

Optimization of mango post harvest treatment using NIRS and One-class classifiers



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Problematic:

- How to face the diversity and heterogeneity of agricultural product and optimize their processing into food product?
- Can we best direct the fate of a fruit - eg a mango - to a consumption as fresh fruit or to processed fruit using a non-destructive measure?



Why ?

- To facilitate and optimize choice of raw materials in regard to consumers.
- To help limit losses and wastes, with less rejected products (before or after processing)

Specific Objectives:

- Estimate the homogeneity of the batches at each stage of the process using the NIR spectra.
- Check that the spectral fingerprint is representative of the transformation step.
- Predict the behavior of a fruit during the process using the NIR fingerprint.

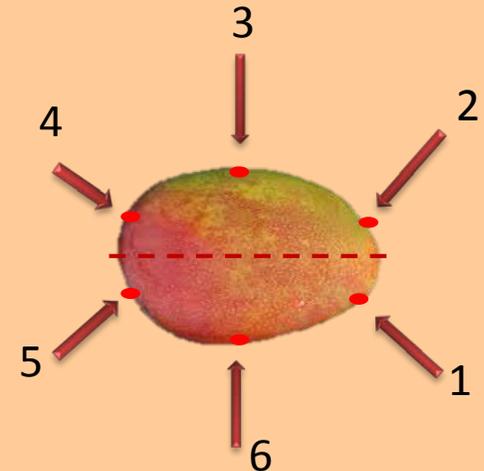
Experimental design

3 Harvests (# dates) with 36, 33 et 32 fruits. One variety one orchard

T0: Harvest

T1: (+18 days)

T2: (+22 days)



10 °c
pendant
18 jours



20 °c
pendant 4
jours



6 spectra per fruit

Average Spectrum

Spectra

Harvest

(n1 + n2 +n3)

[101 x 1050]

Spectra

+18 Days

(n1 + n2 +n3)

[101 x 1050]

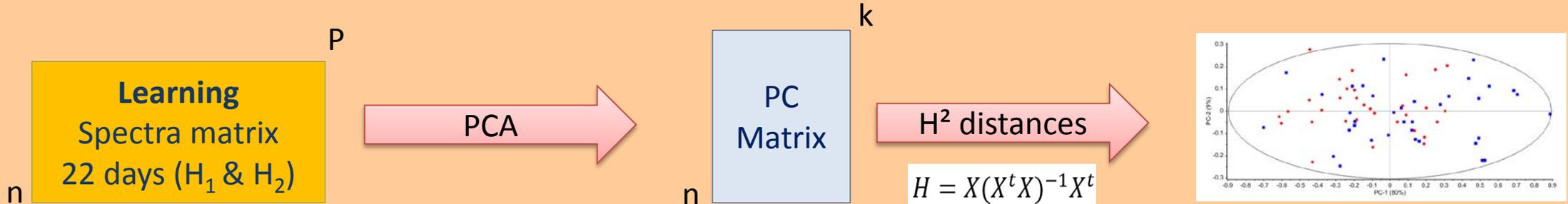
Spectra

+22 Days

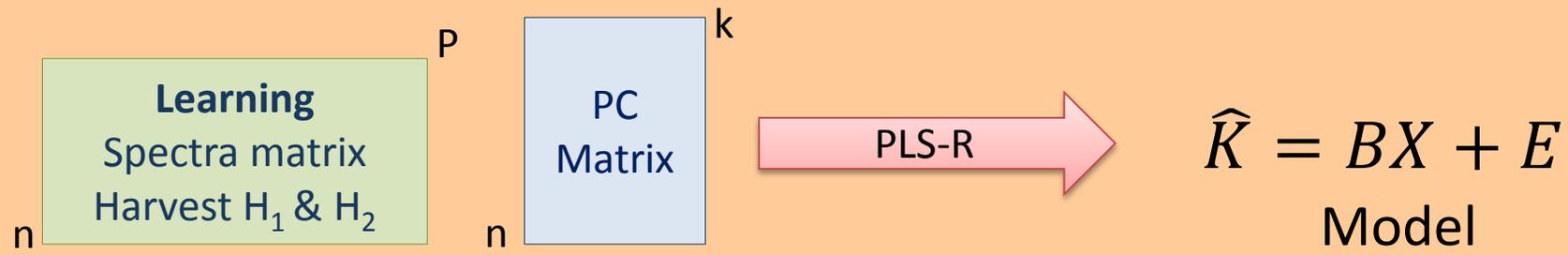
(n1 + n2 +n3)

[101 x 1050]

