TOXICITY OF AIRPLANE APPLICATIONS OF 2,4-D, 2,4,5-T, AND A COTTON DESICCANT TO COLONIES OF HONEY BEES[1,2]

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ABSTRACT

In 1969 2,4-D and 2,4,5-T and a cotton desiccant were applied by airplane to areas where 12-colony apiaries were located. The colonies were apparently not injured, and no herbicide was detected in the honey collected by the bees nor in the honey stomachs of bees during the tests.

INTRODUCTION

REPORTS of losses of honey bees from field applications of herbicides have been reported from time to time in different areas. However, these losses including some attributed specifically to 2,4-D[3] have generally not been confirmed scientifically. Indeed, Hocking (1950) reported that most herbicides including 2,4-D caused more loss through the reduction in forage than through toxicity to the honey bee; the exceptions were 4,6-dinitro-o-cresol (DNOC) and sodium fluoride which may cause severe bee losses. Also, King (1961) and Byrdy (1962) found that 2,4-D was not toxic to bees at the doses used in their field tests. However, Palmer-Jones reported in 1950 that the doses of 2,4-D normally encountered by bees in the field did not cause bee losses in New Zealand. He later (1964) reported that aerial applications of a dust mixture of sodium salt of 2,4-D and superphosphate caused a 20 percent loss in the field force and the loss of the honey crop from colonies in a large area. New Zealand Agricultural Chemical Board (1961) also stated that 2,4-D had appeared nontoxic in earlier tests but that more recent large-scale field applications had caused bee losses.

Amos subsequently (1969) obtained inconclusive results in Virginia in his studies of the effect of 2,4-D on colonies of honey bees. Anderson and Atkins (1968) found 2,4-D and 2,4,5-T[4] to be relatively nontoxic to honey bees in their California tests. We therefore arranged a test that might resolve the conflicting evidence.

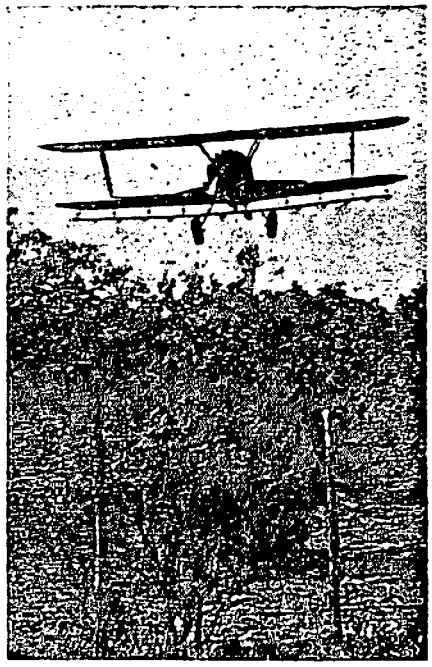
TESTS AND RESULTS

2,4,5-T

This test was made at the Las Delicias Ranch in Pima County, Arizona. On May 22, 12 colonies were moved into the middle of a block of about 1500 acres. This block was sprayed by aircraft starting on May 29 and ending the next day with butoxyethyl ester of 2,4,5-T at a rate of ½ lb. active ingredient/acre to control mesquite [*Prosopis juliflora var. velutina* (Woot.) Sarg]. An adjoining 1500 acres was also sprayed at the same time. Also, on May 22, 12 colonies were moved into a similar unsprayed site 3 miles from the nearest boundary of the sprayed area.

On 2000 of the 3000 acres, a combination of Trans-aid (NH_4SCN) and Cosco-X[5] was added to the spray; on the remaining 1000 acres, Cosco-X was used alone. The applicators emulsified 1 gallon of diesel fuel in 7 gallons of water containing the herbicides and the spreader. Four gallons of this mixture were applied per acre. The area sprayed had a heavy stand of mesquite. Catclaw (*Acacia greggii* A. Gray) and paloverde (*Cercidium microphyllum* Torr.) Rose & Johnston were also blooming and were being visited by honey bees and other insects.

