Effects of Pesticides in Soils

field experiments conducted in coordinated study of effects of insecticide absorption by the soil

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The following article is the first of a two-part report. The second part will be published next month.

Long-range effects—5 to 10 years—of insecticides on flavor, plant health, soil microbiology, water penetration, and physical-chemical changes in the soil are some of the phases of a coordinated investigation of evidence that plant damage can result from the absorption of insecticides by the soil.

In addition to large-scale field plots established in Riverside and Meloland, comprehensive experiments are being conducted in the laboratory and greenhouse to determine the approximate amount of various toxicants in the soil that will cause plant damage and the degree of susceptibility of various crops to the test insecticides.

Representative soil types from the principal agricultural areas in southern California are being used in these experiments.

Field tests have also been conducted to determine the effectiveness of various soil pesticides against some of the common soil-inhabiting insects and to study the reported occurrences of off-flavors resulting from the use of some pesticides.

In an experiment designed to determine the effect of various pesticides—applied to the soil—upon the growth, flavor, and yield of a representative root crop and a fruiting crop grown in treated soils, a field at Riverside was divided into four blocks with 10 plots, 136′ long and 20′ wide, in each block.

In this experiment nine plots were treated with pesticides. The endrin plot was not treated until the fall of 1953. One plot was left untreated, as a check.

The nine plots were treated with the following materials:

Pesticide	Rate per Acre
Aldrin	5 lbs.
Chlordane	10 lbs.
DDT	20 lbs.
Dieldrin	5 lbs.
Endrin	5 lbs.
Ethylene dibromide (EDB)	72 lbs.
Heptachlor	5 lbs.
Lindane	1 lb.
Toxaphene	20 lbs.

The pesticides, excluding EDB, were applied with a power sprayer equipped with a 10-foot boom with D-4 nozzle tips, 45 cores, and slotted strainers. The EDB was applied with conventional soil fumigant injection equipment.

Immediately following the application of the pesticides, the plots were disked to mix the pesticides thoroughly in the top 6″ to 8″ of soil. Five days later the entire field was planted with vetch and barley as a cover crop.

To eliminate the possibility of contamination by irrigation carrying pesticides from one plot to another, a sprinkler system is used to water the plots. Also, plots are cultivated lengthwise to reduce contamination.

When the barley and vetch were 6″ to 8″ tall, germination counts were made and plant weights were determined. There was some variation in the results, but no statistical differences were shown. Because this was the first crop grown on this piece of land since an olive grove was removed, the irregularities are attributed to the variation in soil structure and moisture-holding capacity.

When the crop had reached maximum growth the weights of clippings from

Concluded on next page

Applying insecticides to the soil in the field plots on the Riverside campus of the University of California.

Continued from preceding page

square yard quadrates were made on January 19–21, 1953. Again no significant statistical variations resulted. The cover crop was plowed under and the field prepared for planting.

It was decided that one root crop—carrots—and one above-ground crop—baby lima beans—would be planted in each plot every spring and a cover crop in the fall. During the third or possibly second year, one row of mixed crops may be planted in each plot to obtain additional data. Restricting the planting to two principal indicator crops and a soil conditioning cover crop more nearly approaches the normal practices carried on in commercial farming and will give the desired information concerning the effect the pesticide will have upon certain plants.

Carrots

Chantenez Red Core carrots were planted March 26 and harvested July 29, 1953. The yields were again variable but showed no significant differences.

For chemical analysis, the root tip and stalk base of test carrots were removed and the carrots washed and air dried. The entire sample was ground in a food grinder and the ground material thoroughly mixed. Each of three 450-gram replicates was then tumbled with 900 milliliters of a solvent for one hour. After filtration through sharkskin filter paper, the solvent phase was washed three times with distilled and two times with re-distilled water. No inorganic chloride was detected in the wash waters. The organic phase was stored under nitrogen in the cold for analysis at a later date.

Samples of cooked and raw carrots were presented to a taste panel. Using the paired comparisons test method the results of 36 judgments indicated that no significant off-flavors were detected by the panel members.

Beans

Henderson bush baby lima beans were planted June 17. During the middle of September, green pods were picked and the beans presented to the taste panel for evaluation. No significant or consistent off-flavors were detected.

On October 14 and 15, the dried beans were threshed, and yield records obtained from the middle bed of each plot. There were no statistical significant differences when the records were analyzed at the 5% level.

For chemical analysis samples of the dried baby lima beans were ground to a fine meal and treated in the same manner as the carrots.

Vetch and Barley Germination Counts and Yields

Treatment	Variety				
	Vetch germination counts[1]	Vetch weights in grams[2]	Barley germination counts[1]	Barley weights in grams[2]	Barley + vetch weights in grams[3]
Aldrin	47.00	186.00	16.75	334.50	14,706
Dieldrin	56.50	184.00	15.25	335.75	12,800
Toxaphene	54.50	186.00	17.25	345.00	13,925
Chlordane	51.25	187.75	22.25	333.50	13,798
Lindane	50.00	199.00	19.25	336.75	13,513
Heptachlor	49.00	177.75	18.50	322.75	13,363
EDB	60.00	191.25	18.00	288.00	12,841
DDT	53.25	180.75	19.50	304.25	13,223
Blank	48.50	181.00	16.75	299.25	12,673
Check	45.50	186.25	18.00	319.00	12,890

No statistical significance at 5% level.

[1] Five randomized counts on three feet of row per plot, 11/5/52.
[2] Twenty-five plants picked at random per plot, 11/5/52.
[3] Five samples of one square yard each per plot, 1/19–21/53.

Carrot and Bean Yields for 1953 Arranged in Descending Order.

Carrots		Beans	
Treatment	Wt. in lbs.[1]	Treatment	Wt. in lbs.[2]
1. Check	153.19	Lindane	13.89
2. DDT	149.45	EDB	12.61
3. EDB	149.32	DDT	11.10
4. Dieldrin	147.83	Heptachlor	11.00
5. Toxaphene	142.46	Toxaphene	10.86
6. Blank	138.76	Blank	10.80
7. Lindane	136.82	Check	10.16
8. Chlordane	134.20	Aldrin	10.13
9. Aldrin	130.82	Dieldrin	9.80
10. Heptachlor	122.39	Chlordane	9.44

No statistical difference at 5% level.

[1] Three samples 10-feet long; weights included tops and roots, 7/26/53.
[2] Threshed beans from 130 feet of center bed of two rows, 10/14–15/53.

Imperial Valley Tests

A series of plots similar to those at Riverside was established last fall at the Imperial Valley Field Station. The plots are 103′ long and 21′ wide. There are five replicates of nine treatments. Because these plots are to be furrow irrigated—the general practice in the area—they are arranged so the drainage water from one plot will not contaminate another. The insecticides were applied during the middle of October 1953, at the following rates:

Pesticide	Rate per Acre
Aldrin	5 lbs.
Chlordane	10 lbs.
DDT	20 lbs.
Dieldrin	5 lbs.
Endrin	5 lbs.
Heptachlor	5 lbs.
Lindane	1 lb.
Toxaphene	20 lbs.

Immediately following the application of the insecticides the field was disked to a depth of 6″ to 8″ and carrots and lettuce were planted.

Soils

Once a year soil samples—2″ in diameter and 6″ deep—are taken from each plot at Riverside and in the Imperial Valley. Fifty such samples—a total of 50 to 60 pounds per plot—are sifted and mixed and six 2½ pound samples of the mixture are submitted for chemical analysis; the remainder is saved for future microbiological evaluation.

To be continued.

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