



Pre-breeding strategies for obtaining new resilient and added value berries

NEW PHENOTYPING METHODS – Application of NIR spectroscopy for the rapid quality assessment of different strawberry cultivars

Manuela Mancini, UPM



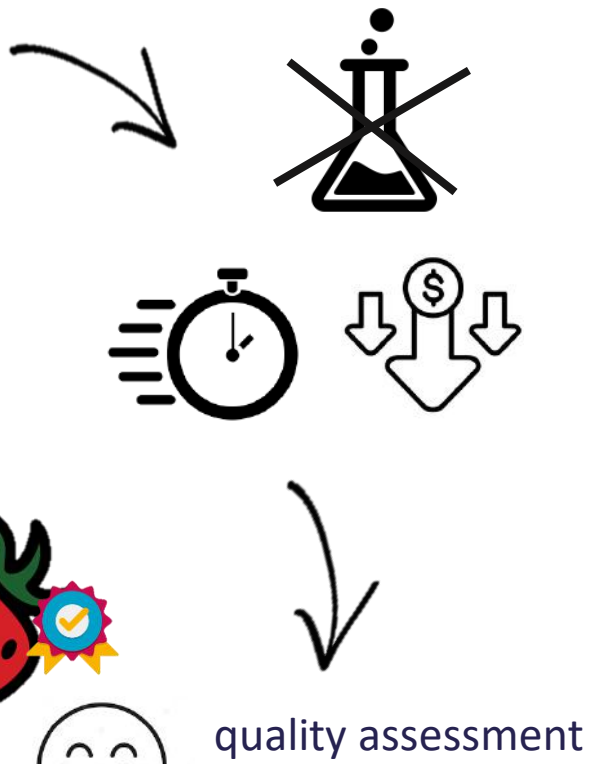
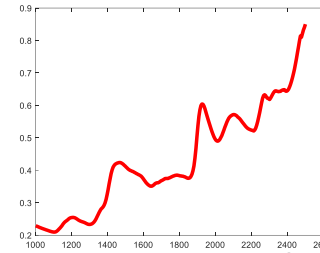
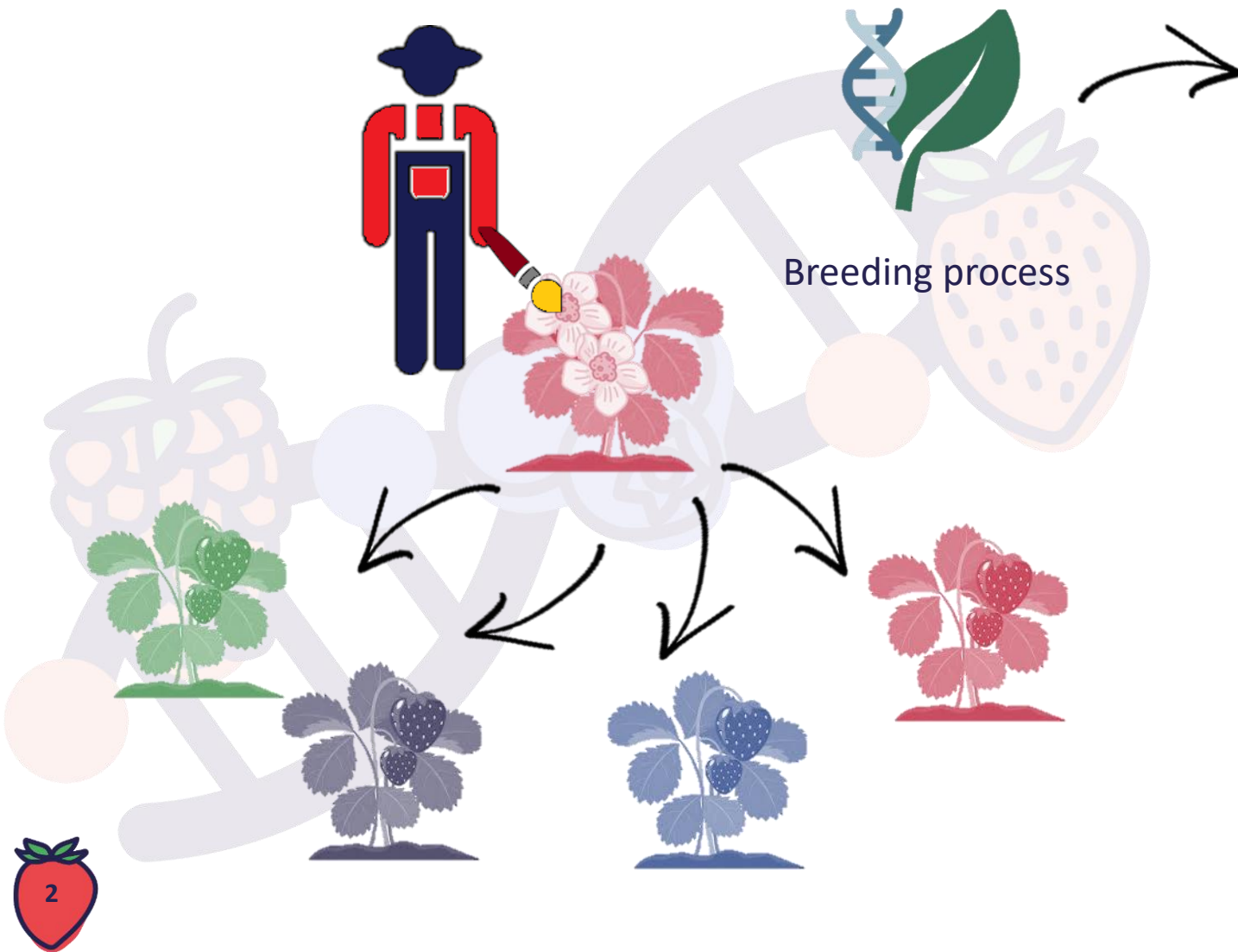
WORKSHOP

Advancing Berry Breeding: From Phenotyping to Genomic Innovation



The BreedingValue project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000747.

Why NIR spectroscopy?



The samples and the instruments

Season 2022

15 genotypes x ~20 fruits for each genotype = ~ 300 samples



one extra
genotype

Season 2023

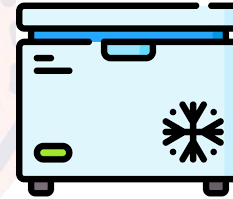
14 genotypes x ~20 fruits for each genotype = ~ 280 samples



harvesting



NIR spectroscopy



freezing



wet lab analysis



Soluble solids
content (°Brix)

NIR analysis



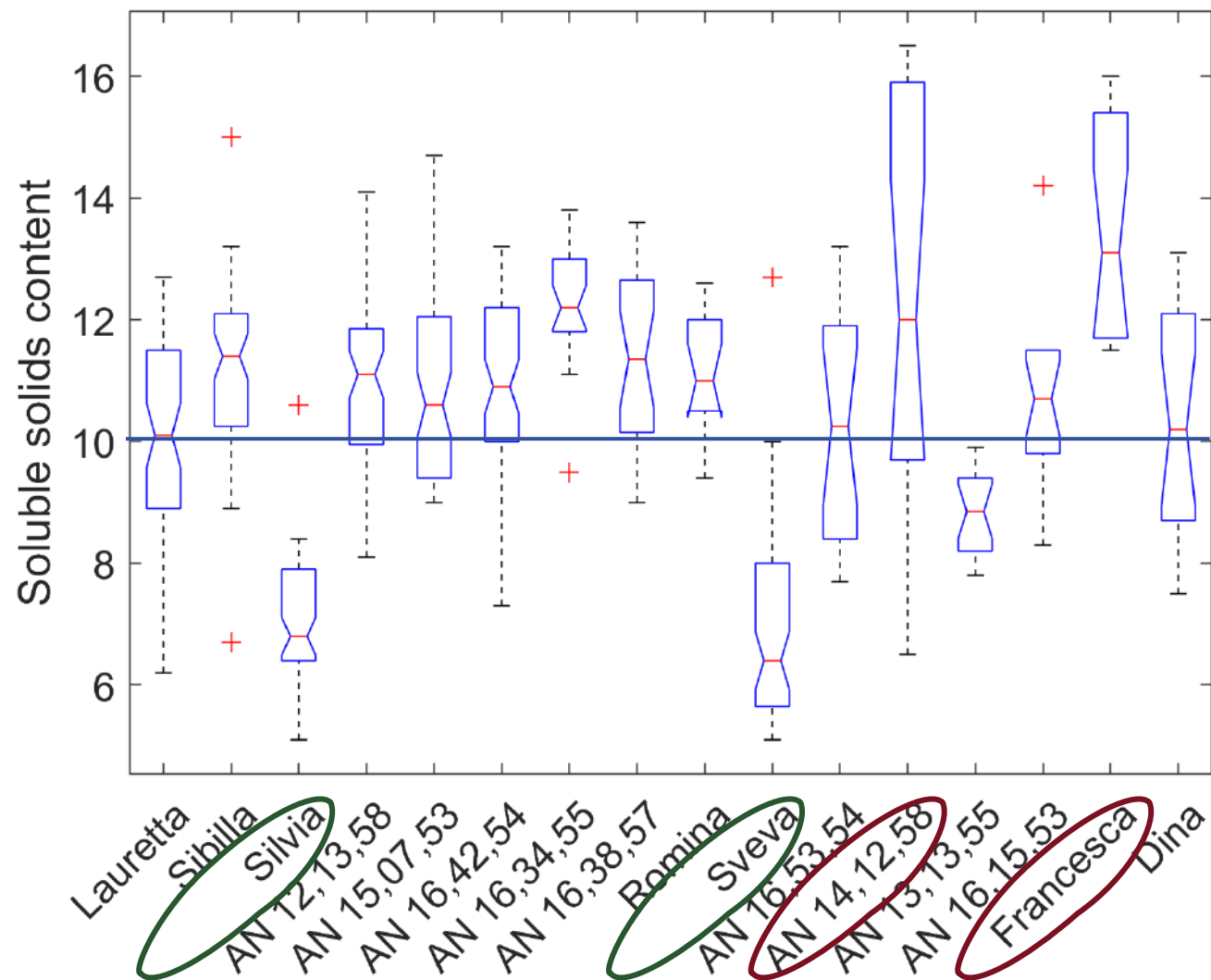
Bench-top spectrophotometer
(FT-NIR mod. Nicolet iS10,
THERMO)



Hand-held spectrophotometer
(MicroNIR OnSite-W | VIAVI
Solutions Inc.)

