# Citrus Ringspot in Corsica

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Ringspot was first described and named by Wallace and Drake (1968) in California. Symptoms similar to those observed in California (Desjardins *et al.*, 1969) have been reported from Italy (Catara and Grasso, 1968). Spain (Planes and Marti, 1972). Australia (Broadbent, 1972), Texas (Timmer, 1974), Greece (Keramidas, 1975), and Florida (Garnsey, 1975; Garnsey *et al.*, 1976). The disease has now been found in Corsica on greenhouse-grown Parsons Special mandarin budlings graft-inoculated from a symptomless Clementine mandarin field tree.

## MATERIALS AND METHODS

Figure 1 summarizes the various bark inoculations which led to the discovery of ringspot in Corsica. The 30-year-old Clementine tree from which bark was taken to inoculate the Orlando tangelos in 1967 and the Parsons Special mandarins in 1979 had severe symptoms of cristacortis and concave gum, and indexing on Etrog citron 60-13 has shown that it carries a severe strain of exocortis. No bark scaling nor foliar ringspot symptoms have ever been observed on the tree, but flecking and oakleaf patterns on young leaves have been observed each year. Fruit has always been symptomless and normal. As far as we know, the tree is free of cachexia.

For comparison of the Corsican and Greek forms of ringspot, Navelina sweet orange budwood from Poros (Greece), infected with the Greek strain, was used to inoculate Hamlin sweet orange seedlings under screenhouse conditions. Three years later, bark of two of these Hamlin seedlings was used to inoculate Parsons Special mandarins under insect-proof glasshouse conditions. The Navelina sweet orange tree at Poros from which budwood was taken not only showed ringspot symptoms, but also was infected with concave gum, cristacortis, and severe exocortis. The tree was about 30 years old and showed no bark scaling.

## RESULTS AND DISCUSSION

The Biagini Clementine tree No. 13 was initially selected as one of several sources of cristacortis. In 1967, bark from these sources was inoculated into healthy Orlando tangelos on sour orange rootstock. Six inoculated tangelos, planted in the field in 1968, have developed psorosis young leaf symptoms (PYLS), cristacortis stem pitting, and concave gum. In 1978, the six tangelos were each indexed on two Parsons Special mandarins grafted on *Citrus volkameriana* under warm glasshouse conditions (27-34°C) (fig. 1). No cachexia symptoms have been seen on the mandarins, but all developed pronounced ringspot symptoms on the leaves within 1 to 4 months. These symptoms were preceded by quickly disappearing PYLS on immature leaves. The ringspot patterns developed when the leaves had reached full size, but were still tender.

At the same time, the Hamlin sweet orange seedlings infected with the Greek ringspot were also indexed for cachexia on Parsons Special mandarin. These mandarins developed ringspot symptoms similar to those in mandarins inoculated with material from the Corsican tangelos, but symptoms were less pronounced.

Since the tangelos found to carry ringspot had been inoculated in 1967 with bark from the Biagini Clementine tree No. 13, it is likely that the Clementine tree carried ringspot. To verify this, Parsons Special mandarin indicator plants were inoculated from this source and from two of the six initial Orlando tangelos in January 1979. All mandarins developed typical ringspot patterns within 5 to 8 weeks (fig. 1).

Many Parsons Special mandarins

have been used in Corsica for cachexia indexing of numerous trees, some of which were infected with cristacortis and/or concave gum. Only mandarins inoculated from the Biagini Clementine tree, the six Orlando tangelos, or the two Hamlin trees carrying the Greek ringspot showed the ringspot leaf pattern. In other words, these patterns are specific for ringspot, and are not associated with cristacortis and concave gum.

In 1978, the Biagini Clementine tree, the six Orlando tangelos inoculated from the Clementine tree, and two Hamlin sweet orange plants infected with the Greek ringspot were reindexed for exocortis on Etrog citron 60-13. Typical ringspot patterns were observed on the citrons before they died of severe exocortis.

