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DE LA VIGNE

VINELINK INTERNATIONAL
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ASSEMBLEE GENERALE 2017
2017 General Assembly

NOUVEAUX OUTILS POUR LE SUIVI DE LA QUALITE DES RAISINS :

Capteurs, analyse des données, outils d'aide à la décision

New tools for monitoring grapes quality : sensors, data analysis, decision

Hyperspectral imaging for viticultural applications

Javier Tardaguila

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Televitis
DATA-DRIVEN VITICULTURE

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10-year-experience in precision viticulture

New non-invasive sensing technologies

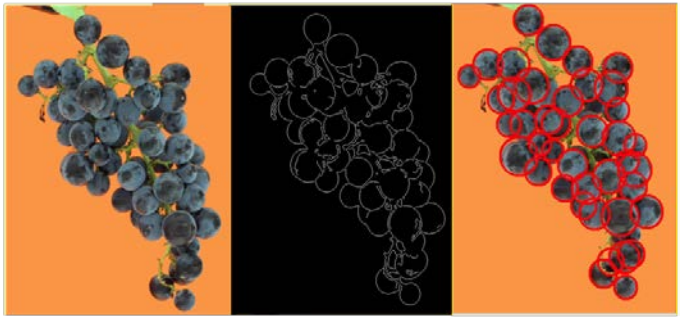
Vineyard monitoring / Phenotyping

Vineyard monitoring / Phenotyping

Water status

vitisFlower Apps

Grape composition



Yield components

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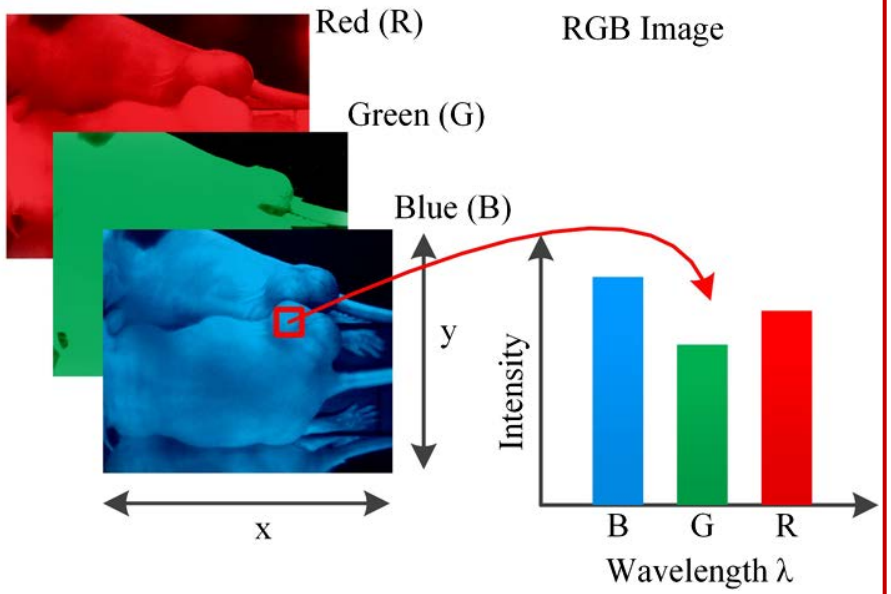
Televitis mobile lab

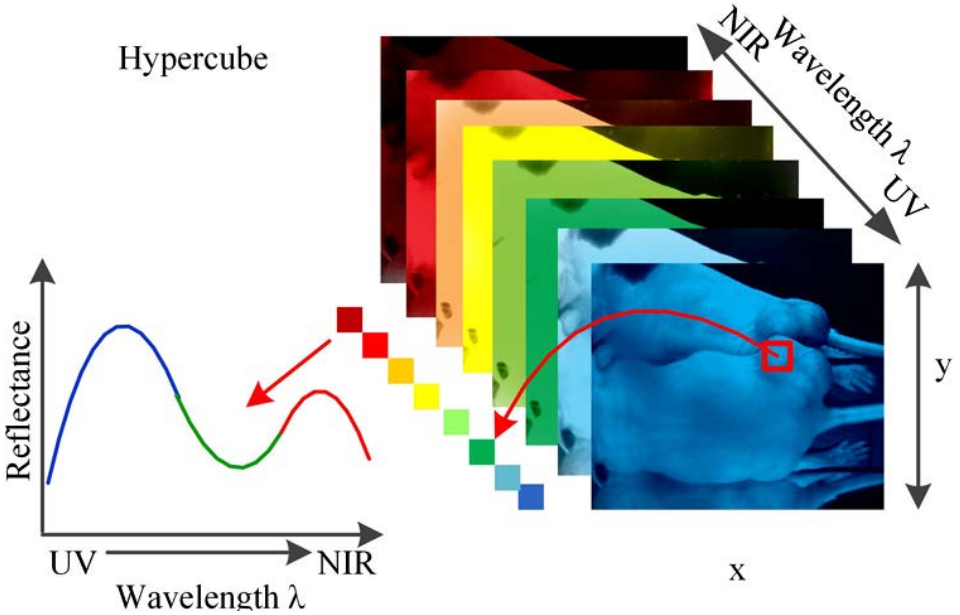
Robotics in viticulture

Hyperspectral imaging

RGB Imaging



Hyperspectral Imaging

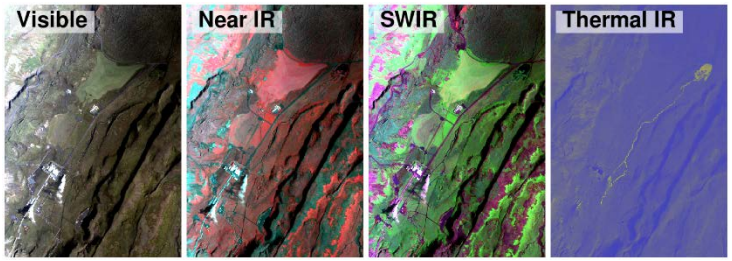


Hyperspectral imaging are based on the combined acquisition of an **image** and **spectral data**

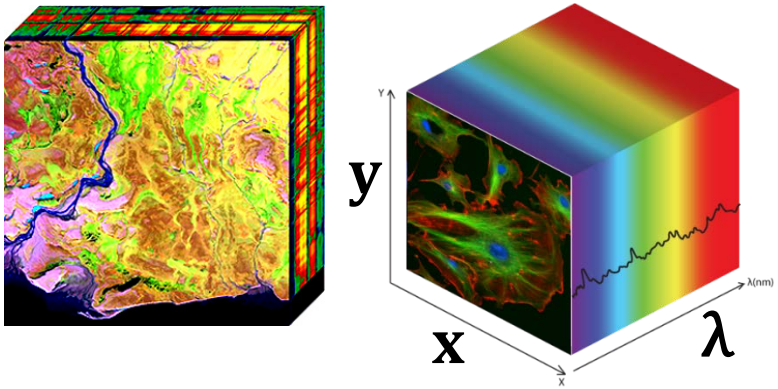
Hyperspectral and multispectral imaging

- ***Multispectral imaging*** consists in acquiring an image within **narrow discrete spectral bands**
- ***Hyperspectral imaging*** provides one **full spectrum** for each pixel of the collected image