Soluble solids content (lab analysis)

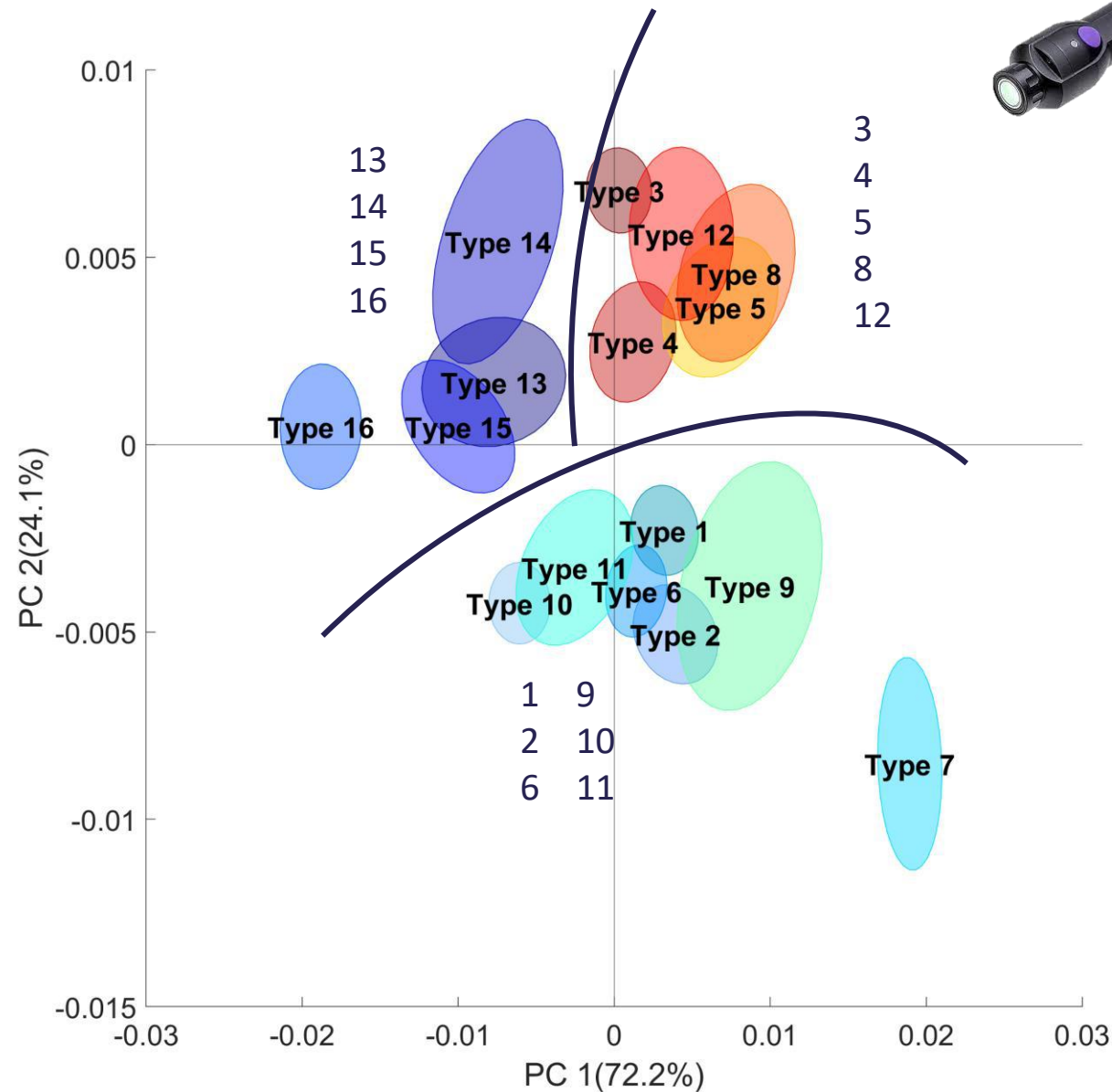
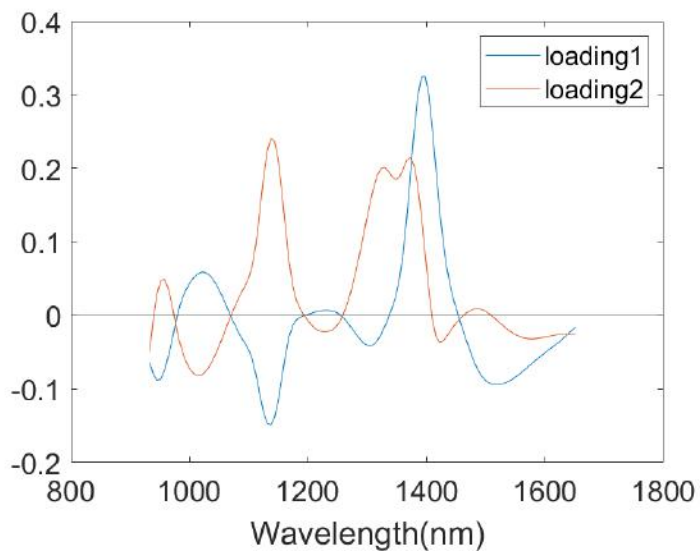
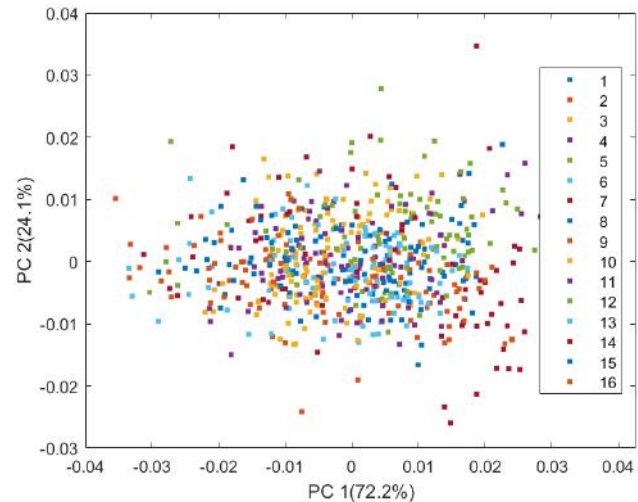
Season 2022



Principal Component Analysis



Season 2022

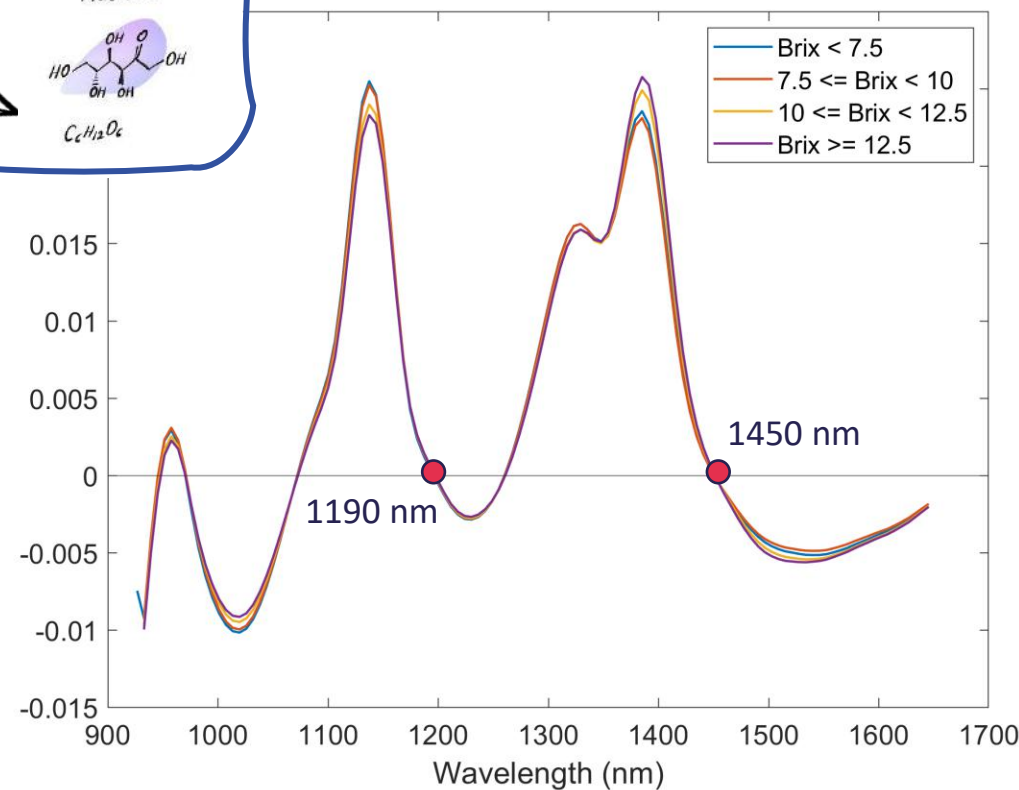
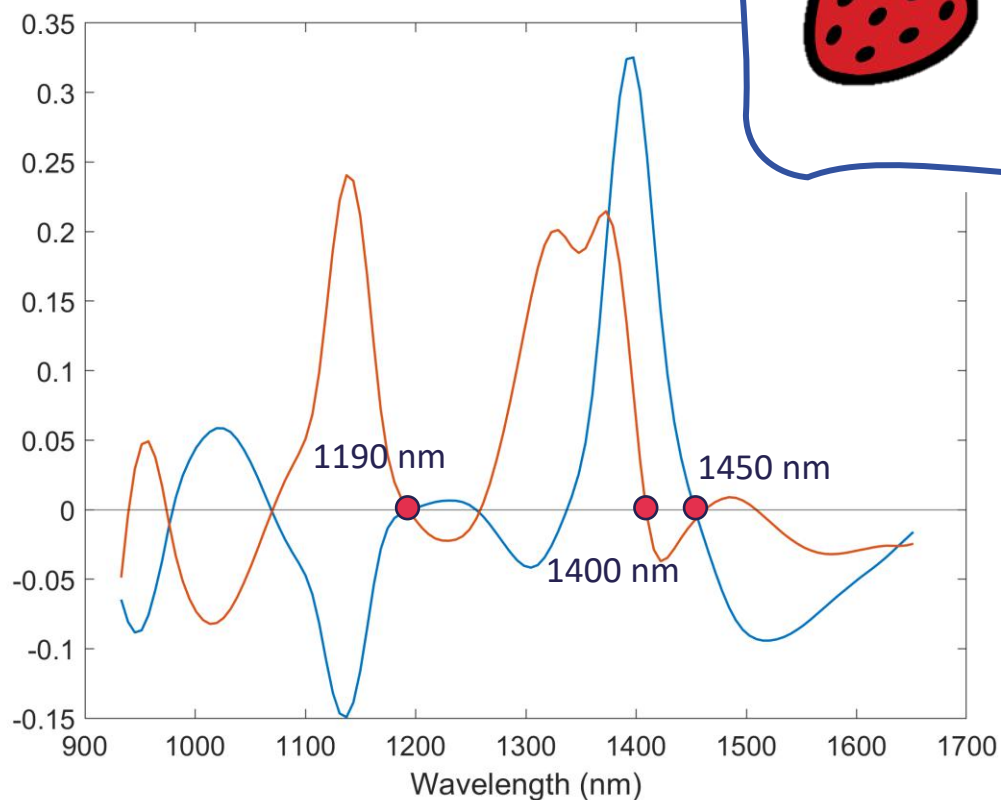
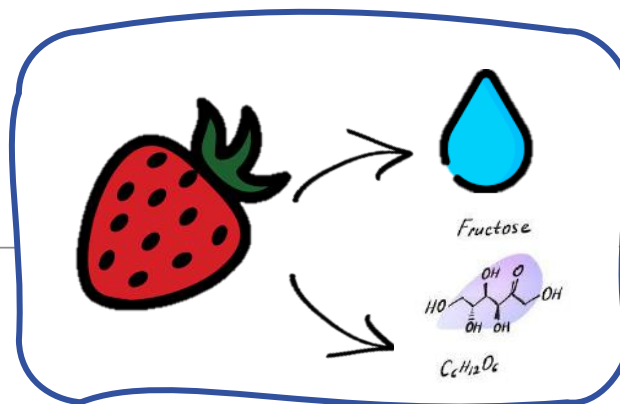


