Crop Rotation and Citrus

cropping old citrus soil to other plants studied to learn effect on the growth of citrus replants

J. P. Martin and J. O. Ervin

When some plants are grown in the same soil for long periods of time, organisms detrimental to the species develop and reduce the growth of the plants or replants, if perennials, and of subsequent crops, if annuals.

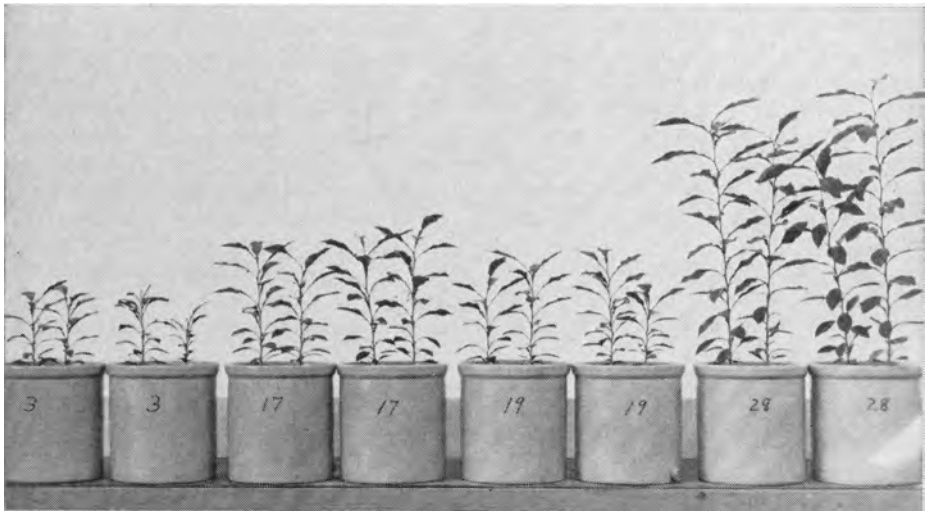
One method for control of such soil-borne plant parasites is crop rotation—a form of biological control long in use. Growth of a different crop or incorporation of a different type of organic residue in the soil may depress growth of the detrimental organisms by reducing the food supply and by stimulating growth of other organisms, some of which may be antagonistic to the parasitic forms.

The growth of citrus in some soils markedly reduces the growth of citrus replants, and there is good evidence that much of the reduced growth is caused by the buildup of detrimental microbes, including nematodes and various fungi.

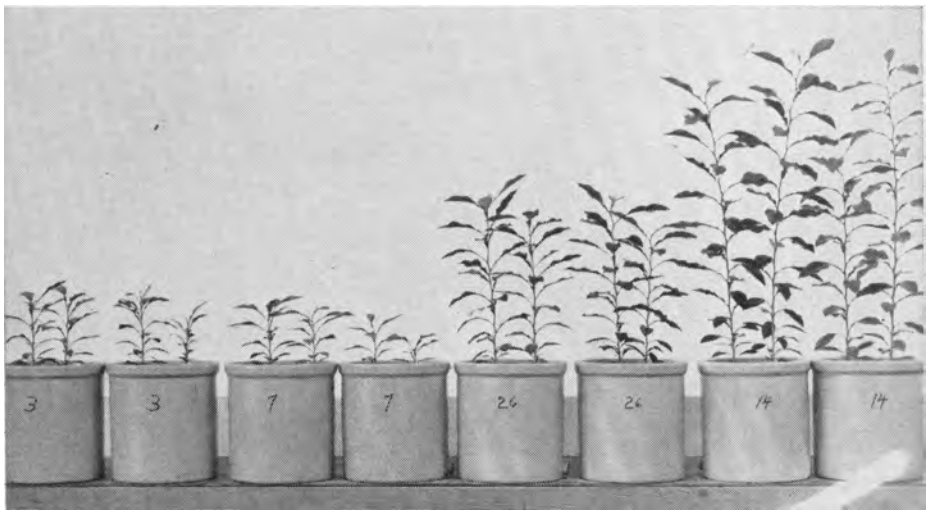
Greenhouse studies are under way to determine what effect cropping of old citrus soils to other plants has on growth of subsequent plantings to citrus.

Hanford sandy loam soil taken from a 6″ to 24″-depth of old citrus soil near Covina was used for one study. To accentuate the reduced growth effect, the soil was uniformly cropped to sour orange seedlings for six months, after which it was all mixed, repotted, and differentially cropped.

Cropping treatments included sweet orange seedlings, dry fallow, moist fallow, and cropping to 25 different plants—legumes and nonlegumes. All crops were grown to maturity and allowed to remain in the pots for a 4-month period. The tops were then removed and discarded. The soil and roots



Effect of crop rotation on growth of sour orange seedlings in an old citrus soil. Rotation crops were: *Above, First pair,* Sweet orange seedlings; *Second pair,* Lima beans; *Third pair,* White mustard; *Fourth pair,* Timothy. *Below: First pair,* Sweet orange seedlings; *Second pair,* Brabham cowpeas; *Third pair,* Onions; and *Fourth pair,* Rhodesgrass.



