

Freeze Injury to Fruit Spurs of the Apple¹

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Abstract. Fruit spurs of apple trees on which the pedicels remained after harvest were injured by winter freeze, as illustrated by photomicrographs and by gross morphology. The fruiting spurs from which the pedicel had abscised contained a normal periderm. In the samples where the pedicel remained, extreme damage to the xylem tissue was evident.

The adverse climatic conditions so detrimental to deciduous fruit crops have increasingly become a limiting factor in production throughout many areas of the country. Recent reviews concerning some aspects of this problem have been presented (2, 3, 4, 5, 6). However, no reports have been found pertaining to the specific injury of localized tissues as a result of the fruit pedicel remaining on the spur after harvest.

A freeze which occurred November 23 (17°F), 24 (10°), and 25 (19°), 1970 throughout the fruit producing areas of southern Illinois caused injury to the distal portion of fruit spurs (1969-70 growth) at the point where the fruit pedicel had been separated from the apple and remained on the spur after the current harvest season. In all cases no injury was apparent in buds from current season shoots, fruiting spurs for 1971, and where the apple had naturally abscised. The freeze took place 2 weeks after leaf fall. No freezing temperatures were recorded prior to these dates. The remaining minimum November temperatures were recorded in the 35° to 52° range. Maximum temperature during this same period was 68°. A temperature rise to 60° after the last day in which 19° was recorded indicates the extreme fluctuations of temperature during this period.

Tissue sectioning of the fresh plant material for Figs. 5 and 6 was accomplished by using a freezing microtome "Cryostat." The material was quick frozen at 14°F and sectioned 20 μ thickness.

Cultivars 'Starkrimson' and 'Royal Red Delicious' had many pedicels remaining on the fruiting spurs after harvest. These are illustrated for 'Royal Red Delicious' in Fig. 1-6. The fruit buds of 'Jonared' and 'Golden Delicious' were uninjured as the fruit pedicel remained on the fruit at harvest. In isolated instances where the pedicel was on the fruit spur, no injury was evident for these cultivars. 'Golden Delicious' and 'Jonared' did not have hypertrophied growth at the pedicel base. This might indicate cultivar