Multispectral imaging

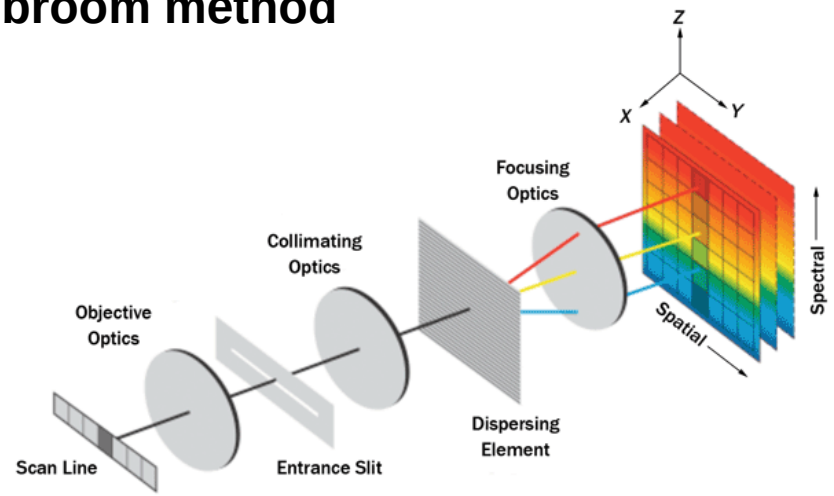


Hyperspectral imaging

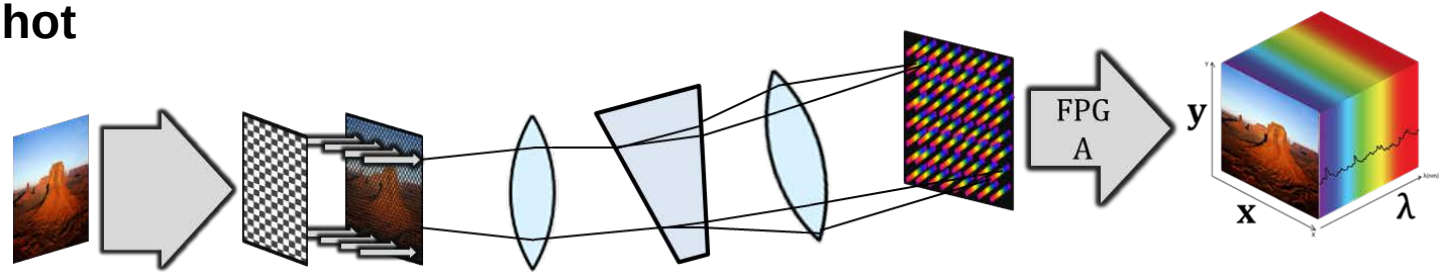


Hyperspectral imaging adquisition technologies

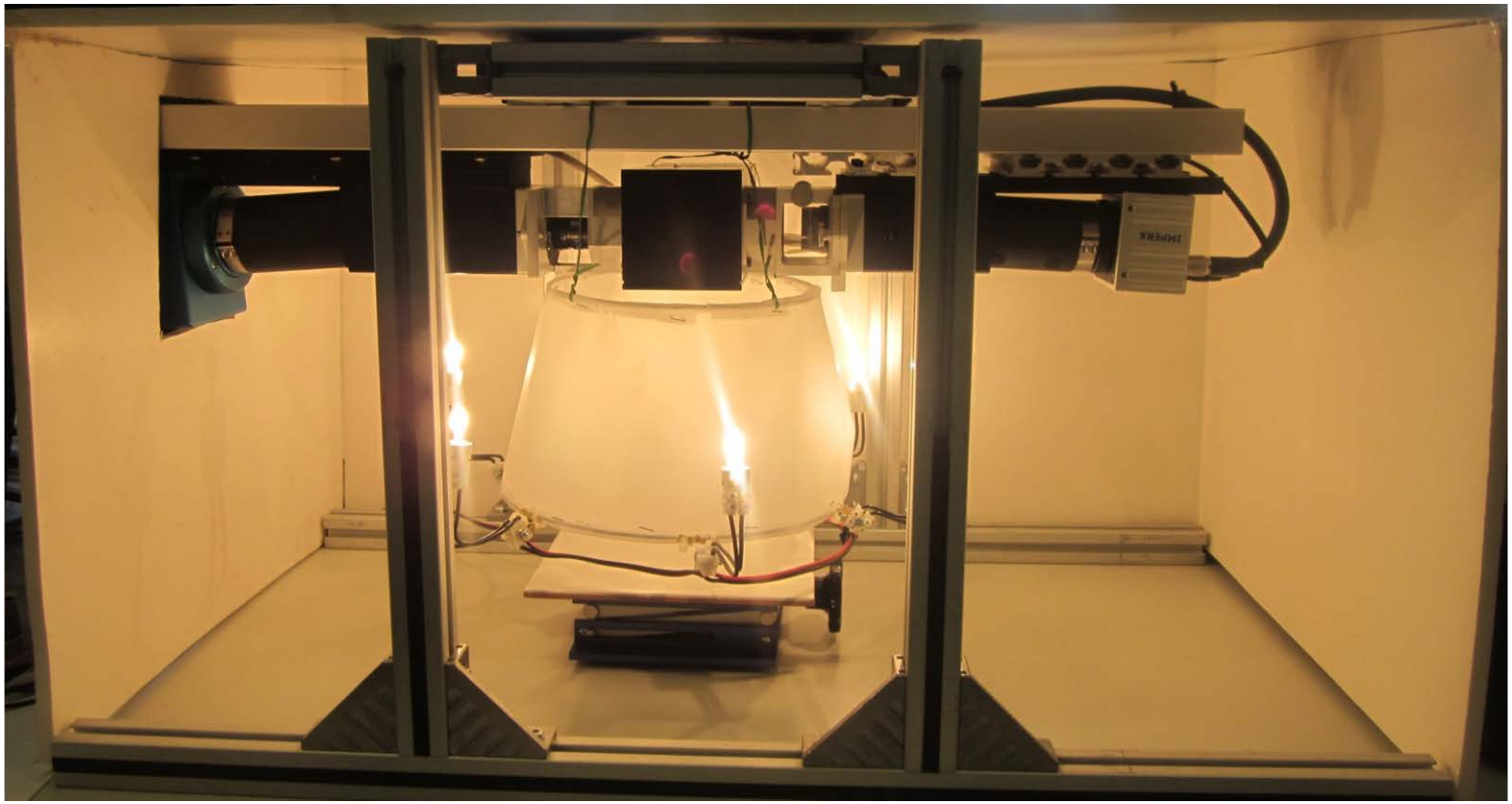
1. Scanning or push-broom method



2. Snapshot



VIS and NIR hyperspectral cameras at the Televitis lab



- Visible: 400 - 1000 nm (1200 bands)
- Near Infrared: 900 - 1700 nm (256 bands)