Effect of Crop Rotation and Fallow on Growth of Sour Orange Seedlings in an Old Citrus Soil.

Rotation crop or other treatment	Av. dry wt. per pot of seedlings	Growth increase, assuming citrus after citrus = 0
	gm.	%
Brabham cowpea	6	–25
Sweet orange seedlings	8	0
Giant Ramshorn cowpea	10	25
White mustard	11	37
Blue lupine	12	50
Lima beans	13	62
Hairy vetch	13	62
Yellow sweet clover	14	75
Dry fallow	15	87
Moist fallow	15	87
Common vetch	18	125
Head lettuce	18	125
Onions	18	125
Alfalfa	19	137
Tomatoes	19	137
White icicle radishes	20	150
Crested wheatgrass	21	162
Big trefoil	24	200
Bird's-foot trefoil	24	200
Oats	26	225
Bromegrass	26	225
Orchardgrass	27	237
Barley	27	237
Sweet corn	27	237
Sudangrass	30	275
Timothy	31	287
Rhodesgrass	34	325
L.S.D. 5%	4	50

Variable Leaf Punch

improved foliage sampling tool aid in studies with unit leaf sections

Gordon L. Smith and Donald E. Little

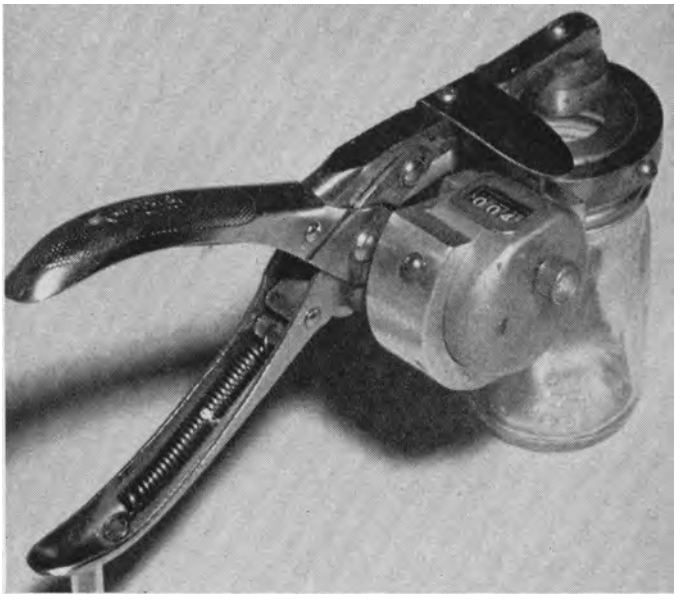
Developed for taking unit area samples of cotton leaves, an improved leaf punch has advantages for the entomologist, the plant pathologist, and for others working in plant sciences.

The new leaf punch has interchangeable cutting dies that are variable in diameter from 1.0 centimeter to 3.2 cm. The dies are so constructed that they make no contact with either surface of the leaf section, except for a 0.5-millimeter-wide rim of the inner knife, which has a one-sixteenth-inch recessed face. The opening between the knives, or dies, is three eighths of an inch—sufficient for leaves to be inserted without scraping the surfaces—so deposits such as insecticides or mite populations are not disturbed. In some work it might be necessary to have more than three eights of an inch between knives. The leaf sections fall freely into a screw-cap glass jar which can be removed and sealed tightly against dehydration of the samples or leakage of fluids in which the sections may be collected or stored. The jars are compact and suitable for storage or transportation of the samples.

The punch—as illustrated—weighs 1.5 pounds with jar and removable tally, and is 9″ long.

Accumulation of plant sap and tissue, which occasionally cause the knives to stick, can be reduced if the thrust or overlap of the cutting edges is just enough to complete the circular cut. A cloth moistened with water will clean off any accumulation.

Variable leaf punch.



The new leaf section sampler was adapted from a heavy-duty, single—one hole—handgrip paper punch, with a double-action hinge. The punch die in the lower jaw was rounded at the tip and retained to serve as a guide for the parallel movement of the jaws.

An extension was welded to the upper jaw to increase its length 1¾ inches beyond the guide. A hole drilled in the extension—½″ from the end—is slightly larger than the screw holding the upper knife die in place. This allows for centering the upper knife with the lower die.

A ring of three-eighths-inch thickness and two and three-sixteenths-inch outside diameter was welded to the lower jaw. The ring extends two and three-eighths inches beyond the guide and is recessed to hold the lower knife of one and five-eighths-inch outside diameter and ¼″ thick. The inner circular opening is made the size of the desired leaf area but is relieved by one sixteenth of an inch to the lower opening. The shoulder within the ring, supporting the knife, extends about one-eighth inch. The knife is held in the recessed ring by a set screw.

If the knives are made of stainless steel and the extensions are plated, corrosion will be prevented.