1	Lauretta
2	Sibilla
3	Silvia
4	AN12,13,58
5	AN15,07,53
6	AN16,42,54
7	AN16,34,55
8	AN16,38,57
9	Romina
10	Sveva
11	AN16,53,54
12	AN14,12,58
13	AN13,13,55
14	AN16,15,53
15	Francesca
16	Dina

Into strawberry chemistry: spectra interpretation



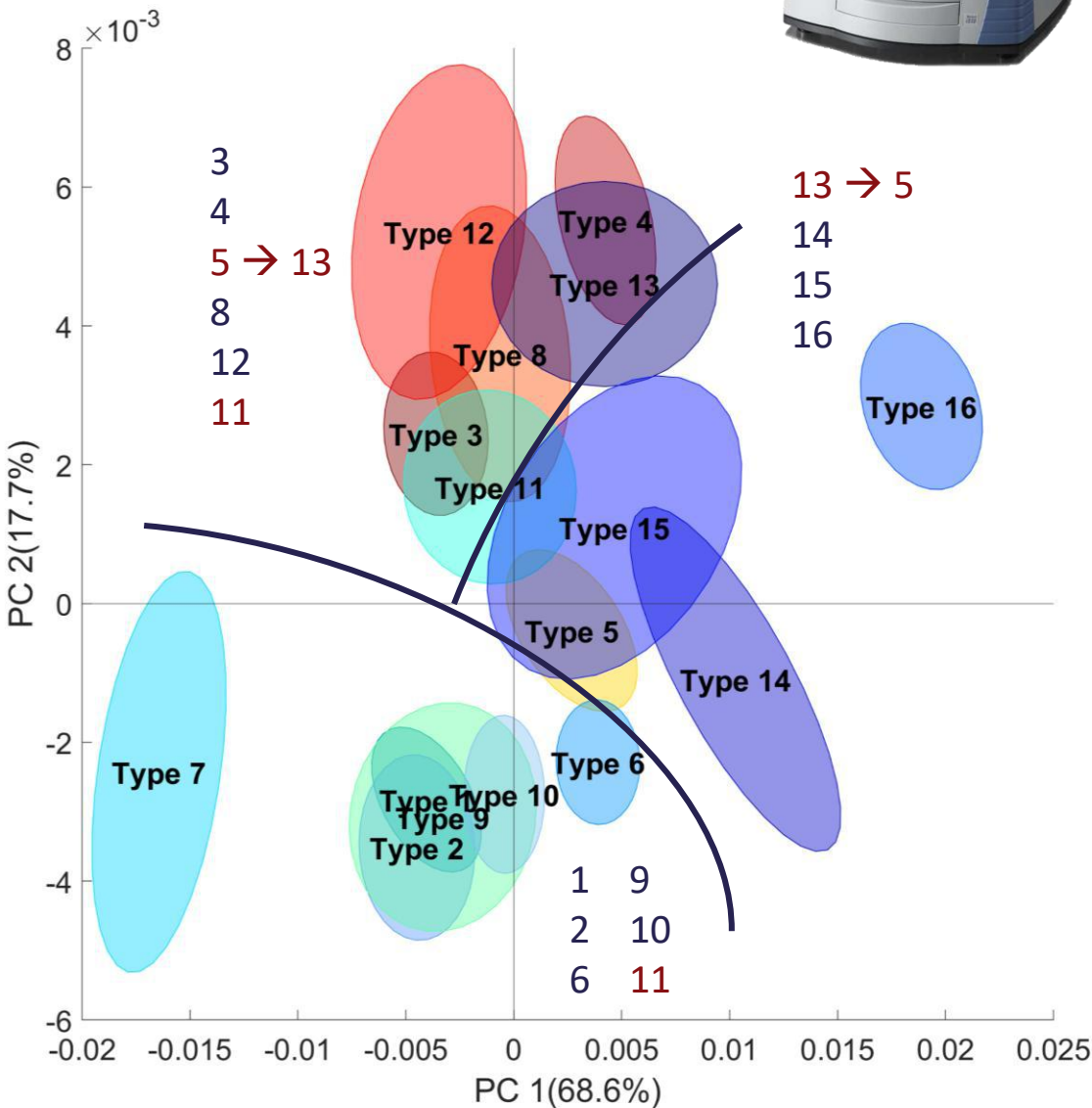
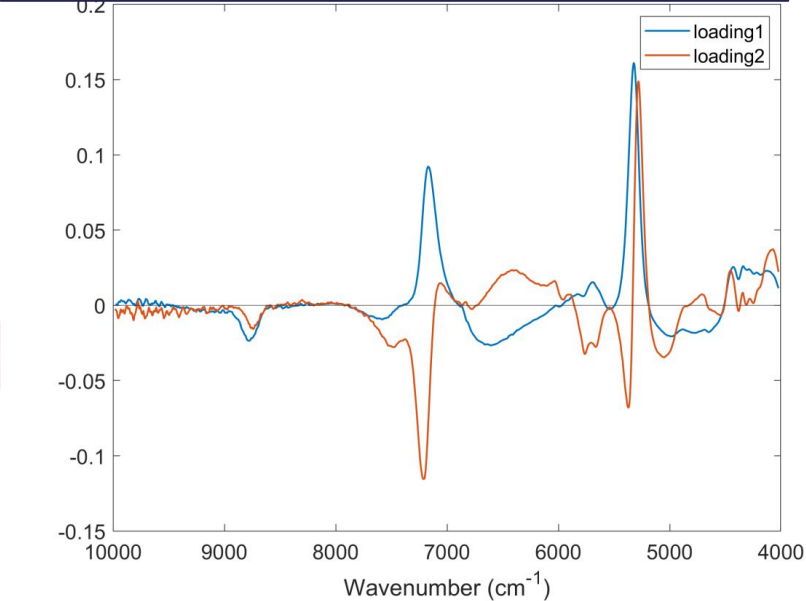
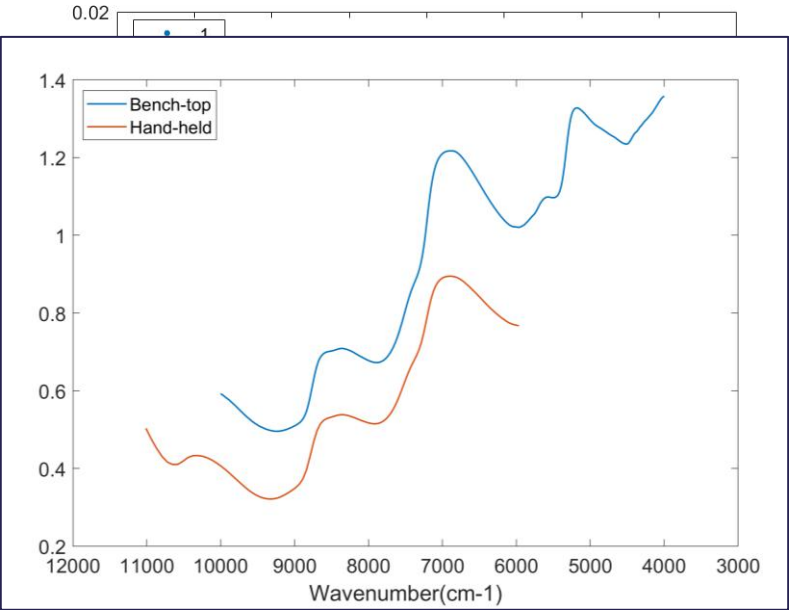
Season 2022



