## SOIL AMENDMENTS

Continued from preceding page

stream from the point of injection is nearly the same as the concentration added.

Field soils generally are not saturated and have void areas where the soil pores are filled with air instead of water and the moisture between the air-filled voids does not move readily and will not be displaced as easily as the water in the filled smaller pores. A special apparatus, designed to measure movement of a water-soluble substance through soils demonstrates the influence soil water content and rate of flow have on the spreading of the solute. As an example, the manner in which chloride ion passed through Oakley loamy sand at three different water contents, but at the same flow velocity, is reflected by measurements made of soil columns taken downstream. In the driest soil column the chloride water displaced only 0.3 of the total water content before chloride appeared downstream. In the wettest sample columns 0.7 of the total water in the column was displaced before chloride was measured.

Field irrigation might carry large quantities of dissolved fertilizer to an undesired greater depth than that predicted by measuring moisture changes within the soil profile. Also, the efficiency of a bactericide or fungicide applied by irrigation depends on whether or not the organism resides in pores easily flushed with treated water.

The distribution of dissolved material also depends upon the rate at which the water moves through the soil. Important differences between soils are manifested by the comparison of the movement of additives for different flow velocities. Concentration curves for two velocities obtained for Yolo loam and Columbia silt loam were markedly different. The Yolo soil, unlike the Columbia, has a greater number of smaller pores that do not receive chloride ion at a fast flow velocity. Only at a slow velocity, when ionic diffusion takes place to a greater extent, were the smaller pores filled with chloride ion.

If a bactericide were applied to Yolo loam and Columbia silt loam soils, the bacteria population would be reduced more effectively in the Columbia than Yolo soil. Any additive probably would permeate the Columbia soil more thoroughly than the Yolo soil.

The distribution of any additive in any porous material for any range of moisture contents commonly found in the field can be investigated by the solute measuring technique. Such investigations, involving liquid additives as well as gaseous materials, are being made.

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# New insecticides for Lygus Bug Control in seed production from table beet and carrot

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Seasonal and area tolerances of lygus bugs—*Lygus hesperus* Knight—to DDT and toxaphene made it necessary to continue investigations with several new pesticides in 1959 and 1960.

Effects of the tested chemicals on the crop plants, pollinators, predators, aphids, and red spiders were also investigated with the pesticides, singly and in combinations, applied to table beet seed plants and to carrot seed plants.

Results of the investigations confirm that Dylox plus DDT—at one pound active of each per acre—is especially effective for lygus control on table beet and carrot seed crops. Other chemicals with Dylox controlled the bugs satisfactorily, but were considerably more toxic to beneficial predators and pollinators.

Dylox alone shows promise for bug control on vegetable seed crops and is considerably less toxic than most phosphate insecticides to beneficial insects and to humans and animals. However, persistence appeared to be too brief to protect seed crops adequately against lygus bugs.

In one part of the studies the natural lygus population in small plots of table beet seed plants was augmented by introducing additional bugs three times before treatments. The trials on beets involved single sprays in eight replicated treatments, and a series of five applications in two treatments. Five post-treatment counts were made of bugs on ten plants in each plot. Estimates of seed yield, seed size, and viability were based on samples of 20 plants in each plot.

The second part of the studies involved various dusts and sprays applied by aircraft to carrot seed plants. Two applications were made for all treatments, at 35–40 pounds of dust and 12–15 gallons of spray per acre. Eight post-treatment insect counts were made at intervals of about seven days, and in six separate areas per plot. Seed yields and seeds for viability and other tests were obtained from varying numbers of seed heads collected from the four stages of seed head growth in each of five locations per plot.

