oral paper

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Early fungus infection detection in lemon fruits by means of spectral and colour analysis

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Abstract

Citrus are one of the major plants cultivated in the world. They are grown in more than 100 countries including the main producers such as China, Brazil, the USA, Spain, Mexico, Italy and Argentina. With respect to lemon, Argentina is the first producer (approx. 1.4 Mt). This number shows the economic importance of this activity.

Current commercial systems classify the fruit based on quality parameters. The main characteristic to attribute the quality of fresh fruits is the appearance, characterized by combination of size, shape, colour and absence of defects. The defects could be caused by biological, physiological or environmental factors in addition to mechanical damage. These defects could be originated in the cultivar or in the post harvest management. Among the later, fungi of the genera Penicillium are responsible for substantial losses in citrus fruit during post harvest processes. Due to citrus fruit infected with that fungus are not marketable, it is imperative to detect the problem as early as possible, before it becomes visible, to allow the producer to take the corrective actions.

The objectives of this research were (1) to acquire spectral reflectance characteristics of fungus attacked citrus peel conditions, (2) to identify the significant wavelengths that have the maximum discriminatory capability, and (3) to derive a methodology using these wavelengths that could allows the early detection of the infection.

In order to reach those objectives we analyse the infection process by means of spectral reflectance techniques, to detect the infection between 24 and 48 hours after the inoculation.

Measurements of spectral reflectance and colour characteristics of healthy and inoculated lemons were taken with a PR715 Photo Research spectroradiometer, in the range of 380-1050 nm under diffuse lighting conditions, in four experiments with controlled conditions. In all the four series measurements were taken periodically on the inoculation point and on the opposite side of the fruit with intervals of 12 hours, over samples with different size and ripening.

From the results, a wavelength (676 nm) was identified as a carrier of useful information about the infection process, particularly the temporal variation of the spectral reflectance at 676 nm. The increased gradient of the spectral reflectance value at 676 nm compared with the gradient corresponding to the healthy portion of the fruit could be an indicator of the presence of the infection.

Similar analysis was done taken into account the colour measurements. Results obtained suggest that consideration and analysis of “colour-change speed” (i.e. the colour displacement within a suitable colour space divided by the time it takes) seems to be a very efficient tool to diagnose the infection before it becomes visible.