Principal Component Analysis



Season 2022

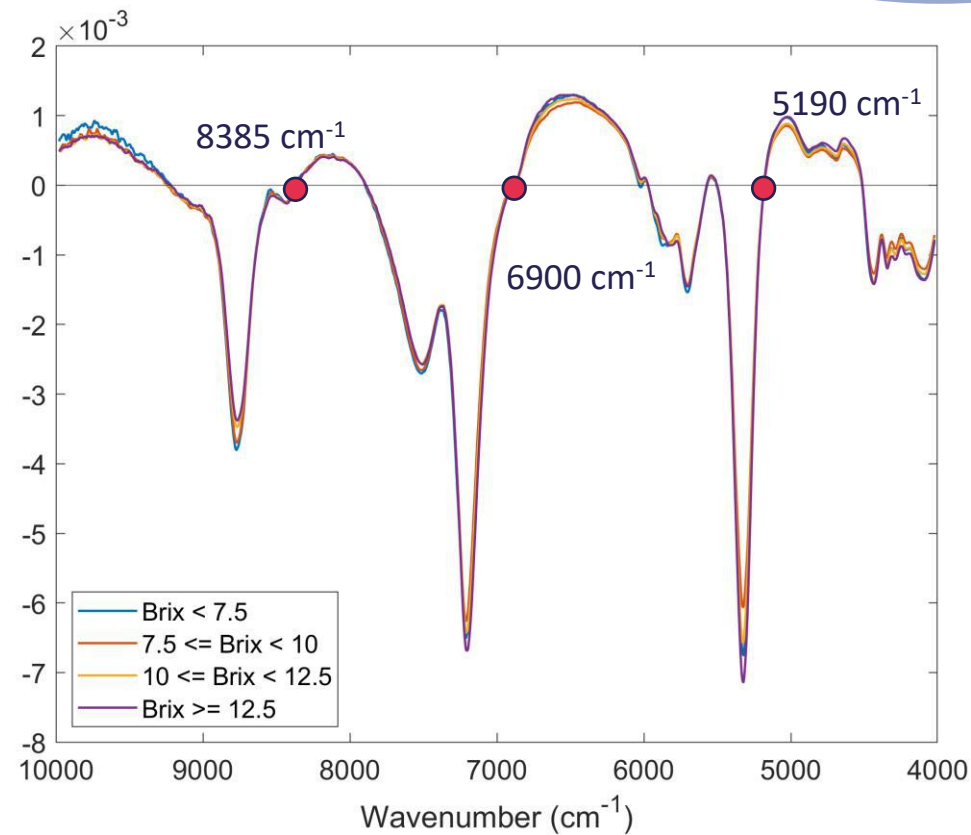
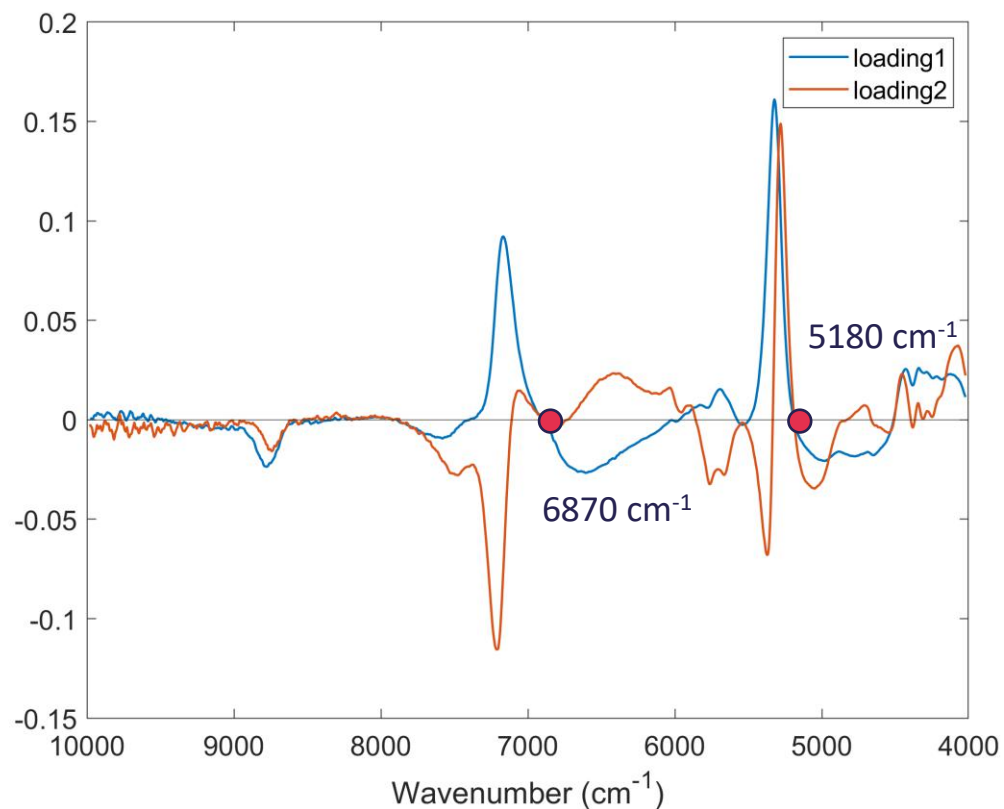


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Into strawberry chemistry: spectra interpretation

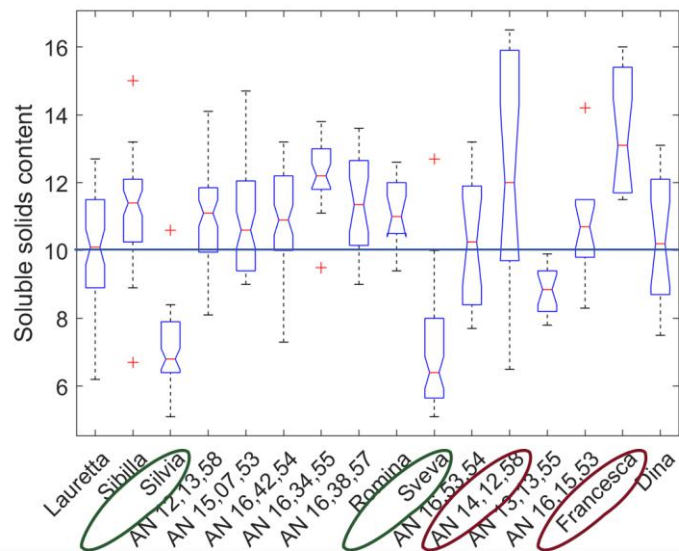


Season 2022



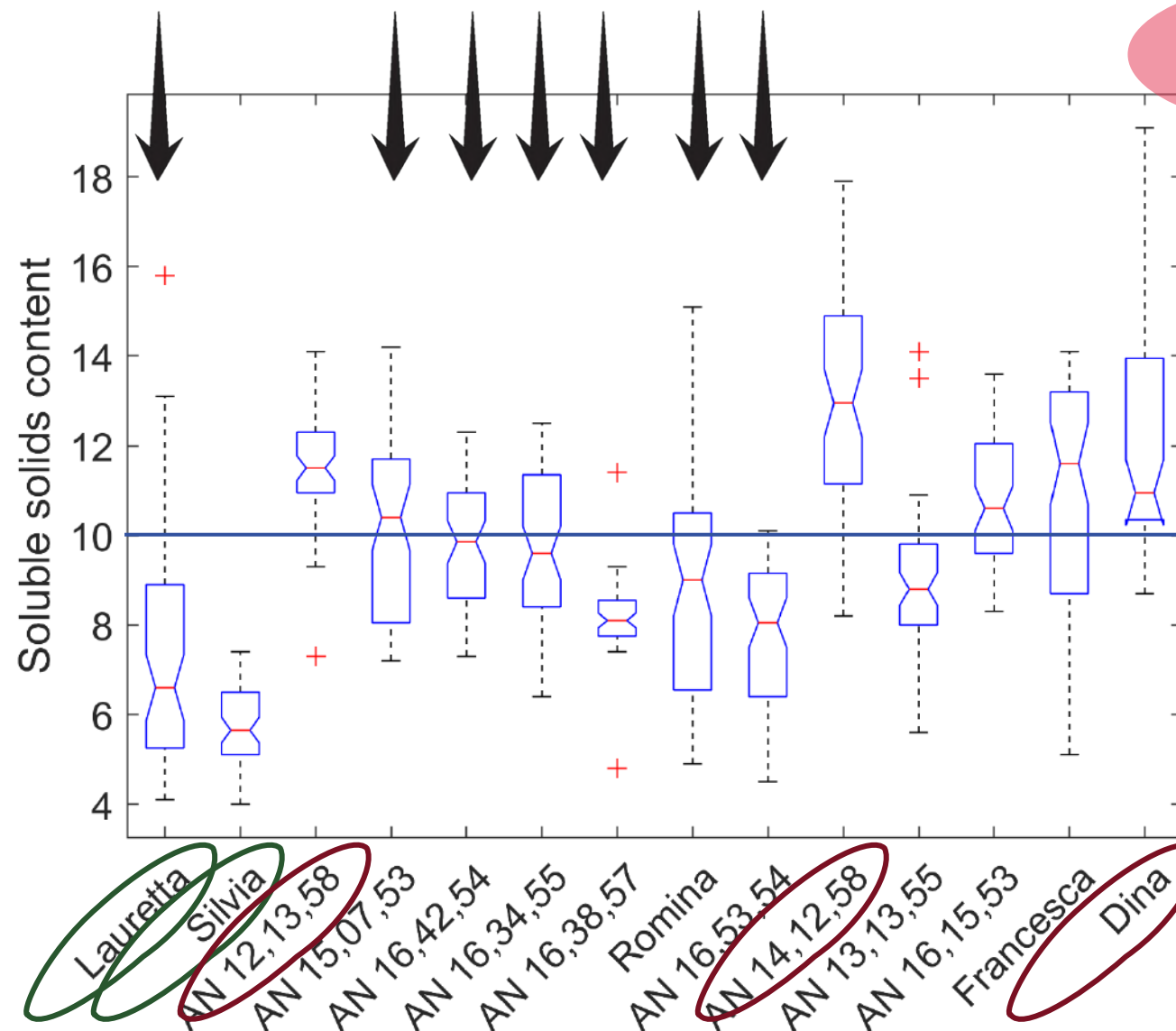
Soluble solids content (lab analysis)

