

Fungicide and Nematicide Update

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Current and Potential Use of Disease-Control Chemicals on Citrus Trees

The major fungal and bacterial diseases of citrus that require spraying of the tree canopy for control are: citrus scab (*Elsinoë fawcetti*), which affects the fruit of susceptible varieties in areas with spring and early summer rainfall; melanose (*Diaporthe citri*), which is troublesome where long wetting of young fruit coincides with relatively high temperatures; greasy spot (*Mycosphaerella citri*), which occurs mostly in tropical and subtropical lowland areas; Alternaria brown spot (*Alternaria citri*), which is specific to some mandarin varieties and hybrids; Botrytis blight (*Botrytis cinerea*) and blast (*Pseudomonas syringae*), which occur mostly under cool wet conditions; mal secco (*Phoma tracheiphila*), a disease of lemons confined to some Mediterranean countries; and brown rot (caused mostly by *Phytophthora citrophthora*), which can be serious when rain occurs during the latter part of fruit development. Important diseases that do not occur everywhere climatic conditions favor their development, because the pathogens are restricted in occurrence, include black spot (*Guignardia citricarpa*), sweet orange scab (*Elsinoë australis*), and canker (*Xanthomonas campestris* pv. *citri*); none of these occurs in the United States.

Copper fungicides continue to be used to control melanose, scab, greasy spot, brown rot, Botrytis blight, mal secco, blast, and canker. This does not mean that citrus growers are unduly conservative. Rather, it emphasizes some practical realities that apply more to citrus than to most other horticultural crops. Spraying citrus trees is a slow, costly process; satisfactory coverage of the dense canopy requires large amounts of chemical and high volumes of water. Repeat applications after short intervals are often impractical, and this gives the chemically stable copper fungicides, with their long residual action, a distinct advantage over most noncopper materials.

Despite their effectiveness and relatively low cost, copper fungicides are not universally popular among citrus growers. In some areas (including California and Japan but not Florida), even the copper fungicides formulated as wettable powders can cause direct injury to fruit rind. Copper fungicides can darken blemishes and also can promote multiplication of certain insects and mites. Furthermore, there is concern about the accumulation of too much copper in the soil. Copper toxicity can be alleviated by liming the

soil to a pH of 6.5–7.0, but even at these pH levels, there may be limits to the amount of copper that can be tolerated without affecting tree performance.

Overall, the dithiocarbamate fungicides have proved useful substitutes for copper fungicides only where repeated applications are feasible. In Japan, where trees are small and growers spray quite frequently, zineb, maneb, or mancozeb controls melanose if applied postbloom three to four times. In Florida, however, where only one or two postbloom treatments are considered feasible for melanose control, the dithiocarbamates perform poorly compared with standard copper treatments. Similarly, unless applied repeatedly, the dithiocarbamates are less effective than copper fungicides or spray oil for greasy spot control.

Captan is seldom used in citrus orchards, except to control brown rot. Captan is less effective than copper fungicides against this disease but is preferred where copper fungicides might injure the fruit rind. In contrast, a close relative of captan, captafol, now plays an important role in citrus disease control. Captafol has a wide spectrum of activity and long residual action but is not without problems. Captafol is sometimes phytotoxic, is incompatible with spray oil, and cannot be safely applied within 60 days of an oil treatment. Captafol is superior to copper fungicides for the control of scab, melanose, and Alternaria brown spot but is generally not applied postbloom if the crop is intended for the fresh market, because of possible rind injury. Captafol is also effective against greasy spot and is used by some growers in Florida as a substitute for oil or copper fungicides to control this disease in orchards producing fruit for processing.

Benzimidazole fungicides are now unreliable against some diseases because of pathogen resistance. In Florida, benomyl originally proved better than copper fungicides for scab control and about equal to copper fungicide for greasy spot control. Then, after 5 years of use, and with only one or two treatments a year, it failed to control scab and greasy spot in some orchards. In Japan, problems arose with the control of Botrytis blight with benzimidazole fungicides because of pathogen resistance. On the brighter side, benomyl continues to control black spot well. For example, in most South Africa orchards, a single spray of benomyl plus oil still provides black spot control equivalent to that previously obtained with four or five mancozeb treatments.

Dithianon successfully controls scab

and melanose in some countries but is not effective against greasy spot. Dithianon is not registered for use in the United States.

The broad-spectrum fungicide chlorothalonil is widely used for fungus disease control on many crops but has shown little promise against citrus diseases. In Texas and Florida, single applications of chlorothalonil have not controlled melanose as well as single applications of a copper fungicide. In Florida tests, chlorothalonil was not effective against scab or Alternaria brown spot, and it controlled greasy spot as well as spray oil or copper fungicides only when applied at costly high rates.

Among newer fungicides, CGA-64251, prochloraz, fenarimol, fenapanil, triforine, and iprodione have shown little or no potential for scab or melanose control. Some of these materials have reduced greasy spot severity but seldom as well as, and never better than, copper fungicides, captafol, or spray oil.

In Florida, petroleum spray oils are the mainstay for greasy spot control and need to be supplemented or replaced with copper fungicides or benomyl (where still effective) only when disease pressure is heavy. Oil is not lethal or fungistatic to *M. citri* but seems to act by increasing the naturally long disease incubation period. Oils with a distillation temperature around 224 C give maximum control of greasy spot without adversely affecting the tree.

Chemicals are also used in citriculture to prevent or cure *Phytophthora*-induced gummosis or foot rot on the tree trunks. In Texas and Florida, captafol is applied to the trunk of young trees to prevent foot rot. Formerly, the only procedure known to cure foot rot was to surgically remove the diseased bark and paint the infection site with a copper fungicide or captafol to prevent further infection. Now, two new systemic fungicides, metalaxyl and phosethyl Al, show promise for controlling existing infections without laborious bark surgery. Metalaxyl is now approved for use on nonbearing citrus trees in some areas, including Florida, but phosethyl Al has not yet been approved for use in the United States.

Dr. Whiteside is editor of the citrus, tropical, and miscellaneous crops section of Fungicide and Nematicide Tests, William C. Nesmith, Editor, published annually by the New Fungicide and Nematicide Data Committee of The American Phytopathological Society. Copies of current and past volumes may be obtained from Richard E. Stuckey, Business Manager F & N Tests, Plant Pathology Department, University of Kentucky, Lexington 40546.