Wood Pitting—Gum Pocket—Gummy Pitting of Trifoliate Orange: Considerations About Their Etiology

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ABSTRACT. The terms "gum pocket", "wood pitting" and "gummy pitting" have been used to describe a characteristic disorder of trifoliate orange. Affected trees show gum pockets, which develop only in the bark and wood of the trifoliate orange rootstock, but the etiology remains unclear. Viroid-infected Clementine trees grafted on trifoliate orange were monitored for the presence of symptoms that were identified in all the viroid-infected treatments as well as in some uninoculated controls. These observations suggest that these symptoms may be of physiological or stress origin and that viroid infection may act simply by enhancing its development.

The terms "wood pitting", "gum pocket", and "gummy pitting" have been used to describe a characteristic disorder of trifoliate orange. Wood pitting was the name given in Argentina to a cachexia-like disorder characterized by "the presence of wood indentations with gum deposits accumulating both in the xylem and the bark at the site of the pit" in trees grafted on trifoliate orange rootstock (5). These symptoms were usually found associated with the "bud-union crease" and "laminate shelling" disorders of unknown origin, and were shown to be unrelated to cachexia (6). Gum pocket was described in South Africa as "a new disease characterized by gum pockets and malformation of the trunks in trifoliate orange rootstocks under sweet orange scions" (14). The disease was mainly found in commercial orchards of Palmer Navel and Olinda Valencia located in the Transvaal region with 70-80% incidence and the symptoms were defined as similar to those of wood pitting found Argentina. Gummy pitting was described as "development of gum-impregnated pits in the surface of the wood of the stock, associated with gumming in xylem and phloem", and initially appeared associated with bud-transmissible dwarfing factors assays conducted on trees grafted on trifoliate orange (7). Similar symptoms have also been observed in Italy (3), Turkey (1) and Chile (Besoain, pers. comm.).

The symptoms of wood pitting, gum pocket, and gummy pitting of trifoliate orange, are similar to those of cachexia in Orlando tangelo (4), xyloporosis of Palestine sweet lime (13), gummy bark of sweet orange (10), and Kasala disease of grapefruit (2), but the etiology of these disorders has only been demonstrated for cachexia and xyloporosis which are caused by the same viroid agent (11, 12). The observation that gum pocket described in South Africa was found on trees that had been graft-inoculated with a common source of a mild protecting isolate of *Citrus tristeza virus* (CTV) was considered as an indirect evidence indicating that the causal agent of gum pocket was graft transmissible agent probably present in the original source as CTV (14). Similarly, since the gummy pitting disorder described in Australia was consistently seen in field trials conducted to evaluate the potential of graft-transmissible dwarfing factors, this was considered as an additional evidence for its graft–transmissibility. Since dwarfing factors are now known to be associated with the infection of specific viroids or viroid combinations (8), a viroid etiology was taken into consideration (9). This working hypothesis was consistent with earlier observations indi-

TABLE 1
GUM DEPOSITS OBSERVED ON VIROID-INOCULATED CLEMENTINE TREES GRAFTED ON TRIFOLIATE ORANGE

Viroid	Gum deposits[z]		Rootstock/scion[y]
	Clementine	Trifoliate orange	
CEVd	0/12	2/12	1.50
CVd-I	0/5	5/10	1.43
CVd-II (non cachexia)	0/5	1/5	1.34
CVd-II (cachexia)	11/11	0/11	1.41
CVd-III	0/24	11/24	1.57
CVd-IV	0/6	1/6	1.34
Uninoculated	0/5	1/5	1.34

[z]Number of trees showing gum deposits over total number of trees.
[y]Rootstock perimeter/scion perimeter.

cating that the severity of the symptoms varied with locality, scion variety, and dwarfing strain (7).

The first transmission assays were conducted with a gum pocket source from South Africa and the results showed evidences indicating an association of the disease with a viroid-like RNA with the electrophoretic mobility of CVd-III (9), but since the viroid-like RNA has not fully characterized the Koch's postulates cannot be considered as satisfactorily fulfilled. In a separate trial on the use of viroids as dwarfing agents, gum pocket symptoms were found in trifoliate orange rootstock of trees inoculated with an uncharacterized viroid source containing a viroid with the electrophoretic mobility of CVd-III (15).

