Symptoms of Stubborn Disease in Florida

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STUBBORN DISEASE of citrus, as now recognized, was first described by Fawcett *et al.* (6). A contemporary paper by Haas *et al.* (7) described acorn disease of citrus as synonymous with stubborn. Previously, Reichert and Perlberger (9) had described a citrus disorder, with stubborn-type symptoms, that they called little leaf disease. Later, when trees with symptoms of both stubborn and little leaf diseases were found, the symptoms were ascribed to xyloporosis disease (10). Xyloporosis was subsequently shown to be a virus disease (4) distinct from and not characterized by little leaf (stubborn) symptoms (5), although both diseases may occur in the same trees. Stubborn disease has been recognized in Arizona (2), Morocco, Algeria, Lebanon, Tunisia, Turkey (3), and other areas.

The symptoms have been described repeatedly and will not be detailed here. However, the transitory nature of certain symptoms, and the effect of environment on symptoms should be noted. Maximum expression of stubborn symptoms occurs under desert conditions of high temperature, low humidity, wide diurnal fluctuation in temperature and humidity, and high moisture tension in the tree. Even under such conditions trees long affected by stubborn disease may not produce characteristically malformed fruits every year. This fact is well recognized.

Stubborn disease has not been reported previously from Florida, although mild or marginal symptoms were observed on numerous occasions. For example, vertically positioned leaves (Fig. 1), small leaves, and long sprouts with short internodes (Fig. 2) have been observed repeatedly. Stylar-end greening of sweet orange [*Citrus sinensis* (L.) Osb.] and of Temple orange (probably a tangor) (Fig. 3) was first observed in Florida in January, 1960, and a study of stylar-end greening (a symptom of stubborn) in relation to fruit quality was reported (8). This study showed that there are major changes in the normal order of tissue ripening of fruits that exhibit stylar-end greening. The total soluble solids in juice from the stylar half of fruits with stylar-end greening was significantly less than that from normal fruits. These results are paralleled by the findings of Bové *et al.* (1) for acorn fruits from stubborn-infected navel orange trees in Morocco. The normal gradient in acid content of the juice from the calyx and stylar halves of fruits was reversed. The results of Bové *et al.* (1) for acorn fruit are parallel. Also, the dif-

FIGURE 1. *Vertically positioned or picket-fence leaves on Satsuma mandarin.*

FIGURE 2. *Long sprout with short internodes on Valencia orange.*

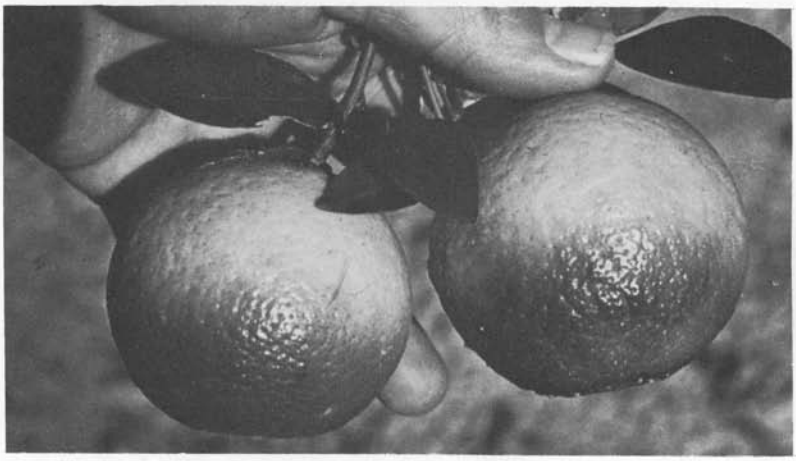

FIGURE 3. *Stylar-end greening of Temple orange fruits.*

ference between the solids-to-acid ratio of the calyx half and that of the stylar half of fruits with stylar-end greening was reversed as compared to normal fruits.

In May, 1961, malformed fruits (Fig. 4) of sweet orange (Valencia var.), typical of stubborn, were first observed in Florida. Also, swollen fruit stems (peduncles), a recognized symptom of stubborn disease in Arizona, were observed on sweet orange (Tresca and other navel orange varieties) trees in Florida (Fig. 5) in January, 1961, following a period of abnormally hot, dry weather. Equally clear-cut symptoms on fruit have not been observed since.

Attempts to transmit stubborn in Florida by budding and grafting in the greenhouse have been unsuccessful so far, possibly because of the

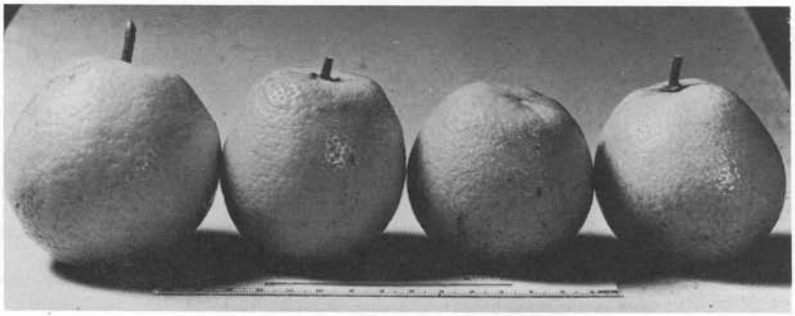

FIGURE 4. *Malformed fruits of Valencia orange.*

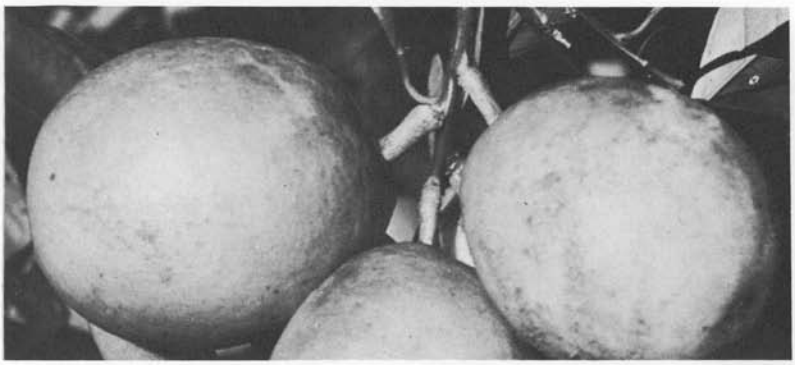

FIGURE 5. *Swollen peduncles on Tresca navel orange.*

normally poor expression of symptoms under Florida conditions. Nevertheless, the symptoms reported here are considered good evidence that stubborn disease exists in Florida, although it appears to present no economic problems to citrus culture.

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