Dead bee traps were placed on the 24 colonies on May 23, and daily counts of the dead bees in each trap were made from May 24 through June 5. On May 29 frames of drawn comb were placed in colonies in both the sprayed and unsprayed pasture. Frames were removed on both May 30 and June 2, and the honey stored in the frames was analyzed for 2,4,5-T by electron capture gas chromatography. In addition, the contents of the honey sacs from about 200 worker bees from colonies in the sprayed and unsprayed areas were collected May 31 and analyzed for 2,4,5-T.



This airplane is applying 2,4,5-T to control mesquite. Thousands of acres of mesquite have been sprayed in the last decade in the Southwest.

Spraying with 2,4,5-T did not cause a statistically significant loss of bees based on the count of bees in the dead bee traps. Although the colonies in the sprayed area had a higher average count the first day after spraying than the check colonies (Table 1), the number was still small. Such traps do not account for all the bees in a colony that die, but the relative number trapped should be similar for each colony. Therefore, the data on numbers of dead bees indicate relative bee mortality and are not absolute values.

Analysis of the honey removed from the colonies in both areas and the analysis of the contents of the honey sacs did not reveal any 2,4,5-T.

The 24 colonies were observed for 2 months after the spraying. No abnormal behavior or brood development was detected.

2,4-D

Mountain pastures near Washington Camp in the San Rafael Valley of Santa Cruz County, Arizona, were used for the study, of 2,4-D. On July 23, 12 colonies were moved both into the area that was to be sprayed and into a similar unsprayed location 5 miles from the sprayed pastures. Dead bee traps were placed on all colonies the next day. The 1500 acres that were treated July 29, 30, and 31 had a dense stand of pointleaf manzanita (*Arctostaphylos pungens* H.B.K.). A mixed

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[1] Entomology and Plant Science Research Division, respectively, U.S. Department of Agriculture. Approved by the Arizona Agriculture Experiment Station, Tucson, Arizona.

[2] Mention of a pesticide in this paper does not constitute an endorsement of this product by the U.S. Department of Agriculture.

[3] (2,4-dichlorophenoxy) acetic acid.

[4] (2,4,5-trichlorophenoxy) acetic acid.

[5] octyl phenoxy polyethoxy ethanol.

stand of oaks (*Quercus* spp.), juniper (*Juniperus* spp.), and other plants typical of the area was also present.

The isooctyl ester of 2,4-D was applied by fixed-wing aircraft at the rate of 2.5 lb active ingredient/acre in a carrier containing 1 part diesel oil and 5 parts water. Six gallons of this mixture were applied per acre.

Frames with drawn comb were placed in 2 colonies in both the sprayed and the unsprayed areas on July 29. These frames were removed July 30, and the honey stored in the frames was analyzed for 2,4-D.

The colonies in the area treated with 2,4-D showed an increase in the number of dead bees compared with the check colonies (Table 2), but it was not significant, even on the 3 days the spray was being applied (July 29-31). Our results therefore contrast with those of Palmer-Jones (1964) who reported a 20 percent loss resulting from treatment with 2,4-D pyrophosphate. The difference may be explained by his use of a dust compared with our use of a water spray or to his use of the pyrophosphate instead of the 2,4-D. After treatment with either 2,4,5-T or 2,4-D, the daily counts of dead bees were much less after the spray was applied than after the colonies were moved.

Analysis of the honey taken from the colonies in the sprayed and unsprayed areas did not reveal any 2,4-D. The colonies all produced normal, healthy brood during the 10 weeks after spraying.

Cotton Desiccant

The study of the cotton desiccant was undertaken to determine whether desiccating cotton was hazardous to honey bees.

On October 17, 1969, 12 colonies were moved into a 28-acre field of Pima cotton located east of Marana, Arizona. On the same day, 12 similar colonies were moved to another similar site which was not sprayed. Dead bee traps were placed on the colonies on October 17, and daily counts of the dead bees in dead bee traps were made for each colony for 5 days before and 7 days after the spray was applied.

