and the ready availability of this chemical also makes it ideal for this practice.

**CYANIDE TREATMENT DOES NOT POISON HONEY**

The active killing agent liberated by the action of the air upon calcium cyanide is hydrocyanic acid gas (HCn). Since this is one of the most deadly gases known, the question naturally arises, will the salvaged honey be safe for consumption by human beings or even by the bees? To answer this question, the following experiments were conducted.

In the preliminary experiment three frames of honey containing both open and closed cells were subjected to the treatment. These were placed in a 3-frame standard depth nucleus with the \( \frac{3}{4} \)-inch entrance left open. Twenty-five grams of calcium cyanide placed upon a dry cardboard were introduced at the entrance. The nucleus was allowed to remain in a closed room at 18 to 22 degrees Centigrade for 24 hours. Immediately at the end of the exposure, the honey was cold-extracted, by means of pressure upon a cheese cloth bag, from both open and closed cells. Twenty cubic centimeters of this honey were diluted with an equal amount of cold, distilled water, and the 40 cubic centimeters of diluted honey fed to a rabbit. This amount of honey was all given to the rabbit at one time, the introduction being made directly to the stomach through a stomach tube. The rabbit suffered no ill effects whatsoever.

The same general procedure was followed in the subsequent experiments, which were repeated, except that the manner of con-
ducting the fumigation was varied to simulate all conditions which would be encountered in the field. This variation is shown in the table:

**TABLE SHOWING METHODS OF FUMIGATION**

<table>
<thead>
<tr>
<th>No.</th>
<th>Amount of Ca(Cn)₂</th>
<th>Introduction on Cardboard which was</th>
<th>Nucleus Entrance</th>
<th>Condition of Honey</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 oz.</td>
<td>Dry</td>
<td>Open</td>
<td>Normal in open and closed cells</td>
</tr>
<tr>
<td>2</td>
<td>2 oz.</td>
<td>Moist</td>
<td>Open</td>
<td>&quot;</td>
</tr>
<tr>
<td>3</td>
<td>2 oz.</td>
<td>Dry</td>
<td>Sealed</td>
<td>&quot;</td>
</tr>
<tr>
<td>4</td>
<td>2 oz.</td>
<td>Moist</td>
<td>Sealed</td>
<td>&quot;</td>
</tr>
<tr>
<td>5</td>
<td>5 oz.</td>
<td>Dry</td>
<td>Sealed</td>
<td>&quot;</td>
</tr>
<tr>
<td>6</td>
<td>5 oz.</td>
<td>Moist</td>
<td>Sealed</td>
<td>Diluted to Nectar Consistency</td>
</tr>
<tr>
<td>7</td>
<td>5 oz.</td>
<td>Moist</td>
<td>Open</td>
<td></td>
</tr>
</tbody>
</table>

At the close of the 24-hour period of fumigation the honey was extracted and diluted as above described, except in the case of experiment No. 7. The rabbits used varied in weight from 1299 grams to 1952 grams. Twenty-five cubic centimeters were given in experiments 1 and 2, and 50 cubic centimeters in all others. Neither in the initial nor the repeated experiment was there the slightest abnormality noted in any of the rabbits following the forced feeding of the honey.

It will be noted that an extraordinary large amount of calcium cyanide was used in all of the experiments. Likewise, the amount of honey fed to the rabbits was abnormally large. By weight comparison, a man weighing 150 pounds would have to eat from 34 to 70 ounces of honey to have consumed a proportionate amount.

These results were much as was expected because of the reactions of the chemicals involved. In order that the cyanide might remain in the honey, it would have to form some salt of cyanide. All of the cyanide compounds are extremely unstable in the pres-
ence of the slightest acid. Honey is acid in reaction, and would, therefore, preclude the formation of cyanide compounds within it.

KILLING DISEASED BEES WITH CALCIUM CYANIDE

The method here given, was developed by the Wyoming Experiment Station and is based not only upon experimental work, but also upon three years of field experience by the Apiary Inspection Division of the Wyoming State Department of Agriculture.

The dosage of calcium cyanide to be used is one tablespoonful. If the hive bodies are not tight or if the colony is more than three full depth hive bodies high, the amount is doubled. The chemical is spread out on a small cardboard and gently slipped into the entrance of the hive. The entrance is then closed for two minutes or until the colony is burned. However, if application is made during the day along with normal manipulations in the apiary, the entrances should be opened after two minutes, primarily for the purpose of admitting any flying nurse bees, so that they too will be killed inside the hive. Having allowed an hour for all flying young bees to return to the hive, one may proceed with the actual burning.

