Ripening monitoring of plums using NIR-instruments

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Introduction

One of the main challenges in plum crop is to harvest the fruits at their optimal stage of ripeness allowing transport, storage and market distribution while ensuring taste and flavor that meet consumer's preferences. The aim of this study was to evaluate NIR technology as a non-destructive tool for the ripening monitoring of plums in order to help determining optimal harvest date.



Material and Methods

Plum fruit

- Cultivars Fellenberg, Jojo and Tophit: sets of 20 fruits at four different stages of ripeness
- Cultivar Tophit: on-tree measurements during 7 weeks

NIR Spectroscopy

- **Phazir** (Polychromix): portable spectrometer, wavelength range from 900 to 1700 nm
- **NIR Case** (SACMI): diode-array Vis-NIR spectrometer, wavelength range from 600 to 1000 nm

Quality measurements

- Total soluble solids (°Brix), acidity (g/L), firmn ess (kg/cm^2)

Results

Calibration models

Based on the values of R^2 and RMSECV the Phazir instrument showed a slightly lower performance in terms of accuracy compared with NIR Case, but it is a portable device allowing fruit measurements directly on the field. Calculating the mean per batches of 10-20 fruits significantly enhanced the performance of the calibrations.

Table 1. Comparison of the performance of NIR prediction models for total soluble solids (TSS), titratable acidity (TA) and firmness obtained by means of two different NIR instruments for the cultivars Fellenberg, Jojo and Tophit.

	Phazir					**NIR Case**		
		single fruit		batch of 20 fruits			single fruit	
Quality Parameter	Pre-treatment	R^2	RMSECV	R^2	RMSECV	Pre-treatment	R^2	RMSECV
TSS [°Brix]	MSC	0.88	0.85	0.98	0.29	MSC	0.97	0.40
TA [g/L]	SG-1-5-2	0.58	1.46	0.92	0.57	SG-1-5-2	0.74	1.15
Firmness [kg/cm^2]	SG-1-5-2	0.75	0.31	0.96	0.11	MSC	0.80	0.28

On-tree measurements

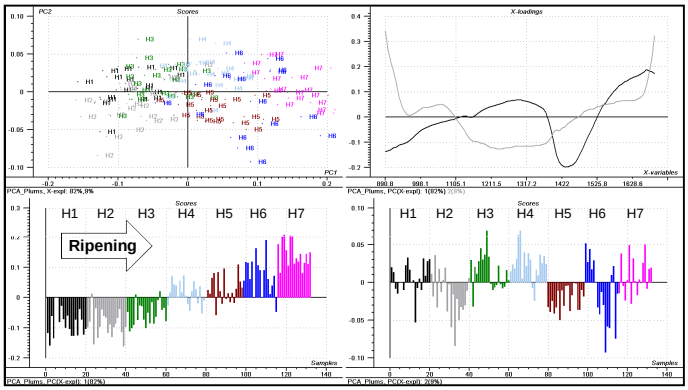

Figure 1. PCA analysis of spectral data (930 – 1650 nm) of 20 Tophit plums weekly measured on tree with the portable NIR-instrument Phazir. H1 = 21.8.2009, H4 = 11.9.2009, H7 = 2.10.2009.

Principal Component Analysis

The spectral variation along the first principal component accounted for 82% of the total variability and was mainly related to harvest dates and therefore to ripening (Fig. 1).

Discriminant Analysis

Except for the first harvest (H1) all groups were perfectly classified (data not shown). Wavelength regions around 960, 1260, 1400 and 1540 nm were highly correlated with the first three discriminant factors.

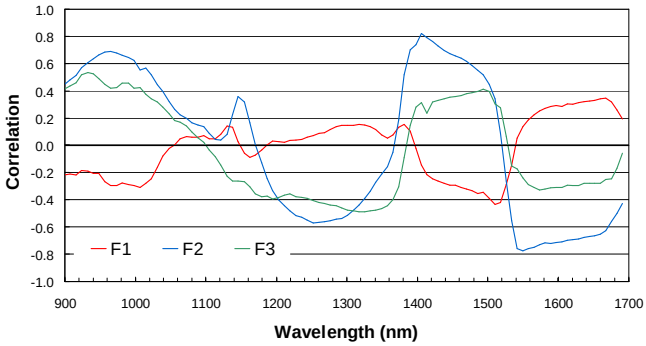

Figure 2. Correlation between wavelength and the first three factors of the DA based on spectral data of 20 Tophit plums measured on-tree with the portable device Phazir during the ripening period (21.8. – 2.10.2009).

Conclusions

- NIR Case yielded greater precision for TSS, TA and firmness calibrations of single fruits
- Using means according to commercial practice improved the quality of the predictions obtained with the Phazir
- NIR technology has been successfully used to classify Tophit plums according to harvest date

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