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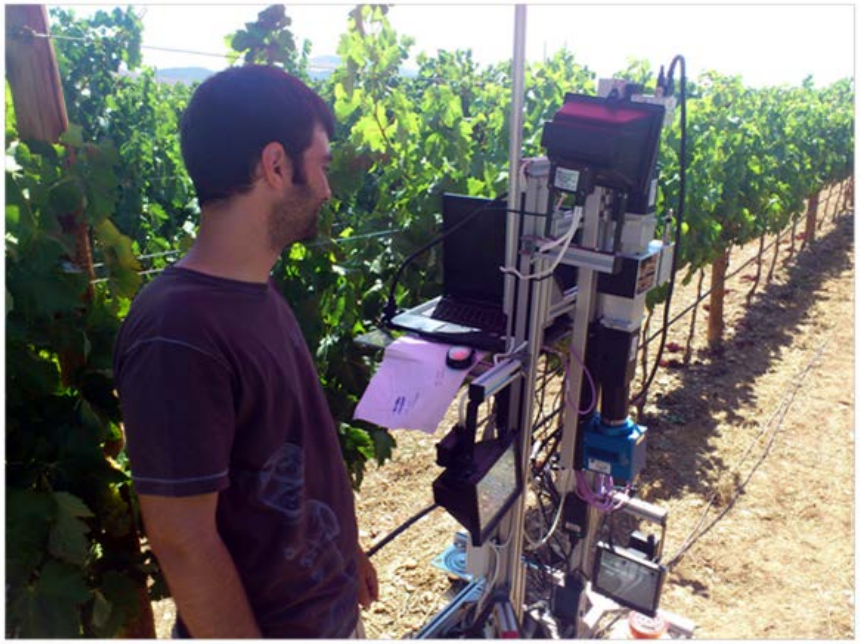
Hyperspectral imaging under field conditions



Tempranillo commercial vineyard
Logroño, La Rioja, 2013

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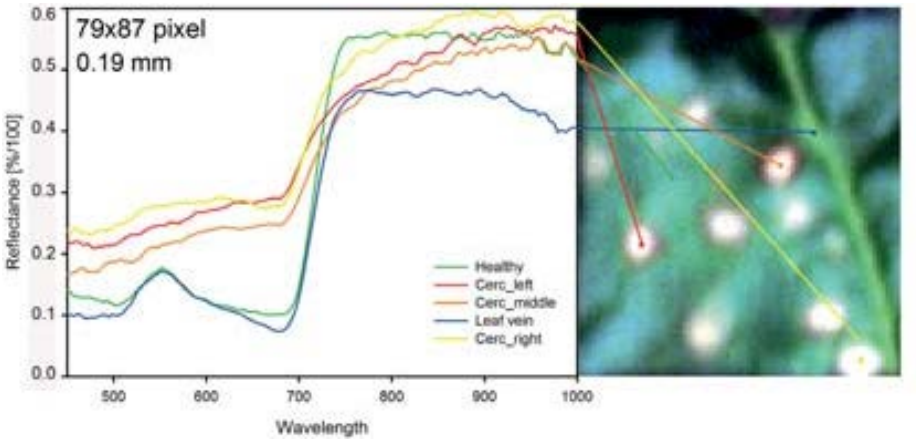
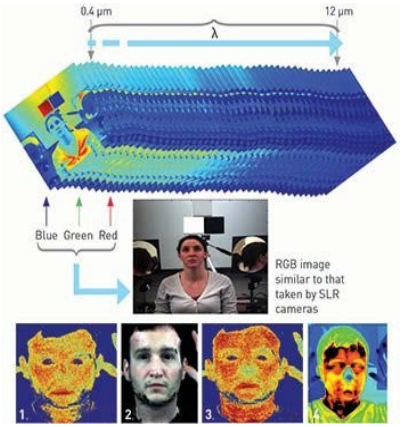
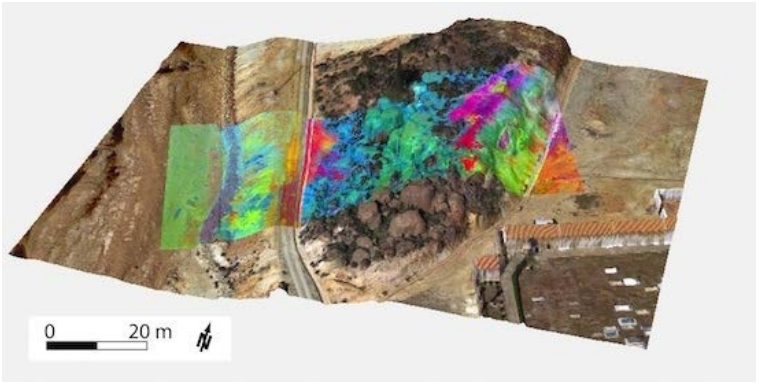
Hyperspectral imaging applications

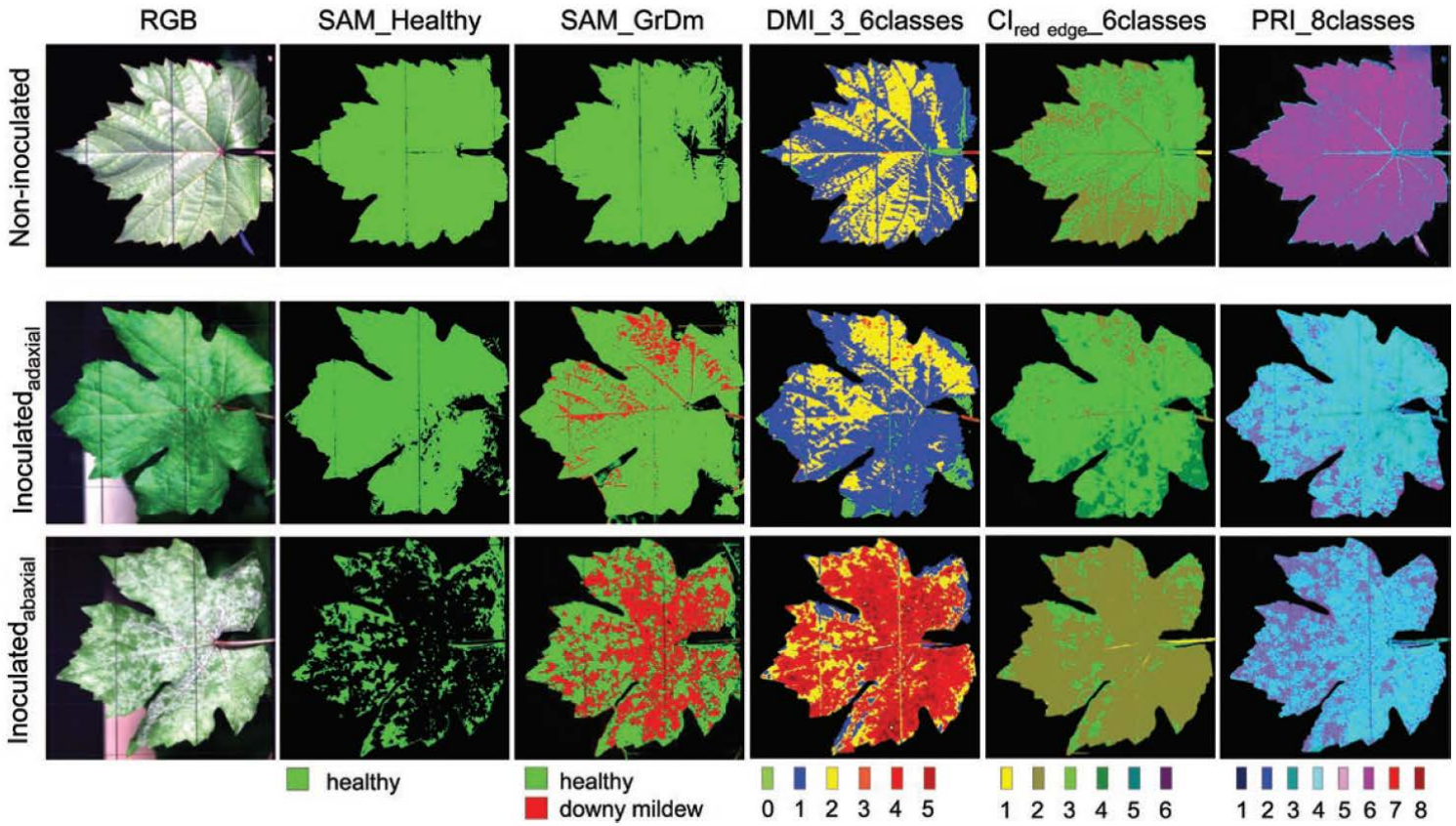
- Agriculture
- Forestry
- Environment
- Defence
- Medicine
- Water
- Food quality and safety control
- Geology
- Crime scene detection