The insect counts tabulated on page 9 are summed for five successive samplings and averaged for five replications and show that DDT plus Dylox spray gave the greatest decrease in bug numbers. The final percentage of control from the single spray of DDT plus Dylox averaged 78% over the entire 28-day post-treatment sampling period. Thiodan plus Dylox was almost equally good. Both combination treatments were significantly better than all of the others in

**Mortality of Insects for 51 Days After Dusting Carrot Seed Plants, and the Effects on Seeds***

| Treatments and concentrations | Average number of adult plus nymphal bugs per subsample | | Average weight of 100 seeds and average yield per seed head in grams | | | |
|---|---|---|---|---|---|---|
| | | | Weight of 100 seeds | | Yield per seed head | |
| | Lygus bugs | Pirate bugs | 3rd stage | 4th stage | 3rd stage | 4th stage |
| DDT, 10% plus | | | | | | |
| Dylox, 5%...... | 20.2a | 66.7ab | 0.141a | 0.146a | 1.75b | 0.076a |
| †Thiodan, 3% .. | 25.0a | 55.0a | .110c | .106d | 1.77b | .041bc |
| DDT, 10% plus | | | | | | |
| ‡Trithion, 2% .. | 29.2a | 72.1ab | .116bc | .122b | 2.19a | .053b |
| DDT, 10% ........ | 57.5b | 80.8b | .121b | .126b | 1.68b | .034cd |
| Untreated......... | 136.8c | 167.8c | .120b | .117c | 1.49c | .029cd |

* Significant differences between means (5%) are indicated when compared values have no letters in common.
† Not registered for use on table beets or carrots at this time. ‡ Registered for use on table beets only.

the series. All of the listed treatments decreased the numbers of lygus significantly below the numbers recovered from the untreated plots. Lygus control was poor from the least effective treatments —Thiodan, ethion, Thiodan plus ethion, and Thiodan plus Trithion. All bug populations were high—23.5 per plant—because of the pre-treatment introductions of additional bugs.

All applications containing Thiodan, as well as that containing DDT plus Dylox, were appreciably more toxic than the other materials to the pirate bug—*Orius tristicolor* White. DDT was least toxic to the pirate bugs, and no serious buildup of spider mites occurred in any of the plots.

DDT plus Dylox spray had no perceptible effect on ladybeetles—*Hippodamia* spp.—but five applications of sprays containing Di-Syston or ethion reduced the ladybeetle numbers drastically. A great increase in ladybeetles induced by five applications of DDT plus Trithion dust was related to a correspondingly great increase in numbers of aphids, and the low order of toxicity of the mixture to the predators. Unusually large numbers of aphids—*Myzus persicae* (Sulz.) and *Aphis fabae* Scop.—occurred only in this plot. Conversely, aphid numbers were not significantly reduced by any of the treatments.

Five applications of Di-Syston spray significantly reduced the number of plants infected by beet mosaic. Infection was 22.4% in the control and 10.4% in the treated plot. This treatment also significantly reduced severity of infection, from an index of 0.91 to 0.34.

All treatments but one increased average yields of seed, but significantly only for plants sprayed five times with Di-Syston. The exception—five applications of DDT plus Trithion dust—reduced yields significantly.

Seeds were of greater average weight and size in the plot sprayed with DDT plus Dylox. Seed weight was the same for untreated plants and plants sprayed with ethion alone or with Thiodan plus ethion. Seeds were of lowest average weight in plots that received five dustings of DDT plus Trithion, probably because of the buildup of aphids. The number of germs per seed ball was significantly greatest for plants sprayed with DDT plus Dylox. Seed viability was also significantly increased by five applications of Di-Syston and DDT, but ethion spray reduced seed viability appreciably below values for the control.

The insect counts tabulated on page 8 are summed for eight successive samplings and averaged for six subsamples taken from each large plot treated by aircraft. A fairly damaging, though not severe, infestation of lygus bugs developed during the investigations. As judged from counts of lygus adults plus nymphs, the first three treatments were not distinguishable. However, they were significantly better than the plain DDT dusts; and again the DDT plus Dylox appeared to give the greatest decrease in lygus numbers.

Pirate bugs were appreciably reduced by each of the treatments. They were most susceptible to Thiodan, and least affected by DDT. Spider mites did not appear in any of the plots.

