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Further Studies on a Virus-like Gummosis of Bergamot*

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ABSTRACT. The etiology of a gummosis of bergamot, a disease characterized by copious gum exudation from branches, stems and twigs, has been investigated. Limbs which grew from bergamot buds topworked on an Avana mandarin tree affected by concave gum developed concavities. No gumming was seen. Conversely, budsticks of Tarocco sweet orange, Avana and Parsons Special mandarin, and Marsh seedless grapefruit topworked on to the sour orange rootstock of 20-year-old bergamot trees affected by gummosis did not show symptoms of gummosis, psorosis or concave gum. Parsons Special mandarin scions showed a cachexia-xyloporosis reaction. Inoculation and propagation tests were inconclusive because both inoculated and control trees showed pustules in the bark. These and other results strengthen the hypothesis that both inherited components and environmental factors are involved.

Index words. concave gum, Rio Grande gummosis.

In a previous paper (1) we described a gummosis of bergamot on sour orange rootstock. The main features of the disease are a) formation on the bark of pustules or longitudinal cracks 0.5-2.0 cm long; b) cicatricial tissue originating within the bark-lesions and exudation of water-soluble gums from spring to autumn; c) layers of gum pockets in the wood alternating with normal xylem layers; d) no symptom on sour orange rootstock except some gumming in the xylem near the graft union.

The disease has been considered to be concave gum based on oak-leaf symptoms in sour orange seedlings and on its likeness to a gum disease observed on Washington navel sweet orange attributed to concave gum (7, 8). Some results of previous investigations did not support that conclusion (1). Further inoculation and propagation tests were therefore undertaken to further investigate the disease, and to test its relatedness to concave gum.

MATERIALS AND METHODS

Topworking. In May 1977 ber-

gamot buds from a tree without gummosis symptoms were topworked to a tree of Avana mandarin in a field near Catania (Lentini) showing severe symptoms of concave gum, i.e. typical concavities on the trunk and limbs and gum oozing from bark lesions.

In spring 1980 the sour orange rootstocks of twelve 20-year-old bergamot trees showing severe symptoms of gummosis were topworked with budsticks of nucellar Tarocco sweet orange, Marsh grapefruit, and Avana and Parsons Special mandarin. Each tree was topworked with all varieties.

Thousands of trees, topworked with lemon, sweet orange and grapefruit onto the rootstock of healthy and symptomatic trees by growers in different areas, were inspected periodically.

Inoculation. In January 1977, 30 apparently healthy 2-year-old Femminello bergamot trees on sour orange rootstock were transplanted into a field near Catania (Sicily). Two more trees were transplanted into another field 25 miles to the south of the first location. The following spring 18 of the trees in the first field were inoculated with bark of twigs from branches of bergamot trees showing symptoms of gummosis.

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Twenty-one 3-year-old Volkamer lemon seedlings were inoculated with bark patches of affected bergamot trees collected in different areas of Calabria. Three other seedlings were inoculated with bark patches from Avana mandarin affected by concave gum.

Propagation. Buds from affected tree were propagated on four Volkamer lemon seedlings in the same field.

RESULTS AND DISCUSSION

Two years after grafting bergamot buds on Avana mandarin, limbs developed with typical concavities of concave gum, and gum layers in the wood. Gum oozing from the bark also appeared near the graft-union in late spring and summer. This demonstrates that bergamot is susceptible to concave gum *sensu* Fawcett and Bitancourt (3).

Nucellar Tarocco orange, Marsh grapefruit, Avana and Parsons Special mandarins topworked to affected bergamot trees showed no symptoms of concave gum, psorosis A or gummosis in April 1983 by which time they had reached 6 cm in diameter. About 75% of Parsons Special mandarin scions developed a mild gumming and wood pitting reaction, typical of cachexia-xyloporosis.

Lemons scions topworked to the rootstock of bergamot trees showed no symptom after more than four years.

Three Volkamer lemon seedlings inoculated with bark of bergamot showed symptoms of *crustacortis*. The other 18 showed no symptoms. The seedlings inoculated with concave gum showed no symptoms three years later.

These results do not support the hypothesis that bergamot gummosis is a form of concave gum because a) in spite of the susceptibility of bergamot to the agent of the disease, none of the thous-

ands of affected trees examined has shown concavities in the trunk or limb, even when oak leaf symptoms were present; b) none of the 12 trees topworked with susceptible varieties were affected by concave gum since no concavities have been observed on these varieties. Moreover the latter experiment does not suggest any relation with psorosis A since none of the varieties topworked to bergamot showed symptoms in spite of their susceptibility to this disease (6).

Furthermore, the results do not give any evidence for a viral etiology of bergamot gummosis because none of the varieties (sweet orange, mandarin, lemon and grapefruit) topworked to gummosis affected trees have shown symptoms of the disease. Inoculation and propagation trials were inconclusive because both inoculated and control trees showed a gummosis-like reaction.

In the field near Catania, where water stress occurred, gumming appeared in both inoculated and control bergamot trees on sour orange the summer following transplanting. The trees recovered the following year. The trees transplanted in the field near Lentini grew vigorously and have shown no symptoms of gummosis to date (April 1983). Also trees on Volkamer lemon rootstock in the field near Catania, which grew more vigorously than trees on sour orange, have shown no symptoms of gummosis to date.

In conclusion, the lack of known virus-free bergamot made this investigation difficult. Bergamot is a species which reacts with abundant gum to a great variety of stimuli (1). Like other citrus virus or virus-like diseases of bark and wood, symptoms of gummosis *sensu strictu* generally affect trees older than 3-4 years. Symptoms are delayed in vigorously growing trees. Water soluble gums, which exude

from the bark, originate from dissolution of immature young xylem mother-cells and their production is strictly dependent on cambial activity (4, 5).

The above results strengthen

the hypothesis that, like Rio Grande gummosis (2), both genetic or inherited components and environmental factors are involved in determining and conditioning the appearance of gummosis.

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