Effect of Pesticides in Soils

results of insecticide absorption by the soil is subject of field and greenhouse studies

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The following article concludes a two-part report of progress on a long-term project.

A potato flavor evaluation test was one phase of a coordinated investigation of the effects insecticides—absorbed by the soil—might have on plants, crops, and soils.

On April 2, 1953, 28 plots—involving six treatments and a check—were sprayed with various materials at the rates listed below:

Material	Rate per acre
Aldrin	3 lbs.
Dieldrin	3 lbs.
DDT	20 lbs.
Lindane	¼ lb.
Lindane	½ lb.
Lindane	1 lb.

The materials were sprayed on the soil and disked in to a depth of 6″ to 8″. Russet potatoes were planted. On August 8, the plots were harvested, and samples taken and set aside in storage for one to two months before being submitted to a taste panel for flavor evaluation. Lindane resulted in an objectionable flavor in all instances. DDT caused a change in flavor but was not significantly objectionable; with aldrin there was a suspicion of flavor change, and with dieldrin no apparent change.

During the spring and summer—1953—14 field experiments were conducted to evaluate various insecticides for seed protection against seed-corn maggot. As fungus diseases are a prime consideration, a fungicide—thiram—was included in some of the treatments. Lindane—75%—and dieldrin—75%—at ⅓, ⅔, and 1½ ounces were used with 1½ and 3 ounces of either thiram—75%—or an inert carrier per 100 pounds of seed. Peas, spinach, cotton, and nine varieties of cucurbit seeds were treated.

Part of a toxicity series with DDT in sandy loam soil on stringless Black Valentine bush bean. Concentration from left to right: 0, 256, 512, and 1,024 parts per million.

Insecticide-fungicide combinations gave good seed-corn maggot and disease control. When maggots were absent, insecticides alone often decreased plant stands. The heavier insecticide and fungicide applications occasionally caused damage.

Three types of soil are being used in this series of experiments: *1*, a fine sand from the Coachella Valley; *2*, sandy loam from the Riverside area; and *3*, a heavy Yolo clay loam from Orange County. These three types of soils are representative of the extreme variation in soil types found in southern California. They differ greatly in both chemical and physical characteristics. Soil samples were taken from the surface 2 inches, air-dried, screened, and stored under cover.

Insecticides being tested are DDT, lindane, aldrin, dieldrin, heptachlor, chlordane, and toxaphene. Dosages of each insecticide used are 0, 16, 32, 64, 128, 256, 512, and 1,024 pounds per acre or parts per million in the top 3″ of soil.

Stringless Black Valentine bush beans, Kanota oats, and Rosen rye are being tested at the present time, and of these, the beans appear to be most susceptible to the majority of the insecticides used. A series of other crops will be tested with the idea of finding several that will be susceptible to all the insecticides at relatively low dosages. In addition, susceptibility tests to the insecticides of a wide range of crops will be conducted.

Given amounts of air-dried soil were weighed out and placed in friction-top gallon cans. The insecticide was added, and the soil and insecticide were mixed in a rotary mixer for a definite length of time.

A weighed amount of soil-insecticide mixture was placed in No. 2 cans. Each treatment was replicated five times. For rapid and uniform distribution of the water, one third of the soil in the bottom of the can is moistened, then a second portion of the soil is added and moistened; the seeds are planted, then the

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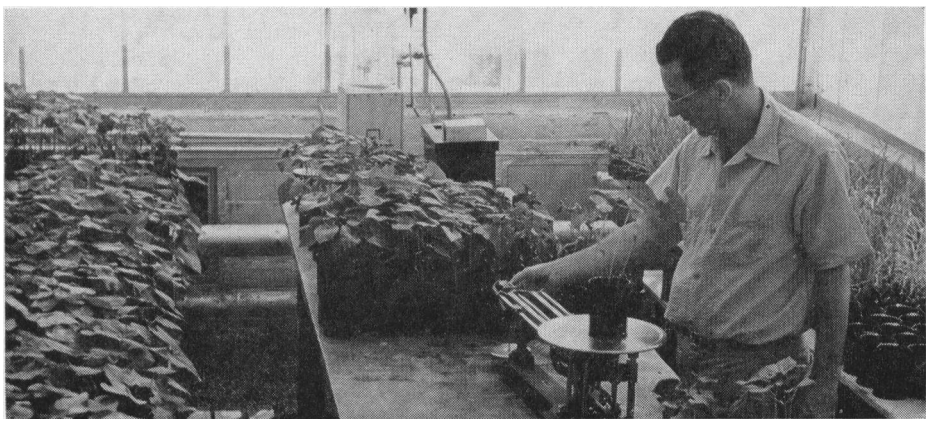
Checking moisture contents by weight in soil insecticide greenhouse studies.



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last portion of the soil is added and the final volume of water is poured on. Thus, the soil is uniformly moistened in less than one minute. The volume of moisture used is sufficient to bring the soil to field capacity.

The seeds usually germinate in 4–5 days and are thinned to a standard number at the end of about 10–12 days. The plants are watered by bringing them back to field capacity by weight as often as necessary. The five replicates are rotated within the series to overcome any effects of position within the greenhouse. The total number of cans for any one insecticide is 40.

The data taken are germination, height, and fresh weight, 20–30 days following planting. In harvesting, the height of the plants is measured, a visual estimate being made of an average value. They are then cut off at the surface of the soil, cut into pieces about 3″ in length, and weighed on an analytical balance. After weighing, the plants are returned to the can from which they were taken.

