MEASURING SAP FLOW THROUGH SMALL DIAMETER STEMS

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Most techniques for measuring xylem sap flow involve the use of heat as a tracer, and the insertion of linear probes radially into the secondary xylem. The disruption caused means probe based techniques can generally only be used with stems larger than approximately 10 mm in diameter. For smaller diameter stems, constant power heat balance gauges are available, but they can be difficult and expensive to use, and may not resolve very small flows. As part of our studies of kiwifruit fruit development we need to better understand factors affecting the movement of water and solutes into and out of the fruit via the pedicel. There are also many other potential applications for measurement of sap flow through small diameter stems and roots. We therefore set out to develop gauges capable of measuring sap flow in both directions through stems as small as 1 mm in diameter. We describe a modification of the 'heat ratio' heat pulse technique. Instead of probes as heating and sensing elements, a chip resistor is used as a miniature heater, and both the heater and temperature sensing thermocouples are pressed against the surface of the stem. For calibration, excised *Actinidia deliciosa* fruit pedicels were connected to a pressurized water supply and actual flow measured gravimetrically. Heat pulse velocity measured using the gauge was linearly related to actual sap flow in both the acropetal and basipetal directions. On intact fruit pedicels the gauges were used to measure sap flow into *Actinidia* fruit from shoot, and from the fruit to the shoot when the shoot was allowed to dehydrate. Development of the technique is continuing with further calibration and modelling of the propagation of the heat pulse through the bark, phloem and xylem.