

Two Additional Viruslike Disorders of Sweet Orange in Sicily

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Two viruslike disorders of sweet orange trees were observed recently in Sicily: genetic brown spots on orange rind (Catara and Cartia, 1973) and a graft-incompatibility disorder of Tarocco

orange on sour orange rootstock (Davino and Granata, 1975). This paper reports the symptoms and etiology of the two disorders.

GENETIC BROWN SPOT OF ORANGE RIND (GBS)

Symptoms of GBS appear on fruits at the end of June as small, yellow-green areas, 2-3 mm in diameter with irregular margins (fig. 1A), which sometimes coalesce into larger spots. At first, the syndrome is very similar to injury caused by *Empoasca decipiens* Paoli, a leafhopper present in some Sicilian citrus orchards; however, GBS interglandular cells become necrotic and turn brown (fig. 1B) whereas those damaged by insects remain yellow. The center of the spot develops a corky crust which cracks and falls off as the fruit enlarges. Radial sections of affected pericarp stained with thionin and orange G (Sadik and Minges, 1964) show necrotic cells of epidermis, hypodermis, and flavedo under which there is a layer of flat cells. Almost all fruits on the tree are affected. In two years of observation only 12 out of 3,500 fruits were unaffected. The number of spots per fruit varies greatly: 47 per cent showed less than 10 spots; 42 per cent had 10 to 50 spots, and 10 per cent had more than 50 spots per fruit. The incidence of spots appeared to be highest on the northwest and southwest sectors of the canopy. Affected trees have an open crown and sparse foliage, with symptoms like those of zinc and manganese deficiency.

In some respects the disorder is similar to other diseases or disorders of citrus

fruits such as leprosis (Kitajima *et al.*, 1972), Valencia rind spot (Klotz, 1973), star-shaped spot (Fawcett and Lee, 1926), cancrioid spot (Knorr, 1963, 1968), concentric ring blotch (Dippenaar, 1957), orange brown spot (Petri, 1933), or fetola (Carrante, 1938).

In a field survey, the disorder was found mainly on Tarocco and Tarocchino orange, with only a few trees of other orange varieties showing suspected symptoms.

No biotic agent was found consistently associated with the disorder, although *Colletotrichum* sp. and *Alternaria* sp. were isolated from spots on fruit. Any relationship with insects or mites has been excluded. In an experiment where very young fruits were wrapped with cheesecloth and/or sprayed weekly with a pesticide, all the fruits developed symptoms.

Five years after inoculation no trees of the following citrus species and cultivars showed symptoms: Tarocco orange, Eureka lemon, Marsh grapefruit, Rangpur lime, Orlando tangelo, Palestine sweet lime, and Etrog citron.

Healthy bud grafts of Tarocco orange forced into growth on one branch each of four affected trees developed normal leaves and fruits over a four-year period whereas fruits on the other branches of