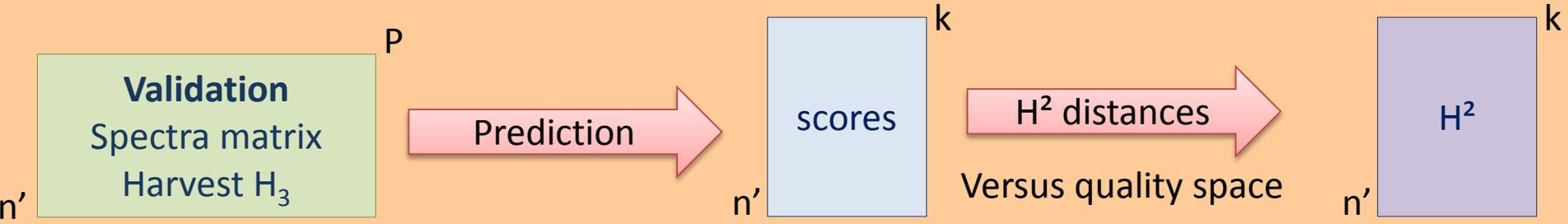
Step 1



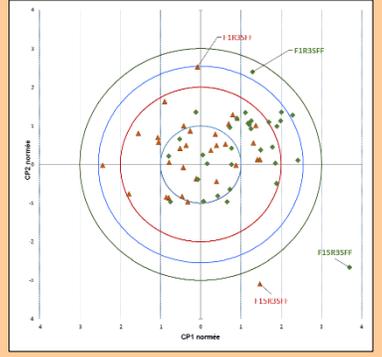
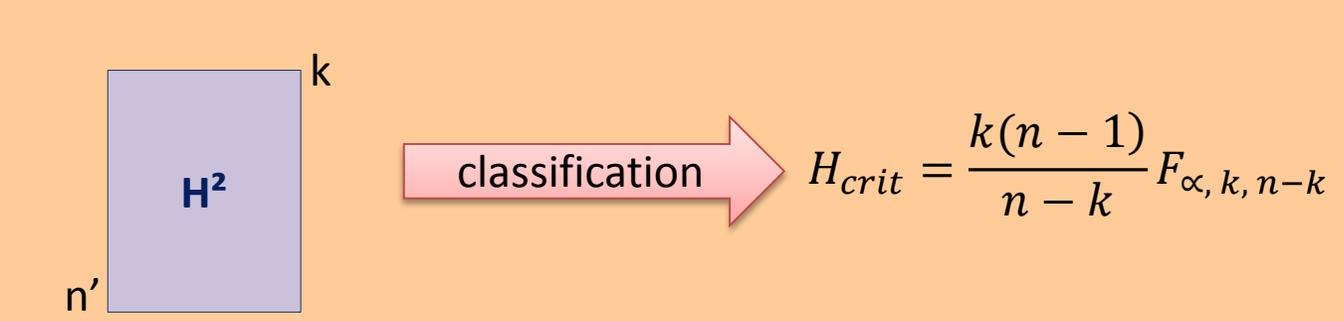
Step 2



Step 3

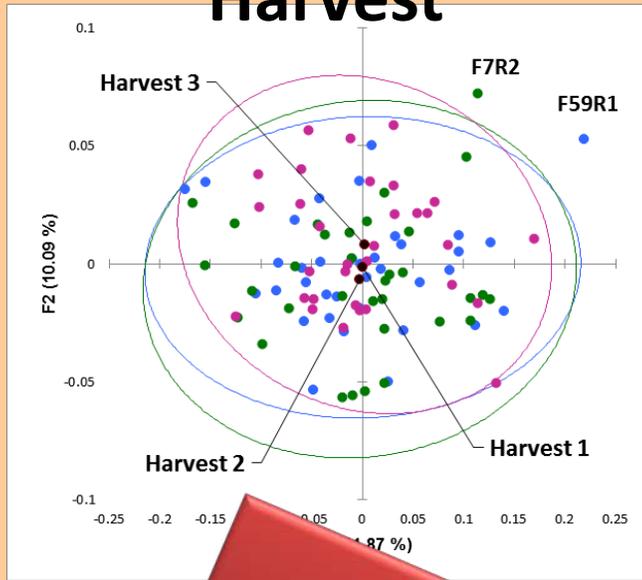


Step 4



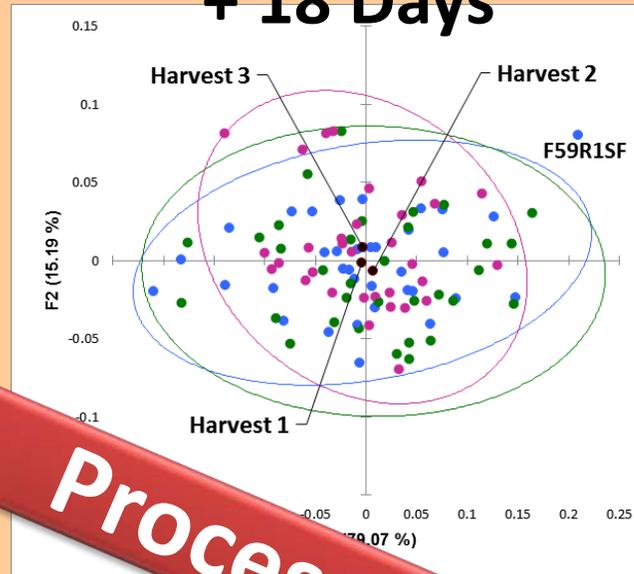
Overall observations about the # data sets

Harvest

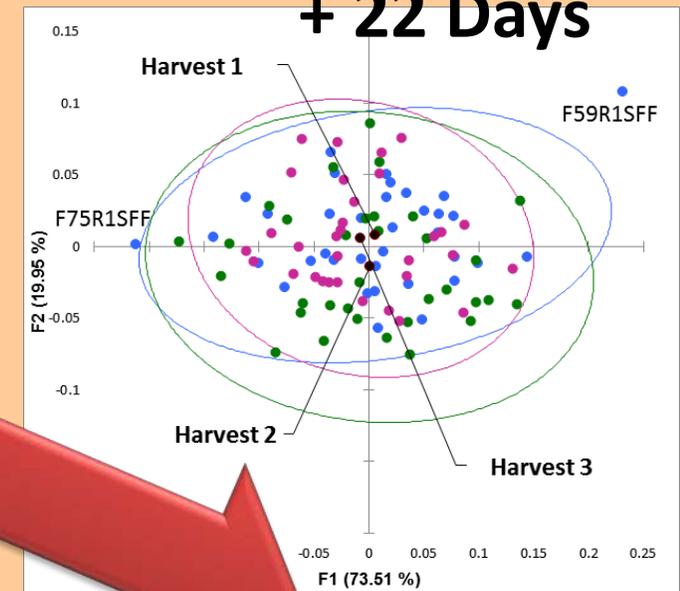


The dispersion of the samples is identical for the 3 Batches with barycenter close to the average spectrum. This confirms the homogeneity of mangoes harvested “green mature”.