Downey mildew phenotyping

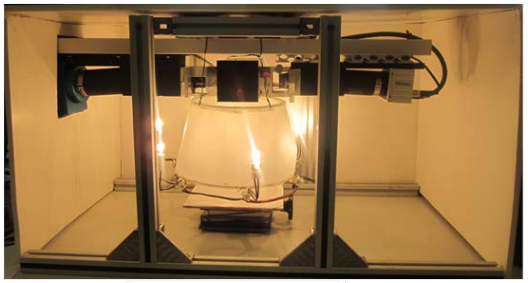


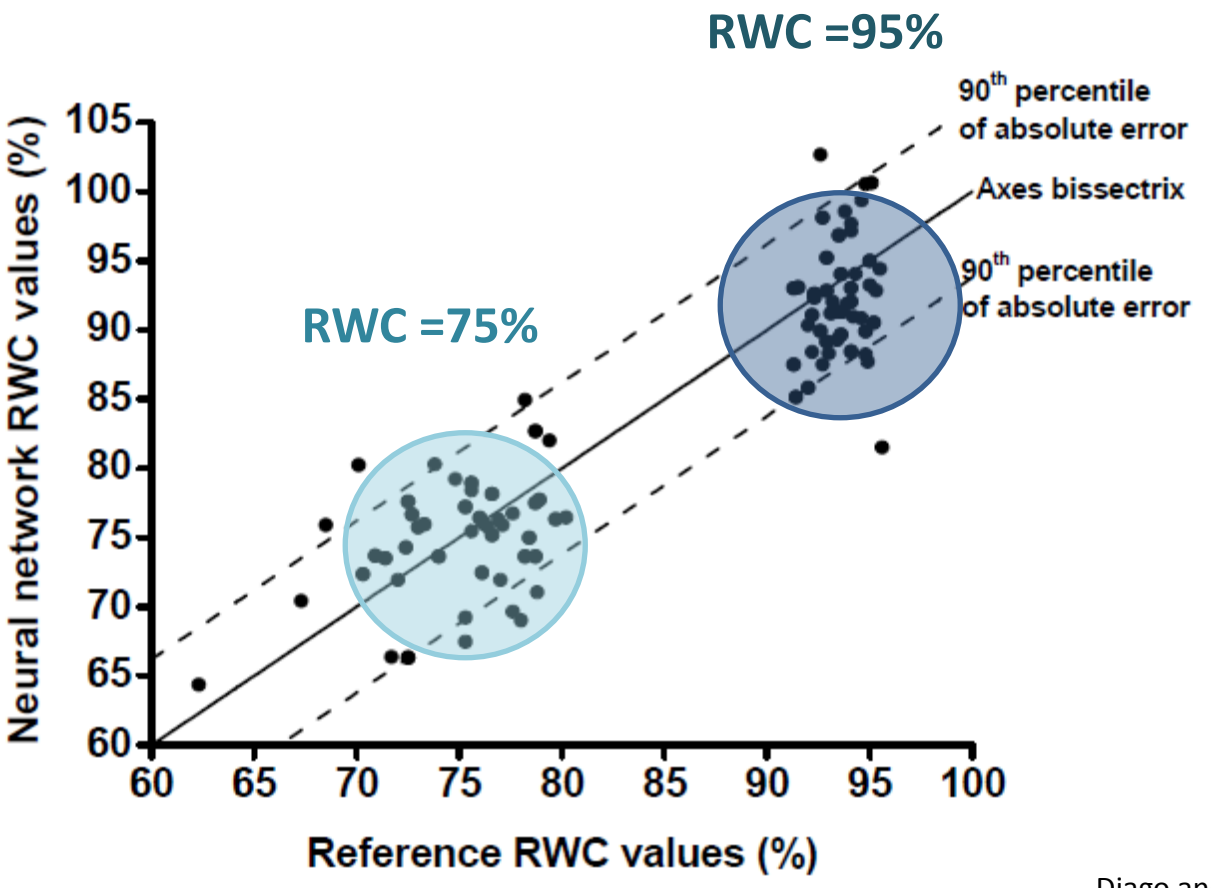
Hyperspectral phenotyping of the reaction of grapevine genotypes to *Plasmopara viticola*

Erich-Christian Oerke[1,*], Katja Herzog[2] and Reinhard Toepfer[2]