Season 2022



Investigate seasons variability

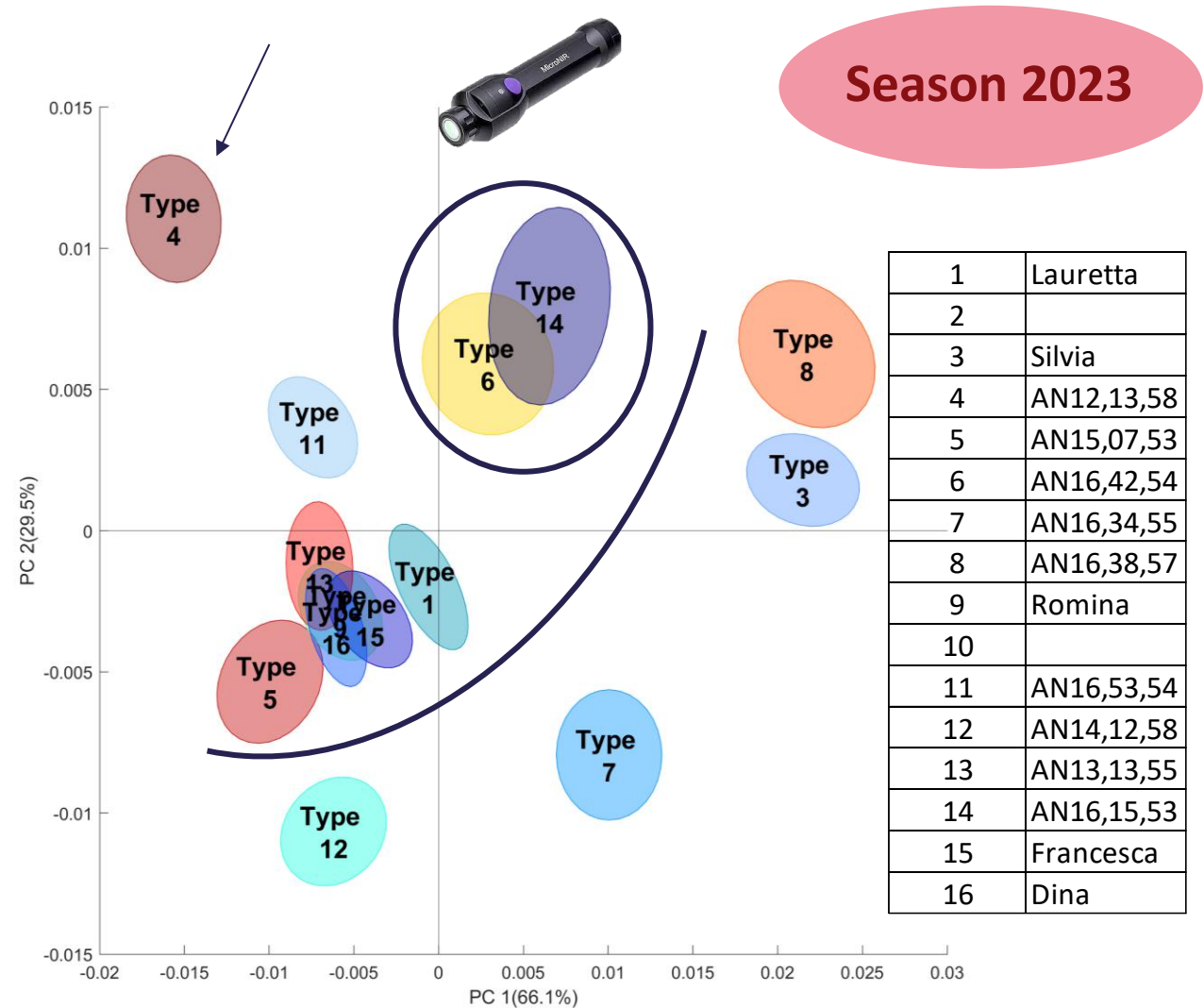
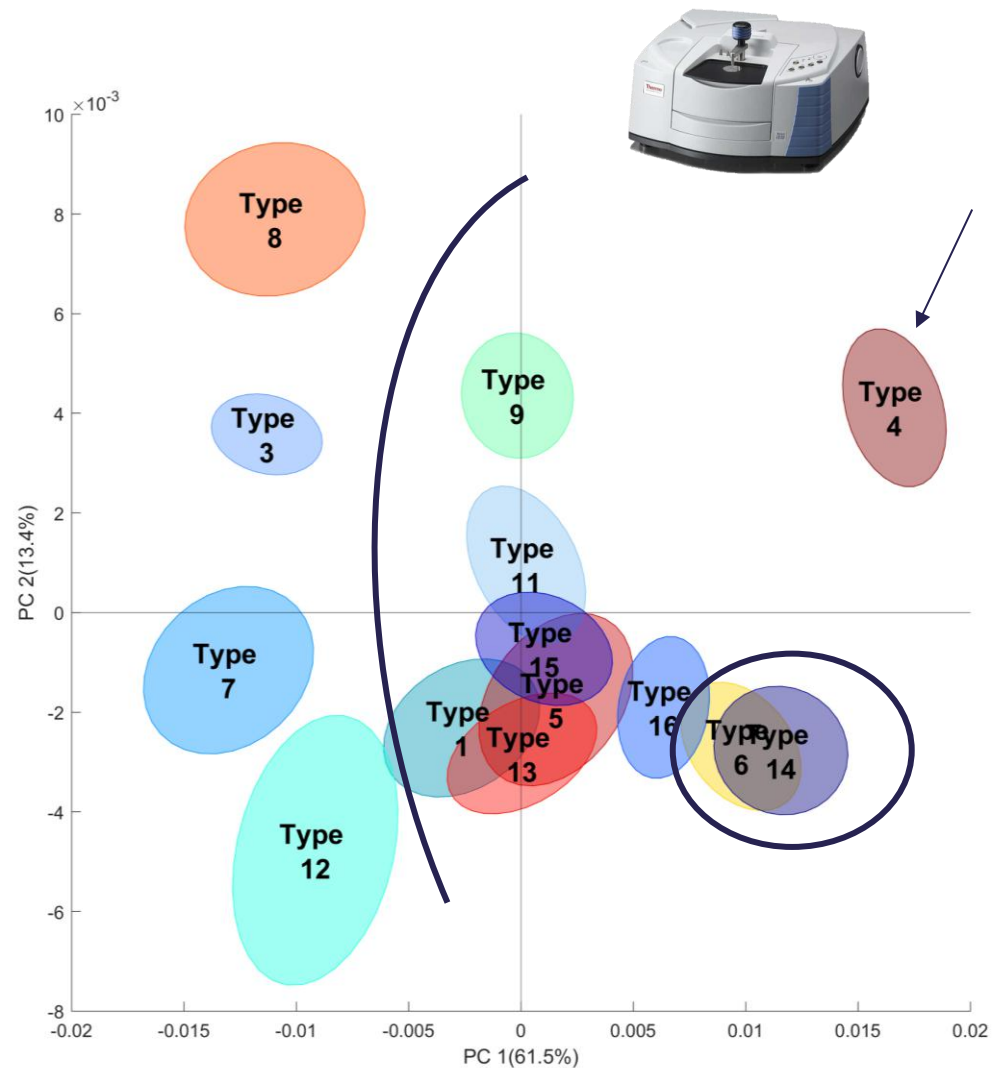
Season 2023