On October 23, the cotton field was sprayed at 9:00 a.m. from a fixed-wing aircraft. At 9:45 a.m. the pilot sprayed one strip directly over the bee yard.

Two gallons of desiccant concentrate plus 8 gallons of water were applied per acre. The concentrate contained the following ingredients:

1. sodium chlorate 18.9%
2. ammonium phosphate fertilizer (10-34-0) 16.6%
3. phosphoric acid 2.7%
4. water 61.8%

Table 1. — Effect on colonies of honey bees of spraying mesquite with 2,4,5-T, May, 1969, Las Delicias Ranch near Three Points, Pima County, Arizona.

Date counts taken	Average daily counts of dead bees/ trap[1] in: Sprayed area	Unsprayed area
6 days before spraying (May 24-29)	49	54
1st day after spraying (May 30)	53	30
2nd day after spraying (May 31)	22	19
3rd day after spraying (June 1)	13	19
4th through 7th day after spraying (June 2-5)	15	22

[1] 12 colonies/area. Differences between treated and untreated colonies were not statistically significant.

Table 2. — Effect on colonies of honey bees of spraying manzanita with 2,4-D, Washington Camp, Arizona. 1969.

Date counts taken	Average daily counts of dead bees/ trap[1] in: Sprayed area	Unsprayed area
July 27 (2-day average)	47	41
July 28	30	15
July 29 (spraying started)	70	15
July 30 (spraying)	8	43
July 31 (spraying ended)	14	9
August 1	9	8
August 4 (3-day average)	9	6
August 6 (2-day average)	8	6

[1] 12 colonies/area. Differences between treated and untreated colonies were not statistically significant.

Table 3. — Effect on colonies of honey bees of spraying Pima cotton with a cotton desiccant (a sodium chlorate mixture), October 1969, near Marana, Arizona.

Date counts taken	Average daily counts of dead bees/ trap[1] in: Sprayed area	Unsprayed area
October 19	45	26
20	29	40
21	33	40
22	35	30
23	30	26
October 24, first day after spray applied	48	39
25	30	30
26	24	21
27	17	18
28	18	14
29	22	18
30	19	17

[1] 12 colonies/area. Differences between treated and untreated colonies were not statistically significant.

Seven days after the spray was applied the colonies were moved from the sprayed and unsprayed sites. Each colony was examined at least once a month for 6 months following the spraying.

The cotton desiccant did not cause a noticeable increase in dead bees in the dead bee traps (Table 3). Brood development in the sprayed and unsprayed colonies appeared to be normal during the 6 months after spraying. ●

REFERENCES CITED

1. Amos, J. M. 1969. 2,4-D spraying near beehives. Virginia Ext. Serv. Mimeograph paper, 4 pp.
2. Anderson, L. D. and E. L. Atkins, Jr. 1968. Pesticide usage in relation to beekeeping. Ann. Rev. Entomol. 13: 213-238.
3. Byrdy, S. 1962. Untersuchugen über die Wirkung des 2,4-D-Präparates 'Pielik' auf Bienen. Tagungsberichte Deutsche Academie der Landwirtschaftswissenschaften zy Berlin 54:15-21.
4. Hocking, B. 1950. The honeybee and agricultural chemicals. Bee World 31: 49-53.
5. King, C. C. 1961. Effects of herbicides on honey bees and nectar secretion. Unpublished Ph.D. thesis, Ohio State Univ., Columbus. 177 pp.
6. New Zealand Agricultural Chemicals Board, Technical Committee. 1961. Effect of hormone weedkillers on bees. New Zealand Beekeeper 23:32.
7. Palmer-Jones, T. 1950. Chemical weedkillers and the beekeeping industry. New Zealand J. Agr. 80:129, 131-2.
8. Palmer-Jones, T. 1964. Effect on honey bees of 2,4-D. New Zealand J. Agr. Res. 7:339-42.

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