+ 18 Days



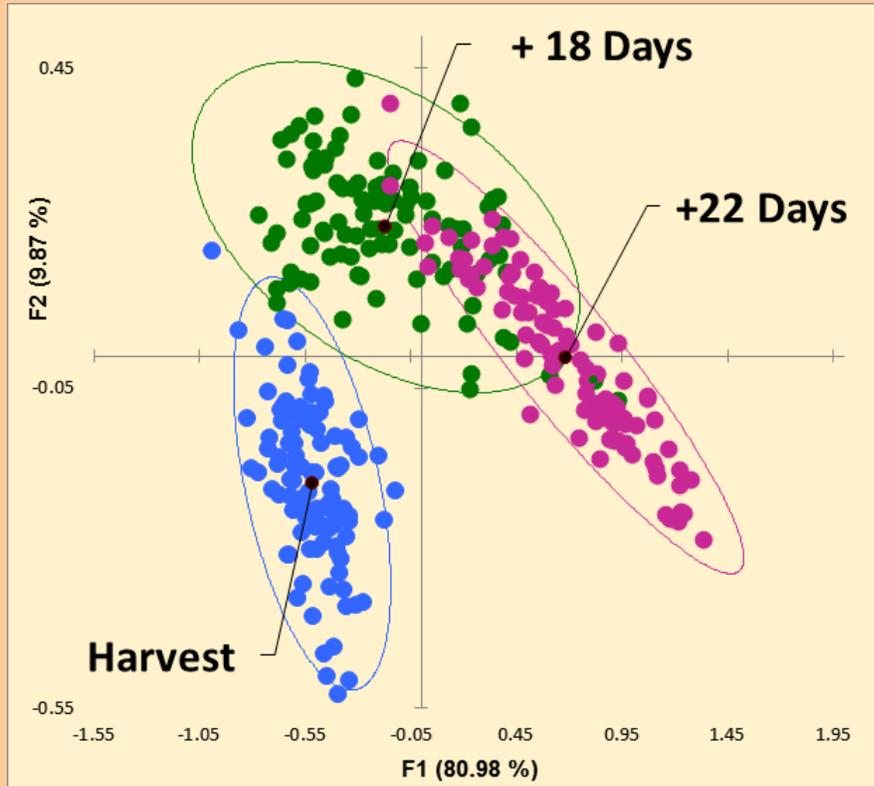
+ 22 Days



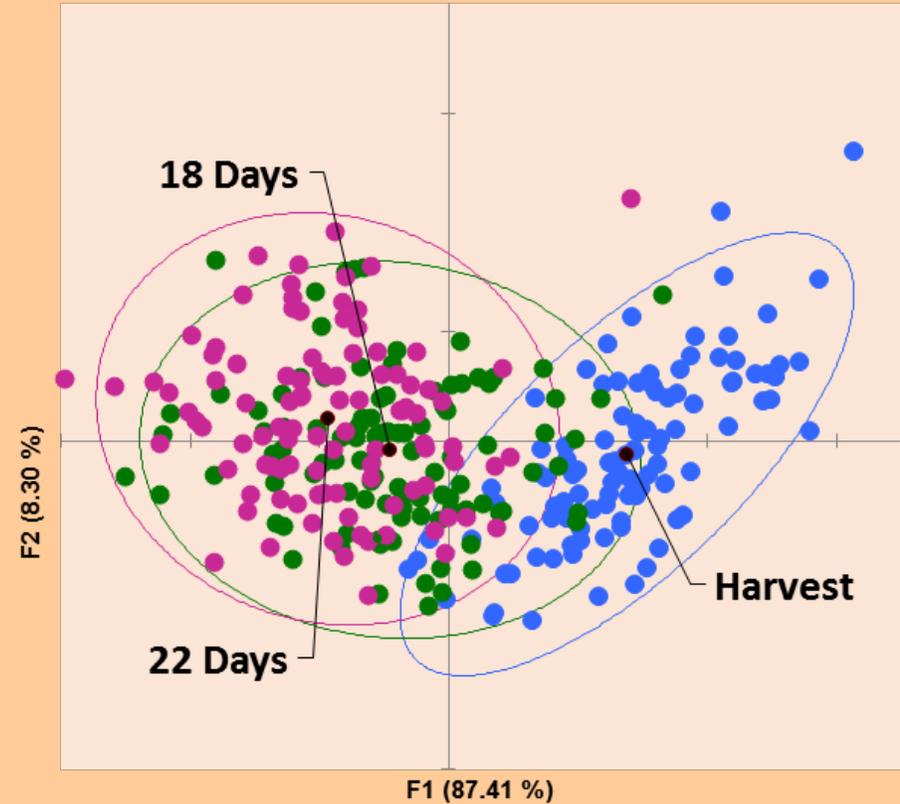
Process

This intra and inter-batch variability is maintained throughout the process

Overall observations about the # data sets



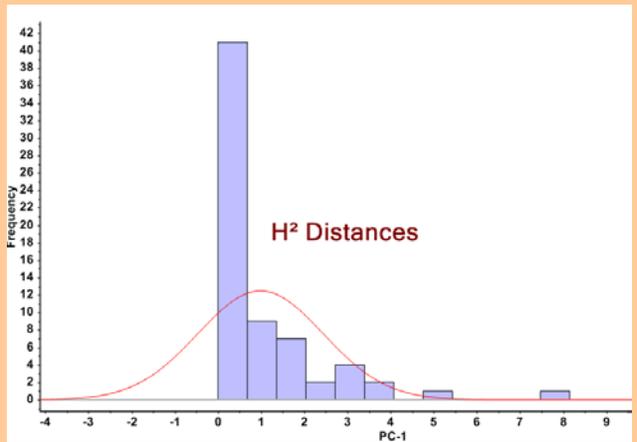
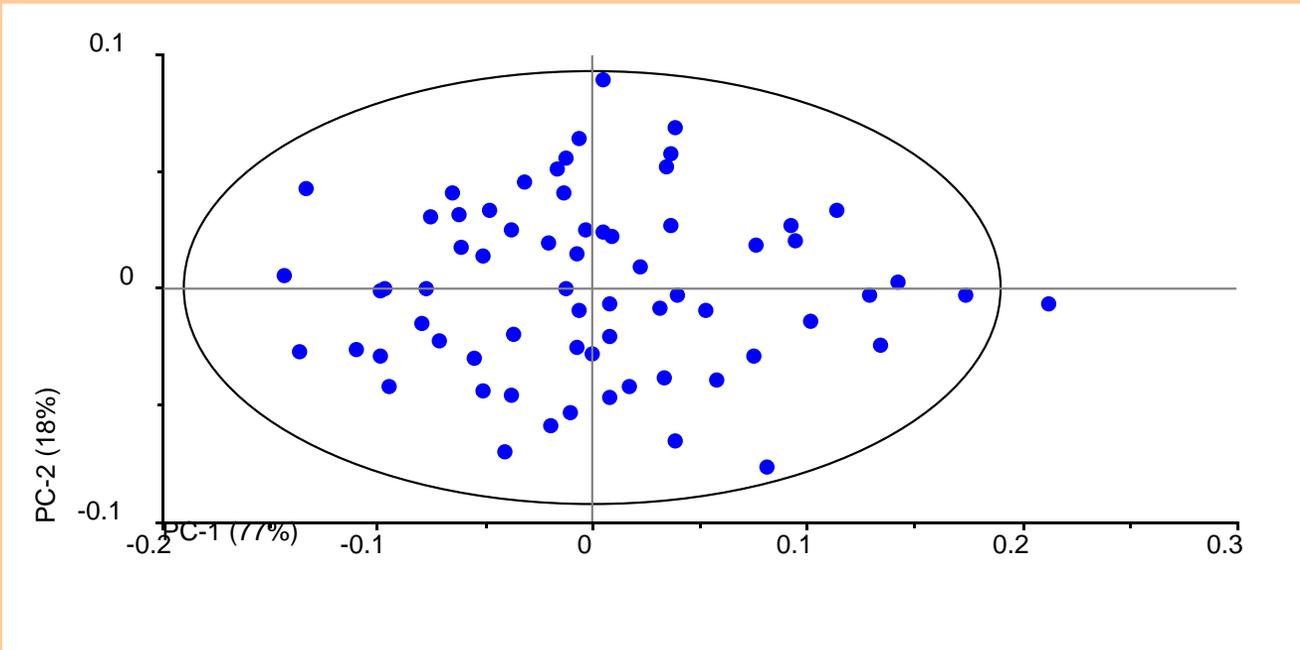
Visible + Near Infrared