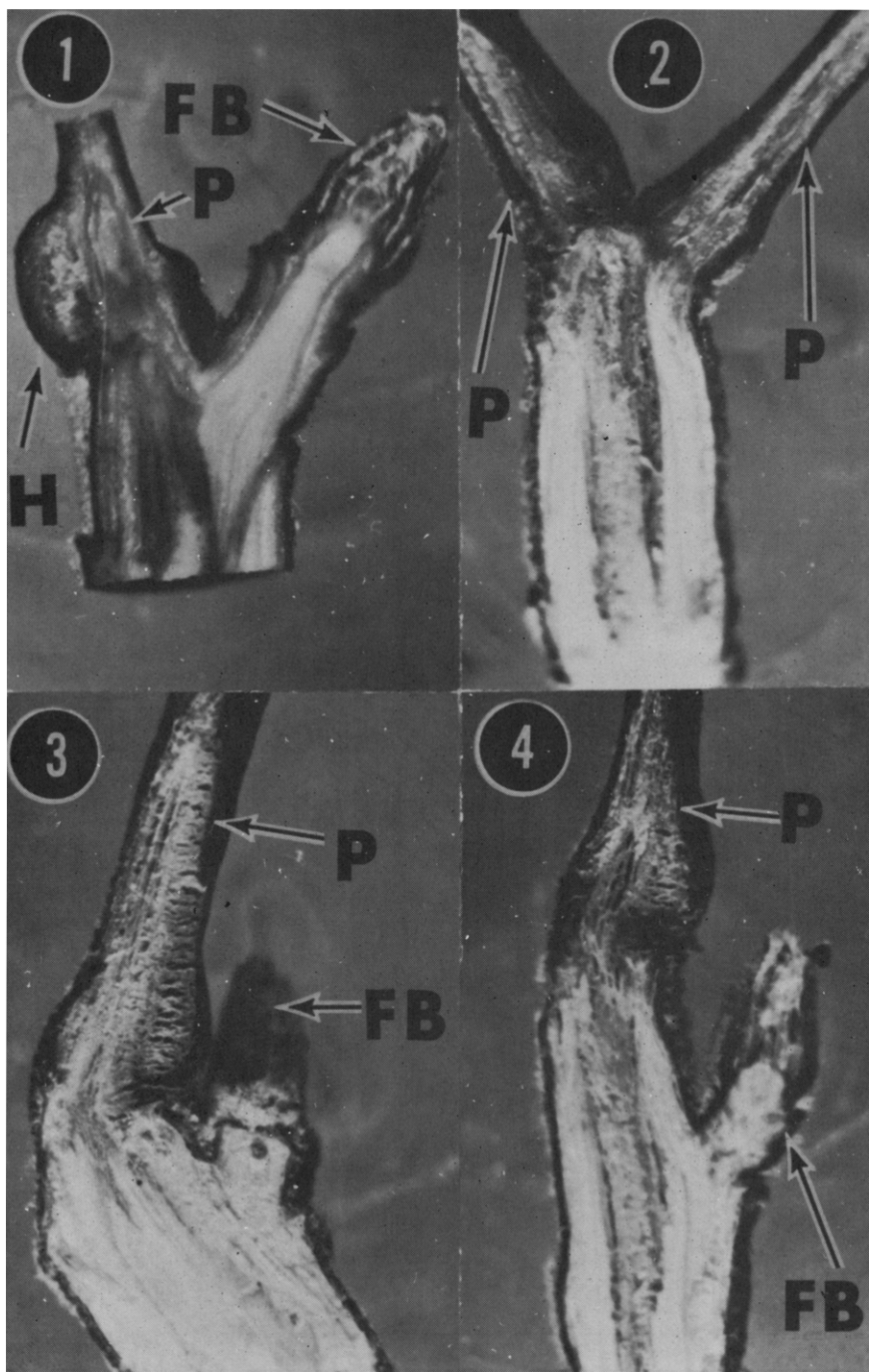


Fig. 1-4. Longitudinal sections through the fruit spur of 'Royal Red Delicious' showing injury persisting from fruit pedicel to the spur. FB = Fruit Bud; P = Pedicel.

variability in which the ease of pedicel separation from the fruit is accomplished.

The fruit pedicel of 'Royal Red Delicious' had not completely abscised, and hypertrophied growth (H) consisting of parenchyma cells was evident on the enlarged side of the pedicel, as indicated in Fig. 1 and 5.

Approx 70% of the samples observed had this characteristic type of enlarged pedicel base. Immaturity of these tissues produced a localized damage originating from the pedicel base and appeared to be translocated to the adjacent conducting tissues of the fruit spur. It was located in the distal or apical portions of the spur which was

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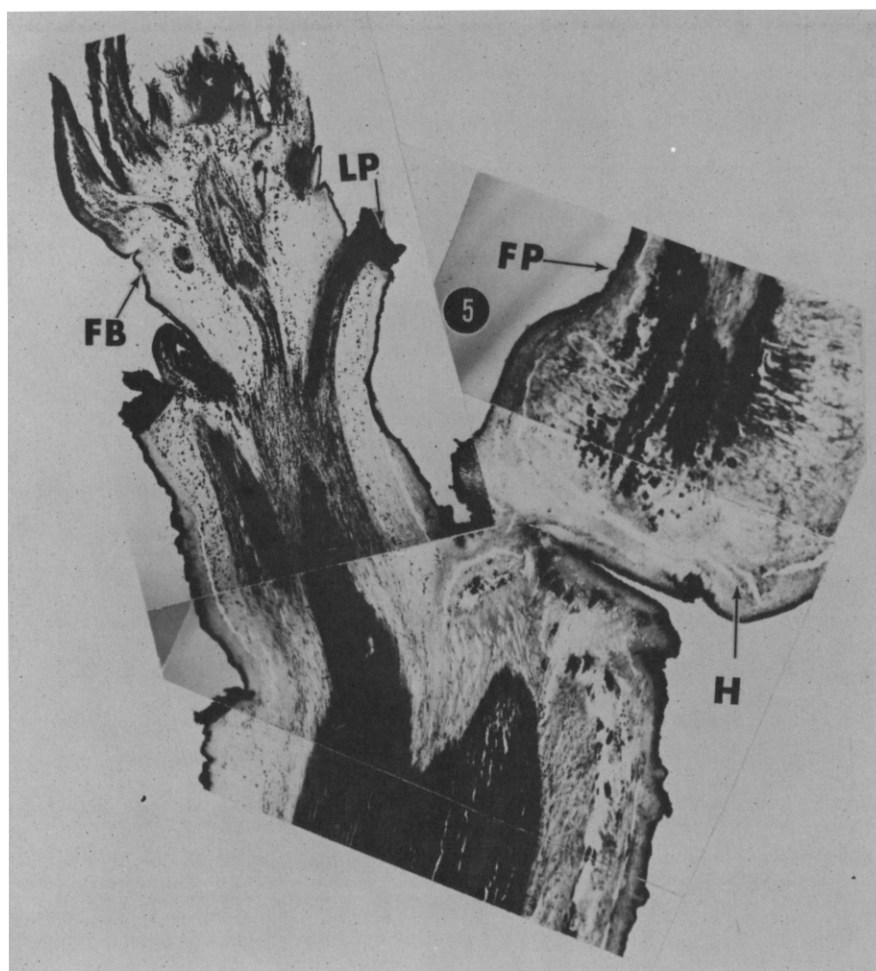


