Nematodes on Citrus

soil fumigation and resistant citrus varieties promising as controls

R. C. Baines

Nematodes injurious to citrus roots are being investigated at Riverside to find efficient means of control.

The amount of damage caused by the pest is being determined in greenhouse and orchard tests.

Soil is under study to identify the temperature range most favorable for the survival of the nematodes.

Citrus and related trees are being tested for their susceptibility and resistance to the soil-borne pest.

Chemical control experiments include chemicals applied in irrigation water and as fumes.

The larvae or young nematodes are wormlike in shape, whitish, and about 1/50 of an inch long. Only the females infect and feed on citrus roots.

The female larvae bore into the small feeder roots until approximately a fourth of the length of the nematode is in the root tissues. Then the part of the nematode extending out from the root surface becomes greatly enlarged. The mouth of the female is equipped with a short spear-like organ which punctures root cells in feeding. Eggs are laid in a mucilaginous material and frequently 75–100 unhatched eggs are found near the female. Soil particles adhere to the egg masses and roots, severely infested, appear encrusted.

The amount of damage caused by the nematode has not been reliably determined.

In one of the current experiments young sour orange seedling trees, inoculated with the nematode, were 12% shorter than similar, but noninfested trees, one year after inoculation.

Usually, considerable time is required for a high population of nematodes to build up on the roots of the inoculated trees, even though large numbers of nematodes are applied to the soil. The reduction in growth of the inoculated trees may be greater after the roots become infested severely.

Observations indicate that nematodes do not directly kill trees but apparently reduce their growth, and possibly, yield.

The experiments show that temperature of the soil affects the activity and development of the nematode. Only slight infection of orange roots occurs at 59° F and at 95° F. The optimum temperature of the soil for infection and development of the nematode is between 77° F and 88° F. During the winter and early spring when the soil temperature is below 59° F the nematode becomes quiescent, but does not die.

In fact, larvae of the citrus-root nematode were found to live longer at low than at high temperatures. In moist soil in the laboratory larvae remained alive for 2½ months at 91° F, 6½ months at 81° F, for one year at 70° F, and for more than one year at 59° F and 48° F.

In the field the citrus-root nematode has persisted in fallow land more than three years, and in soil in five-gallon containers for more than two years. Thus a long period free from citrus is required to eradicate the nematode from soil.

A large number of species and varieties of citrus tested in the field and in the greenhouse were found to be susceptible to the nematode. Some close citrus relatives, such as *Atalantia citroides*—Cochin China atalantia, *Eremocitrus glanca*—Australian desert lime, *Fortunella* sp.—kumquat, and *Microcitrus australasica*—Australian finger-lime are also susceptible.

Some selections or strains of the trifoliate orange—*Poncirus trifoliata*—are highly resistant to the citrus-root nematode, while other selections are infested severely.

The following species of trees, botanically close to citrus, were examined and found to be immune to the nematode: *Balsamocitrus Dawei*—Uganda powder flask-fruit, *Clausena lansium*—Wampee, *Murraya paniculata*—Orange jassamine, and *Severinia buxifolia*—Chinese box-orange.

Some of the resistant plants, such as the resistant trifoliate orange, may be of value as nematode-resistant parents in the development by breeding of satisfactory nematode resistant rootstocks for citrus. Such breeding work is underway.

Many tests of the efficacy of different dosages of ethylene dibromide and a mixture containing about equal parts of 1,2-dichloropropene and 1,2-dichloropropane have been conducted on bearing Valencia orange trees in an orchard. These chemicals were applied in irrigation water.

Other chemicals have been tested in the laboratory and on young trees in the greenhouse.

Results obtained to date do not justify recommendations for the use of any of the chemicals tested for controlling nematodes on the roots of living citrus trees.

A number of the chemicals used for fumigating agricultural soils are effective for killing the citrus-root nematode in bare land to be used for replanting to citrus. However, even high dosages of the chemicals have not always completely eradicated the nematode in the field.

In some cases, fumigation of soil with high dosages of soil fumigants has resulted in poor growth of orange trees in the greenhouse.

Sour orange roots infected with the citrus-root nematode. *Left*, Noninfected roots; *right*, roots infected by the nematode. They appear thicker, and soil particles adhere. Enlarged 2 times.

R. C. Baines is Associate Plant Pathologist in the University of California College of Agriculture Citrus Experiment Station, Riverside.

The above progress report is based on Research Project No. 1377.