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100
1918 · 2018

forward together · saam vorentoe · masiye phambili

Making the invisible, visible at Department of Food Science, SU

Dr Paul J Williams

15 October 2020

Contents

Background and context

Making grain great again

Analytica Chimica Acta 653 (2009) 121–130

Contents lists available at ScienceDirect

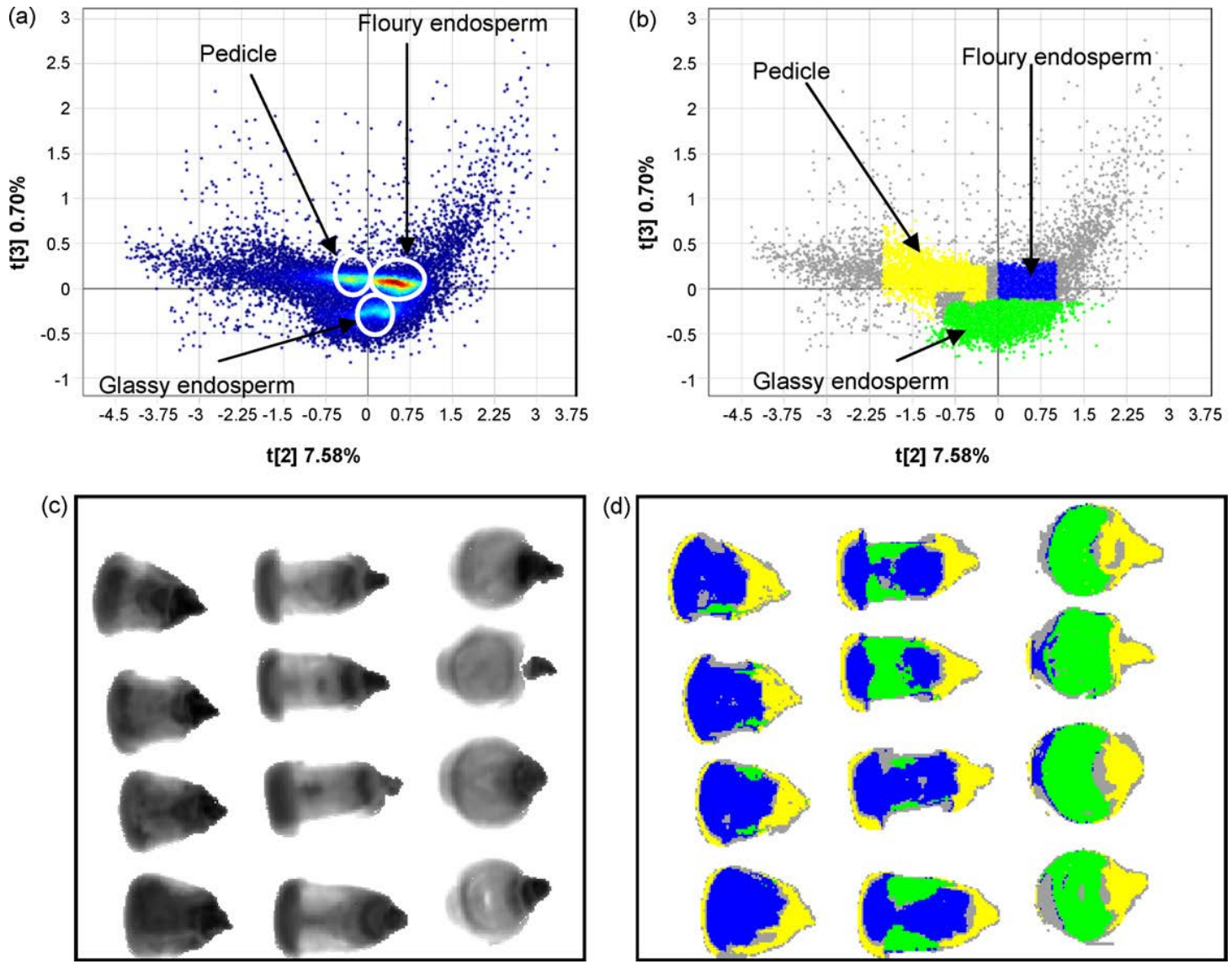
Analytica Chimica Acta

journal homepage: www.elsevier.com/locate/aca

Maize kernel hardness classification by near infrared (NIR) hyperspectral imaging and multivariate data analysis

Paul Williams[a], Paul Geladi[b], Glen Fox[a,c], Marena Manley[a,*]