High SSC

Low SSC

Principal Component Analysis



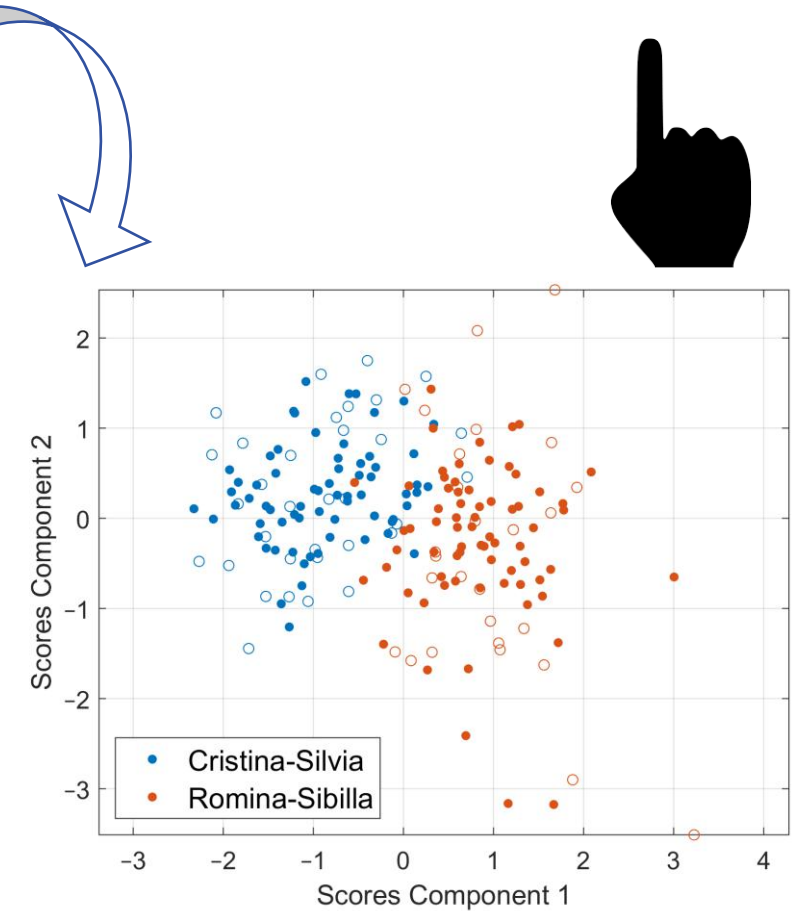
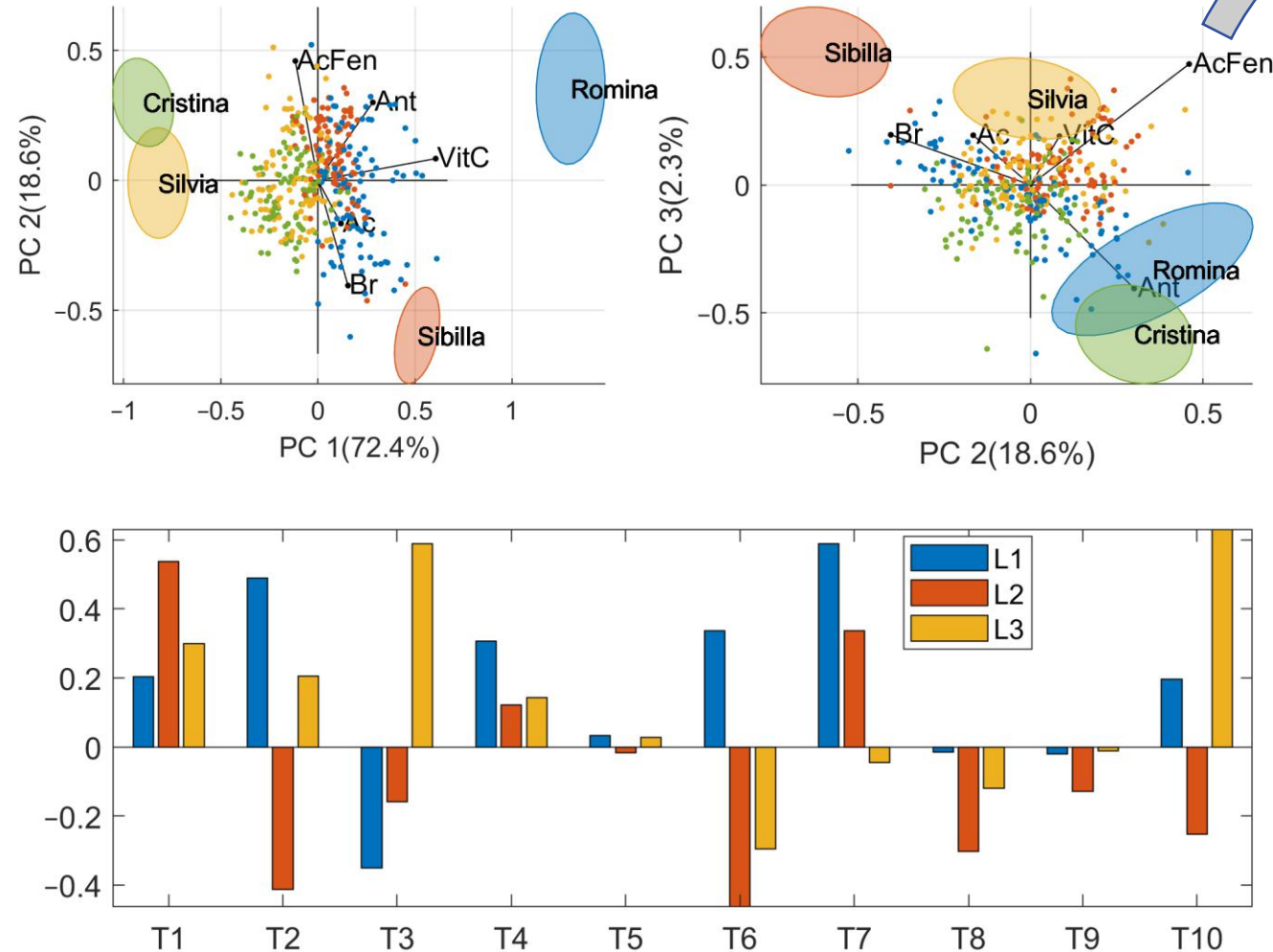
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How can
spectroscopy be
used in the
breeding process?



A better way of using PCA!

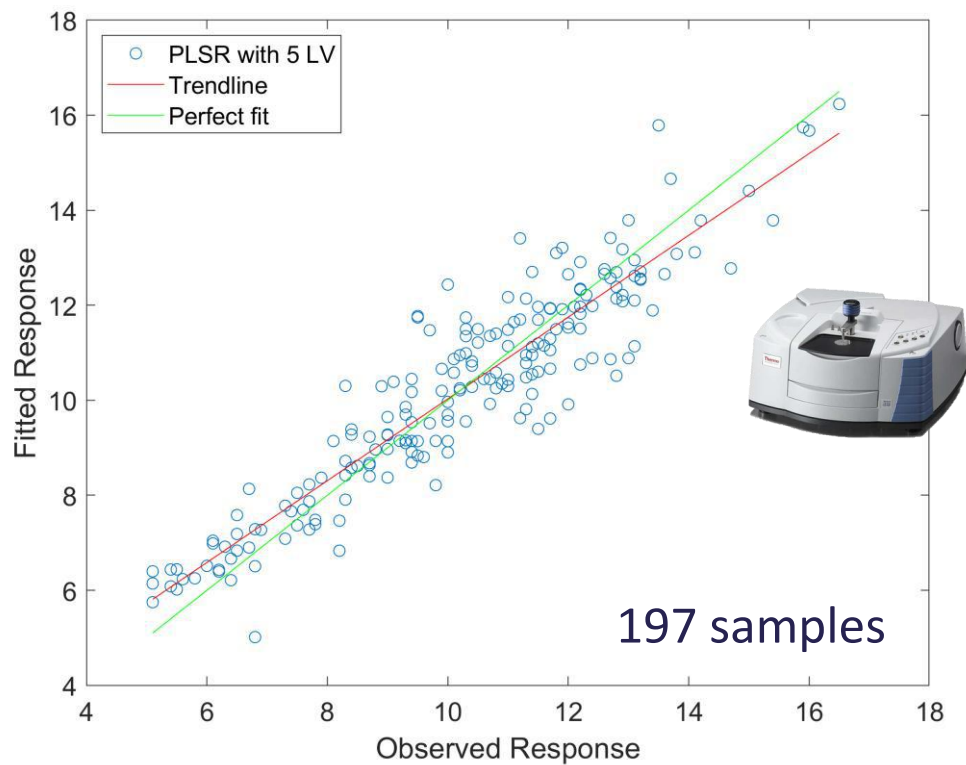
Data fusion!