A tally counter mounted on the side of the punch in an aluminum cup or receptacle is held by a set screw. A small strip of spring steel extends from the upper jaw and strikes the plunger of the counter when the upper jaw is depressed.

The variable leaf punch is useful for sampling foliage when unit leaf sections are required for determining chemical deposits, insects, mites, eggs, disease organisms, or for leaf tissue analyses, or other data.

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were mixed and returned to the pots. Large roots and root masses were chopped so that they would mix more readily with the soil.

The soil-root mixtures were kept moist for about three months to allow the roots to decay. At this time, all the soil from a single treatment—four pots—was combined, mixed, and returned to the pots. Inorganic nitrogen in all treatments was adjusted to 80 ppm—parts per million—and each pot received a small amount of potassium and phosphorus fertilizer.

The soils were next uniformly cropped to sour orange seedlings for eight months, after which the plants were harvested and dry weights obtained.

The effect of the various crop rotation sequences on growth of the sour orange seedlings is indicated in the table and pictures on page 12. Some of the rotation crops greatly improved subsequent growth of the citrus while others had little or no effect.

In general, the nonlegumes produced a much more favorable effect than the legumes but there was some overlapping. Among the legumes, the trefoils increased growth the most and the cowpeas the least; the nonlegumes, Rhodesgrass produced the greatest growth stimulation, and white mustard the least.

That the increased growth of the citrus following the Rhodesgrass, and other crops, was a biological control effect is supported by the fact that fumigation of the citrus-sick soil—a process which kills soil organisms and changes the microbial population—also increases growth of the citrus plants.

However, crop rotation or additions of organic materials will not always aid in the control of detrimental soil organisms. In many instances benefit does occur but in others, the detrimental organisms may be favored. In this study, the cowpeas and mustard had little or no effect on seedling growth. In a previous study, a variety of organic residues were applied to an old citrus soil. All plants died in the soil treated with ground alfalfa. Examination of the soil for fungi showed that *Phytophthora*

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ROTATION

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species and *Thieleviopsis basicola* had greatly increased in numbers. Both species have been found under certain conditions to reduce growth of citrus plants. During the later stages of decomposition of the alfalfa, however, relative numbers of these species declined sharply, and replants survived.

If the tops of the plants had been incorporated with the soil, some of the rotations giving poor results might have stimulated growth to a greater degree. In another test—using legumes only—plant tops as well as roots were incorporated with the soil. In this test, a slight increase in growth of citrus followed a crop of cowpeas. The tops were not incorporated in the soil in the present study because nitrogen fixation—by some of the legumes in the previous test—resulted in excess soil nitrates, following decomposition of the large amount of top growth.

The nature of the soil population developing as a result of crop rotation, covercropping, or organic matter applications would be expected to depend to a certain extent on the kinds of soil organisms existing in a particular soil. For this reason it is possible that a certain plant would stimulate the development of an antagonistic microbe in one soil but not in another. This and other considerations are evidence that certain biological control relationships may be very complex and will require considerable careful work before they are properly understood.

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For research on Fusarium stem rot of carnation

Corn Industries Research Foundation $2,500.00
For research on California canned cling peaches and the effect of various sweetening agents

Ethyl Corporation $500.00
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Fuji Nurseries ..... 1500 carnation cuttings
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Fukushima Nursery ..... 1500 carnation cuttings
For research on Fusarium wilt of carnation and Fusarium stem rot of carnations

Geigy Chemical Corporation $600.00
For research on deciduous fruit pest control

To establish test plots on insects of ornamental plants ..... 25# Diazinon 25 W

Sato Nursery ..... 250 carnation cuttings
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Shell Chemical Corporation ..... 5 gal. Endrin
2 gal. Isodrin
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Twin Nurseries ..... 1850 carnation cuttings
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Velsicol Corporation $500.00
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Border Fertilizer Supply Co. ..... 1 gal. 2,4-D Amine
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John Brownell & Co. ..... 20# field corn seed
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California Spray Chemical Corp. ..... 15# pelleted I.P.C.
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Chilean Nitrate Educational Bureau, Inc. ..... 1 ton nitrate of soda
For experiments with fertilizers

Chipman Chemical Company, Inc. $500.00
For research on control of weeds in rice

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Dow Chemical Company ..... 2# Delapon
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E. I. du Pont de Nemours & Co. ..... 150# uramite fertilizer
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Gerber's Baby Foods ..... Hollo-Flite screw steamer
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Holly Sugar Company ..... 50# sugar beet seed
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Holstein-Friesian Research Foundation $1,000.00
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Naugatuck Chemical Division of U. S. Rubber Co. 16# Maleic hydrozoide
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Westvaco Chemical Division... 50-gal. barrel phosphoric acid, grade 75%
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Brown Bulb Ranch ..... 150 camellia double begonias
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Matlin's Nursery ..... 40 roses
For study of rose chlorosis

RIVERSIDE

Carbide & Carbon Chemicals Company $3,000.00
For research on mode of action of insecticides
For research on bacterial or fungicidal control
10# CRAG Fungicide 658

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