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The Effect of Field Applications of Insecticides on Honey Bees

by

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In general, investigators have concluded that, while these new insecticides are lethal to bees, field applications have caused minor or no losses. The opinion of beekeepers in certain areas is contrary to this view. They attribute poor honey crops and depleted field forces to DDT dustings, although they have not found large numbers of dead bees.

Experimental Procedure

On September 1, 1948, eleven colonies of bees were placed approximately 30 feet from 2 acres of blooming alfalfa. The September dearth of honey plants assured their visitation to this alfalfa. The short distance from the field to the hives lessened the chance of losing affected bees along the line of flight. Surveys disclosed that a Ladino clover pasture nearby was the only other field attracting appreciable numbers of bees. The
FIGURE I. DEPRESSION OF HONEY BEE VISITATION ON ALFALFA AND TOTAL PICKUP OF DEAD BEES AT HIVES, AS RELATED TO EXPERIMENTAL APPLICATION OF INSECTICIDES.

CLOSEST APIARY WAS APPROXIMATELY 3 MILES AWAY.

VARIOUS INSECTICIDES WERE APPLIED IN THE SEQUENCE AND AT THE DOSAGES GIVEN IN TABLE 1. AT EACH APPLICATION THE WHOLE ACREAGE IN BLOOM WAS DUSTED WITH A POWER DUSTER. ALL APPLICATIONS WERE MADE BETWEEN 7 AND 7:45 A.M., WHEN AT THIS SEASON BEES HAD NOT LEFT THE HIVES. THE INTERVAL BETWEEN APPLICATIONS WAS 48 HOURS, OR A TIME SUFFICIENT FOR THE VISITING FIELD FORCE TO RETURN TO NORMAL VOLUME AND ACTIVITY.

THE NUMBER OF BEES EXPOSED TO A TREATMENT WAS ESTIMATED BY COUNCING THOSE OBSERVED ON 50 OR MORE SQUARE YARDS BETWEEN 1:30 AND 2 P.M. EACH DAY, ACCORDING TO THE METHOD DESCRIBED BY VANSELL AND TODD (1946).

MORTALITY WAS ESTIMATED BY COLLECTING DEAD BEES AT THE HIVES AND IN THE FIELD. THE DAILY PICKUP AT THE HIVES WAS MADE FROM 8:30 TO 9 A.M. ON AN AREA EXTENDING 10 FEET FORWARD FROM THE REAR OF THE HIVES.

THE NORMAL NUMBER OF DEAD BEES WAS ESTABLISHED BY MAKING COUNTS FOR SEVERAL DAYS BEFORE THE FIRST DUST APPLICATION. THE MEAN OF THESE COUNTS, 150, WAS THEREAFTER DEDUCTED FROM EACH DAILY PICKUP.

BEGINNING AT 4 P.M. ON THE FIRST AND SECOND DAYS AFTER EACH DUSTING, DEAD BEES WERE PICKED UP ON SEVERAL STRIPS 1 FOOT WIDE EXTENDING ACROSS THE FIELD. ONLY BEES THAT APPEARED TO BE FRESHLY DEAD WERE INCLUDED IN THE COUNT.

MEASUREMENT OF RESULTS

THE EFFECT ON HONEY BEES OF INSECTICIDES APPLIED AS DUSTS UNDER VARIOUS CONDITIONS TO 2 ACRES OF FLOWERING ALFALFA WAS ASSESSED IN THE FIELD AT LOGAN, UTAH, 1948.