If the cyanide is applied during the day when the entrances have to be opened, an occasional bee may have got outside the hive and died in front of the entrance. The treatment has been observed to induce regurgitation of honey so such dead bees should be covered with dirt to preclude even the slightest possibility involved of transfer of such honey to healthy bees. This is of especial importance if there is any danger of robbing.

BURNING BEES AND EQUIPMENT

The final step in the treatment, that of burning, should be handled with as much care as the killing. The fire should be laid in a pit sufficiently deep to permit the covering of the debris with one to two feet of earth when the work is completed. It is next to impossible to burn all of the honey or even to heat it sufficiently to kill the organisms which produce the disease. The fire should be built a sufficient length of time before the diseased colonies are thrown on to result in a good bed of coals which will catch and char the bulk of the dripping honey. Every precaution should be exercised to see that all of the dead bees go into the fire.
The parts of the hive which should go into the fire will be determined by the conditions. All brood combs should always go in. In the case of a primary outbreak of the disease in the particular yard and territory in question nothing should be spared from the conflagration. Similarly, everything should be burned by those who are inadequately equipped to handle and disinfect properly the materials salvaged. However, if the disease is well established in a locality and the beekeepers are prepared to cope with the situation, then it will be a needless waste of valuable equipment to burn the tops, bottoms, hive bodies, supers and combs in which the bees have not raised brood. It is questionable if honey from diseased colonies in all cases should be considered sufficiently contaminated to cause reinfection. This, of course is true only when the disease is discovered and treated in the early stages, and there are but few unhealthy larvae present. In this event comb honey is probably entirely safe and should be salvaged for human food. This is likewise true of honey in an extracted super, provided it has been isolated from the brood nest by an excluder, and the queen has not had access to it. In any event, all salvaged honey and equipment should be immediately removed to a bee-tight building, and the equipment disinfected as soon as possible.

The pit containing the debris that remains after burning should be well filled in with earth to preclude any possibility of bees gaining access to honey which has not been sufficiently heated by the fire to disinfect it. If there is danger of burrowing animals opening up the pit, as is sometimes the case, the added precaution of covering the bottom of the pit with a repellent should be taken. Crude oil or creosote dip may be sprayed over it to close the last possible chance of danger.

THE DESTRUCTION OF WILD BEES

In the control of American foulbrood in Wyoming, it is essential that so-called "wild bees" in all situations be eliminated insofar as possible. Calcium cyanide applied with an inexpensive hand duster is an efficient chemical to be used in the destruction of wild bees within the walls of houses, trees, rocks and other cavities. When used in dwelling houses, the only precaution necessary is to see that the house is well ventilated during the treatment. Follow-
ing the killing of the bees in these situations, the entrances to the cavities must be securely plugged or else filled brimming full of crude oil.

FUMIGATION FOR WAX MOTH

The standard chemical used in the fumigation of combs for the control of waxworms is carbon bisulphide. Although this material is efficacious in the destruction of these insects in all stages of development, it is disagreeable and dangerous to use. This is due to its pungent, repelling odor and to its high degree of inflammability. When used in buildings, as it must be for this purpose, the danger of explosion is great.

Para-di-chloro-benzine has been found safer and more convenient to use than carbon bisulphide, but is not readily available upon the retail market.

Hence, experiments were conducted to determine the value of calcium cyanide for the control of waxworms in stored combs, since it is now a standard method for indoor fumigation for the control of many insect pests. It was found to be 100 per cent efficient in the destruction of all stages of waxworms.

If the supers are fairly tight, they may be stacked for treatment, with a telescope cover at the bottom and the top of the stack. For stacked super treatment, calcium cyanide is used at the rate of 4 pounds for every 1,000 cubic feet of space, or 6½ ounces for every 100 cubic feet of space. The period of treatment is 24 hours.

The fumigation may also be done in a more or less air tight building. The supers should be stacked crisscross, to allow free access of the gas. If the building is fairly tight, one-half the amount of calcium cyanide may be used, figured upon the entire capacity of the building, as for stacked super treatment. The cyanide is spread out finely upon newspapers placed at several places in the room. The operator should place the charges rapidly and immediately leave the room. All doors and windows must be locked for the 24-hour period of fumigation. At the end of this time, the building should be opened to give a good draft through it and no one should enter for at least a half hour. If these simple
directions and precautions are followed, there is not the least
danger of poisoning the operator. Likewise, the combs are not
harmed in the slightest degree by the treatment.