Journal of Experimental Botany 2016

Assessment of leaf water status





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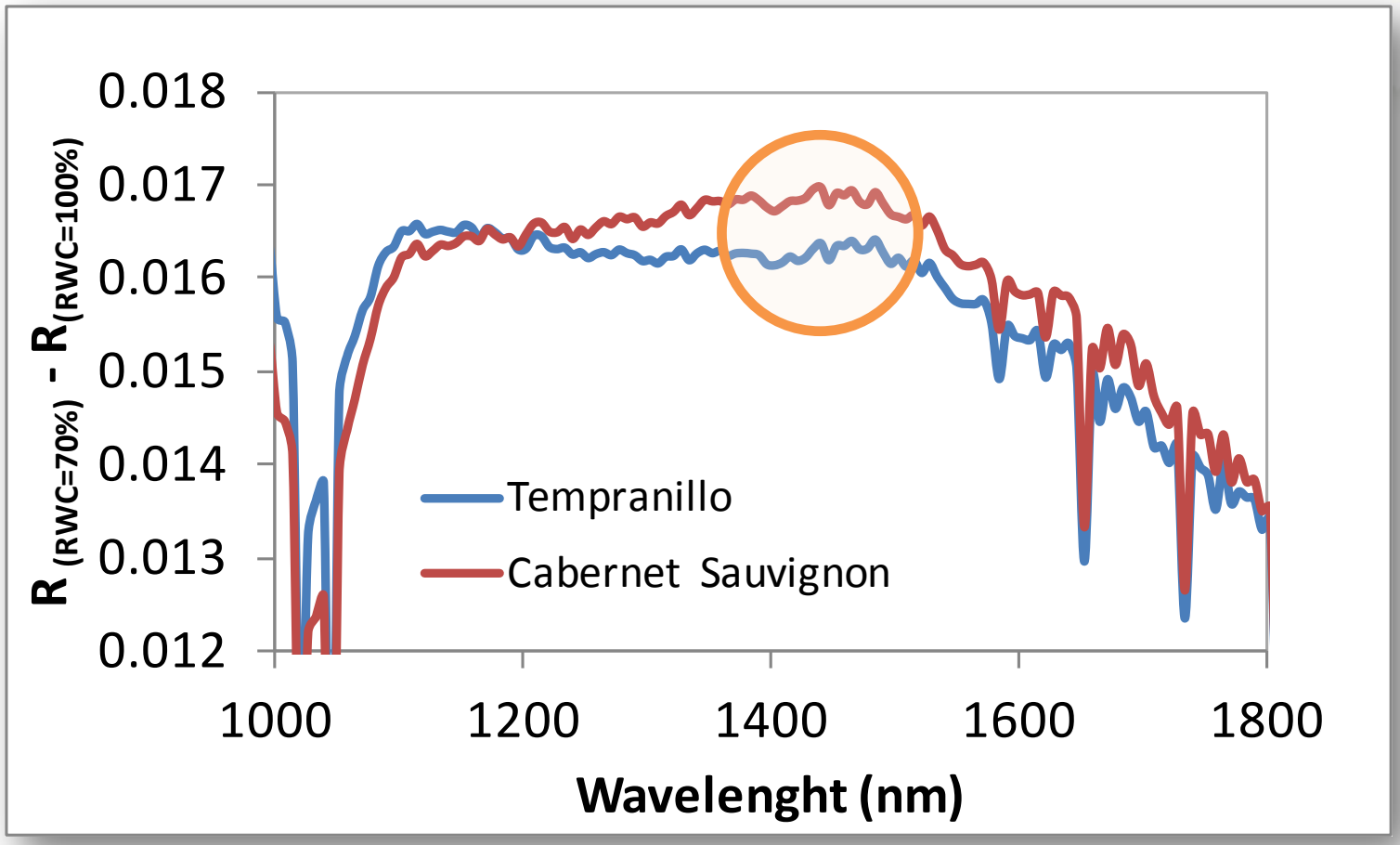
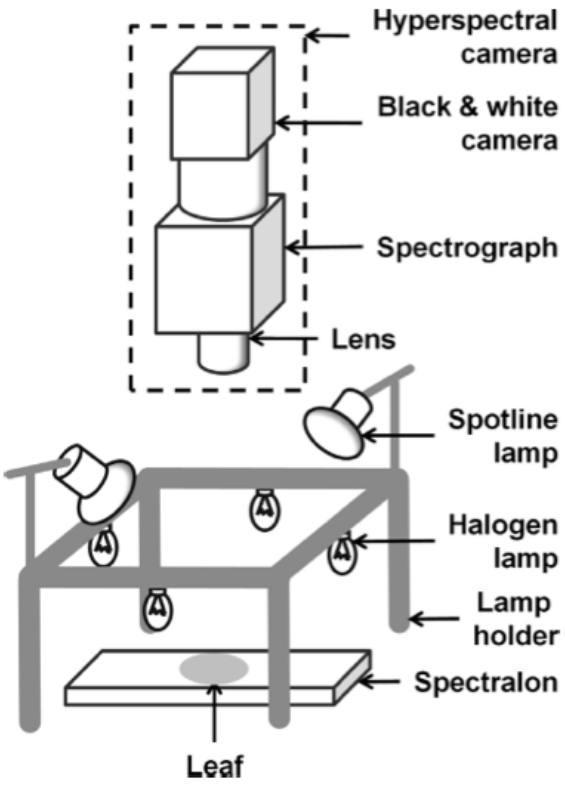
Diago and Tardaguila 2012.
7th Inter. Symp. on Irrigation of Horticultural Crops.

Spectral response to grapevine variety



Discrimination of grapevine varieties and clones

OBJECTIVE: *Varieties and clones discrimination by hyperspectral imaging*



IMPLEMENTATION:

SPECTRA ADQUISITION:

- Passive sensor: hyperspectral cameras working in the visible and NIR range
- Using leaf disc images

DATA MINING:

- Different preprocessing techniques: normalization
- PLS for classification
- Model evaluation: Montecarlo CV

