Orchards are generally non homogeneous due to several factors. This heterogeneity is not only caused by soil variability, hill slope and other physical factors, but to variations in management as well, including those related to irrigation performance. As water scarcity forces growers to reduce irrigation supply, the assessment of the heterogeneity in orchard water status is of paramount importance for water management under precision agriculture (Fereres and Gonzalez-Dugo, 2009). If knowledge of the variability exists, the design of irrigation systems and the scheduling could be optimized according to this information, which should also be useful as a decision-support tool. Here we present a novel approach for the assessment of the heterogeneity in water status found in commercial citrus orchards.

A thermal camera mounted on an unmanned aerial vehicle (UAV) was flown over a 60-ha commercial orchard located in Seville (Spain) (Fig. 1). The high resolution (pixels of less than 0.5 m) of the acquired imagery enables to target pure crowns and avoids soil-vegetation mixed pixels, which is essential in discontinuous canopies, such as tree orchards. After calibration, the images were assembled in a mosaic (Fig. 2), corresponding to the 60-ha orchard. Irrigation units (IU) were located and analyzed separately (Fig. inserted into 1A). Canopy temperature was determined for every tree comprised in each IU. An empirical approach was used to calculate the Crop Water Stress Index (CWSI). The Lower Limit was calculated as $T_c - T_a$ for the 5% coolest tree crowns. The Upper Limit was assumed as a fixed value ($T_a + 8$). Mean value, standard deviation and other indicators linked with data dispersion within each IU were calculated.

Mean value of CWSI ranged between 0.19 and 0.50 among the different IUs (Table 1) which corresponded to a variation of about 3°C in canopy temperature. The coefficient of variation showed values between 0.20 and 0.52, with an overall mean of 0.37. The spatial analysis of thermal data allows the comparison among IUs displaying contrasted mean values (as shown in Figs. 2A and 2B). Zone 9 was clearly underirrigated. The variability within each IU can also be analyzed according to the standard deviation (SD) and CV (Table 1). As an example, Figs. 2C and 2D compare two zones with a similar mean value but different frequency distribution. Zone 2 was more homogeneous than Zone 4.

### Results and discussions

The heterogeneity in orchard water status can be characterized with precision via variability in temperature-derived indicators, specifically the CWSI. Maps of CWSI allow the assessment of irrigation uniformity and may also be used as decision support tools for scheduling applications in precision irrigation in horticulture.