Verticillium Wilt Controlled

chloropicrin achieves effective control of Verticillium wilt in strawberry plantings if properly applied as soil fumigant

Stephen Wilhelm and Edward C. Koch

Three milliliters of chloropicrin injected 6" deep into moist soil will diffuse a cubic foot of soil volume in sufficient concentration to kill the Verticillium wilt fungus. This information—obtained from laboratory and greenhouse research—has been generally substantiated in commercial fumigation for Verticillium wilt control in chrysanthemums. It applies to soils varying from light sandy loams to moderately heavy clay loams; to soil temperatures of 45°F to 60°F; to soil moisture of a seedbed level extending to the soil surface; and to a completely pulverized soil tilth extending to at least a 9" depth.

Experience has shown that the cloddiness of the soil and the level of soil moisture—particularly in the surface soil—are the key factors affecting disease control by fumigation. In one heavily infested soil where Verticillium wilt control in chrysanthemums was studied, 90% of healthy Verticillium-free plants were obtained in plots sprinkled two days prior to fumigation, in contrast to only 52% of healthy plants in beds not sprinkled. The dosage was three milliliters of chloropicrin to each square foot of soil surface in each instance. The sprinkling provided adequate moisture in the surface soil in the plot giving the better level of disease control.

Studies carried on at the University of California Deciduous Fruit Field Station at San Jose indicated that if the soil is moist to the surface at the time of fumigation, a light rolling will take the place of a water seal, and also that rototilling and rolling the fumigated soil 24 to 48 hours after fumigation will take the place of a water seal. Neither of these procedures is effective in soil dry two to three inches down from the surface. The Verticillium wilt fungus occurs in high concentration in surface soil, and if the soil is dry, the fungus escapes the action of the chloropicrin vapors.

Beginning in 1953, Verticillium wilt control in strawberries was studied in a 2½-acre test plot near Soquel. From previous studies, the land was known to carry a heavy infestation of the Verticillium wilt fungus, and Verticillium wilt was responsible for the nearly complete failure of the strawberry planting during the three previous years.

In November 1953, one acre was fumigated by the use of handguns. Three milliliters of chloropicrin was injected 6" into each square foot, requiring approximately 480 pounds for the acre. The soil was moist up to the surface from recent rains. An area 20' by 50' in one corner of the acre was left untreated as a check. As additional checks, an adjacent area of 1½ acres and a neighboring four acres were fumigated with six gallons of ethylene dibromide to the acre. Certified Shasta strawberry plants were planted in January 1954.

During the first growing year of 1954, an average of 14 plants to each 3,100—0.45%—showed Verticillium wilt in the chloropicrin fumigated acre. In no portion of the fumigated acre was the disease incidence higher. In the check areas the distribution of Verticillium wilt was spotty. Large areas failed, with as high as 82% wilt. On the average, and excluding the areas of near complete failure from wilt, 120 plants to each 1,060—11.3%—showed wilt.

Growth of the strawberry plants in the chloropicrin-fumigated area was exceptional. Feeder rootlets were long, glistenable growth two years—1955—after fumigation with ethylene dibromide, showing the general up-and-down condition.
in fruit development. Three of the seedlings were regarded as worthy of distribution and trial in other areas. One especially, Number 143-5, has proven to be of sufficient promise—fruits were first produced in 1947—to warrant the distinction of having a variety name given to it. The selected name—Conadria—is a combination of the names Adriatic and Condit.

Conadria seems to be a very promising new variety of fig for the production of both fresh and dried fruit. It is especially promising for dried fruit in the San Joaquin Valley.

Ira J. Condit is Professor Emeritus of Subtropical Horticulture, University of California, Riverside.

Robert M. Warner is Associate Pomologist, University of California, Davis.

The above progress report is based on Research Project No. 869.

### HORSERADISH

Continued from page 6

Developement of Conadria

Actual fig breeding has been carried on at Riverside since 1928. A total of 16,650 seedlings, involving 273 combinations, have been grown and tested. Many varieties of edible figs have been used as female parents, including the commercial varieties of Dottato in 33 combinations, Franciscana in 13, Sari Lop in 16, and Verdente in 31.

Of the many combinations, the most promising seedlings producing edible figs were obtained from the Dottato and the Verdente crosses, especially from the latter. One such cross—Number 143—made in 1944, involved Verdente and a seedling male fig or caprifig, Number 72–80. Both parents are parthenocarpic—the fruits reach maturity without the stimulus of flower pollination or deposition of eggs by fig insects—in development of fruit. The resulting progeny totaled 72 seedlings; 38 produced edible fruit and 26 of these were parthenocarpic.

ripening figs to become flabby in texture and made them unfit for shipment to the fresh-fruit market.

At Fresno and Chowchilla, Conadria produced dried figs of excellent quality and remarkably free from defects.

Sugar analyses of a large number of samples of dried figs in 1951 showed the total sugar content of Verdone to be 55.88%, Calimyrna—Sari Lop—56.00%, Franciscana 57.02%, and Kadota—Dot tato—57.69%. A representative sample of Conadria tested in 1954 showed 63.3% total sugar.

### Other Observations

One grower’s pit was located under the eves of a building where it collected much more water than those in the open. The roots were wet when the pit was opened and were more turgid and in better condition than the roots in any of the other pits.

Stecklings were actually frozen in some of the shallower covered pits but thawed when the ground warmed up with no apparent damage to the roots. Stocklings which were much shriveled on arrival were buried in a wet sawdust pit and emerged in excellent turgid shape.

Stecklings did not keep satisfactorily in the common nonrefrigerated earth-covered potato cellars of the area.

Burton J. Hoyle is Associate Specialist in Vegetable Crops and Superintendent of the Tulelake Field Station.

The above progress report is based on Research Project No. 1175A.

### STRAWBERRY

Continued from page 3

During the second growing year—1955—the acre fumigated with chloropicrin showed exceptional vigor, and the check areas began to decline. The decline is thought to be due to the presence of root-invading fungi not related to Verticillium wilt. The yield from the fumigated acre was estimated at 33,400 pounds—16.7 tons—in contrast to an average of approximately 7.6 tons per acre for the check areas. The increase per acre attributable to the disease control and increased growth attending chloropicrin fumigation was 9.1 tons. The fumigated acre manifested exceptional vigor to the end of the second year and gave every indication of a good third year.

Since the beginning of this experiment late in 1953, considerable progress has been made in machine application of chloropicrin. Machine application may ultimately take the place of hand guns without loss in precision performance.

Stephen Wilhelm is Associate Plant Pathologist, University of California, Berkeley.

Edward C. Koch is Farm Advisor, Santa Cruz County, University of California.

The above progress report is based on Research Project No. 981.