Near Infrared

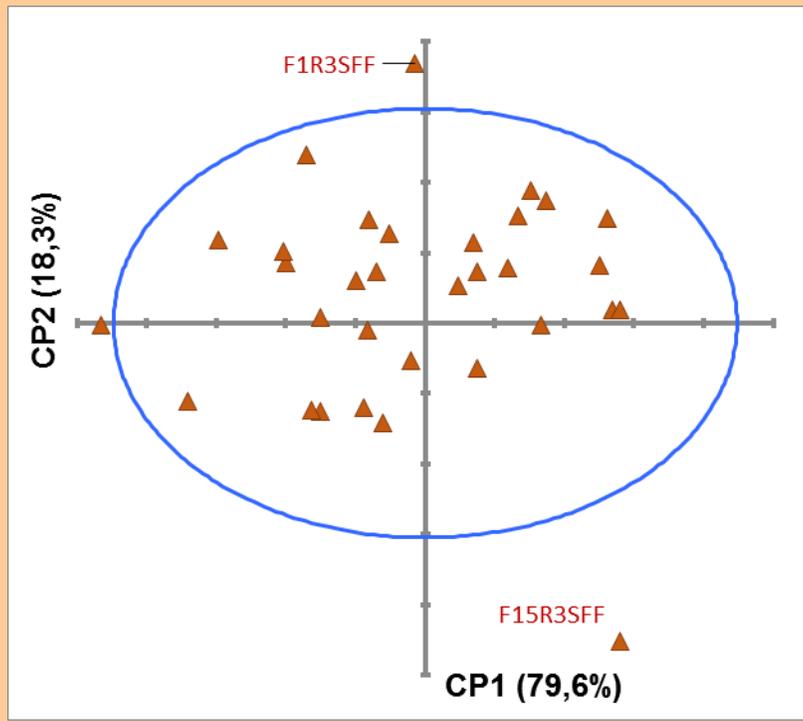
The Spectral fingerprint changes with the level of transformation

