Fumigation of Avocado Soils

fungus causing root rot can be controlled by fumigant but its use may prove lethal to trees

C. D. Gustafson

Avocado root rot fungus is effectively killed by methyl bromide when applied to the soil, but thus far no fumigant has been found that will not damage the roots.

Avocado root rot disease is caused by a combination of cinnamon fungus—*Phytopthora cinnamoni*—and a wet or poorly drained soil, and when there is excessive soil moisture, the fungus destroys feeder roots faster than replacements can be grown.

In the spring of 1952, a field test plot was established on an avocado orchard in San Juan Capistrano, which was affected with avocado root rot. The trees in the test plot were between 20 and 25 years old. The use of methyl bromide was encouraging because it resulted in a good kill of the fungus, although there was damage to the trees, mainly on the side fumigated.

Because of the satisfactory results obtained in this first field trial, further work was conducted with methyl bromide. In the summer of 1952, a program of soil disinfection to kill the cinnamon fungus was started. This program included two field test plots—one in Orange, the other in Santa Ana; a test plot at the University of California, Los Angeles; and a greenhouse fumigation experiment at Riverside, which also tested the effectiveness of dithane D-14, chloropicrin, and vancide 51.

The test plot on the avocado orchard in Orange included three trees—one diseased tree between two healthy trees. The soil is a Ramona loam, gravelly series. The orchard is 20–25 years old. The cinnamon fungus was first obtained from roots on the sick tree in November, 1951, and during this field test, subsequent isolations were made.

Three dosages of methyl bromide were used: one pound, two pounds, and four pounds per 100 square feet. Sampling of roots was done prior to treatment to determine the extent of the fungus. The fumigated area totaled 10′ × 30′ and was divided into three sections of 10′ × 10′. Samples were taken in two different locations in each section at 6″, 12″, 18″, and 24″ levels. Each section was then covered with a plastic tarp and sealed with dirt around the edges. Methyl bromide was introduced under the tarp through a rubber tube and allowed to penetrate the soil for 24 hours.

Twelve days after fumigation, the roots were resampled. In all cases where there was fungus prior to fumigation with methyl bromide, there was no evidence of it after treatment.

Ten days after fumigation, a small amount of damage was observed in the treated tree—a tip burn of the leaves on the fumigated side. Three to four weeks later, the tree died. This tree was weak, and it is not known whether one in the first stages of the disease could have survived the treatment.

The test plot established on the orchard in Santa Ana involved two diseased trees. Four dosages of methyl bromide were used: one pound, two pounds, three pounds, and four pounds per 100 square feet. The effectiveness of methyl bromide was once again shown in that the cinnamon fungus was destroyed at all levels of sampling. Damage to the trees was observed ten days after fumigation.

In January, 1953, two of the test plots—San Juan Capistrano and Santa Ana—were resampled to see if the cinnamon fungus had reinvaded the treated areas. The time interval between fumigation and resampling on the Capistrano property was eight months and on the Santa Ana plot, five months. In both cases, the fungus had re-entered the fumigated plots from adjacent infected soil, but not as a uniform invasion. Complete isolation was not the purpose of these tests, but only to determine the effectiveness of methyl bromide on the fungus.

The treatment on the test plot at the University of California, Los Angeles, was different from that used on the test plots in Orange and Santa Ana. Three 10′ × 10′ areas—with a diseased tree in the center of each—were fumigated with methyl bromide—½ pound per 100 square feet. The cinnamon fungus was not entirely destroyed by this lighter dosage. The trees, however, were killed, but this may have been because they were in a weak condition from a prolonged attack of the cinnamon fungus. Nevertheless, treating diseased trees in place

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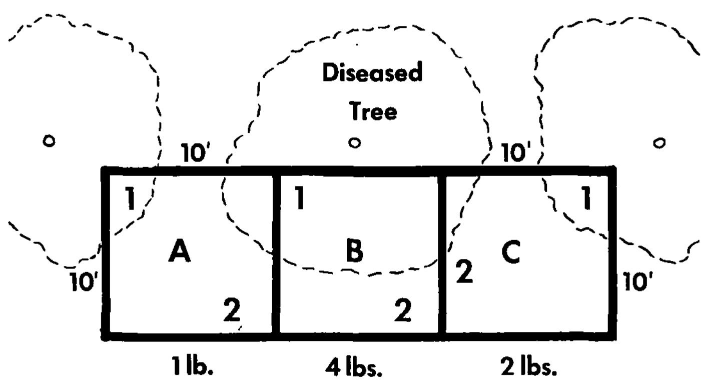
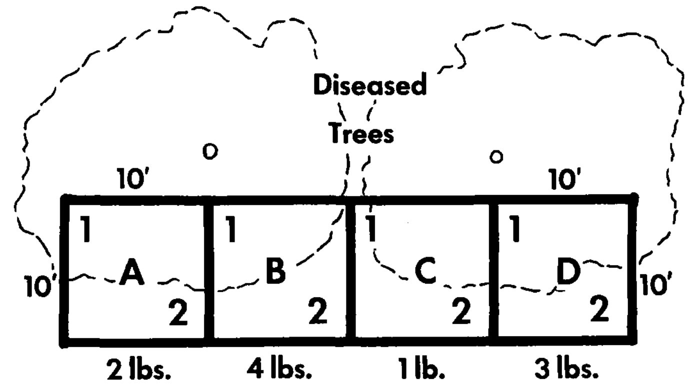
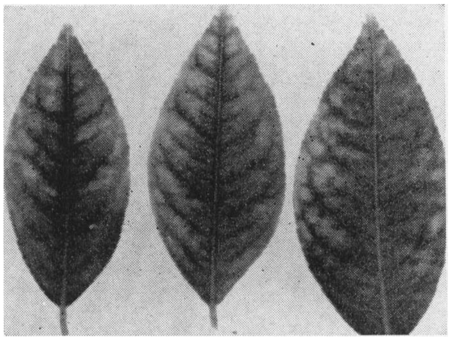
One diseased tree between two healthy trees was treated with three dosages of methyl bromide: one pound, four pounds, and two pounds per 100 square feet. This orchard, in Orange County, is on a Ramona loam, gravelly series.



