

Title Quantitative evaluation of Tarocco sweet orange fruit shape using optoelectronic elliptic Fourier based analysis

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Abstract

Blood orange cultivars of the sweet orange [*Citrus sinensis* (L.) Osbeck] differ from the common sweet orange group (Valencia Late, Washington navel, Navelina) by the presence in the flesh and sometimes in the rind, of red anthocyanin pigments. Among blood orange varieties, Tarocco is the most variable due to its particular characteristics. The presence of several Tarocco varieties, often characterized by similar maturation periods, necessitates accurate postharvest fruit evaluation, particularly appearance, since this is a primary criterion of consumer preference. In this work a total of 929 fruit belonging to 17 different Tarocco genotypes were analyzed. Optoelectronic techniques were used to discriminate among fruit shapes using elliptic Fourier analysis (EFA) to analyse fruit lateral shapes. Fruit shape for different genotypes was classified according to the IPGRI e Citrus Industry classification. The efficiency of these methods was tested by reclassifying fruit shape typologies by *k*-means analysis. We also computed the best number of *k* (4) by implementing a suited script in MatLab. Results were screened by multivariate classification techniques (i.e., PSLDA) in order to evaluate the efficiency of the group classifications. The combined EFA and *k*-means analysis increased the efficiency of genotype classification based on fruit shape in comparison with reported descriptive methods. For example, comparing the two models with 5 groups (Citrus Industry and *k*-means-5), the percentage of correct classification in the independent test dataset was higher in the *k*-means-5 model (respectively, 46.6% vs. 26.0% compared to a random probability of classification of 20%). EFA could measure single fruit shape allowing the comparison of their conformity within a standard of reference. The results set the basis for a shape description of different Tarocco varieties based on quantitative morphological statistics, a practice that, until now, has been carried out exclusively in a descriptive fashion. Consequently, our work represents the first discrimination of genetically different cultivars of the same species based on fruit shape.