Classification of varieties and clones

Grenache

Clones

RJ 26
RJ11
ARA 4
ARA 24

Tempranillo

Clones

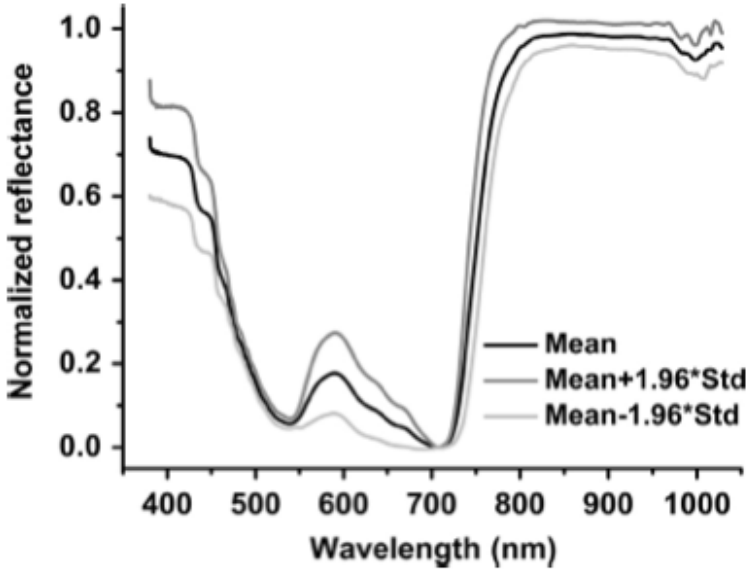
RJ 75
RJ 43
RJ 26
RJ 24

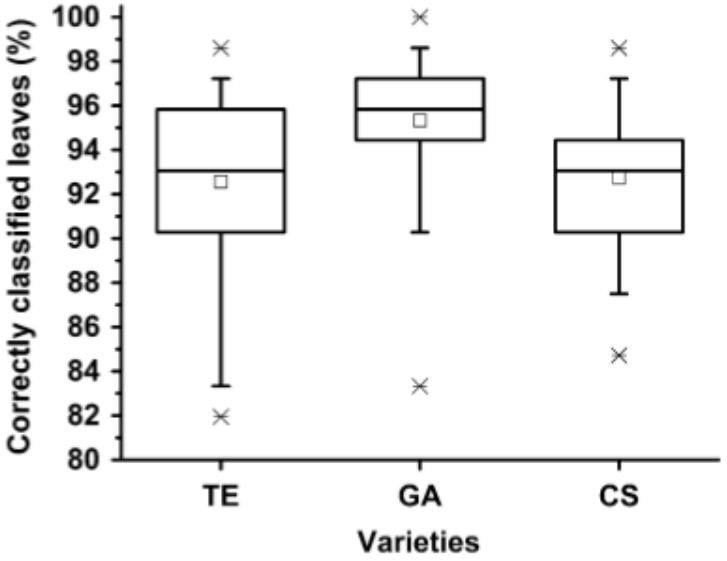
Cabernet Sauvignon

Clones

R5
169
15
685

Classification of grapevine varieties



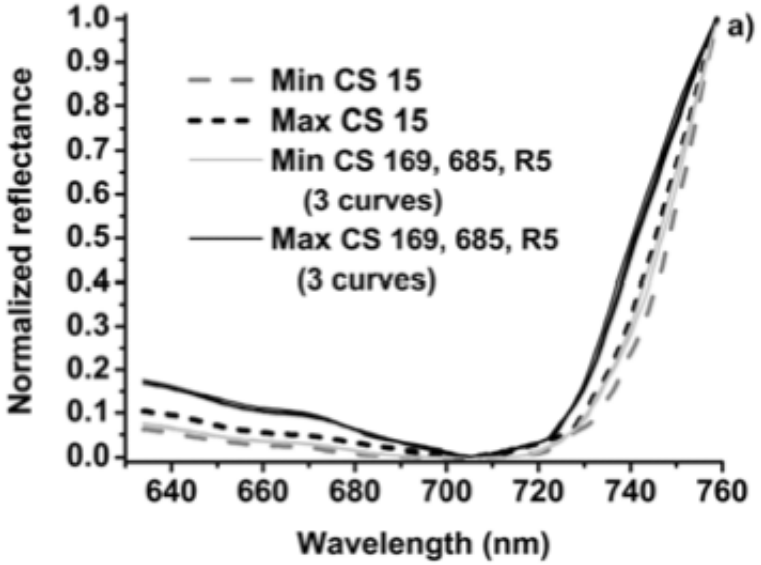


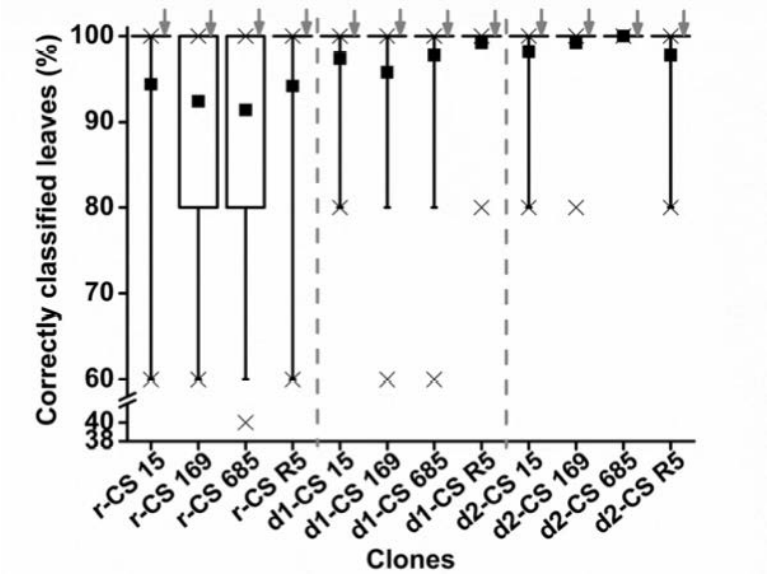
Diago, M.P., Fernandes, A.M., Millan, B., Tardaguila, J., Melo-Pinto, P 2013. Identification of grapevine varieties using leaf spectroscopy and partial least squares. Computers and Electronics in Agriculture 99, 7– 13.

Three correctly classified varieties:

- Grenache (GA)
- Cabernet Sauvignon (CS)
- Tempranillo (TE)

Discrimination of grapevine clones





Fernandes, A.M.,, Melo-Pinto Millán, B., Tardáguila, J. Diago, M.P., 2015. Automatic discrimination of grapevine (Vitis vinifera) clones using leaves hyperspectral imaging and partial least squares regression. Journal of Agricultural Science 153:455-465

Hyperspectral imaging to fingerprint anthocyanins

JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

Article

pubs.acs.org/JAFC

Use of Visible and Short-Wave Near-Infrared Hyperspectral Imaging To Fingerprint Anthocyanins in Intact Grape Berries

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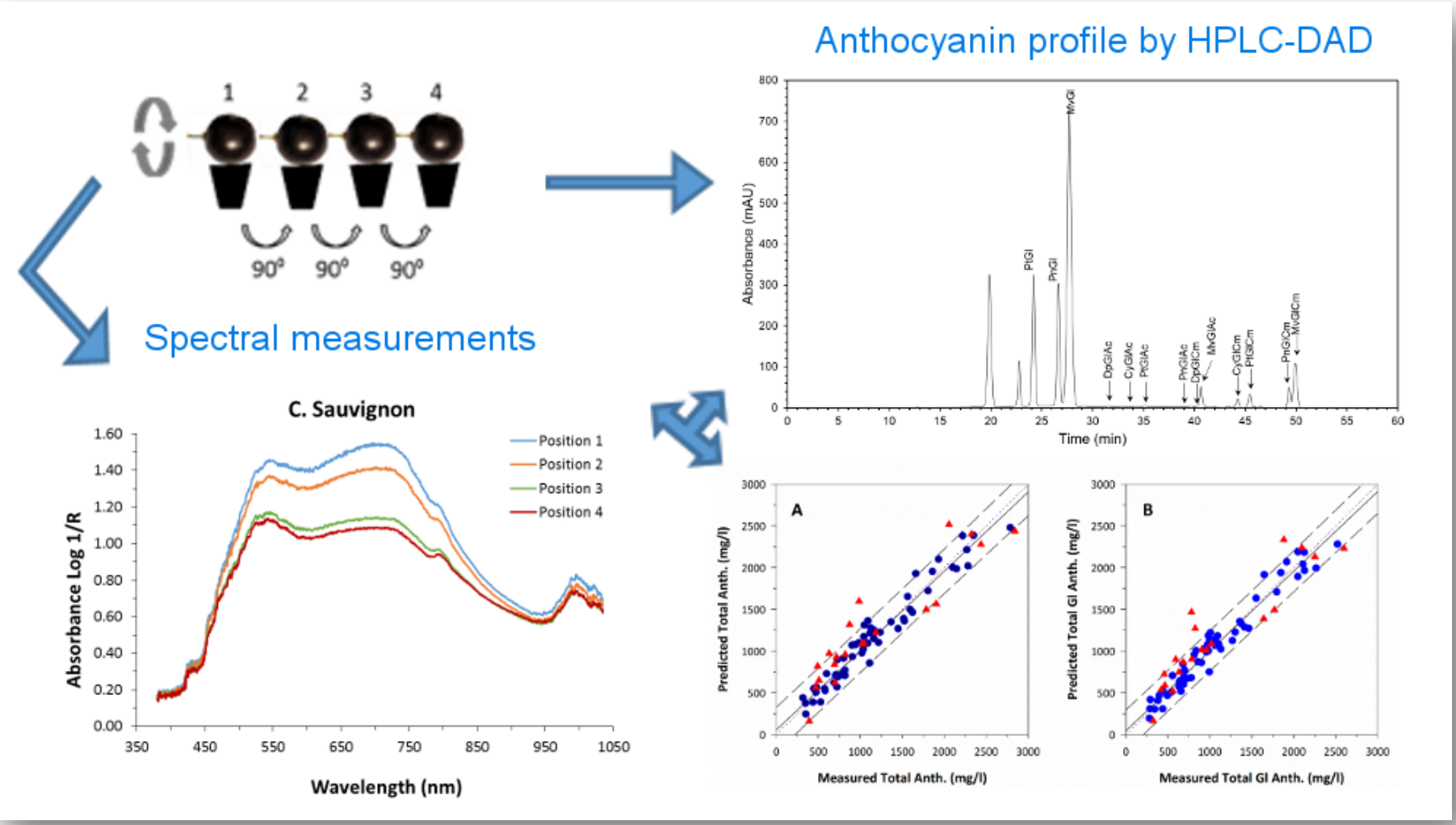
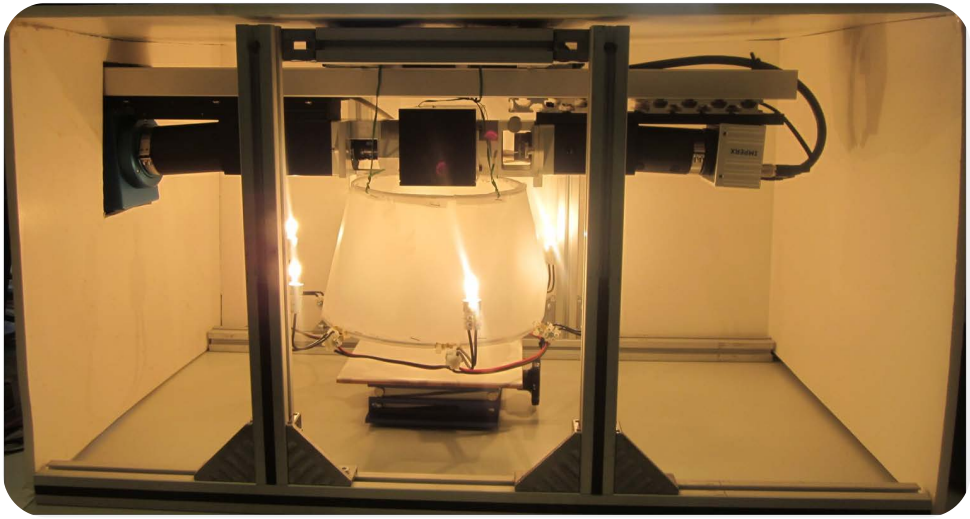
Hyperspectral imaging for fingerprint anthocyanins