TABLE 1

<table>
<thead>
<tr>
<th>Date</th>
<th>Insecticide</th>
<th>Dosage (Pounds per Acre)</th>
<th>Temperature °F.</th>
<th>Dew at Time of Treatment</th>
<th>Number of Bees Exposed</th>
<th>Number of Bees Killed At Hive</th>
<th>Number of Bees Killed In Field</th>
<th>Per Cent Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>September</td>
<td>Chlorinated</td>
<td>camphene 10% 17 35-70 Moderate</td>
<td>29,040</td>
<td>86</td>
<td>3049 (92)</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Chlordane 5% 22 37-82 Heavy</td>
<td>21,253</td>
<td>1779</td>
<td>457 (46)</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Chlorinated</td>
<td>camphene 10% 19 41-87 Moderate</td>
<td>19,630</td>
<td>149</td>
<td>1471 (46)</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>DDT 3%</td>
<td>80 47-92 None</td>
<td>8,228</td>
<td>149</td>
<td>1471 (46)</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Chlorinated</td>
<td>camphene 10% 28 46-75 heavy</td>
<td>23,232</td>
<td>77</td>
<td>523 (92)</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Parathion 1% 23 34-69 None</td>
<td>7,357</td>
<td>1969</td>
<td>1007 (115)</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Numbers in parentheses indicate square yards covered in sampling.
It is recognized that not all dead bees are recovered by these methods. Some bees affected in the field strayed to other acreage, others dying at the hive were carried beyond the examination area by the house cleaners, and doubtless scavengers removed specimens from the field and at the hive.

Results—Death of bees after the various dustings apparently was confined to the field force, with a possible exception in the case of parathion. The second morning after the parathion application a conspicuous number of bees were crawling around the hives. The fact that their number exceeded the dead of the previous morning suggested a possible mortality among the house bees. This feature was not investigated.

In this experiment, toxaphene was much less lethal to bees than was parathion, chlordane, or DDT (table 1). Of the four insecticides used, parathion was the most destructive to bees. In two previous field tests, not reported here, toxaphene caused no conspicuous damage to colonies.

The place where the bees died, varied with the insecticide used. After the parathion application, two-thirds of the dead bees were found about the hives. About two-thirds of the deaths from chlordane and most of the mortality from toxaphene and DDT occurred in the field. It is possible that failure to search for dead bees in the field may largely account for previous conclusions regarding the hazards of DDT to beekeeping. However, heavy concentrations of dead bees are not to be expected when live bees in alfalfa fields seldom exceed three per square yard.

That the death of bees caused by chlordane or parathion occurred largely during the two days after application is shown in figure 1. The danger period from DDT is probably about the same. Figure 1 shows also a depression in the number of bees visiting the field after the application of chlordane, parathion, or DDT. In the case of chlordane and parathion this decrease is largely accounted for by the death of bees.

Bees react quite differently to DDT than to chlordane, parathion, or toxaphene. DDT dust is a slow repellent. After about one-half hour in the DDT-dusted field the bees began to rub their hind legs together as do pollen collectors, clean themselves, and stopped collecting from the alfalfa. Many bees, stupefied or cleaning themselves, were clinging to vegetation or other objects about the fields, but were capable of flying when disturbed. About 95 per cent of the bees observed during the field counts showed symptoms of DDT poisoning. Many of them were not recovered among the dead bees and are presumed to have survived contact with DDT. By depressing visitation the repellency of DDT limits mortality to bees that persist in their collecting. Our observations indicate that the repellency factor is more effective during a period of abundance than during a dearth of honey plants.

Daily counts of bees visiting a 7-acre alfalfa field dusted with 10 per cent DDT and a nearby 6-acre field treated with 10 per cent toxaphene are shown in figure 2. Both insecticides were applied when bees were not on the field. The characteristic depression in numbers of visitors to the DDT-treated field continued for two days, after which the population followed a trend similar to that on the field dusted with toxaphene. The depression on the day that toxaphene was applied is attributed to a strong wind rather than to the insecticide.