After harvest, the cultures are air-dried for 30 days, the soils are pulverized, and the previous crop is placed in the bottom of the can where it decomposes. They are then seeded and handled as in the first run. This process is repeated as often as necessary to study the behavior of the chemical under continued cropping.

Some results have been obtained with Kanota oats, Rosen rye, and stringless Black Valentine bush bean planted in soils containing 0, 16, 32, 64, 128, 256, 512, and 1,024 pounds per acre—parts per million—of actual DDT, lindane, aldrin, dieldrin, heptachlor, chlordane, and toxaphene. These relatively high dosages were selected in an attempt to produce plant injury.

In the first of four plantings of Kanota oats, DDT at 1,024, lindane at 16, and dieldrin at 512 pounds per acre significantly reduced the growth of Kanota oats as did lindane at 32, aldrin at 256, dieldrin at 512, heptachlor at 128, and chlordane at 256 pounds per acre in the fourth planting.

DDT had no effect in the fourth planting, and toxaphene had no effect on plant growth of Kanota oats at the dosages tested in either the first or fourth plantings.

In the fourth planting, aldrin, heptachlor, and chlordane reduced the growth of Kanota oats at a lower dosage per acre than in the first planting. This may indicate that when these insecticides have remained in the soil for a period of time, they become more toxic to Kanota oats, possibly due to decomposition products.

Toxicity of Various Insecticides to Kanota Oats Grown in a Sandy Loam Soil.

Insecticide	Treatment—pounds per acre 0	16	32	64	128	256	512	1024
	1st Planting—Harvested March 11, 1953							
	gms	gms	gms	gms	gms	gms	gms	gms
DDT	4.04	4.10	3.89	4.03	4.21	4.31	3.88	3.63*
Lindane	3.95	2.56*	0.23*	0.21*	0.19*	0.20*	0.20*	0.20*
Aldrin	3.53	3.69	3.42	3.77	3.57	3.70	3.95	3.99
Dieldrin	4.15	4.01	4.60	4.09	4.37	4.67	3.31*	3.12*
Heptachlor	3.50	3.92	3.63	3.50	3.55	3.70	4.31	4.53
Chlordane	3.72	3.96	4.08	4.05	4.32	4.57	4.19	3.76
Toxaphene	3.93	4.26	4.05	4.20	4.23	4.58	4.66	4.07
	4th Planting—Harvested September 3, 1953							
DDT	4.98	5.52	4.80	4.42	4.48	4.54	4.60	3.80
Lindane	5.28	4.98	1.00*	0.16*	0.10*	0.10*	0.10*	0.10*
Aldrin	4.74	4.74	4.56	4.52	4.00	3.36*	2.50*	2.62*
Dieldrin	5.48	5.72	5.52	5.08	5.68	5.20	4.66*	4.26*
Heptachlor	5.54	5.10	5.40	4.70	3.80*	4.10*	3.90*	2.94*
Chlordane	5.70	5.08	4.62	4.54	4.66	3.96*	2.68*	0.66*
Toxaphene	5.68	5.40	5.52	5.36	5.00	5.44	5.32	5.24

* Significant plant weight reduction at the 1% level.

Toxicity of Various Insecticides to Stringless Black Valentine Bush Beans Grown in a Sandy Loam Soil.

Insecticide	Treatment—pounds per acre 0	16	32	64	128	256	512	1024
	1st Planting—Harvested April 9, 1953							
	gms	gms	gms	gms	gms	gms	gms	gms
DDT	13.2	11.6	11.9	11.2	3.8*	1.8*	3.5*	2.1*
Lindane	14.8	12.9	9.1*	5.1*	4.8*	4.4*	4.3*	3.1*
Aldrin	10.7	9.1	5.9*	4.8*	3.9*	3.0*	2.8*	0.0*
Dieldrin	14.4	12.1	6.3*	5.1*	2.4*	0.0*	0.4*	0.0*
Heptachlor	12.9	11.4	10.9	8.7	8.7	6.1*	1.7*	2.6*
Chlordane	13.5	12.5	12.2	13.7	8.0*	2.9*	2.9*	1.7*
Toxaphene	11.7	14.1	11.1	10.7	11.5	6.1*	2.0*	0.0*
	3rd Planting—Harvested July 23, 1953							
DDT	12.5	13.7	13.5	10.5	9.8	5.9*	3.8*	1.6*
Lindane	11.5	11.3	9.7	6.4*	2.9*	3.0*	2.1*	2.9*
Aldrin	9.3	6.1	6.9	6.5	5.7	2.6*	0.9*	0.6*
Dieldrin	13.6	11.5	13.9	9.0*	7.5*	5.0*	0.8*	0.7*
Heptachlor	13.0	10.9	12.5	13.0	9.2	10.3	5.6*	1.4*
Chlordane	14.7	13.9	12.4	13.6	12.6	9.9*	7.9*	2.2*
Toxaphene	14.0	10.8	11.7	11.0	14.4	11.1	8.9*	7.3*

* Significant plant weight reduction at the 1% level.

The table on this page shows the effects on the growth of various dosages of several insecticides applied to sandy loam soil.

Three crops of stringless Black Valentine bush beans were grown in the test cultures. In the first planting, DDT at 128, lindane at 32, aldrin at 32, dieldrin at 32, heptachlor at 256, chlordane at 128, and toxaphene at 256 pounds per acre significantly reduced the growth of the plants. In the third planting, DDT at 256, lindane at 64, aldrin at 256, dieldrin at 64, heptachlor at 512, chlordane at 256, and toxaphene at 512 pounds per acre also significantly reduced the growth. In all cases in the third planting there was a reduction in toxicity of the various insecticides to stringless Black Valentine bush beans.

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