Step 1 Learning: PCA, and H² distances using batches 1 & 2 (n = 69) at + 22 Days

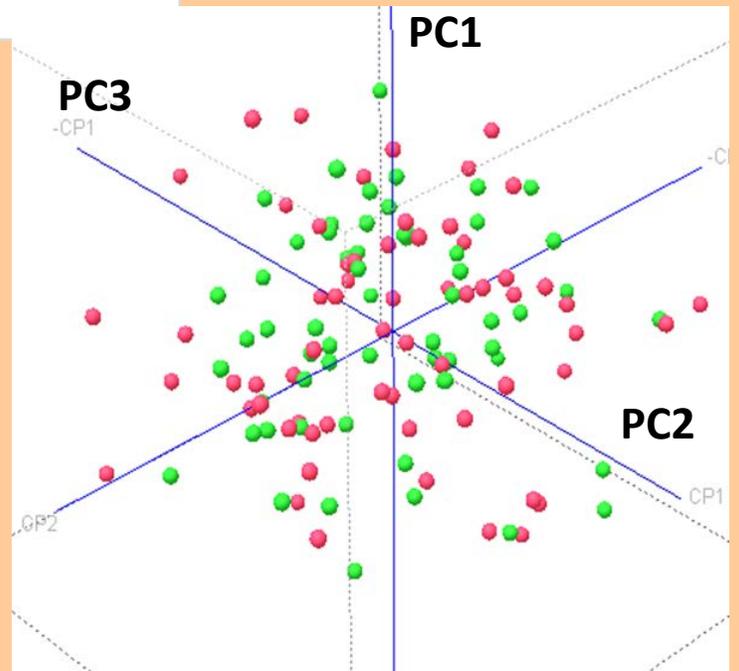
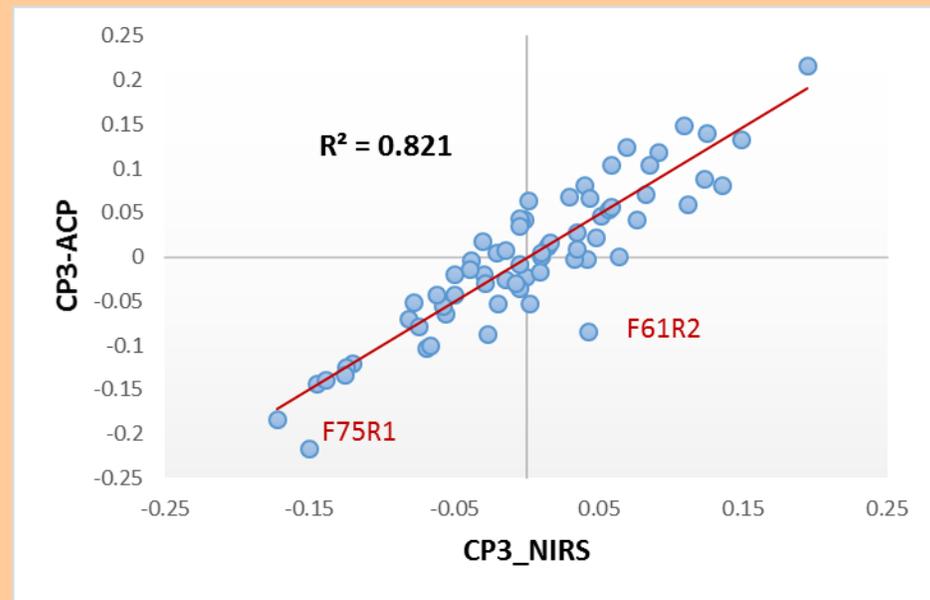
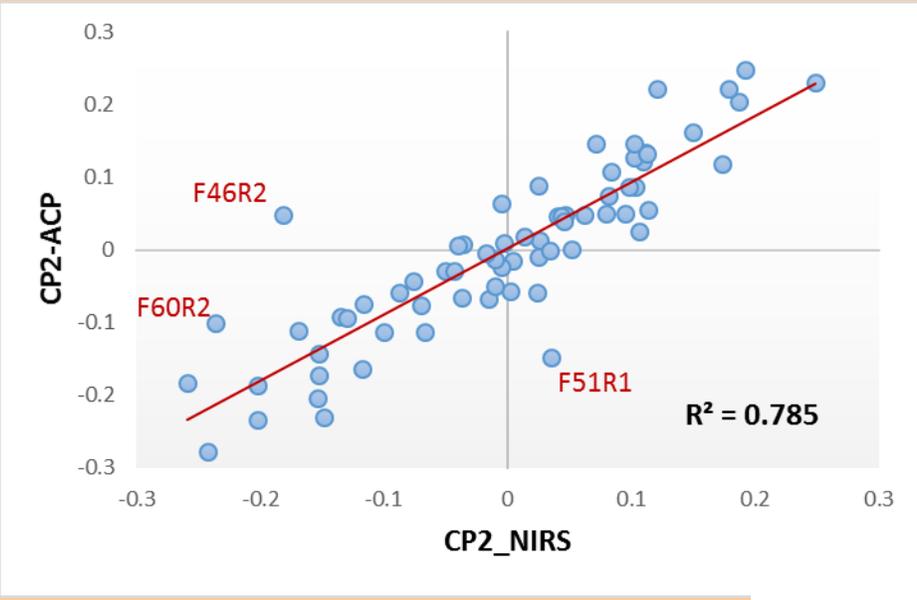
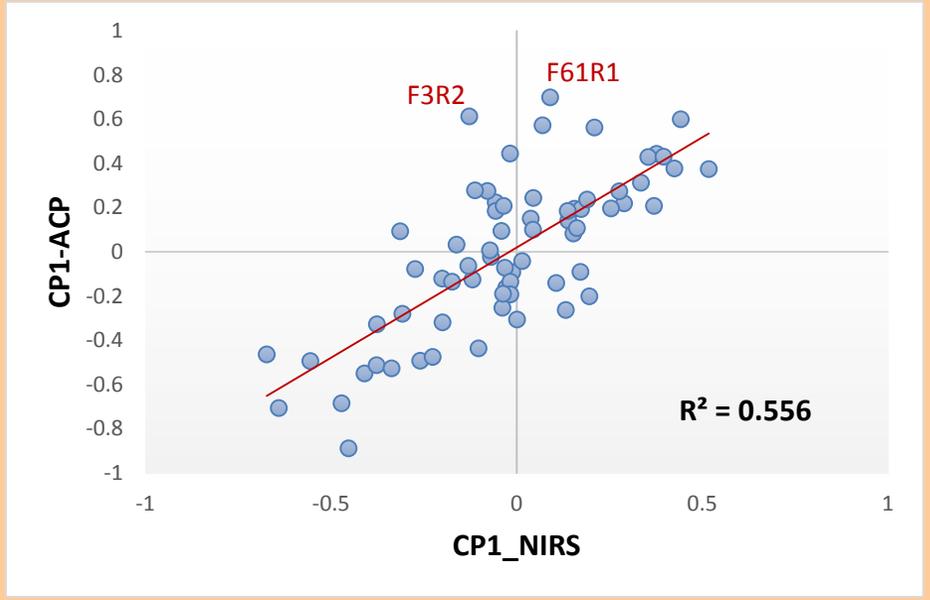


Batches 1 & 2, + 22days

Batch 3 (+22 days) projection
Onto the B1 & B2 space.
Fisher Confidence ellipse 95%