[a] *Department of Food Science, Stellenbosch University, Private Bag X1, Matieland (Stellenbosch), 7602, South Africa*
[b] *Unit of Biomass Technology and Chemistry, Swedish University of Agricultural Sciences, KBC Huset, Linnaeus vaeg 6, SE 901 87 Umeå, Sweden*
[c] *Department of Primary Industries and Fisheries, Queensland Grains Research Laboratory, PO Box 2282, Toowoomba, Queensland 4350, Australia*


(a)
Pedicle
Floury endosperm
Glassy endosperm
t[3] 0.70%
t[2] 7.58%
(b)
Pedicle
Floury endosperm
Glassy endosperm
t[3] 0.70%
t[2] 7.58%
(c)
(d)

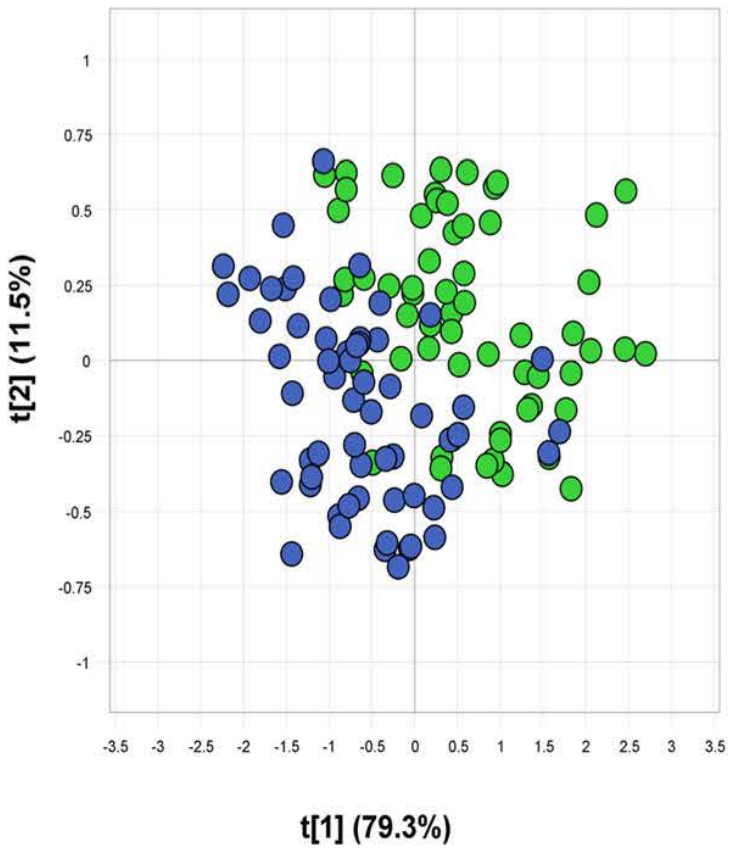
Food Analytical Methods (2019) 12:1612–1624
https://doi.org/10.1007/s12161-019-01464-0

Near Infrared Hyperspectral Imaging for White Maize Classification According to Grading Regulations