~ 10%
misclassification
error

Prediction of SSC

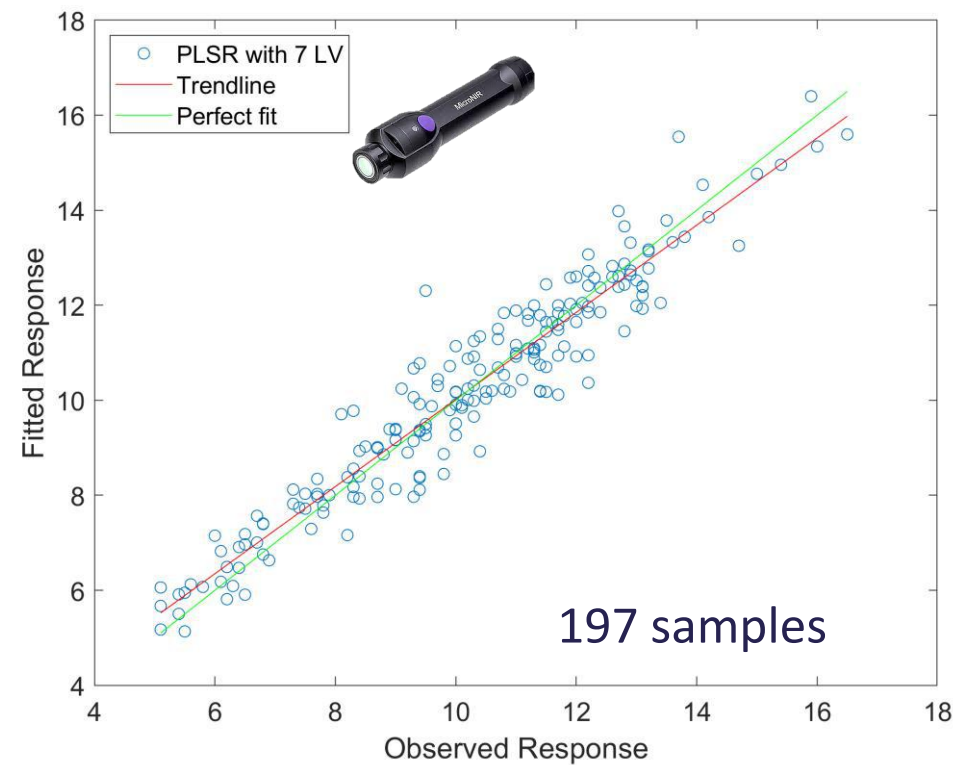
Season 2022



R^2 : 0.83

RMSECV: 1.00 ° Brix

RER: 11.4; RPD: 2.4



R^2 : 0.90

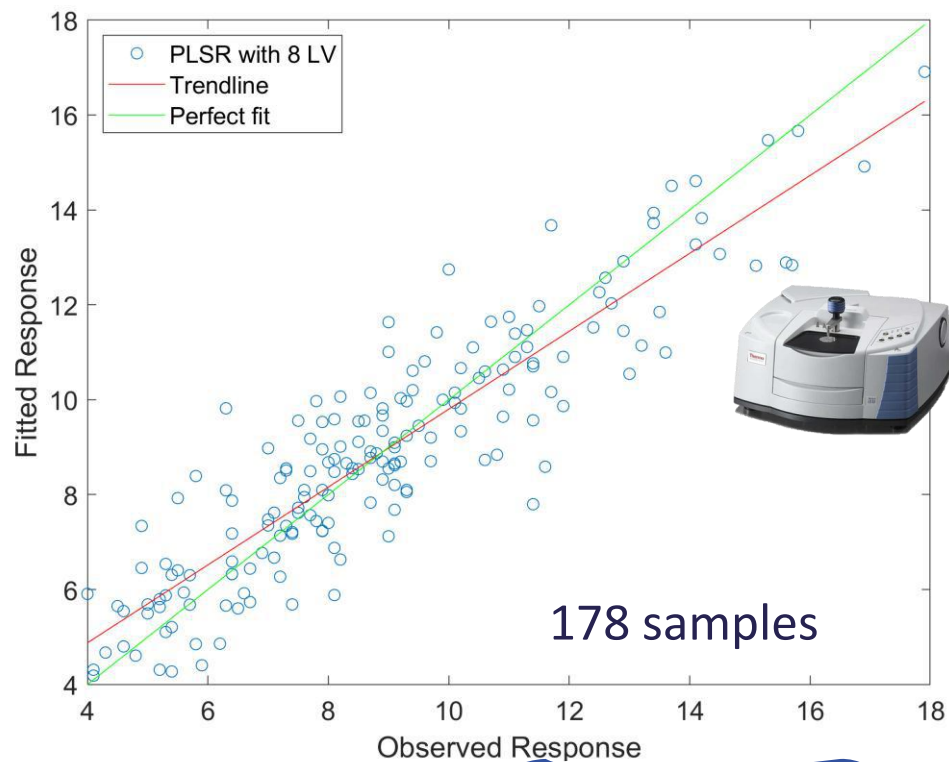
RMSECV: 0.75 ° Brix

RER: 15.2; RPD: 3.2



Prediction of SSC

Season 2023



178 samples

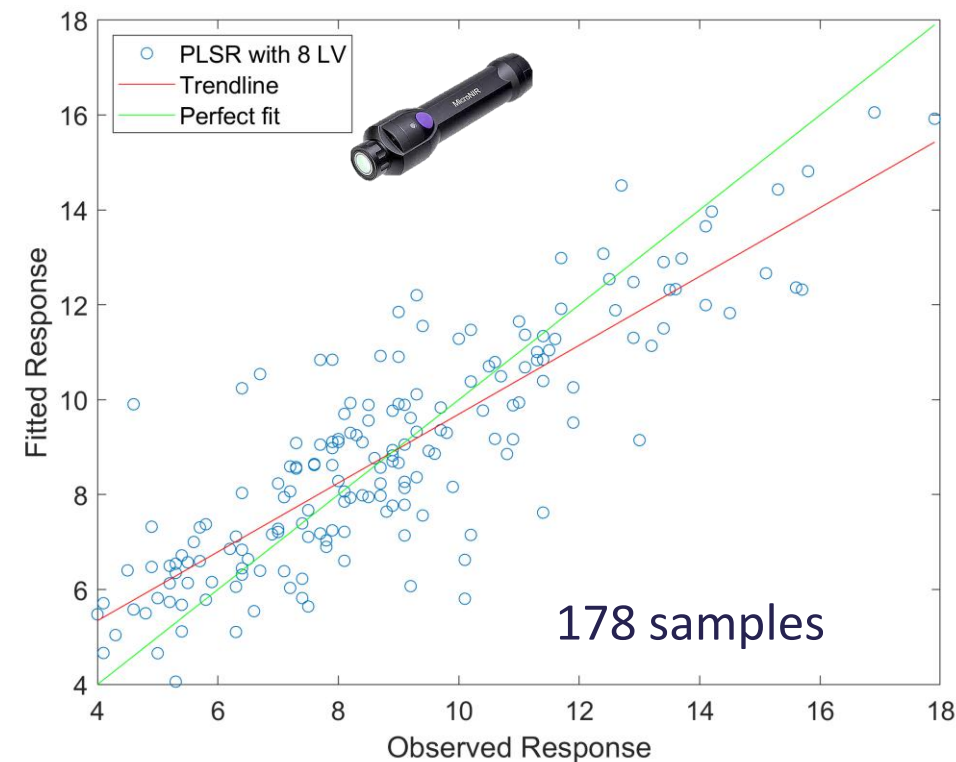
R^2 : 0.78

RMSECV: 1.33 ° Brix

RER: 10.5; RPD: 2.3

Genotypes removed from the model

- Dina
- AN12,13,58
- AN16,42,54
- AN16,15,53
- Francesca



178 samples

R^2 : 0.68

RMSECV: 1.60 ° Brix

RER: 8.7; RPD: 1.9

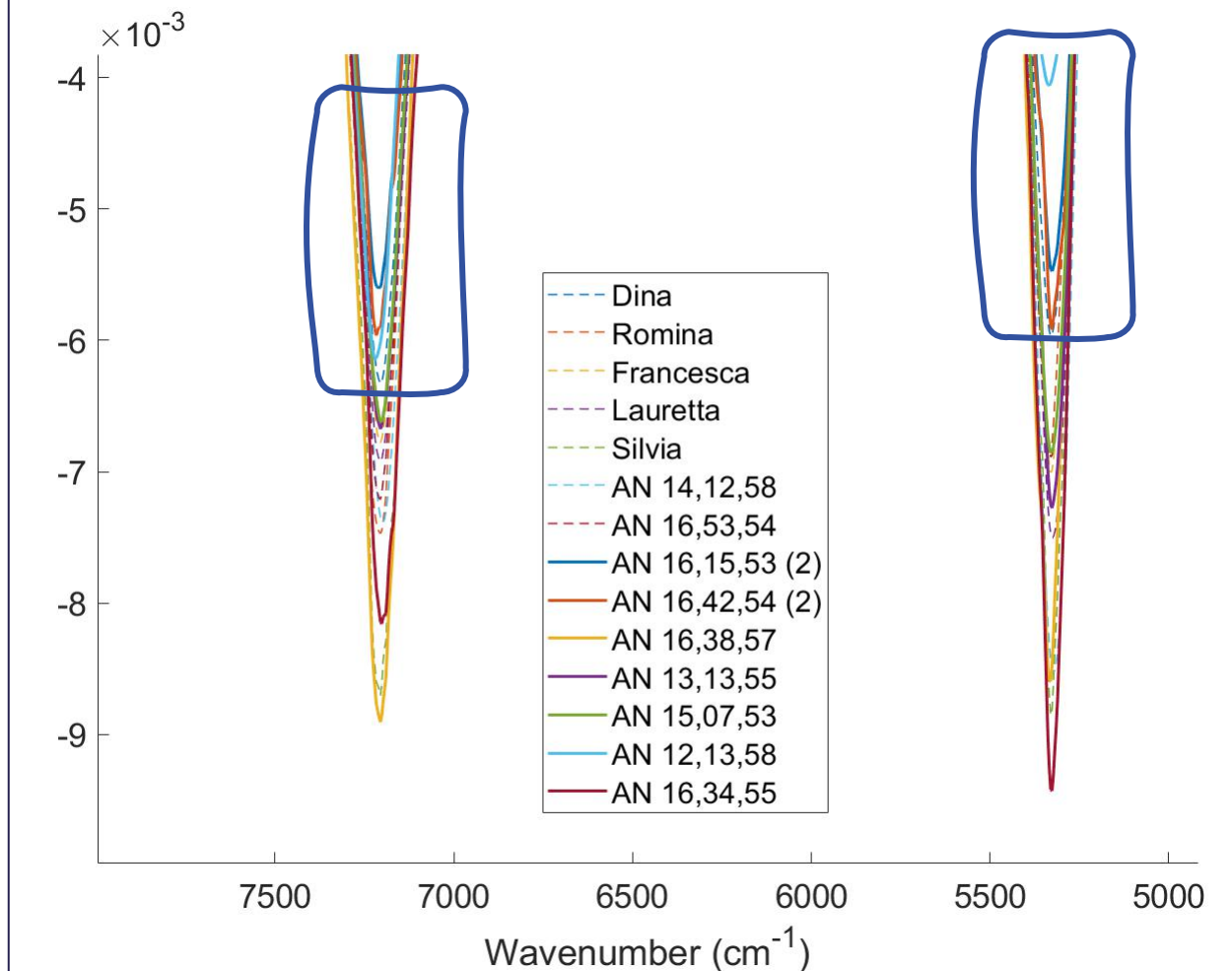
Genotypes removed from the model

- Dina
- AN12,13,58
- AN16,42,54
- AN16,15,53
- Francesca



14

Season 2023



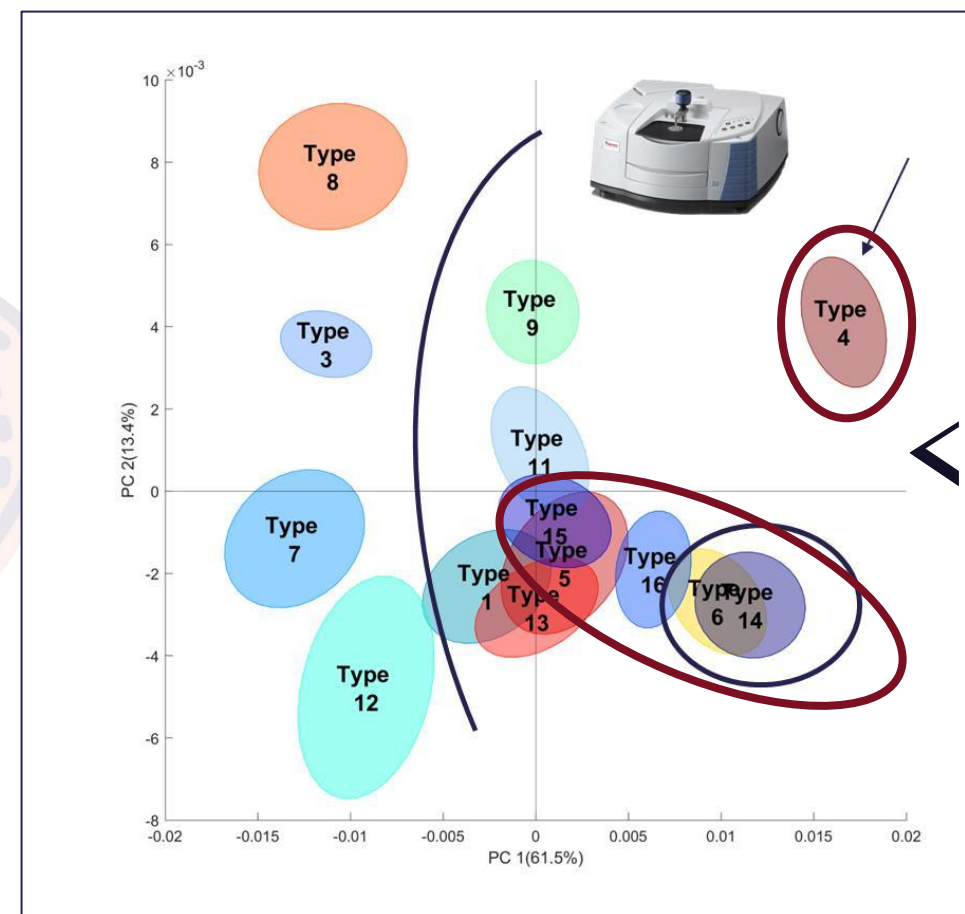
R^2 : 0.78

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RER: 10.5; RPD: 2.3

Genotypes removed from the model

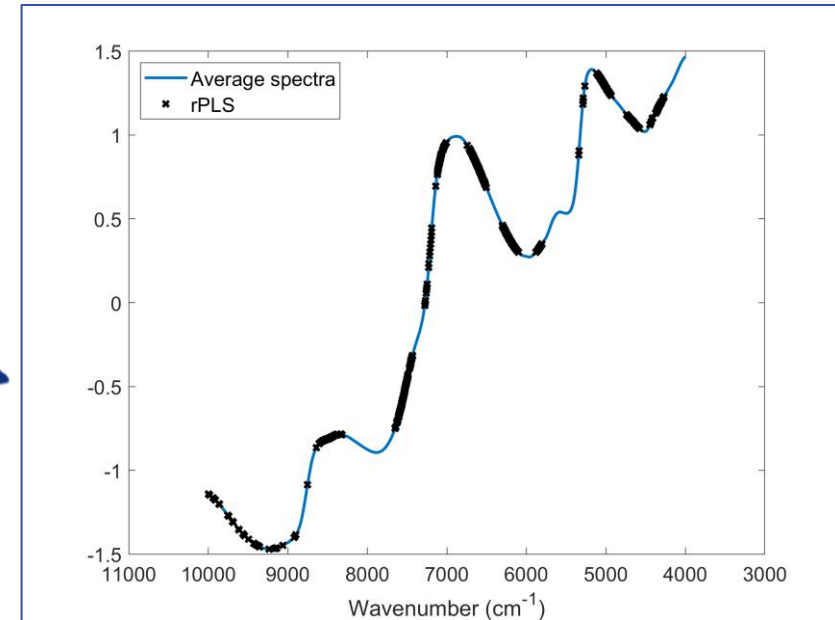
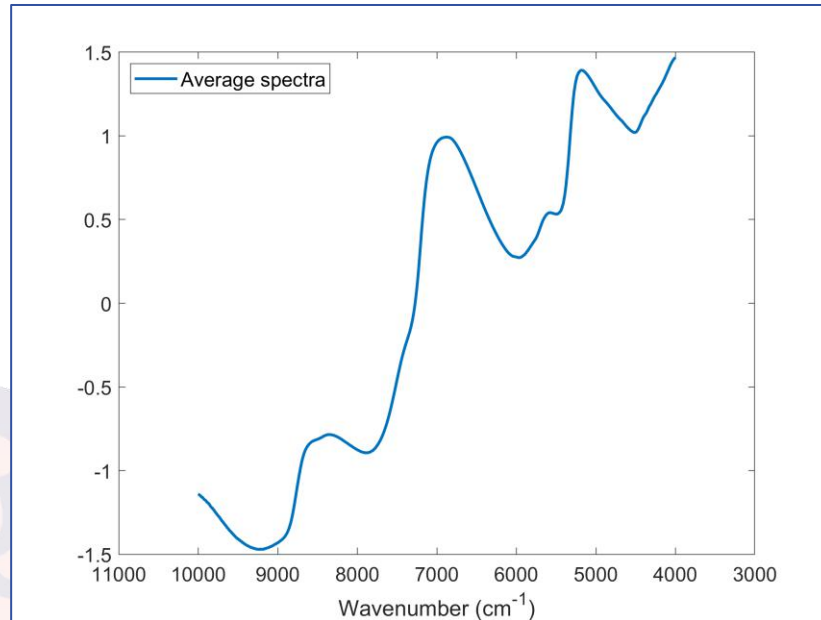
- Dina
- AN12,13,58
- AN16,42,54
- AN16,15,53
- Francesca



- Type 4
- Type 6 and 14
- Type 16
- Type 15

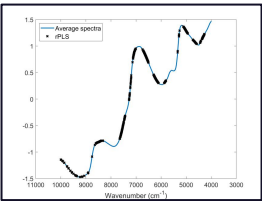
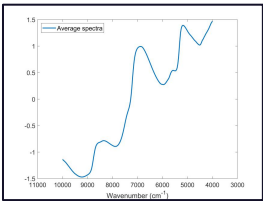


Variables selection



Recursive Partial Least Squares

Variables selection



Season 2022



Season 2022



Season 2023