Seed yield was significantly increased in third-stage seed heads by DDT plus Trithion dust. Yields of fourth-stage seed heads were increased only by DDT plus Dylox. No treatment significantly increased seed yield for seed heads of the first and second stages. DDT plus Dylox was the only treatment that significantly increased seed weight or size for third- and fourth-stage seed heads. All treatments increased the germination of seeds from the first three stages about equally. Increased seed viability was less pronounced in third-stage seed heads, and was no different from the control in seeds of the fourth-stage heads.

More recent aircraft spray plots on carrot seed plants gave satisfactory bug control with Dylox at 1.5 pounds active ingredient per acre. However, under the conditions of these tests the bug population was relatively low, causing only moderate plant damage. Dylox proved a good substitute for DDT where drift could have damaged nearby alfalfa hay fields. A more recent phosphate insecticide, Dimethoate, reduced bugs considerably more than did Dylox; but also, Dimethoate is more toxic to pirate bugs, big-eyed bugs, and ladybeetle predators, and caused a much greater decrease in numbers of honeybees.

The necessity for proper timing of insecticide applications was also demonstrated. In one series of aircraft dusting of carrot seed plants, a late-morning DDT dust application gave a 10-day average count of 7.1 bugs per sample, compared with 2.9 bugs per sample from an early-morning DDT dust application. This observation, made at the time of the first application, led to two extra DDT dusts.

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*Seed grower Bert Swartz, seedsman Anthony Bernal, and aircraft operator Joe Borges, all of Clarksburg; and Nurseryman John Campbell, University of California, Davis, assisted in the above reported studies.*

*The above progress report is based on Research Project No. 1565.*

**Insect Mortalities for 28 Days Following Application of Test Materials to Table Beet Seed Plants, and Effects on Seed Yields, Weight and Viability***

| Treatments and amounts (active) per acre† | Average number of insects per replicate | | | | Average weight of seeds in grams and viable seeds per 100 | | | |
|---|---|---|---|---|---|---|---|---|
| | Lygus | Pirate bugs | Ladybeetles | Aphids | Wt. of 100 seeds | No. viable seeds | No. of germs per 100 seeds | Seed yield per plant |
| DDT, 1 lb. plus Dylox, 1 lb. | 193a | 85abc | 11c | 167a | 1.84a | 90.4a | 156a | 53.8c |
| ‡Thiodan, 1 lb. plus Dylox, 1 lb. | 216ab | 72a | 8bc | 178a | 1.62bcd | 80.2bcd | 126de | 53.8c |
| ‡Di-Syston, 2 lbs. (5 applic.) | 335c | 141f | 3a | 10a | 1.64bc | 88.2ab | 142bc | 55.3a |
| DDT, 10% plus §Trithion, 4% dust (5 applic.) | 357cd | 177g | 37d | 4,260b | 1.24f | 74.2cd | 116gh | 32.9b |
| DDT, 1 lb. plus §Trithion, 1 lb. | 382cd | 210h | 8bc | 71a | 1.59bcde | 80.6bcd | 124def | 52.7c |
| DDT, 1 lb. | 394cd | 247i | 9bc | 138a | 1.62bcd | 82.4abc | 139bc | 52.1c |
| ‡Thiodan, 1 lb. plus ‡ethion, 1 lb. | 460de | 78ab | 5abc | 13a | 1.41f | 78.6cd | 119fg | 52.2c |
| ‡Thiodan, 1 lb. plus §Trithion, 1 lb. | 504ef | 101bcd | 6abc | 28a | 1.60bcd | 78.4cd | 123ef | 47.8ac |
| ‡Thiodan, 1 lb. | 531efg | 92abc | 6abc | 17a | 1.70ab | 79.2bcd | 130d | 52.3c |
| ‡Ethion, 1 lb. | 629gh | 110cde | 4ab | 20a | 1.46def | 71.8d | 107h | 52.7c |
| Untreated | 891i | 277j | 10c | 27a | 1.37f | 74.8cd | 117fg | 44.8c |

*Significant differences between means (5%) are indicated when compared values have no letters in common. † Colloidal X-77 (an adjuvant) was added to all sprays at the rate of 4 ounces per 100 gallons. ‡ Not registered for use on table beets or carrots at this time. § Registered for use on table beets only.