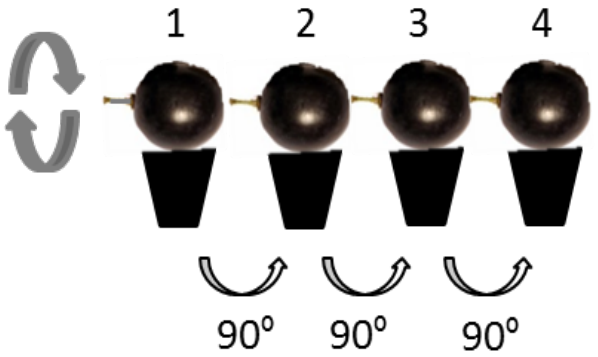


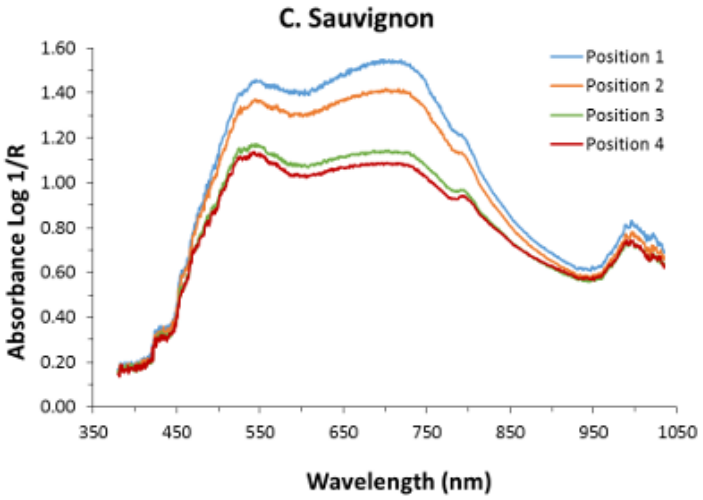
Hyperspectral imaging to fingerprint anthocyanins

- 8 red varieties
- 10 berries/variety

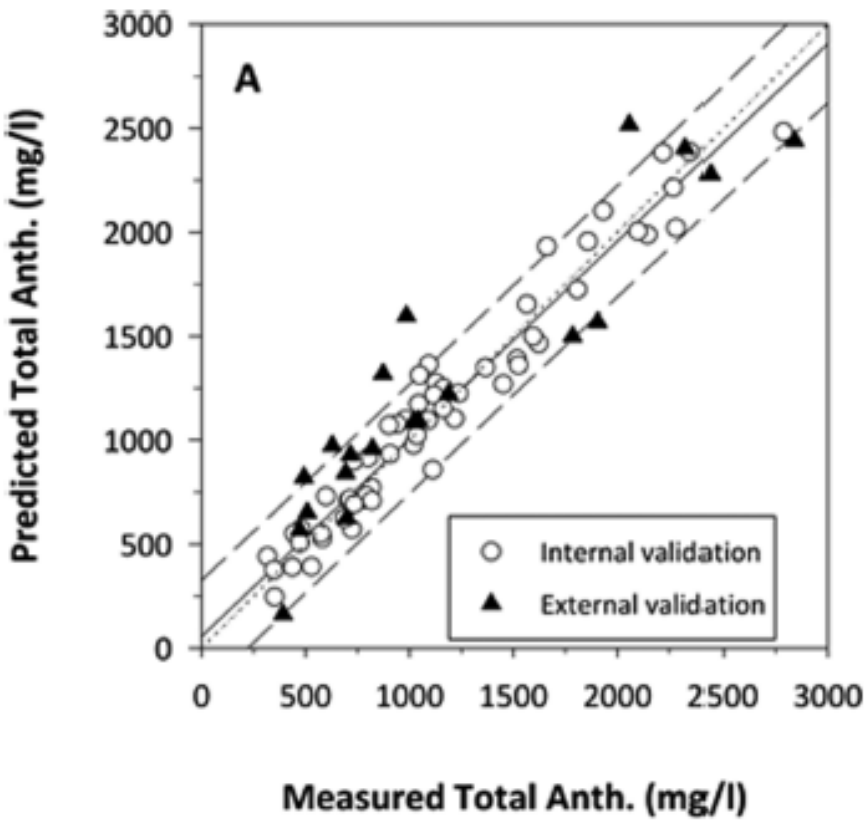


VIS-SWNIR Hyperspectral camera (400-1000 nm)