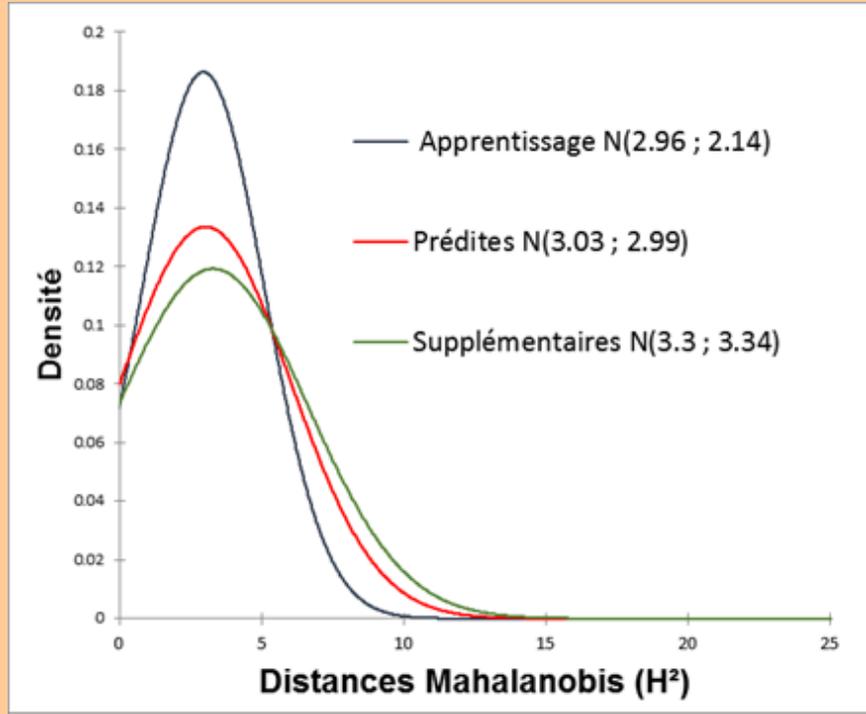
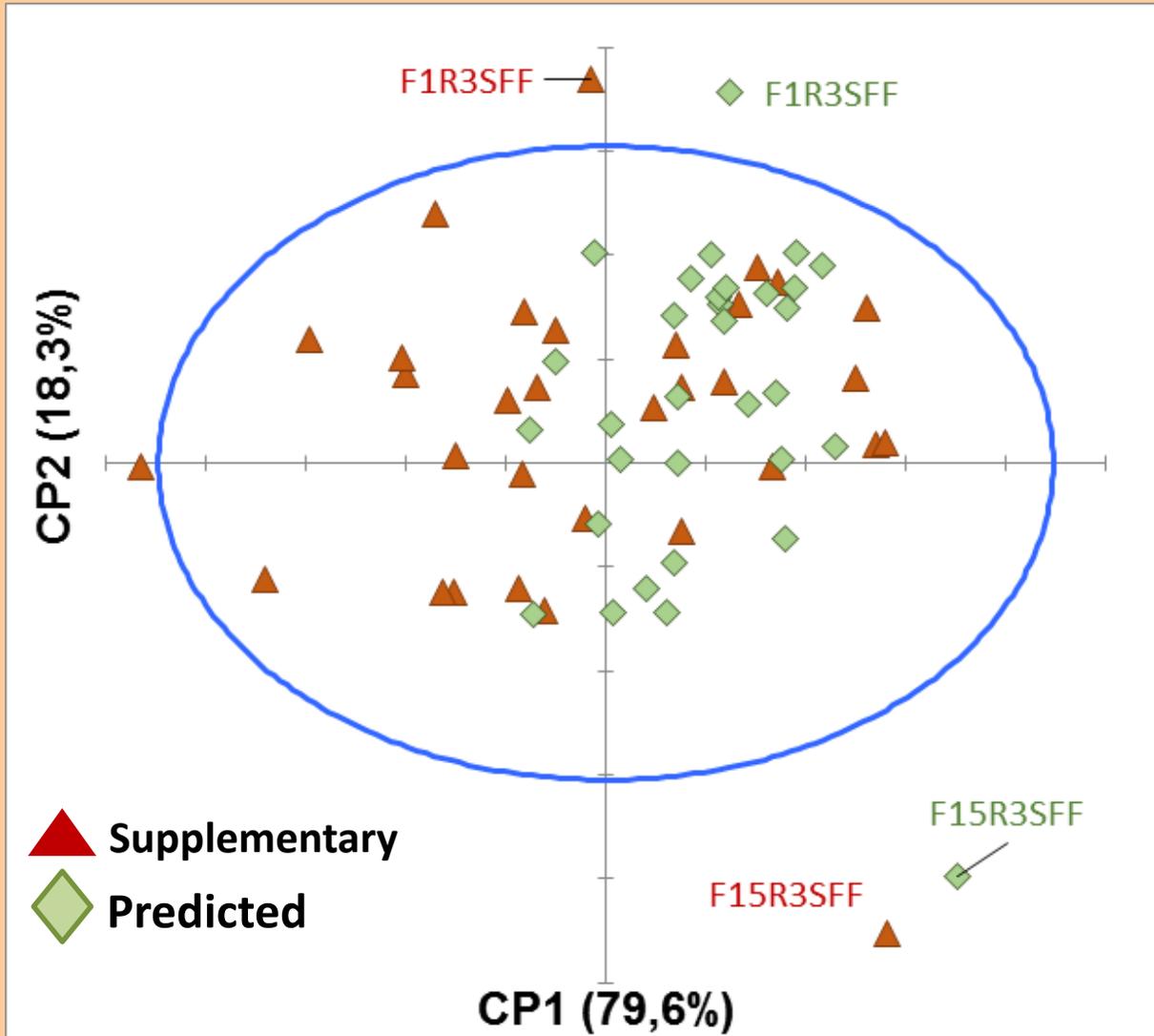


Step 2 Learning: Calibration PLS regression using Scores (3 PCs) batches 1 & 2 at Harvest