Two diseased trees were treated with four dosages of methyl bromide: one pound, two pounds, three pounds, and four pounds per 100 square feet. Located near Santa Ana in Orange County, it is on a Ramona loam soil.





Effect of excessive concentrations of urea spray mixtures on leaves of lemon trees on sour orange rootstock grown in soil cultures resembles the patterns induced by biuret.

BIURET

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To explore excessive spray applications of such urea mixtures, these same four cultures on July 22, 1954, were again sprayed out-of-doors, but this time with a mixture three times as concentrated as previously. The two cultures formerly in the glasshouse were again placed in the glasshouse following the second spraying. Leaf burn was soon evident in all four sprayed cultures. The test was continued until August 4, 1954, when the sprayed trees—continuously left out-of-doors—were considerably greener than nonsprayed control trees but were not nearly as green as the trees moved into the glasshouse after each spraying.

After August 4, 1954, all cultures were kept out-of-doors. Within three weeks the cultures formerly in the glasshouse showed considerable new growth whereas those continually out-of-doors showed none.

Following the double spraying, some of the leaves of the sprayed trees—kept continuously out-of-doors—had symptoms with patterns suggestive of biuret. The marked change to continuously high air temperatures, together with the high concentrations of the urea spray, were possibly responsible for the appearance of leaf patterns having some resemblance to those produced by biuret.

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DEFECT

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the bean. The affected beans are usually at the blossom end of the pod—at the end away from the place of attachment of the pod to the plant. Sometimes all the beans in a pod are affected, but most frequently only one or two.

Half-grown beans show this defect less frequently than beans that are at the mature green stage for freezing.

In laboratory tests, thin sections from affected beans were stained and examined microscopically to determine precisely the region of the seed covering which becomes discolored. The dark tissue showing injury—except where the whole seed covering is split—is confined to the inner surface of the covering. The exact nature of the affected layer cannot be determined without study of younger seeds, but it appears to be the remains of a nutritive tissue known as endosperm. It is this layer and not the testa or the cotyledons that disorganizes, cracks, and discolors.

Fertilizer experiments in Santa Clara County did not indicate any important relationships to soil nutrients. The experiments included three irrigation treatments—normal and with one and two irrigations omitted late in the season. In all cases, the omission of two irrigations increased the percentage of wrinkled beans. However, on the lightest soil, even the normal irrigation gave 3.4% wrinkled beans, whereas when two irrigations were omitted, 8.8% of the beans were affected. These data indicate a relationship between the relative amount of this defect and irrigation treatment.

There are two sources of economic loss from wrinkled beans: the added cost of extra help to sort the defective beans at the processing plant—as well as the loss due to lower grades with lower sales value—and the abandoning of fields or sections of a field.

Because most of the difficulty with wrinkled beans has been with Concentrated Fordhook, it might be desirable to use the U. S. 242 variety—in less favorable climates and on marginal soils low in water-holding capacity—although it does not always give as high yields and the plant is larger.

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FUMIGATION

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does not seem practical because of the damage done to them.

In the greenhouse fumigation experiment at Riverside, methyl bromide, chloropicrin, vancide 51, and dithane D-14 were tested. Cultures of the fungus were inserted in wire mesh traps on strings of wire and placed in large cans of sterilized soils. Results showed that all four fumigants and fungicides were effective in killing the fungus, but methyl bromide and chloropicrin were the fastest acting and gave the most complete destruction.

Although treating diseased trees in place does not seem practical because of the damage done to them, methyl bromide can be effective in sterilizing potting soil prior to its use for growing avocado seedlings. It is possible that methyl bromide could also be used as a chemical barrier to isolate infected areas in an orchard, but further work needs to be done on the uses of methyl bromide.

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Test plot at the University of California, Los Angeles, involved three diseased trees. Three 10′ × 10′ areas, with a diseased tree in the center of each, were fumigated with methyl bromide, ½ pound per 100 square feet.