Effect of Pesticides on Honeybees

relative toxicity of pesticide dusts studied in laboratory tests with controlled temperature, humidity, and time

E. L. Atkins, Jr., L. D. Anderson, and T. O. Tuft

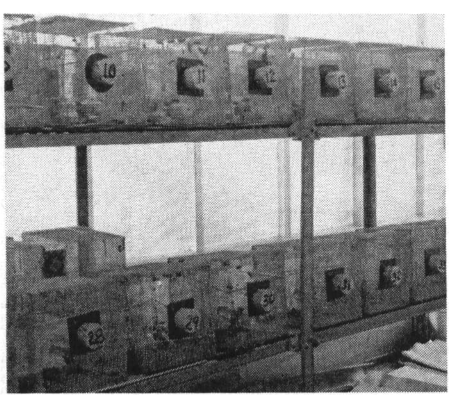
In comparative toxicity studies of 57 pesticide dusts, DNOSOBP—2,4-dinitro-*o*-secObutyl phenol (DN-211)—was the most toxic to honeybees.

The pesticides were tested in the laboratory under precisely controlled conditions of temperature, humidity, and time. All the more toxic pesticides were tested at dosages of 100, 200, and 400 milligrams; less toxic materials were tested at 400 milligrams only. Each material was evaluated by dusting at least nine replicates of 20 bees each at each dosage level. A 200-milligram dosage of 5% DDT dust was included in each series of tests as the standard treatment, in addition to untreated checks.

After bees of uniform age were dusted, they were transferred to clean holding cages provisioned with food consisting of a 50% honey-water solution. The treated bees were held in a greenhouse room having a constant temperature of 80F and a relative humidity of 65%.

In these experiments DNOSOBP gave complete mortality in about half the time required for the next material. DNOSOBP and sabadilla affected bees similarly in that each caused an early permanent paralysis followed by death.

Bees treated with EPN—O-ethyl O-*p*-nitrophenyl benzenethiophosphate—exhibited unusual behavior because after the initial early paralysis, mortality proceeded most rapidly in reverse proportion to the dosage level. This phenomenon may have been due to the regurgitative effect that the organophosphates had on the bees. EPN, methyl parathion, metacide, parathion, TEPP—tetraethyl pyrophosphate—malathion and diazinon caused the bees to regurgitate violently. This effect was most pronounced with the 400-milligram dosage, slightly less with the 200-milligram dosage, and only slightly or not at all with the 100-milligram dosage. With EPN, it seems possible that violent regurgitation delayed the absorption of a lethal amount of the chemical. In addition, the above-named phosphates caused a complete paralysis of the bees within 15 minutes after treatment. Subsequently, the bees regained some spasmodic movement, particularly of the stinger, wings, antennae, and legs, and, especially of the tarsi; but in no instance did any bee regain normal movements.



Holding cages of dusted honeybees on greenhouse shelves.

Nicotine caused partial paralysis within a few minutes after treatment, followed by complete recovery within approximately 30 minutes.

DDT and most of the more toxic chlorinated hydrocarbons effected almost all of their mortality within the first 24 hours.

Calcium arsenate and compounds 1189, 923, and 876 apparently exhibited a substantial amount of toxicity as stomach poisons, for most of the mortality caused by these materials was delayed 24 to 48 hours. Dusted honeybees not seriously affected by a pesticide began cleaning themselves immediately after transfer into the holding cages. Some insecticides may reach the gut by this method.

In the present series of tests, a bee was considered dead only after no movement had been observed for several seconds. Particularly with the organophosphates, it was necessary to observe the apparently dead bees for several subsequent time intervals to be certain that there was no recovery from complete paralysis.

Field experience has demonstrated that DDT can be used safely when applied while the foraging bees are not actively working a field. Therefore, it is assumed that pesticides less toxic than DDT—in these laboratory tests—may usually be utilized safely under commercial conditions. Pesticides may generally be assumed to be too toxic for commercial usage where bees are present—unless special application techniques of proper timing, dosage, and method of application can be employed.