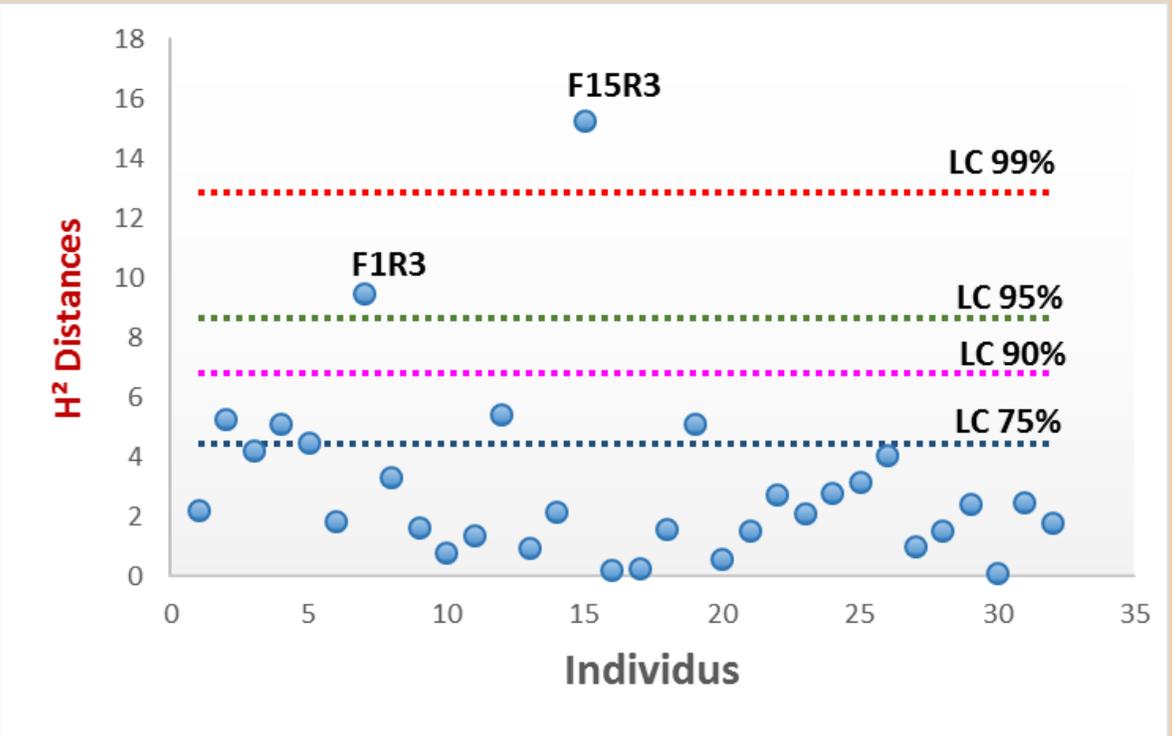


Calibration scores ●
Predicted scores ●

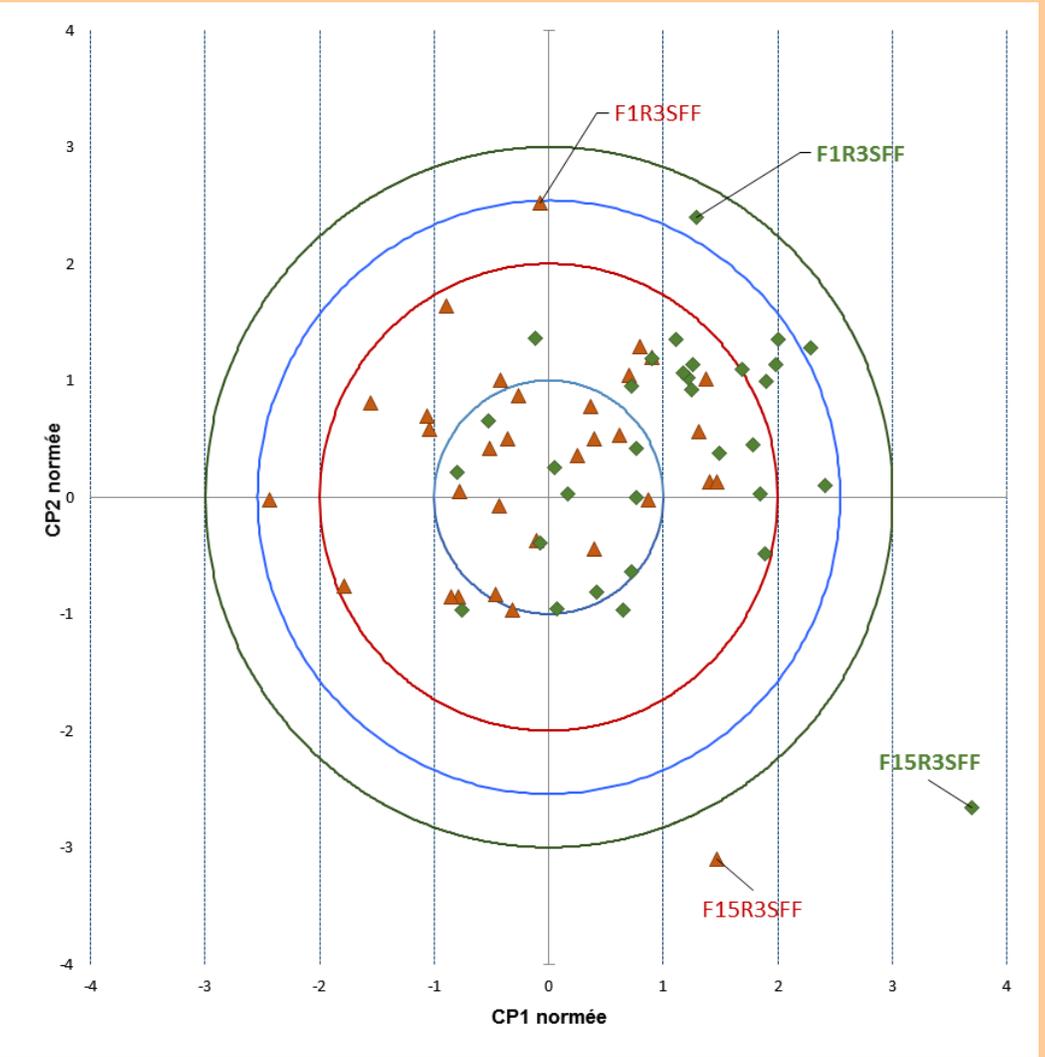
Step 3 Validation: Prediction batch 3, Harvest spectra



