The weak vines in the southern portion of the plot showed no moisture extraction and no root activity at the 6′ depth. Following irrigations the water table rose to 7′–8′ below the soil surface and stayed there for several days. In the past when excessive water was applied the lower roots may have been drowned.

The unirrigated centers had very low soil moisture content after mid-June and the roots remained in dry soil during the rest of the growing season. The unirrigated centers never received moisture by lateral subbing. Lateral movement of water from the furrows toward the vines was found to be fair when furrows were placed on both sides of the vine row. There was little or no lateral movement to the vine row when a single furrow was used in every other middle.

The strong vines in the northern portion of the plot began the growing season with low soil moisture content at the 6′ level because of insufficient winter rainfall. An early spring irrigation would supplement light rainfall in dry years.

Although there has been but one year of work on a long-term project, the results indicate that irrigation of a vineyard by a single furrow in every other vine row does not provide adequate soil moisture throughout the entire root zone.

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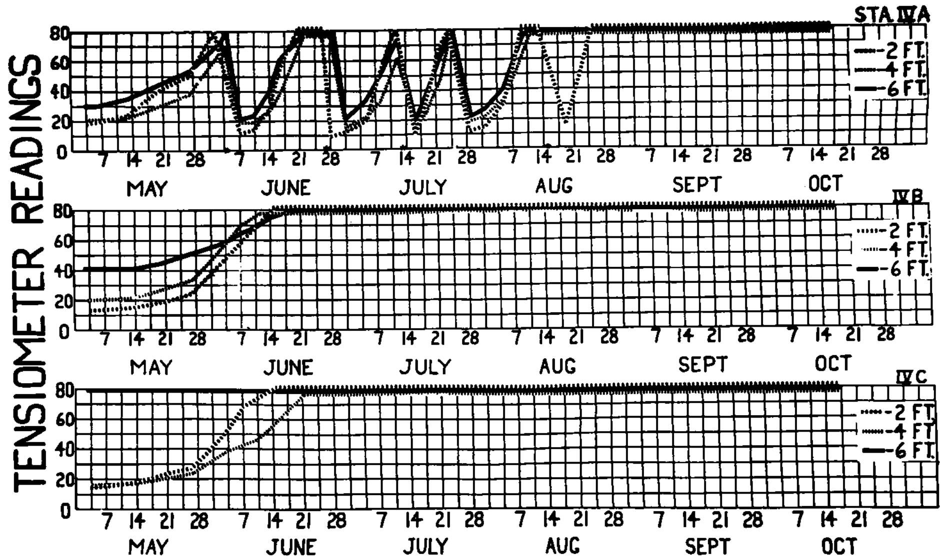
The above reported studies were established at the request of the Tokay Marketing Agreement industry committee.

Tokay grape grower James Sanguinetti, of Lodi, also participated in the investigations.



Tensiometer readings, showing the inadequate irrigation of grapes by use of a single furrow every other vine row.

Plots irrigated June 5, June 27, July 13, July 25, and August 15.

Measuring movements of

Soil Amendments

made possible by new technique

D. R. NIELSEN and J. W. BIGGAR

The success or failure of fertilizers, herbicides, and pesticides applied as soil amendments depends on distribution and concentration of the material in the soil.

Fertilizers—the most common amendment—usually are applied by side-dressing or broadcasting, or are dissolved in irrigation water. Surface application of herbicides is a common practice but the depth of penetration or lateral movement in the soil must be minimized to protect the crop. On the other hand, the success of soil fumigants depends upon depth of penetration and uniform distribution.

Whether applied to the soil as a liquid or as a dry material soluble in the soil solution, an amendment spreads through the soil as a result of several processes taking place simultaneously.

The process most commonly considered to cause the spreading of a material through the soil—and the least understood—is the movement of water. The volume of soil through which water moves is a complicated network of large and small pores resulting in tortuous interconnecting paths that depend upon the average water content of the soil. The movement of water through small pores is much slower than through the larger pores. A considerable volume of soil may have pores so small that the soil moisture filling the pores is not

Schematic diagram illustrating the manner in which soil additives spread through small and large pores.

displaced by applied water. Because the larger, moisture filled pores conduct the material faster, a substance injected at one point in a soil can be measured very early in the spreading outflow. Eventually, as the smaller and more tortuous pores are flushed with the material, the concentration measured down-

Concluded on next page

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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The above progress report is based on Research Project No. RRF 1880.

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

ELMER C. CARLSON

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.