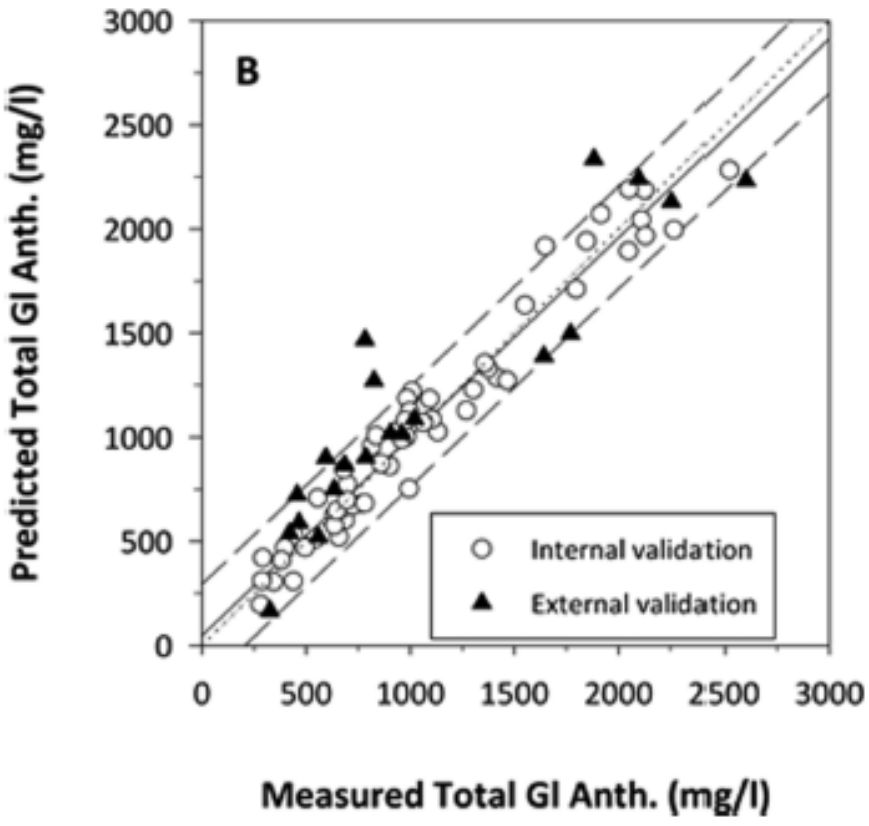




Hyperspectral imaging to fingerprint anthocyanins



R^2_P=0.86

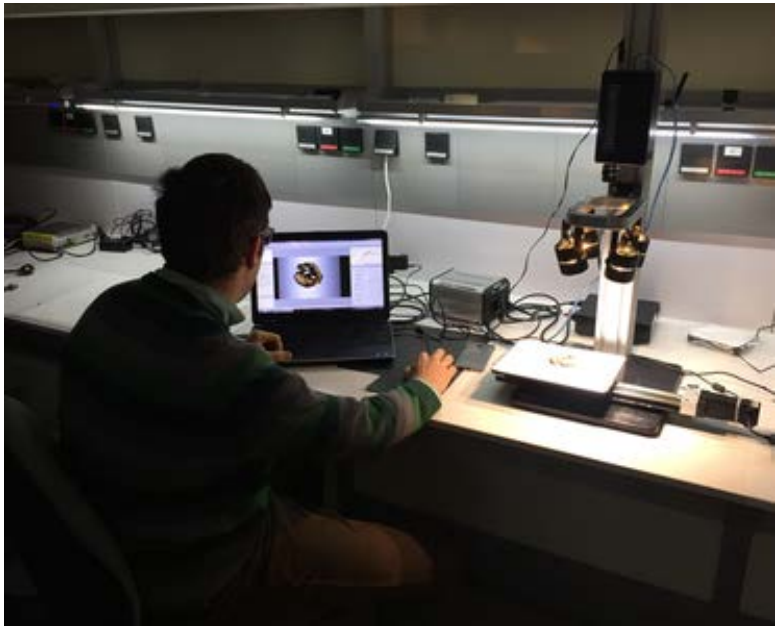


R^2_P=0.86

Hyperspectral imaging to fingerprint anthocyanins

compound	spectral treatment	N	SD	minimum	maximum	PLS factor	calibration		cross-validation			external validation[b]	
							SEC	R^2_C	SECV	R^2_{CV}	RPD	SEP	R^2_P
Total Anth	Snv-DT 1.5.5.1	76	629.46	315.87	2839.96	4	148.25	0.94	189.05	0.91	3.51	281.58	0.86
Total Gl Anth	1.5.5.1	74	562.69	280.73	2521.24	4	125.97	0.95	155.94	0.92	4.03	272.60	0.86
Total GlAc Anth	2.5.5.1	73	12.80	1.16	54.26	5	1.98	0.98	4.12	0.90	4.10	4.82	0.51
Total GlCm Anth	1.5.5.1	73	56.49	4.02	221.37	6	13.42	0.94	23.09	0.83	2.55	42.72	0.40
MvGl	Snv-DT 1.5.5.1	76	201.85	226.56	1100.02	4	56.014	0.92	73.93	0.87	2.87	109.10	0.83
MvGlAc	2.5.5.1	48	13.39	0.09	46.49	6	1.32	0.99	4.13	0.90	4.27	3.30	0.90
MvGlCm	Snv-DT 1.5.5.1	75	29.78	0.73	119.94	7	6.99	0.94	13.32	0.80	2.33	23.33	0.57
PtGl	Snv-DT 1.5.5.1	75	108.00	16.25	426.94	4	23.29	0.95	29.44	0.93	4.01	49.66	0.87
PtGlAc	1.5.5.1	72	1.50	0.23	6.09	3	0.73	0.76	0.98	0.57	2.00	1.18	0.35
PtGlCm	1.5.5.1	71	6.72	0.28	26.06	7	1.12	0.97	2.04	0.91	3.98	4.44	0.84
DpGl	Snv-DT 1.5.5.1	78	158.65	9.67	657.71	4	36.89	0.95	48.41	0.91	3.78	71.39	0.88
DpGlAc													
DpGlCm	Snv-DT 1.5.5.1	72	11.59	0.50	46.49	7	1.83	0.97	3.28	0.92	4.51	2.34	0.48
PnGl	Snv-DT 1.5.5.1	73	86.47	10.06	383.09	7	15.93	0.97	30.35	0.88	3.46	49.10	0.81
PnGlAc	Snv-DT 2.5.5.1	69	0.69	0.02	2.82	2	0.26	0.86	0.31	0.80	2.61	0.35	0.88
PnGlCm	Snv-DT 2.5.5.1	71	7.56	0.34	37.53	4	2.14	0.92	3.81	0.75	2.38	6.50	0.54
CyGl	1.5.5.1	67	47.50	0.58	159.63	6	8.59	0.97	16.43	0.88	6.51	48.85	0.69
CyGlAc	1.5.5.1	54	0.33	0.01	1.26	2	0.14	0.81	0.16	0.77	3.94	0.16	0.85
CyGlCm	1.5.5.1	70	4.80	1.46	19.14	5	1.21	0.94	1.78	0.86	3.10	3.82	0.63

Hyperspectral imaging to assess esca disease



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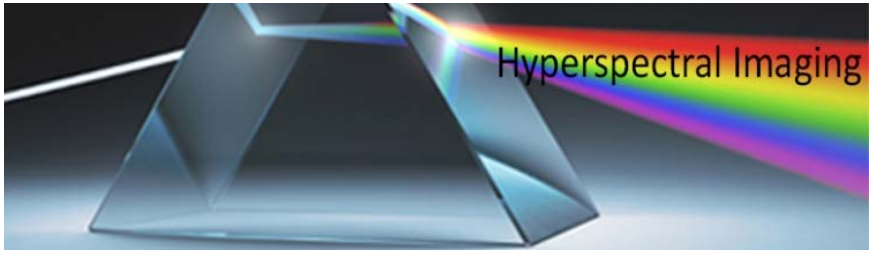
Conclusions

- Advanced and powerful technology for vineyard monitoring and phenotyping
- Indoor and outdoor working conditions
- Proximal and remote sensing applications
- Assessment of grape composition, water status, diseases, etc.
- High flexibility to target specific problems



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