Certain sources of psorosis A induce shock symptoms on sweet orange and Mexican lime seedlings. The shock reaction is defined as the sudden wilting and necrosis of young shoots which develop after inoculation. We have observed these symptoms under warm glasshouse conditions (27-34°C), as well as in the field in summer in Corsica (Vogel and Bové, 1977). None of the Parsons Special mandarins inoculated with the Greek or Corsican ringspot developed shock symptoms. When Mexican lime seedlings known to give a good shock reaction under our conditions were inoculated from the Parsons Special mandarins with either Greek or Corsican ringspot, no shock reaction was observed. However, when Greek or Corsican ringspot was inoculated on Hamlin and Madam Vinous sweet orange seedlings or on Parsons Special mandarin budlings, chlorotic zones appeared on certain shoots followed by cracks in the bark which sometimes showed gumming, especially when the shoots were young. Later, the chlorotic zones become necrotic with a brownish red discoloration. These necrotic zones occasionally enlarged and girdled the shoot, and the part of the shoot above the necrotic ring dried up and died. An identical symptom was observed on some thorns. With Greek and Corsican ringspot, even relatively old shoots one centimeter in diameter can be affected. This symptom is entirely different from the shock reaction. Under our conditions, shock reactions result in the sudden wilt and death of very young shoots, only a few days old, without the formation of a necrotic ring at the base of the shoot.

The necrosis associated with Greek and Corsican ringspot is also different from the bark-scaling symptoms induced on sweet orange or mandarin seedlings by nonlesion bark inoculation of certain sources of psorosis A, such as California source 339, or by psorosis A lesion bark inoculation (psorosis B). In these cases, bark scaling is observed and eventually entire shoots may die. With ringspot we have never observed bark scaling.

Preliminary observations indicate some differences between the Corsican and Greek forms of ringspot. Under field conditions, leaf symptoms of Greek ringspot on sweet orange are pronounced while Corsican ringspot induces no symptoms on Clementine nor on Orlando tangelo. It remains to be seen whether Corsican ringspot symptoms will develop on sweet orange under field conditions, and whether Clementine and Orlando tangelo are also symptomless carriers of Greek ringspot under field conditions. Under warm glasshouse conditions (27-34°C), leaf symptoms of Corsican ringspot are far more pronounced than those of Greek ringspot when compared on Parsons Special mandarins.

Finally, a leaf homogenate from an Etrog citron 60-13 inoculated with Greek ringspot induced chlorotic local lesions when mechanically inoculated on *Chenopodium quinoa.*

## CONCLUSION

Ringspot is present in Corsica and can be carried by Clementine mandarin and Orlando tangelo without showing symptoms. At present, we have no indication that ringspot might be related to psorosis A or psorosis B, that is, the disease experimentally induced by inoculation of psorosis A lesion bark.

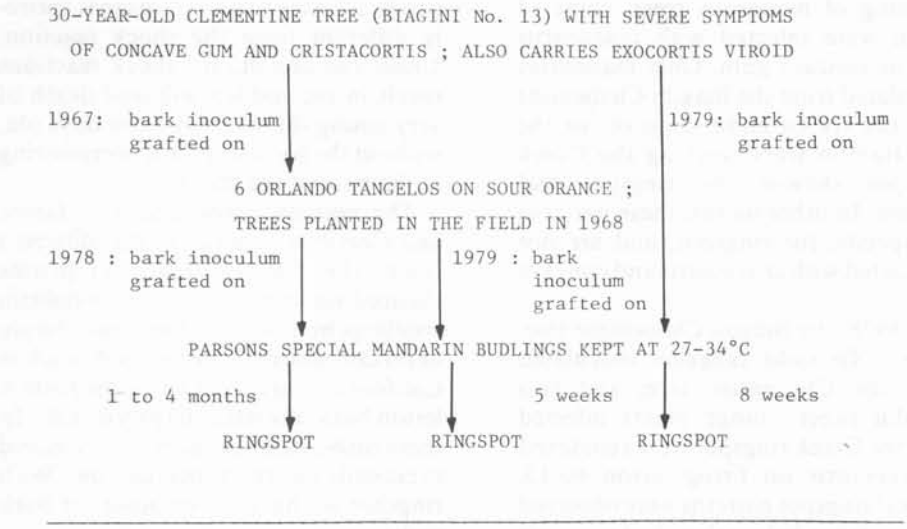


**Fig. 1. Source of inoculum and graft inoculations which led to the discovery of ringspot in Corsica.**

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