

Pollen Transmission to Citrus of the Agent Inducing Cristacortis and Psorosis Young Leaf Symptoms

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The agent(s) inducing psorosis young leaf symptoms and cristacortis was transmitted by placing pollen from affected trees under the bark of healthy Orlando tangelo seedlings (Vogel and Bové, 1976). In the meantime, of the eight source trees from which pollen was collected in 1971, one, known to carry impietratura, showed unexpected symptoms of concave gum, and a second, which had shown only psorosis young leaf symptoms, developed cristacortis and concave gum symptoms. The effect of these findings on the interpretation of the results published earlier (Vogel and Bové, 1976) will be discussed in this paper. Also, results on pollen transmission of cachexia, exocortis, and impietratura which have become available since 1976 will be presented here.

MATERIALS AND METHODS

The following methods have been described previously (Vogel and Bové, 1976): harvest (May 18, 1971) and storage of pollen; inoculation of the Orlando tangelo seedlings by placing pollen under a strip of bark on the cambial surface of the wood and wrapping with plastic tape; and the care of inoculated seedlings in the greenhouse and in the field. The eight source trees and the nature of the causal agents which they contain are listed in table I. Two source trees deserve special mention. The Hamlin sweet orange in experiment D was inoculated with California psorosis 340, known to carry a mild strain of cristacortis and to induce shock symptoms (Vogel and Bové, 1977), and with California concave gum 158-62, which also carries exocortis viroid. The Marsh grapefruit tree in

experiment F inoculated with Corsican impietratura Biagini No. 3 is also infected with mild concave gum.

RESULTS

Cachexia (table I, experiment A) was not transmitted, as indicated by the absence of symptoms on the six inoculated tangelos and by the negative results of indexing these tangelos on Parsons Special mandarin. Exocortis viroid was present in the source trees in experiments B, C, D, and G. None of the 24 Orlando tangelos inoculated with pollen from these sources carried exocortis viroid, as shown by indexing on Etrog citron 60-13. Crinkly leaf virus was not transmitted (experiment E), as indicated by the absence of psorosis young leaf symptoms and crinkly leaf symptoms on the inoculated tangelos under conditions where graft inoculation of Orlando tangelos would induce such symptoms. In experiment F, none of the tangelos showed impietratura fruit symptoms, and indexing on grapefruit trees was negative. Five of the six Orlando tangelos inoculated with pollen from the Orlando tangelo source tree (experiment B) showed typical cristacortis stem pitting and psorosis young leaf symptoms (oak leaf and flecking). Transmission of psorosis young leaf symptoms was also obtained in experiments C, D, and F. In experiment C, symptoms are probably due to the transmission of the concave gum agent, although no concave gum symptoms have been seen as yet.

DISCUSSION

The five Orlando tangelo seedlings that show cristacortis stem pitting (experiment B) as a result of pollen

TABLE 1
 INOCULATION OF ORLANDO TANGELO SEEDLINGS WITH POLLEN FROM VARIOUS SOURCES

Exp. No.	Variety and species	Source of pollen		Number showing symptoms/ number inoculated	
		Causal agent(s) present	Strain	Psorosis young leaf symptoms	Other symptoms
A	Marsh grapefruit	Cachexia	California 114	0/6	0/6
B	Orlando tangelo	Cristacortis Concave gum Exocortis	Corse 8C4	5/6	5/6: cristacortis stem pitting
C	Parson Brown sweet orange	Concave gum Exocortis	California 158-62	6/6	0/6
D	Hamlin sweet orange	"Psorosis" Concave gum Cristacortis Exocortis	California 340 and California 158-62	6/6	0/6
E	Mexican lime	Crinkly leaf	California 81-A-65	0/6	0/6
F	Marsh grapefruit	Impietratura Concave gum	Corse Biagini No. 3	1/6	0/6
G	Eureka lemon	Exocortis	California No. 3 (severe)	0/6	0/6
H	Orlando tangelo	none	—	0/6	0/6

inoculation also show psorosis young leaf symptoms. These symptoms could be due to cristacortis, since we have shown that cristacortis sources free of concave gum-blind pocket, psorosis A, infectious variegation-crinkly leaf, and impietratura induce psorosis young leaf symptoms (Vogel and Bové, 1974). They could also be caused by concave gum, since in experiment C the psorosis young leaf symptoms on the tangelos provide evidence for the transmission of concave gum. However, no trunk symptoms of concave gum have been observed in experiments B, C, D, or F, where the concave gum agent was present in the source trees.

In experiment D, it is difficult to associate the psorosis young leaf symptoms obtained on all six inoculated tangelos with "psorosis 340", concave gum, or cristacortis, because no symptoms other than those on young leaves have been observed on the tangelos.

In experiment F, the leaf symptoms on one of the tangelos are probably due to concave gum, and not to impietratura as thought previously (Vogel and Bové, 1976); no evidence of impietratura transmission was obtained, whereas concave gum was transmitted in other experiments. The other possibility is that psorosis young leaf symptoms are due to an agent independent of cristacortis, concave gum, etc., and that this agent is readily transmitted by pollen.

In the transmission experiments, the flowers were collected from source trees

while the petals were still closed, and were kept for 7 days at 4°C before pollen was collected, during which time the flowers opened and the stamens and anthers dried. After removing the petals, pollen was obtained by shaking the open flowers over a petri dish. No live tissue was present among the pollen grain clusters. In the absence of any living tissue other than the pollen grains, positive transmission implies that pollen germination had taken place between bark and wood. In experiments B, C, and D where a high percentage of transmission was obtained, the pollen came from source trees such as tangelos and seedy sweet oranges known to have a high average percentage of viable pollen (Soost, 1963). In experiment F, where only one out of six tangelos showed symptoms, the source tree was Marsh grapefruit, which has a low percentage of viable pollen. Pollen viability, however, is not the only factor involved in pollen transmission. In a recent experiment, no transmission of cachexia to Parsons Special mandarin or of exocortis to Etrog citron 60-13 was obtained, even though the pollen was collected on Clementine trees known to have a high percentage of viable pollen.

No natural transmission of cristacortis has ever been noted, in spite of numerous noninoculated control trees, including Orlando tangelos, dispersed within the many cristacortis-infected trees in a number of field experiments.

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