The present tests evaluate primarily the contact effect of the various materials because materials like calcium arsenate are known to be fairly strong stomach poisons to honeybees.

In the field, arsenicals have caused serious losses to apiaries. There may be materials other than arsenicals that are less toxic to bees than DDT as a contact poison but more toxic as a stomach poison; thus both methods of toxicity must be considered before a chemical can be positively identified as safe.

Another factor to be considered in the use of pesticides that appear to be more toxic than DDT is that sometimes such small amounts of the chemical are required to control the insect pest that a bee toxicity hazard does not exist. This may be true with sabadilla used for thrips control on citrus. Another important factor that must be considered when making comparisons is the length of residual action of a given pesticide. For example, TEPP is highly toxic to bees but it dissipates very rapidly and thus kills only bees contacted at the time of application.

Still another factor that has arisen with the new systemic chemicals is translocation of the poison to the nectaries and pollen of the plants treated. In this way the chemical is available to the bees to feed on and store in their hives.

Pesticide materials highly toxic to honeybees were the following: DNOSOBP, EPN, sabadilla, lindane, BHC, heptachlor, Compound 22/190, metacide, aldrin, dieldrin, diazinon, malathion, methyl parathion, parathion,

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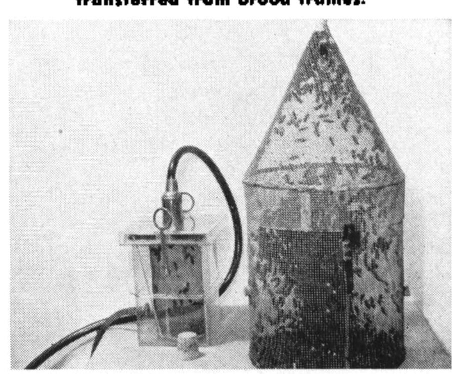
Left: aspirating apparatus containing dusting cage. Right: stock bee cage containing honeybees transferred from brood frames.



TURKEY

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and expenditure on sales efforts limit the validity of any average or generalized estimates based on these data alone. The operators are pursuing different goals, the one seeking a wide market for direct sales, the other furnishing supplies through intermediary channels. This phase of the study indicates the character and range of the special pedigree expenses.

Similarly no attempt was made to evaluate the efficiency of these particular enterprises and thus to consider whether services of equal quality may be obtained at lower cost.

This exploratory study points the way toward the development of systems by which the cost of various alternative genetic programs might be estimated in advance. The effect of variations in the proportion of birds of different ages maintained, in the duration of the testing periods, and in the price of labor and feed could be analyzed. Geneticists are able to forecast provisionally the degree of gain which may be expected from the maintenance of standard selection programs for a given number of generations. Economic values may also be attached to these expected gains. The synthesis of these two approaches would permit both individual breeders and industry groups to balance the cost of a proposed breeding program against the probable gain.

J. C. Abbott was Instructor in Agricultural Economics, University of California, Davis, at the time these studies were made.

V. S. Asmundson, Professor of Poultry Husbandry, University of California, Davis, cooperated in the studies reported here.

MARGINS

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lower purchase prices put the large stores in a position to quote lower retail prices and have lower absolute margins but still have relative spreads averaging not less than some other stores. In terms of returns in relation to investment in fresh citrus, the large stores are in a favorable position, particularly in view of their volume handled and rate of inventory turnover.

Lower wholesale price is not a consistent advantage held by large stores at all times. When the detailed daily and weekly record is studied, it is found that only periodically, with an irregular timing, do their wholesale prices go sharply and markedly below the wholesale prices paid by other stores. The same applies to the absolute spreads in the large stores. At other times, and not for brief periods, the wholesale prices paid by the large stores hover close to or not much under the wholesale prices paid by medium-sized or small stores. The lower average retail and wholesale prices, and also absolute margins, in the large stores are due in the main to the occasional intervals when the large stores enjoy marked differentials in their wholesale prices and at the same time operate with reduced absolute margins.

