

# LEAF COOLING CURVES:

Measuring leaf temperature in sunlight.

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In spite of the obvious benefits of using thermography under field conditions, most infrared studies at the leaf level are generally conducted in the laboratory.

One reason for this bias is that accuracy can potentially be compromised in sunlight because reflected radiation from the leaf might affect the calculation of the temperature measurement. We have developed a method for measuring leaf temperature in sunlight by using thermal imagery to generate cooling curves from which the time constant for cooling,  $\tau$ , can be calculated. The original temperature of the sunlit leaf may be determined by extrapolating backwards in time.

In the absence of specular reflection, there is close agreement between the extrapolated sunlit temperature and the sunlit temperature recorded by the camera. However, when reflected radiation is high, the difference between the initial (incorrect) temperature determined from the sunlit image and the temperature extrapolated from the cooling curve can be  $> 2^{\circ}\text{C}$ . Notably, our results demonstrate a close agreement between the extrapolated sunlit temperature and the temperature of the leaf approximately one second after being shaded, suggesting that this shaded image provides a good estimate of the original sunlit temperature. Thus, our technique provides two means for measuring leaf surface temperature in sunlight.