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### Authors

Fernández Valiela, M. V.  
Fortugno, C.  
Corizzi, F.

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M. V. FERNÁNDEZ VALIELA, C. FORTUGNO,  
and F. CORIZZI

***Incidence of Bud-Union Crease in Citrus Trees  
Grafted on Trifoliata Rootstock in the Delta  
del Paraná and San Pedro Areas of Argentina***

**T**HE TRIFOLIATE ORANGE [*Poncirus trifoliata* (L.) Raf.] as rootstock is used exclusively in the Delta del Paraná and San Pedro areas, near Buenos Aires, where about two million plants are growing. It provides to the different citrus varieties grafted on it, when they are apparently virus-free, resistance to brown rot gummosis, good cold tolerance, good quality of fruit, and resistance to the humid condition of the flooded soils in the Delta del Paraná. The main difficulty in achieving good and vigorous plantations is due to exocortis and another virus-like disease called stunting-without-scaling, similar to the disease reported by Fraser *et al.* (1) in Australia.

Recently, trees were observed with an indented ring in the surface of the wood at the bud-union and a dotted or continuous line or orange-yellow discoloration on the inner bark surface (Fig. 1). This indented ring seems to be a symptom of a serious problem and is referred to here as bud-union crease. The purpose of this paper is to report on the present state of knowledge of bud-union crease in Argentina.

Exocortis and stunting-without-scaling affect 18 per cent and 26 per cent, respectively, of the citrus plants in the Delta del Paraná and San Pedro areas. Bud-union crease was observed in higher percentages, chiefly on mature trees more than 20 years old of some sweet orange [*Citrus sinensis* (L.) Osbeck] varieties. This symptom was seen also in 6- to 8-year-old plants. It occurs also in trees that are stunted without

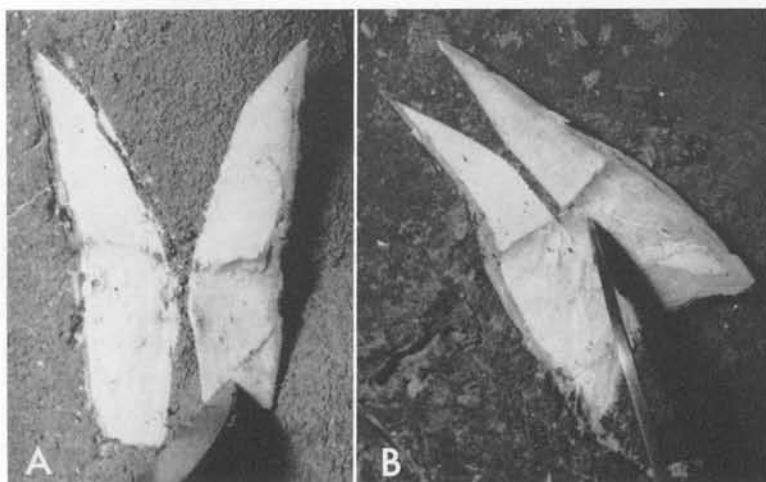


FIGURE 1. A. Indented ring at the bud-union in common mandarin. B. In a strain of Washington Navel orange. Both budded on trifoliate orange rootstock.

scaling and in trees affected by exocortis. It is similar to the condition reported from other parts of the world (1, 2, 5, 7, 10, 11, 13).

### *Symptoms*

The leaves of plants affected by bud-union crease have a pale yellow color as though suffering from a nutrient deficiency. The trees are deteriorated with poor growth flushes. They blossom heavily but bear less fruit than normal trees. In severely affected trees, a groove may be seen in the bark at the bud union. Sometimes one side of the trifoliate orange rootstock is flattened. Bark strips removed from across the bud-union have gum-impregnated projections on the cambial face, and these fit into the crease in the wood. The length of these projections varies from 3 to 10 mm. Brown gummy deposits may be seen commonly in the middle of the bark. The symptoms described above are very similar to those reported by several workers (2, 12, 13, 14, 17, 19) on rough lemon (*C. jambhiri* Lushington) and trifoliate orange.

Sometimes plants were found with abnormalities on the trifoliate rootstock (Fig. 2) similar to those that xyloporosis virus produces on sweet lime (*C. limettioides* Tanaka) rootstock. Xyloporosis-like symptoms without bud-union abnormalities were seen also on trifoliate rootstock with mandarin (*Citrus reticulata* Blanco) tops.



FIGURE 2. *Bud-union crease and xyloporosis-like wood pitting on trifoliate orange rootstock with Washington Navel orange top.*

### *Field Observations*

The survey included only the citrus-producing area of San Pedro because of the irregular and small groves in the Delta del Paraná. In San Pedro, 300 farms were chosen at random to form a representative sample. One plant in 10 in each row in each farm was examined for bud-union abnormalities. The number of plants in the farms varied from 250 to 600.

About 80 per cent of the plants of Washington Navel orange, more than 25 years old, were moderately or severely affected by bud-union crease. A much lower percentage of younger plants was affected. The disease, however, occurred in trees 6-8 years old as well as in older trees.

Not only was the indented ring at the surface of the bud-union found in declining trees, but it was also seen fairly frequently in good thriving trees.

The ring seemed to be more pronounced, with pegs and orange-yellow discoloration and with corresponding projecting ridges, in the

area of the flatted sector of the rootstock than in the more rounded sector and a dotted more or less continuous line was seen in the other sector of the bud-union.

The percentage of bud-union abnormalities was very low in the sweet orange locally called naranjo criollo when budded on trifoliolate orange rootstock; even in aged plants, the incidence was less than 12 per cent. The indented ring was not found in Valencia or Lue-Gim-Gong orange, notwithstanding the greater number of old plants of these varieties that were examined. These varieties were not showing decline or other symptoms of disease. This abnormality was never found on grapefruit (*C. paradisi* Macf.) budded on trifoliolate orange rootstocks. An indented ring was found in only two plants of lemon [*C. limon* (L.) Burm. f.] of the variety locally called four seasons, possibly Eureka lemon.

### *Discussion*

Many suggestions about the probable cause of bud-union crease have been made. Some authors (3, 4) suggest that a virus is the cause. A possible relationship with xyloporosis virus or with exocortis virus has also been proposed (2, 3, 5). A true incompatibility inherited genetically has also been presented as possible explanation (3, 11, 12, 13).

If the virus hypothesis is accepted, then we have no satisfactory explanation for certain facts. For example, we found some Washington Navel orange trees older than 30 years with bud-union abnormalities to be declining and other trees of the same age apparently healthy and thriving well. We found that all trees of Valencia and Lue-Gim-Gong inspected, even very old trees, were vigorous without symptoms at the bud-union and in good growing conditions. We found no symptoms at all on grapefruit on trifoliolate orange rootstock. From these findings we think that if one virus were the cause it should be bud-transmissible only.

Further difficulties in accepting the hypothesis of a bud-transmissible virus are the results of research in other parts of the world; specifically, that the same abnormality occurs in nucellar lines that are presumably virus-free (9). If we assume that a vector exists, then it is possible that all apparently healthy trees are indeed infected carrying the virus in a masked form.

The same difficulties are found in the incompatibility hypothesis, unless we accept the possibility that there are different degrees of congeniality between some strains of Washington Navel orange and different forms of trifoliolate orange rootstock.

## PROCEEDINGS of the IOCV

Because of the widespread dissemination of this bud-union abnormality in the most common variety grown in Delta del Paraná and San Pedro areas, the Washington Navel orange, we emphasize the need to carry out research on this problem and to call it to the attention of the nurseries in order to avoid using buds from the diseased plants.

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