Field trials were established to determine the effect of different citrus viroids on Clementine trees grafted on trifoliate orange (16). Ten years after inoculation, the trees were monitored to evaluate the presence of gum deposits and malforma-

Fig. 1. Symptoms observed in the trifoliate orange rootstock.

tions in the bud union region. Gum deposits in the Clementine scion were observed in all the plants inoculated with cachexia sources of CVd-II (Table 1). Trees showing gum deposits in the trifoliate orange rootstock were, however, identified in all the viroid-infected treatments and uninoculated controls (Table 1). Symptoms were more frequently observed (50% and 46%) on trees infected with CVd-I and CVd-III respectively, than in the other treatments. The symptoms appeared to be associated with trees showing a prominent shouldered stock overgrowth. No symptoms were observed on seedlings of trifoliate orange trial infected with the same viroid sources which were conducted in a different location.

The symptoms observed (Fig. 1) in these field trials consist of pits and indentations with gum deposits similar to those described as terms wood pitting, gum pocket, and gummy pitting. These observations suggest that the symptoms observed in this particular field trial are not caused by viroids but that viroid infection may act simply by enhancing its development. A physiological or stress origin of the symptoms must be entertained until further research provides conclusive results.

LITERATURE CITED

1. Azeri, T.
1985. Gummy pitting, a destructive virus disease of *Poncirus trifoliata* rootstock in Izmir province of Turkey. J. Turk. Phytopathol. 14: 45-52.
2. Bové, J. M.
1995. Virus and Virus-like Diseases of Citrus in the Near East Region. FAO, Rome. 518 pp.
3. Cartia, G., R. La Rosa, and A. Catara
1984. A gummy pitting of trifoliate orange in Italy. In: *Proc. 9th Conf. IOCV*, 184-187. IOCV, Riverside, CA.
4. Childs, J. F. L.
1950. The cachexia disease of Orlando tangelo. Plant Dis. Rept. 34: 295-298.
5. Fernández-Valiela, M. V., C. Fortugno, and F. Corizzi
1965. Incidence of bud-union crease in citrus trees grafted on trifoliata rootstock in the Delta del Paraná and San Pedro areas of Argentina, pp. 182-186. In: *Proc. 3rd Conf. IOCV*, 182-186. Univ. Fla. Press, Gainesville.
6. Foguet, J. L. and C. A. Oste
1968. Disorders of trifoliate orange rootstock in Tucumán, Argentina, p. 183-189. In: *Proc. 4th Conf. IOCV*, 183-189. Univ. Fla. Press, Gainesville.
7. Fraser, L. R., P. Broadbent, and J. E. Cox
1976. Gummy pitting of *Poncirus trifoliata*: Its association with dwarfing of citrus in New South Wales. In: *Proc. 7th Conf IOCV*, 147-151. IOCV, Riverside, CA.
8. Hutton, R. J., P. Broadbent, and K. B. Bevington
2000. Viroid dwarfing for high density citrus plantings. Hort. Rev. 24: 277-317.
9. Marais, L. J., R. F. Lee, J. H. J. Breytenbach, B. Q. Manicom, and S. P. van Vuuren
1996. Association of a viroid with gum pocket disease of trifoliate orange. In*: Proc. 13th Conf IOCV*, 236-244. IOCV, Riverside, CA.
10. Nour-Eldin, F.
1956. Phloem discoloration of sweet orange. Phytopathology 46:238-239.
11. Reanwarakorn, K. and J. S. Semancik
1998. Regulation of pathogenicity in hop stunt viroid-related group II. J. Gen. Virol. 79: 3163-3171.
12. Reanwarakorn, K. and J. S. Semancik
1999. Correlation of hop stunt viroid variants to cachexia and xyloporosis diseases of citrus. Phytopathology 89: 568-574.
13. Reichert, I. and P. Perlberger
1934. Xyloporosis, a new citrus disease. Hadar 7: 163-167, 172, 193-202.
14. Schwarz, R. E. and A. P. D. McClean
1969. Gum-pocket, a new virus-like disease of *Poncirus trifoliata*. Plant Dis Rept. 53: 336-339.
15. van Vuuren, S. P. and J. V. da Graça
1996. Response of Valencia trees on different rootstocks to two citrus viroid isolates. Proc. Int. Soc. Citricult. 2: 705-710.
16. Vernière, C., L. Botella, A. Dubois, C. Chabrier, and N. Duran-Vila
2002. Properties of citrus viroids: Symptom expression and dwarfing. In: *Proc. 15th Conf. IOCV*, 240-248. IOCV, Riverside, CA.