THE CONTROL OF ANTS IN THE APIARY

Very often ants are exceedingly troublesome in the apiary. Weak colonies or queen rearing nuclei are sometimes completely
overpowered by these insects. Although strong colonies may be
able to repel their attacks, the persistence of ants attempting to
gain entrance to the hive is demoralizing to the bees. The ants
swarm over the entrance, and the guarding bees become very ex-
cited. Field bees returning to the colony heavily loaded with
nectar or pollen may be snapped up by the ants before they can get
into the hive. It is certain that the working efficiency of even the
strong colonies is materially cut down.

Most of the difficulty encountered in apiaries in Wyoming is
from the mound-building species of ants. These may be very
quickly and easily destroyed by the use of calcium cyanide. For
treatment, the mounds should be opened with a spade. One or two
spadefuls of the mound should be removed from the top. Two
to three tablespoonfuls of calcium cyanide are then sprinkled over
the bottom of the pit, and the contents of the mound thrown over
it. This process may have to be repeated a week later on a few of
the nests, if there are still live ants in evidence.

If the beekeeper has a small hand cyanide duster, more ef-
ficent application may be made by opening up holes into the run-
ways of the ant nests with a sharp-pointed, round prod. The cya-
nide is forced into these holes with the duster and they are then
closed.

Cyanide should never be applied to ant nests which are
within a few feet of a colony of bees. The poisonous hydrocyanic
acid gas evolved will overcome full colonies of bees if this chemi-
cal is used in ant nests close to them. If the nests occur right in
the apiary, the colonies should be moved several feet away from
them before the treatment is applied.
GENERAL INSTRUCTIONS

“G” grade calcium cyanide is to be used for all purposes herein reported. This material may be secured through the Wyoming Agricultural Extension Service, Laramie, Wyoming. Many local county agricultural agents also keep it on hand. It is available through a few drug stores and hardware establishments.

Calcium cyanide liberates its gas, hydrocyanic acid gas, rapidly upon exposure to the air. When storing, make sure that the container is sealed air tight. Also take the precaution to store the material where it will be out of the reach of children. It is poison and should be treated as such.

SUMMARY

When the proper precautions are taken, calcium cyanide is a safe and efficient chemical to use in the apiary for the following purposes:

1. The killing of bees infected with American foulbrood, as the first step in the burning treatment.
2. The destruction of wild bees.
3. The fumigation of stored combs infested with waxworms.
4. The extermination of mound-building ants in the apiary.
The following publications of the Wyoming Experiment Station may be had upon request. (Revised list, December 1, 1927.)

**ANNUAL REPORTS—**
1909-10 to 1919-1920; 1921-1922; 1923-1924 to date.

No.  **CIRCULARS—**
17. Feeding Yearling Steers.
18. Abortion Disease in Wyoming.

No.  **BULLETINS—**
Index Bulletin D, July, 1907, Indexing Bulletins 54 to 75.*
110. Sweet Clover.
111. Alfalfa in Wyoming.
112. The Poisonous Properties of the Two-Grooved Milk Vetch (*Astragalus bisulcatus*).
113. The Effect of Alkali upon Portland Cement.
116. Winter Grains.
117. Cattle Feeding:
   - Oat and Pea Silage for Beef Cows.
   - Oat and Pea Silage for Growing Cattle.
118. Oats in Wyoming.
119. Spring Wheats in Wyoming.
120. The Chemical Examination of Three Species of Larkspurs.
121. Swamp Fever in Horses.
123. Chemical and Pharmacological Examination of the Woody Aster.
129. Sunflowers, their Culture and Use.
130. Native Feeds for Fattening Lambs.
131. Effects of Alkali and Weathering upon the Wool of Range Sheep.
132. The Regain of Unwashed Wool.
134. Wintering Range Calves.
135. Garbage for Fattening Pigs.
136. Avian Type of Tuberculosis in Cattle: Injection and Testing.
137. Wyoming Forage Plants and their Chemical Composition.
138. Experimental Transmission of Swamp Fever or Infectious Anemia by Means of Secretions.
139. Climatological Data for Wyoming.

*Very limited number.*
142. Tuberculosis of Fowls.
143. Chemical Examination of Three Delphiniums.
144. Lupine Studies II—The Silvery Lupine.
145. Wyoming Hay for Milk Production.
146. Wyoming Forage Plants and Their Chemical Composition—Studies No. 7.
148. Wyoming Corn for Pork.
150. Fallow for Small Grains.
152. A Study of Potato Seed Treatment for Rhizoctonia Control.
153. Type in Beef Cattle.
155. Type in Two-Year Old Beef Steers.
157. Wyoming Forage Plants and Their Chemical Composition—Studies No. 8.

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