

# Fungus Flora Species

## in California citrus soils

J. P. Martin and Harrietann Joseph

IT IS MORE DIFFICULT to grow good trees on old citrus soil than on soil which has never been cropped to citrus.

It appears that, after oranges, lemons, or grapefruit have grown on certain soils for a considerable period of time, some change, either physical, chemical, or biological, or a combination of the three, occurs which renders the soil a less favorable medium for subsequent growth of the same plants.

In connection with experiments conducted to determine the soil changes resulting from citrus growth, and the effect of such changes on plant growth, a study was made of the saprophytic fungi in the root area of orange and lemon trees as compared with that in noncitrus soils.

For this study hundreds of samples of soil were collected from various areas of southern California during the past two and one-half years. The citrus soil samples were obtained from areas near the drip of the tree and from spots where feeder roots were in evidence. The non-citrus soil samples were obtained from garden spots, avocado groves, fig groves, virgin areas, alfalfa fields, and other cultivated land which had never before been cropped to citrus.

The samples were taken from various depths ranging from three to 48 inches. They were immediately brought to the laboratory and plated to determine the nature of the fungi they contained.

### Species Isolated

At this time at least 83 species of fungi representing 41 genera have been isolated. The majority of forms are found in both old citrus and noncitrus soils.

There are persistent differences in the nature of the fungus population of the old citrus and the noncitrus soil.

### Most Common Fungi Found

The most common fungus found in the root zone of citrus trees was a *Fusarium* sp. designated as *Fusarium* sp. 1. Although this mold occurred in all soils, it was present in much greater numbers in the old citrus soils.

Two fungi, Fungus D1—it could not be identified—and a *Pyrenochaeta* sp., both dark colored molds, were consistently isolated in relatively large concentrations from all the old citrus soils but were never found in any of the noncitrus soil samples.

Both forms occurred in relatively greater concentration in the root area of the trees than near the surface of the soil.

The fact that these two molds were only encountered in old citrus soil samples does not prove that they do not exist in other soils. Perhaps, if sufficient samples were plated, one would ultimately find them in noncitrus soils. It does indicate that they are directly or indirectly favored by the growth of citrus trees on the land.

Occasionally, two pathogenic fungi, namely, *Phytophthora* sp. *Thielaviopsis basicola* were isolated from old citrus soil.

The bulk of the fungus population of the noncitrus soils consisted of certain *Penicillium* and *Aspergillus* species and *Trichoderma lignorum*.

Of the fungi listed in the accompanying table, the blue-green penicillia, *Aspergillus niger*, and *Aspergillus versicolor*, were found primarily near the surface of the soil. The other forms were found at all depths.

### In Citrus Rootlets

In order to determine whether or not any of the fungus species encountered around the citrus rootlets could be obtained from the roots themselves, healthy appearing, surface-sterilized feeder roots from several areas were plated.

In nearly every instance, if incubation were continued long enough, various *Fusarium* sp., primarily *Fusarium* sp. 1, grew out of the roots onto the medium.

If rootlets showing evidence of nematode injury were plated, a solid mass of *Fusarium* sp. 1 growth developed from the roots. Occasionally, *Sclerotium* sp. and *Phytophthora* sp. grew from the roots.

*Fusarium* sp. 1 forms a blue to purplish-blue pigment on natural media. Quite commonly, if one breaks open nematode-infested citrus rootlets, the inner portions of the bark, or sometimes the entire root, are blue to purplish-blue. This coloration is undoubtedly due to the growth of this fungus.

In the greenhouse, this organism has been isolated from *Phytophthora* lesions. It appears that *Fusarium* sp. 1 grows in close association with citrus roots. It is doubtful that it alone is capable of attacking and killing healthy roots, but may be considered an opportunist; that is, if

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*Fusarium* sp. 1 growing out of apparently healthy surface-sterilized citrus feeder roots.



until its presence cannot be demonstrated by usual methods, although at several points it has persisted in reduced numbers. We can expect very small populations for the next year or so at least.

*Leslie M. Smith is Associate Professor of Entomology, and Associate Entomologist in the Experiment Station, Davis.*

*Francis M. Summers is Principal Laboratory Technician in the Experiment Station, Davis.*

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some other factor, such as nematodes, pierces or weakens the root, the *Fusarium* is able to enter and cause further damage.

Even if *Fusarium* sp. 1 does not enter the citrus rootlets but grows in close association with them, getting its food material from dead root material, it is in the realm of possibility that it exerts an unfavorable influence on the plant.

When grown on plates it produces a substance which is toxic or antibiotic to other fungi.