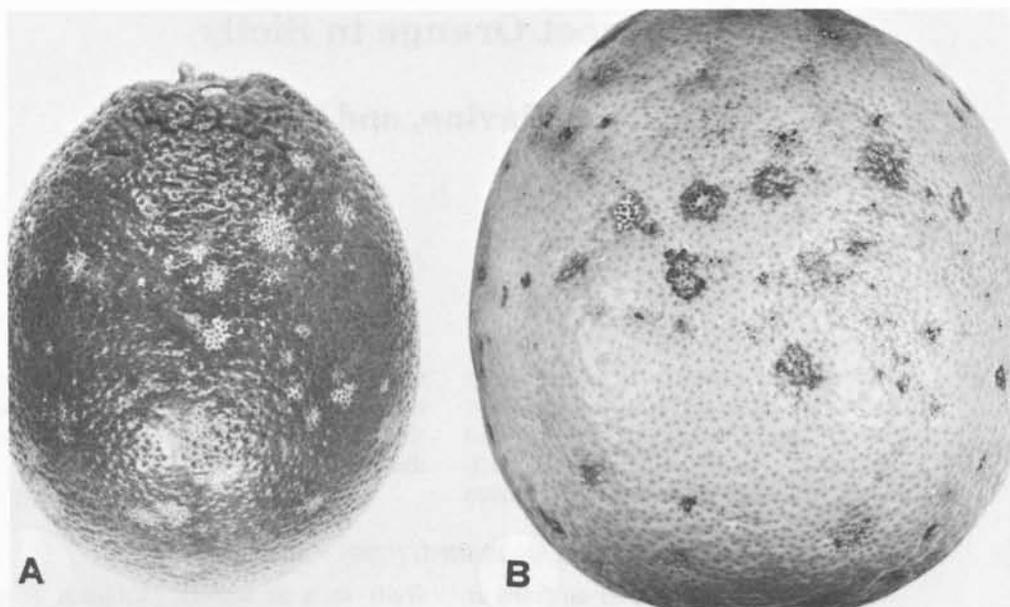


Fig. 1. Genetic-brown-spot symptoms on Tarocco orange. The spots are yellow on the young fruit (A) and brown in the ripe one (B).

the same trees were affected with GBS. Ten sour orange seedlings inoculated with buds from an affected tree showed no leaf symptoms. However, buds taken from affected trees and propagated on sour orange seedlings or on a branch of a healthy Tarocco orange tree and grown far from the area where the disorder was detected, developed leaves and fruits

identical with those of the GBS source trees.

Since the disorder is widespread on trees growing in different soils, under different climatic conditions, is bud perpetuated, and is not associated with any biotic agent, it would appear to be due to an inherited factor in certain clones.

GRAFT-INCOMPATIBILITY DISORDER OF TAROCCO ORANGE ON SOUR ORANGE ROOTSTOCK (GID)

GID was first observed in 1973 on seven-year-old Tarocco trees. Scions of affected trees are larger than their sour orange rootstocks. The rootstocks show pitting on the cambial face of the bark and corresponding pegs with gum on the wood (fig. 2A). Roots are unaffected. The fruits are small and elongated, have a thick rough rind, and contain less juice and lower sugar than normal fruits. Peduncles are enlarged (fig. 2B). Fruiting is poor and flowering unseasonal. Affected trees usually have a bunched or rosetted growth habit due to shortened internodes. Leaves are thick and pale green to yellow in color, especially along the veins.

Transmission trials were made in the field by inserting bark of affected tissue into healthy four-year-old Tarocco orange trees and, in a greenhouse, we inoculated ten 18- to 24-month-old seedlings of the following species and cultivars: sour orange, *Citrus volkameriana*, Mexican lime, Orlando tangelo, Troyer citrange, and Rangpur lime. Eight months later four Rangpur lime plants were rebudded above the inoculum with Madam Vinous sweet orange.

Inoculated Tarocco trees observed for 2 years showed no symptoms. Inoculated seedlings showed only symptoms of psorosis and exocortis but no other symptoms