Fig. 5. A longitudinal section through the pedicel base and adjacent fruit bud showing extensive damage to the xylem tissues. Note uninjured tissues in the meristematic region of the fruit bud. FB = fruit bud; FP = pedicel; LP = periderm of leaf pedicel abscission. X 12.8.

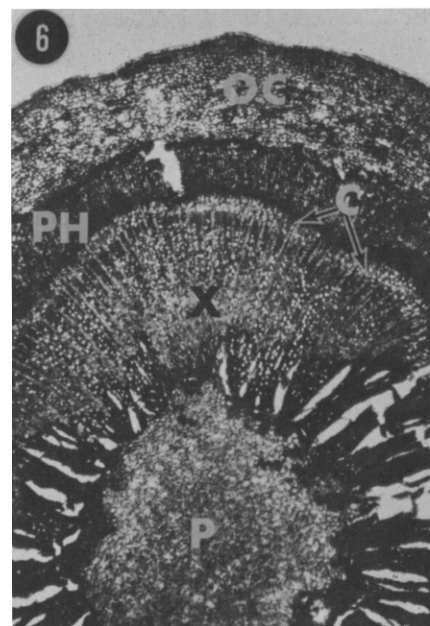


Fig. 6. A cross-section through the base of the fruiting spur showing extensive damage to the xylem protoxylem tissue. The tissue break in the phloem is an artifact. P = pith; X = xylem; C = cambium; Ph = phloem; OC = outer cortex. X 12.8.

"Thanksgiving day" freeze of 1950, (1) in which the dark-brown meristematic tissue changed color to a yellowish-brown when growth resumed.

These conditions, where conducting tissue of the fruiting spurs has been injured, will produce weak fruit bud development during the subsequent fruiting year. Consequently, pre-conditioning the tree by a change in orchard cultural management practices will need to be considered including the fertilizer, pruning, and irrigation program. Cultivars of apples where the pedicel easily remains with the fruit as it is harvested should not be affected by the illustrated freeze injury to fruit spurs. Extremely careful harvesting is suggested for those cultivars in which the pedicel may tend to remain on the spur.

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differentiated in 1969 to produce fruit for 1970. The injured tissues were dark brown.

The leaf and fruit buds were uninjured and the tissues were yellow-green. These areas had no apparent injury, as indicated by arrows to (FB) in Fig. 1, 3, 4 and 5. In all cases observed, the terminal buds of the current season shoots were never injured. Areas where the fruit pedicel had been excised from the spur developed periderm tissue and were devoid of any wood injury. This was also true where the leaf pedicel had abscised. These observations were made on 200 fruit, leaf and terminal buds from random sampling throughout the orchard.

The fruit pedicel remaining on the spur had approximately 1/4 of the connective tissue remaining intact in 70% of the sampled fruit spurs (Fig. 5). Callus tissue formed on both sides of the abscission zone in limited amounts as it progressively developed across the fruit pedicel at the spur base.

Specific areas of tissue injury

included the protoxylem which surrounded the pith, Fig. 6. In the most severe cases, some injury was apparent throughout the external area of the pith tissues. Some parts of the xylem were injured externally towards the line of cambial development, as contrasted to limited injury near the pith in other parts of the fruit spur. Tissues near the axillary leaf or fruit bud were not injured. The thick, well-developed protoxylem cells were more sensitive to this damage than the last formed xylem cells containing thin cell walls which developed near the cambium.

Some injury to cells in the cambial region appeared to be extensive on the distal side away from the live, developing uninjured bud, with slight injury appearing in other areas of the spur. The cambial tissues adjacent to the buds were uninjured. In the most extreme cases, some injury occurred in the phloem-ray cells. The tissues in this area will probably grow, and the yellow-brown areas will resume growth in the spring. A more extreme case, but similar, was noted as a result of the