Temperature kinetics of whole canopy and sweet cherry clusters by means of 4D point clouds

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Abstract

Climate change has had an increasing impact on fruit safety and quality along the supply chain. Moreover, due to marked heat waves, several fruit damages such as sunburn at the fruit skin can cause food losses in orchards. Likewise, unexpected summer rains are commonly associated to trigger fruit cracking, due to a sudden osmotic difference between the fruit surface and its inner matrix. Recent advances in close range remote sensing technologies in orchard can capture physical fruit properties, which can characterise the microclimate at the fruit level. Thereof, integration of LiDAR scanning and thermal imaging provide real time local temperature at fruit surface by means of temperature annotated point clouds (4D point clouds). This research aimed to analyse temperature change of sweet cherry after cooling. Five cherry trees were kept in cold rooms at 6 °C. Subsequently, all trees were placed in ambient room temperatures (19 °C) and scanned at different time steps up to 90 minutes after cooling. The temperature annotated point clouds were obtained for entire canopies, and fruit clusters were manually segmented. Additionally, presence of wetness at fruit surface was visually registered using an annotation software at different locations within the canopy. Fruit wetness classes were established according to the amount of water visually assessed. The relationship between fruit temperature and ambient dew point temperature was compared with visually rated occurrence of moisture at fruit surface. Temperature at fruit surface was found to be lower in comparison to the mean canopy temperature at all measuring scenarios. Estimating the temperature change of sweet cherry by means of 4D point clouds was validated against manual readings. Moreover, the fruit surface temperature was correlated with dew point temperature in the room and wetness class of fruit surface, allowing the potential the estimation of fruit surface wetness from the non-invasive close-range sensing approach.

Keywords: 4D point clouds, dew point temperature, sweet cherry, wetness.

Funded by the European Union