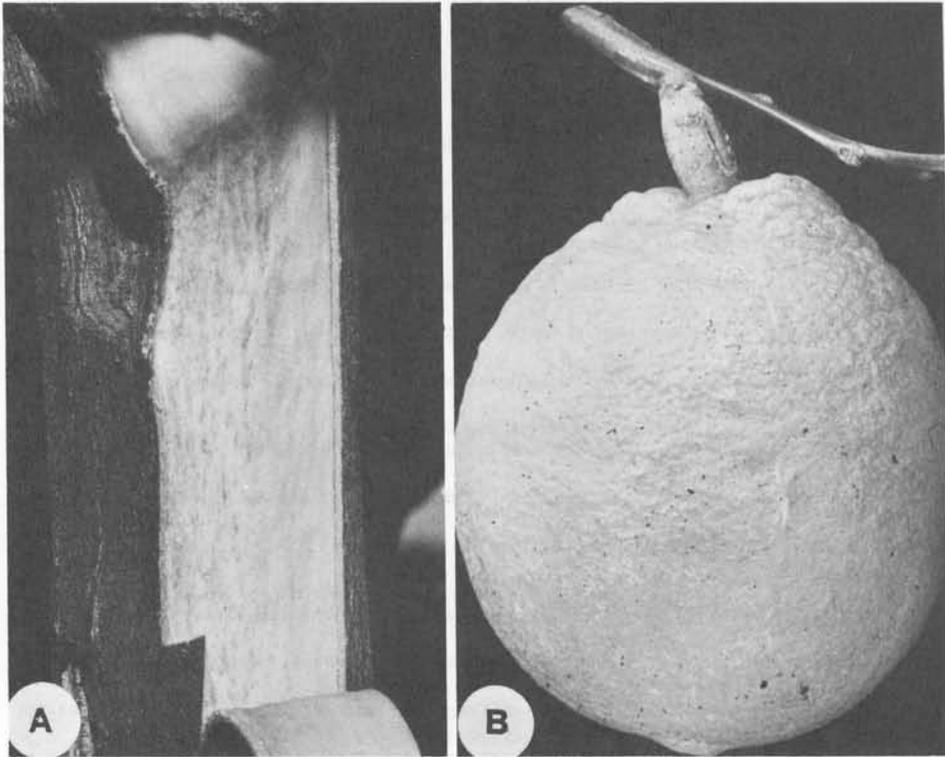


Fig. 2. Graft-incompatibility disorder on Tarocco orange: A) pegs with gum on the wood below the union; B) enlarged peduncle, and rough rind of the fruit.

were found when they were finally cut and peeled to observe the wood.

Buds of a GID tree showing symptoms were propagated on four five-year-old field-grown seedlings each of sour orange, *C. volkameriana*, Mexican lime, Orlando tangelo, and Troyer citrange. After two years none of the bud-propagated trees, including those on sour orange, showed symptoms of the disease.

CONCLUSIONS

The results obtained show that both GBS and GID are not infectious. Brown spot is bud perpetuated whereas the other disorder is restricted to a certain stionic

Culturing young shoots of Madam Vinous on Saglio's medium (Saglio *et al.*, 1971) and thin layer chromatography (Feldman and Hanks, 1969) of albedo and bark extracts of affected trees, gave negative results for stubborn disease.

Our results suggest that GID is due to an incompatibility between an off-type rootstock and scion.

combination of Tarocco orange and sour orange. Observations will be continued on inoculated and budded trees.

LITERATURE CITED

- CARRANTE, V.
1938. La "Fetola" delle arance e dei mandarini. Boll. R. Staz. Sper. Agrum. Frut. Acireale 71: 1-7.
- CATARA, A., and G. CARTIA
1973. Una macchiatura bruna di origine genetica riscontrata su frutti di arancio in Sicilia. Tec. Agr. (Catania) 25: 427-36.
- DAVINO, M., and G. GRANATA
1975. Un deperimento di piante di arancio Tarocco dovuto a disaffinità d'innesto. Tec. Agr. (Catania) (in press).
- DIPPENAAR, B.J.
1957. Concentric ring blotch of citrus: its cause and control. S. Afr. J. Agr. Sci. 1: 83-106.
- FAWCETT, H.S., and H.A. LEE
1926. Citrus diseases and their control. McGraw-Hill Book Co., New York and London. 582 p.
- FELDMAN, A.W., and R.W. HANKS
1969. The occurrence of a gentistic glucoside in the bark and albedo of virus-infected citrus trees. Phytopathology 59: 603-06.
- KITAJIMA, E.W., G.W. MÜLLER, A.S. COSTA, and W. YUKI
1972. Short, rod-like particles associated with citrus leprosis. Virology 50: 254-58.
- KLOTZ, L.J.
1973. Color handbook of citrus diseases. Univ. California, Div. of Agr. Sci., Berkeley, 122 p.
- KNORR, L.C.
1963. Cancroid spot of citrus. Phytopathology 53: 1415-18.
- KNORR, L.C.
1968. Transmission trials with virus-like disease of citrus in Florida, p. 325-31. In W.C. Price, (ed.), Proc. 4th Conf. Intern. Organization Citrus Virol. Univ. Florida Press, Gainesville.
- PETRI, L.
1933. Le alterazioni dei frutti degli arumi. Arti Grafiche Pizzi e Pizio, Milano. 44 p.
- SADIK, I., and P.H. MINGES
1964. Thionin for selective staining of necrosis in plants. Proc. Amer. Soc. Hort. Sci. 84: 661-64.
- SAGLIO, P., D. LaFLÈCHE, C. BONISSOL, and J.M. BOVÉ
1971. Isolement et culture *in vitro* des mycoplasmes associés au "stubborn" des agrumes et leur observation au microscope électronique. C.R. Acad. Sci. Paris 272: 1387-90.