

# Non-destructive quality phenotyping of mandarins

## Development of a non-destructive methodology for phenotyping mandarins by infrared spectroscopy to assist in the study of phenotypic variability in response to water stress and in varietal selection

### ABSTRACT

This study had as main objective the nondestructive phenotyping of mandarins quality by near infrared spectroscopy.

The specific objectives of the project were: 1) Define the protocol for measuring spectral reflectance of whole mandarins using a spectrometer ultra-portable Phazir 1018 (Polychromix, Thermo Fisher Scientific, 2 Radcliff Road, Tewksbury, MA 01876, USA ) 2) Develop calibration equations for Brix and acidity contents.

In a first step, a precise measurement protocol was established to ensure taking a spectrum representative of the whole fruit and repeatable.

During the two years of the project, 1158 fruits at various stages of maturity from Morocco (487 fruits) and Corsica (671 fruits) were analyzed for their infrared spectra and their Brix and acidity contents. Some of the fruits analyzed were also subjected to water stress, allowing extending the range of Brix and acidity concentrations on the basis of a natural phenomenon and thus increasing the spectral variability and thus the robustness of the database.

On the basis of these analyzes, predictive models have been developed and validated. These models whose performance for the determination of Brix ( $R^2 = 0.93$  and prediction error = 0.8) allow precise sorting of mandarins during maturation. The models developed for fruit acidity ( $R^2 = 0.78$  and prediction error of 0.11) were less efficient, but were applicable to rapid screening of fruits based on low or high levels of acidity which is a good maturity marker depending on the variety

**Keywords :** Plant, Ecophysio/architecture/phenotyping, Climat, Fruit quality, Method/tool/technic, Phenotyping, Spectroscopy, Citrus, Mediterraneea

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**Project leader :** Fabrice Davrieux

**Project leader's institution :** CIRAD

**Project leader's RU :** QUALISUD

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### PERSPECTIVES

The calibration equations obtained can be used in breeding programs to monitor fruits maturation in the fields. Quality control of the fruits during development may be realized in the field in a non-destructive

way, this quality control will then be confirmed throughout the chain of packaging and marketing. The use of spectral fingerprint must be applied to other fruit quality criteria such as the hardness, the thickness of the skin, the color, the peel strength ...

The transfer of calibration equations on different types of spectrometers have to be examined and validated.