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Variola—A Probable Virus Disease of Citrus

A VIRUS-LIKE disease affecting citrus trees was recently observed in several groves in the Limeira citrus area, Brazil. The symptoms are similar to those of "false exanthema," described by Bitancourt in 1933 (1), to those induced by boron deficiency (3) and to some of those described for "exanthema" by Fawcett (2) but which are now considered to be induced by copper deficiency. They also resemble convex gum, a disease of citrus trees occurring in China (4).

Symptoms of the Disease

The first symptom of variola is the appearance of small blisters in 4- or 5-month-old twigs (Fig. 1,a); the blisters are caused by development of gum pockets between layers of the xylem. On removal of the bark, small, tristeza-like pits can be seen in the wood, over and around the gum pocket (Fig. 1,b). The blisters may burst with an abundant exudation of gum, leading to crater-like depressions that give to the branches an appearance resembling human smallpox (Variola). A few branches or the entire tree may be affected by the disease. In the latter case, stunting and decline of the tree may occur. The leaves of severely affected branches develop yellow veins and may eventually drop. The fruit show no conspicuous symptoms, but are smaller than normal. The disease was observed in sprouts of the Rangpur lime (*Citrus limonia* Osbeck) rootstock of some severely affected trees, with an exceptional exudation of gum.

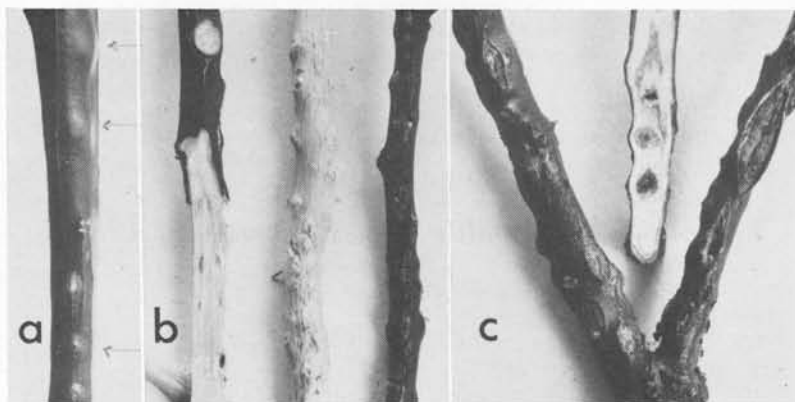


FIGURE 1. *Variola* on young branches: a. small blisters, which are characteristic initial symptoms of the disease; b. gum pockets in the wood and numerous small pits around the blisters; c. advanced stage of the disease, showing crater-like depressions.

Varieties Affected and Area of Occurrence of the Disease

Variola was first seen in trees of Cravo tangerine (*C. tangerina* Hort. ex Tanaka) in 1960. Later it was observed in Baianinha Navel and Pera sweet orange [*C. sinensis* (L.) Osbeck], Eureka lemon [*C. limon* (L.) Burm. f.], Rangpur lime, and Marsh grapefruit (*C. paradisi* Macf.) trees.

Affected trees were found only in the Limeira area in the state of São Paulo. In this area, about 80 per cent of the groves examined were diseased, the percentage of affected trees in each grove being variable. In some groves in the Lagoa Nova region (Limeira county), almost all trees were severely affected. Trees showing symptoms of *variola* were growing in different types of soils, with different ages, on Caipira sweet orange, Rangpur lime, and Cleopatra tangerine [*C. reshni* (Engl.) Hort. ex Tanaka], from old and nucellar lines, of all commercial varieties of the state of São Paulo. The disease was also observed in seedling trees of sour orange (*C. aurantium* L.), Eureka lemon, Caipira sweet orange, Pera orange, Cleopatra mandarin, and Rangpur lime.

Examination of the trees in the collection of the Limeira Citrus Experiment Station revealed the disease in more than 200 different varieties and species of citrus, including varieties of tangelo (*C. reticulata* Blanco x *C. paradisi*), Shaddock (*C. grandis* Osbeck), kumquat (*Fortunella* spp.), and trifoliate orange [*Poncirus trifoliata* (L.) Raf.] in addition to those already mentioned.

Control Experiment

The rapid spread of variola suggests the existence of an efficient vector. An exceptionally long dry season occurred in 1961 and again in 1963 (the driest year of the century). A high population of insects and mites, specially those of the *Tetranychidae* family, was observed in the diseased trees.

Trees were sprayed with a fungicide, an insecticide, an acaricide, and micronutrients (Zn, Mn, Cu, Bo). Non-sprayed trees were left as controls. The sprays were repeated several times. Examinations of the new branches, six months later, revealed that the young twigs of the trees sprayed with the insecticide (Malathion E-50, 0.4%) had apparently been protected. Only a few blisters were found in these sprayed trees.

Discussion and Conclusion

The nature of the variola disease has not yet been established. It was suggested that it may be the result of a systemic or a localized virus, of a nutritional deficiency, or of an insect or mite injury (Moreira, Salibe, and Rodriguez, communication to growers, 1963).

The disease was found to occur in practically all citrus varieties, in trees of old and nucellar lines, on numerous rootstocks, of different ages, growing in various types of soils. This fact supports the hypothesis that a vector exists, which is very probably an insect as indicated by the control experiment. This vector may be the transmitter of a localized virus.

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NOTE.—Since the presentation of this paper at the Conference, G. Müller and A. S. Costa of the Instituto Agronomico have been able to produce variola on citrus trees with the insect, *Platytylus bicolor* (Le Pel. & Serv.) (personal communication). This insect is present in fairly high populations in citrus groves of the Limeira area.

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