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Pith Browning of Pear Buds – A Natural Mechanism for Freeze Protection

Many Bartlett, and Bosc buds from the upper Hood River Valley were observed to have browning in the pith following the hard freeze on the morning of February 26. No other visible injury to individual flowers within the buds or to the vascular (phloem and xylem) tissue connecting the buds was apparent. This pith damage is an adaptive mechanism which serves to protect growing points during freeze events. A brief explanation follows.

When temperatures fall below freezing, water outside of and between cells (extracellular water) freezes to form ice. This is not damaging. When extra-cellular water freezes, liquid water is drawn from inside the cells to the ice formed outside the cells. This occurs because a vapor pressure gradient develops between the liquid water and the ice, driving the movement of the liquid water to the ice. As the ice mass grows, the cell's freeze point is depressed because there is less water in the cell and a higher internal solute concentration. This protects the cell from freezing in much the same way that antifreeze protects engines from freezing.



The center portion of one-year old stems is termed the pith. Piths are comprised of living cells and large intercellular spaces (canals to aid in gas exchange in the stem). An increase in intercellular spaces in the pith occurs as the stem ages. It is likely that this area serves as a reservoir for ice (the browning is indicative that it froze), and the specific location of the zone of damage below the bud suggests that it served as a repository for water moving out of the buds and vascular tissue surrounding it.

Freeze injury is not observed elsewhere in the shoot or bud. With visible damage limited to pith, it seems likely that injury to the flower buds and vascular tissues was avoided with low likelihood that crop potential has been reduced. This protective mechanism is not absolute. If the temperature falls low enough, damage to flowers within the bud or the vascular tissues will result through freezing or dehydration. This damage would be apparent in those tissues.

The photos at left show longitudinal (lengthwise) sections of two Bartlett pear buds with pith browning but no other damage.