If citrus cuttings are placed in a medium in which *Fusarium* sp. 1 has grown, the cuttings die in a short time, whereas cuttings in the same medium, which has not supported fungus growth, remain relatively healthy.

It can be stated that the growth of citrus does influence the nature of the soil fungus population. It is possible that this population directly, or more probably in combination with other factors, may exert a detrimental influence on the growth of the trees. More definite evidence in this connection is currently being sought.

*J. P. Martin is Assistant Chemist in the Experiment Station, Division of Soils and Plant Nutrition, Riverside.*

*Harrietann Joseph is Senior Laboratory Technician, Citrus Experiment Station, Riverside.*

### Approximate Percentage Concentration of Certain Fungi Consistently Isolated from Old Citrus and Noncitrus Southern California Soils

Fungus species	Approximate percentage concentration	
	Old citrus soil	Noncitrus soil
<i>Fusarium</i> sp. 1	19	2
Fungus D1	18	not found
<i>Pyrenochaeta</i> sp.	12	not found
Penicillia (blue-green)	8	19
<i>Penicillium vinaceum</i>	5	6
<i>Fusarium</i> sp. 2	4	1
<i>Penicillium restrictum</i>	4	10
<i>Aspergillus versicolor</i>	2	3
<i>Aspergillus ochraceus</i>	2	1
<i>Mucor</i> sp.	1	2
<i>Aspergillus niger</i>	1	5
<i>Monotospora brevis</i>	1	<1
<i>Aspergillus sydowi</i>	1	2
Fungus M1	1	<1
<i>Sclerotium</i> sp.	1	<1
<i>Penicillium humicola</i>	<1	8
<i>Trichoderma lignorum</i>	<1	7
<i>Penicillium nigricans</i>	<1	3
<i>Rhizopus nigricans</i>	<1	1
<i>Torula</i> sp. 1	not found	2

## PARATHION

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ful consideration as was given DDT in the early applications.

It is suggested for the coming season, in order to reduce possible injury to the fruit and foliage, as well as to the operator, that only the wettable and dust formulations of Parathion be employed.

Due precautions should be taken when handling the undiluted material and from the drift of sprays and dusts.

The wettable material in the drum has a very objectionable musty odor but after dilutions in the water in the spray tank it is not so noticeable. A few days after spraying, the odor can hardly be detected in the orchard.

### Excessive Dosages Not Needed

There is apparently no purpose served by employing excessive dosages of Parathion. The limits will probably be found between one fourth and 1½ pounds of a 15% wettable powder or equivalents of a 25% wettable powder.

Limited tests with 0.5% and 1% dusts have shown them to be adequate in most instances.

### Compatibility

Parathion is on the acid side and is not compatible with strongly alkaline materials. It is not compatible with lime sulfur solution, bordeaux mixture, or oil emulsions.

It is, apparently, compatible with wettable sulfurs, neutral coppers, DDT, rotenone, pyrethrum, lead arsenate, and dusting sulfurs.

## No Injury Noted

At the dosages and formulations thus far used in deciduous fruit orchards, Parathion has shown no injury to fruit or foliage, even under high summer temperatures, but much research is necessary before it can be considered entirely safe.

Its use with kerosene or spray oil has not been explored sufficiently on deciduous fruit. Indications are that these combinations may prove injurious.

### Residue

Analytical methods for the study of spray residue deposits are known, but as yet very little technical data are available on spray residues.

Spray deposits apparently persist for a period of two to three weeks. There should be no spray residue problem on applications which are made a month prior to harvest.

No tolerance has yet been set by Federal agencies.

### Availability

The availability of Parathion, in the coming season, will depend upon the speed at which the manufacturers of the technical material can get under production.

Apparently, Parathion will be available for future seasons, from most of the spray chemical companies, in formulations of wettable powders and dusts.

*Arthur D. Borden, is Lecturer in Entomology, and Associate Entomologist in the Experiment Station, Berkeley.*

## UREA

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more favorable economically, as well as providing a safe and palatable vehicle for this unpalatable substance and also favor bacterial activity in the rumen.

### Use Probably Limited

In general, it would appear that urea will find a place in beef cattle feeding only when natural proteins are unavailable or when the price differential between protein and carbohydrate concentrates is very wide. To meet this possible use in the future, further tests are contemplated using pelleted materials containing urea.

*H. R. Guilbert is Professor of Animal Husbandry, and Animal Husbandman in the Experiment Station, Davis.*

*G. H. Hart is Professor of Animal Husbandry, and Animal Husbandman in the Experiment Station, Davis.*

*K. A. Wagnon is Assistant in Animal Husbandry, Davis.*