Discussion

The number of bees killed by the dusting of 2 acres of alfalfa may appear to be of minor importance. The amount of damage done to an apiary would depend largely upon the time of the dusting in relation to a honey flow and upon the proportion of the bee range treated. The killing of appreciable numbers of field bees during a honey flow would reduce the amount of nectar gathered. The field bees of an apiary may be spread over the 5,000 acres within effective flight range, or they may be concentrated on a few attractive fields. Dusting, during a honey flow, of a large portion of the plants being visited by the field force of an apiary could, apparently, bring about a marked reduction in the honey crop.

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odors or flavors were stronger. Heavy doses of each isomer applied to portions above ground or mixed in the soil affected odor and flavor of some crops, but in general, the effect of the alpha and gamma isomers were much less marked than that of the other isomers.

Conclusions

While these studies are admittedly only preliminary, they do indicate that most of the off-flavor caused in products by benzene hexachloride may result from the presence of the isomers other than gamma. They indicate, particularly, that benzene hexachloride formulations should contain the minimum practical quantity of the delta isomer when they are to be used in situations where plant safety may be involved and the minimum practical quantity of both the beta and delta isomers when the flavor or odor of the edible portion of plants may be affected. They also indicated that it would be helpful to eliminate the major portion of the alpha isomer. This suggests that, where the use of insecticides containing benzene hexachloride may cause off-flavor of the current or future season's crops, future research work should be based on formulations prepared from the relatively pure gamma isomer. Benzene hexachloride has proven to be very effective in the control of various insect pests. The isomer. Benzene hexachloride has proven to be very effective in the control of various insect pests. The results reported indicate that this chemical should not be arbitrarily ruled out because of the fear of flavor or odor contamination of crops until thorough tests have been completed with formulations of essentially pure gamma isomer.

It is urged that all experimenting with benzene hexachloride report the results in a way that will clearly describe the composition of the material tested.

BEE MORTALITY

Continued from page 29

Since in this experiment insecticides were applied during hours when bees were not visiting the field, the results probably represent the minimum mortality to be expected. When DDT was applied during hours while bees were on the field, much higher mortality was observed. The same principle would probably be true with chlordane, parathion, or toxaphene.

Agriculture has need of insecticides negligibly toxic to bees. The tolerances of honey bees to toxaphene exhibited in these tests appears to be of practical importance. For example, this compound will meet the need for emergency treatment during the flowering period for control of *Lygus* and alfalfa weevil in seed alfalfa. Toxaphene is also currently recommended for control of grasshoppers (Parker and Wakeland 1948). It is sometimes advantageous to control grasshoppers on crops after flowers have appeared. Further tests are necessary before we may conclude whether this insecticide can be used with reasonable safety to bees on flowering crops. Future tests on alfalfa should be made on a larger scale and in an area where bees collect pollen as well as nectar from the treated crop.

Summary

An experiment was performed to test the effect on honey bees of dusting in-flower alfalfa with 3 per cent DDT, 5 per cent chlordane, 1 per cent parathion, and 10 per cent toxaphene. All insecticides were applied with a powder duster during hours when no bee visitors were on the field. The time interval between dustings was sufficient to permit the bee activity to return to normal.

The field bees were the affected part of the colony and most of the mortality occurred within two days after applications. Parathion killed about 40 per cent of the visitors, DDT 28 per cent, and chlordane 23 per cent. The mortalities in two tests with toxaphene were 8 and 2 per cent.

Depression of the number of visitors to the field was noted with DDT, chlordane, and parathion. However, mortality largely accounted for the depression in tests made with chlordane and parathion. DDT showed a slow repel­lency, which tended to limit the total number of deaths by reducing the number of collectors working on the field.

In the tests with parathion two-thirds of the bees died in the apiary, whereas two-thirds of the deaths from chlordane and most of the mortality from DDT and from toxaphene occurred in the field.

The results indicate that dusting of flowering alfalfa during a honey flow may reduce markedly the honey yield when applied to a considerable proportion of the bee range. The low mortality of bees caused by toxaphene in this experiment, if maintained in tests under other conditions and on a large scale, indicates a wider use for this material in insect-control programs.

Literature Cited


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