Season 2023



R^2 : 0.90
RMSECV: 0.75 ° Brix
RER: 15.2; **RPD**: 3.2

R^2 : 0.83
RMSECV: 1.00 ° Brix
RER: 11.4; **RPD**: 2.4

R^2 : 0.68
RMSECV: 1.60 ° Brix
RER: 8.7; **RPD**: 1.9

R^2 : 0.78
RMSECV: 1.33 ° Brix
RER: 10.5; **RPD**: 2.3

LVs 5
 R^2 : 0.91
RMSECV: 0.73 ° Brix
RER: 15.6; **RPD**: 3.3

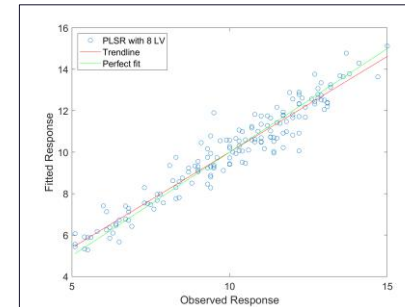
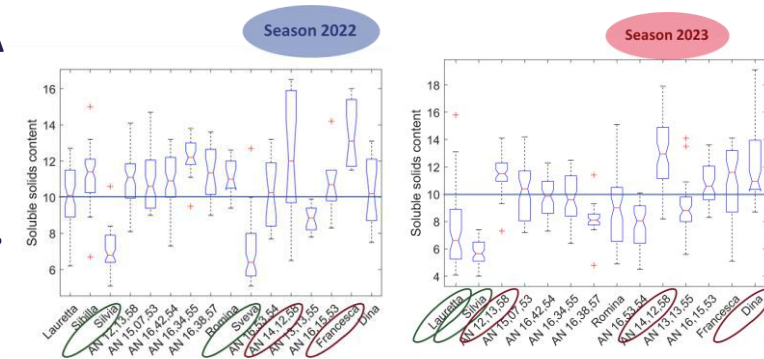
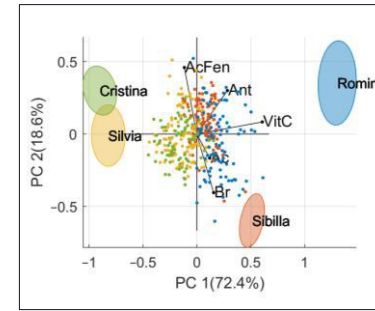
LVs 5
 R^2 : 0.87
RMSECV: 0.86 ° Brix
RER: 13.3; **RPD**: 2.8

LVs 5
 R^2 : 0.69
RMSECV: 1.60 ° Brix
RER: 8.9; **RPD**: 1.9

LVs 7
 R^2 : 0.81
RMSECV: 1.23 ° Brix
RER: 11.3; **RPD**: 2.5

Next activities

- To complete the nutritional analysis on strawberry samples and use PCA as a tool for speeding up the breeding process.
- Investigate season variability among the genotypes (season 2022-2023).
- Improve the regression models for the prediction of SSC.



**WORK IN
PROGRESS**

Conclusions: NIR spectroscopy and chemometrics has the potential to speed up the selection of new cultivars/selections with characteristics of resilience and high fruit quality

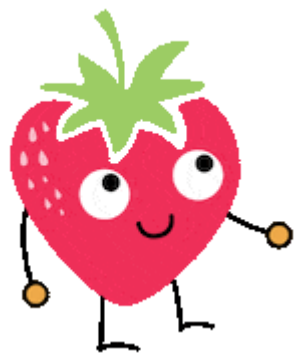
**NIR
measurement**



Early detection of
diseases



Selection of cultivars with
consumer-desirable fresh-
fruit characteristics



Thank you for the attention!