The small stores maintain their competitive position with the medium-sized stores by accepting smaller margins, absolute and relative, than do the medium-sized stores. The latter, however, succeed in maintaining their absolute and relative spreads above those of the small stores as well as the large ones.

Wholesale Prices

Citrus margins, in cents per pound, do not remain fixed; they change in response to changes in the wholesale prices. As the wholesale price increases, the cents-per-pound margin also increases, but the relative or percentage margin decreases. The changes in the margins, as the wholesale price changes, are summarized for oranges as follows:

Average Change in Weekly Margin for a Change of 1 Cent per Pound in Wholesale Price

Store group	Change in absolute margin (cents per pound)	Change in relative margin (per cent retail price)
Small stores	+0.32	−0.55
Medium stores	+0.41	−0.37
Large stores	+0.34	−0.09
Weighted average for all stores	+0.37	−0.36

The above figures show that in response to changes in the wholesale price, the effect on the absolute margin is about the same in the small and large stores; but there is a greater effect on the absolute margin in the medium stores. In terms of the relative margin, however, changes in the wholesale price result in substantially greater effects on the relative margin in small stores than in large stores; the effect for the medium stores being about halfway between.

It is clear that changes in the wholesale price cause different effects on the margins of various sized stores. As the wholesale price varies from day to day or week to week, instabilities result in margins and also in retail prices.

Sales Volume

In addition to wholesale price changes, retail margins are affected by the volume of citrus sales in the stores. As the sales volume increases, the margin tends to decrease; with decreased volume, the margin tends to increase. Such average effects of volume on margins, in each of the three sizes of stores, are shown for oranges in the table below:

Average Change in Weekly Margin for a Change of 100 Pounds in Weekly Retail Sales Volume

Store group	Change in absolute margin (cents per pound)
Small stores	−1.08
Medium stores	−0.32
Large stores	−0.10
Weighted average for all stores	−0.33

These results not only show how much the margin is affected with changes in retail sales volume in each of the three store groups but the effects differ in each of the groups. Thus, as business volume fluctuates from week to week and shifts from store to store, it carries along with it fluctuations in the store margins.

Margins, and their changes over time, do not occur by chance or haphazardly. Changes in retail margins are intertwined with changes in many business factors, particularly, changes in wholesale prices and changes in retail sales volume.

Sidney Hoos is Professor of Agricultural Economics, University of California, Berkeley.

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HONEYBEES

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TEPP, Compound A-42, Compound 340, endrin, and chlordane.

Moderately toxic materials were: potasan, Compound 21/116, Compound Q-137, DDT, calcium arsenate, isodrin, Compound 1189, tartar emetic, Chlorobenzilate, Compound 21/199, cryolite, Compound 876, *ryania*, NPD, TDE, R-242, OMPA, methoxychlor, Compound 2066, DNOCHP, Aramite, and toxaphene.

Relatively safe materials were: sulfur, Compound 2131, rotenone, Ovotran, chlorinated terpine, Compound Q-128, pyrethrins, Compound 923, Neotran, CMU, demeton, allethrin, DMC, cunilate, dilan, and nicotine.

E. L. Atkins, Jr., is Associate Specialist in Entomology, University of California, Riverside.

L. D. Anderson is Entomologist, University of California, Riverside.

T. O. Tuft was Senior Laboratory Technician, University of California, Riverside, when the above reported studies were made.

P. H. Gerhardt, Assistant Entomologist; M. H. Frost, Principal Laboratory Technician; G. E. Printy, Senior Laboratory Technician; R. M. Hannibal, Laboratory Technician; and Richard Smith, Laboratory Technician, University of California, Riverside, co-operated in the laboratory phase of these tests.

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