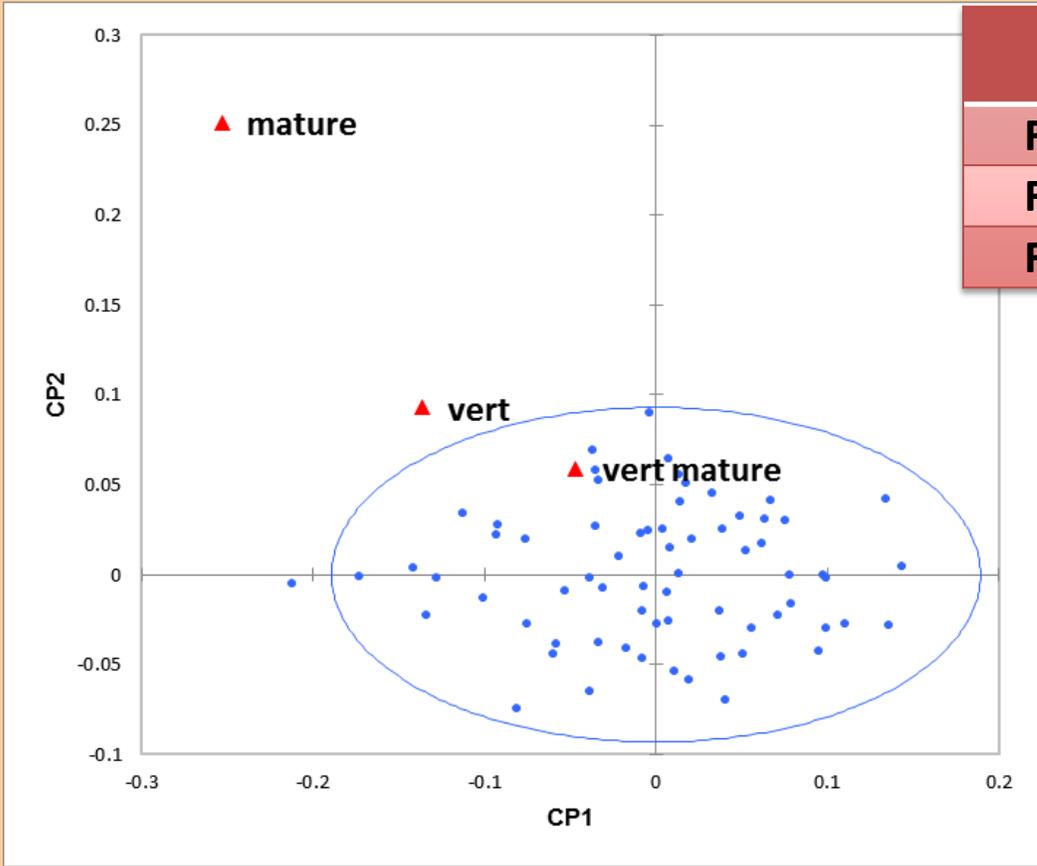
Step 4 Validation: Classification



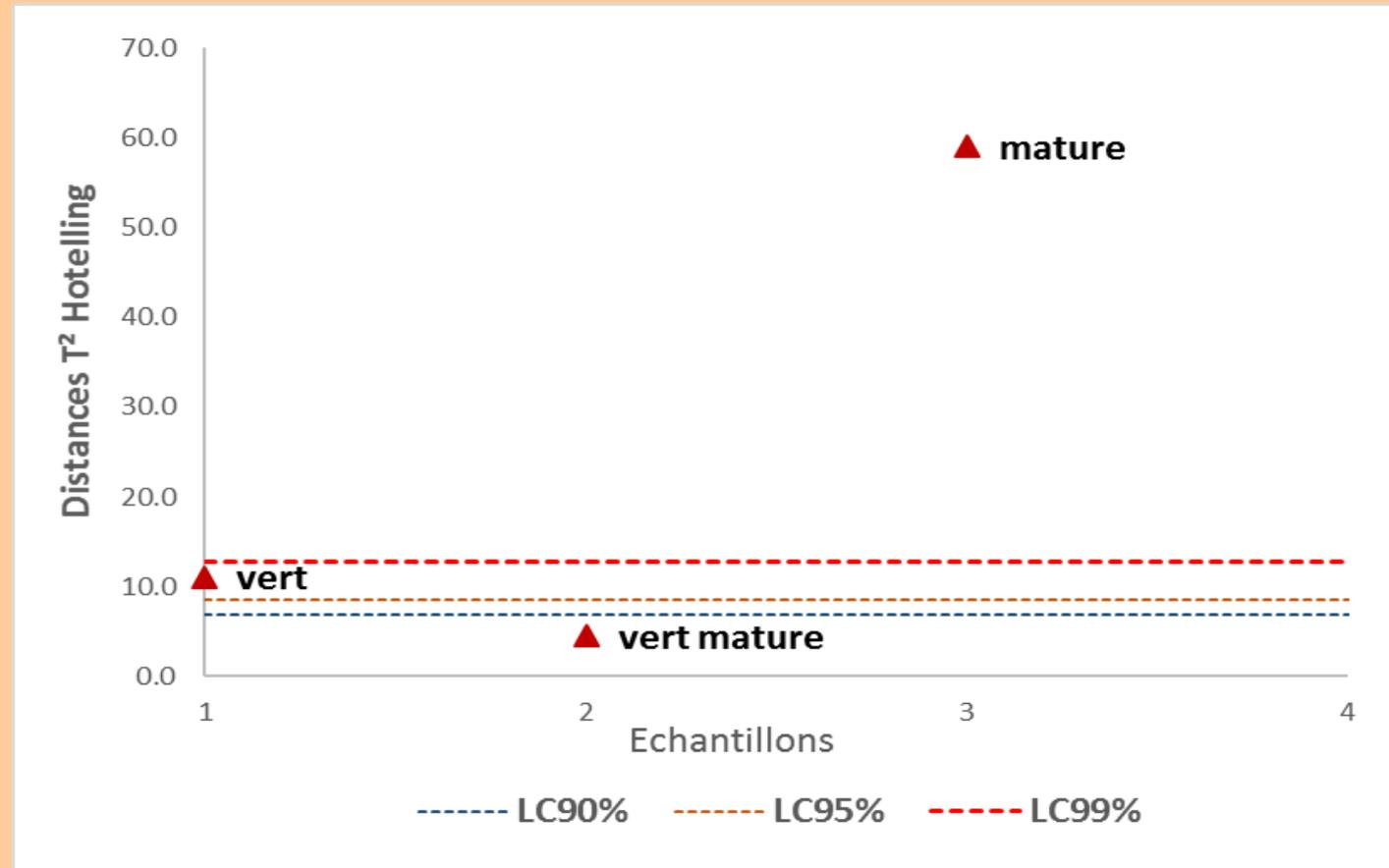
Hotelling limits			
IC	PC-1	PC-2	PC-3
0.10%	12.02	15.83	19.17
0.50%	8.55	11.84	14.72
1%	7.13	10.18	12.86
5%	4.04	6.46	8.62
10%	2.82	4.91	6.81
25%	1.37	2.92	4.40



Validation extern: 3 fruits # stages of maturity



	maturity	PC1	PC2	PC3	H ²
Fruit1	Green	-0.136	0.093	-0.012	11.10
Fruit2	Green mature	-0.047	0.059	-0.013	4.58
Fruit3	mature	-0.253	0.251	0.006	59.03



Conclusion

It was possible to construct multidimensional spaces characteristic of the homogeneity of fruit's batches at different steps of the maturation process.

This approach makes it possible to envisage an early selection of the samples presenting the required quality potential (thus the physiological state) for treatment.

In other words, this method makes it possible to orient the post-harvest treatment of the fruits.

It is a guarantee of

- Reduction of losses.
- Homogenization of the quality of fruit.
- Optimization of post harvest procedures.

Thanks for your attention