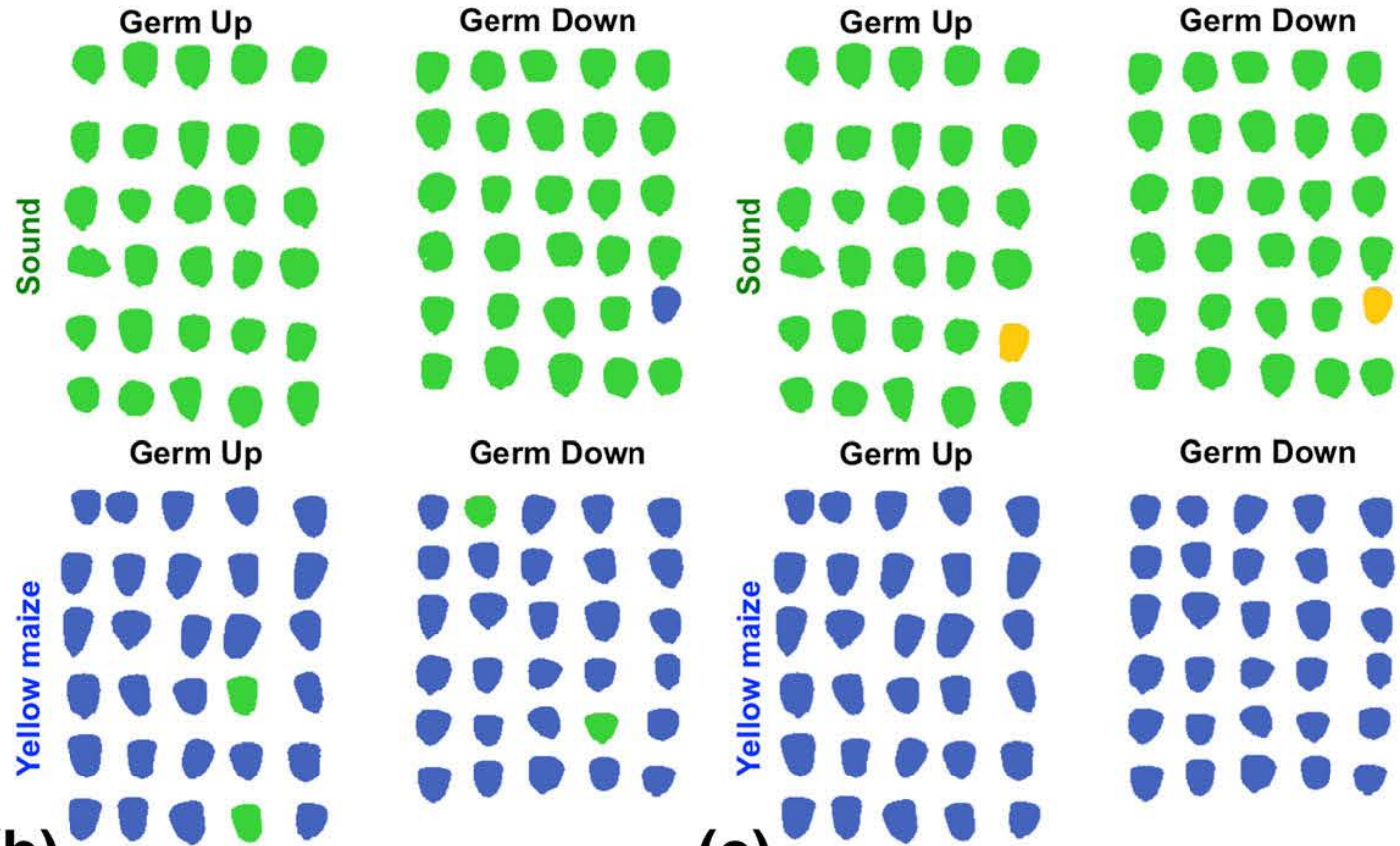
Kate Sendin[1] · Marena Manley[1] · Vincent Baeten[2] · Juan Antonio Fernández Pierna[2] · Paul J. Williams[1]

Received: 31 October 2018 / Accepted: 4 February 2019 / Published online: 13 April 2019


cra-w
D7-EQ741-1
D7-EQ742
cra-w


t[2] (11.5%)
t[1] (79.3%)
1
0.75
0.5
0.25
0
-0.25
-0.5
-0.75
-1
-3.5 -3 -2.5 -2 -1.5 -1 -0.5 0 0.5 1 1.5 2 2.5 3 3.5

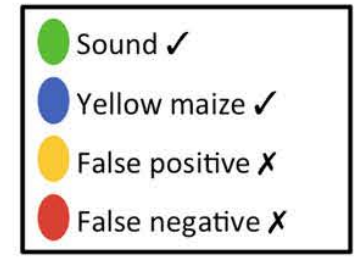
(a)


Germ Up
Germ Down
Sound
Germ Up
Germ Down
Yellow maize

(b)

Germ Up
Germ Down
Sound
Germ Up
Germ Down
Yellow maize

(c)


Sound ✓
Yellow maize ✓
False positive ✗
False negative ✗

Undesirable material	PLS factors	Classification accuracy (%)	False negatives (%)	False positives (%)	Sensitivity (%)	Specificity (%)
Fusarium damage	5	98.33	0.00	1.67	100.00	96.67
Diplodia damage	5	100.00	0.00	0.00	100.00	100.00
Water damage	4	98.33	1.67	0.00	96.67	100.00
Rodent damage	3	98.33	1.67	0.00	96.67	100.00
Heat damage	4	100.00	0.00	0.00	100.00	100.00
Screenings	3	100.00	0.00	0.00	100.00	100.00
Pinked maize	4	98.15	1.85	0.00	95.83	100.00
Yellow maize	4	98.33	0.00	1.67	100.00	96.67
Plant material	2	100.00	0.00	0.00	100.00	100.00
Wheat	4	100.00	0.00	0.00	100.00	100.00
Sorghum	5	100.00	0.00	0.00	100.00	100.00
Soy	3	100.00	0.00	0.00	100.00	100.00
Sunflower	2	100.00	0.00	0.00	100.00	100.00

Received: 7 May 2009 ■ *Revised: 5 November 2009* ■ *Accepted: 7 November 2009* ■ *Publication: 17 December 2009*

JNIRS JOURNAL OF NEAR INFRARED SPECTROSCOPY

Indirect detection of *Fusarium verticillioides* in maize (*Zea mays* L.) kernels by near infrared hyperspectral imaging

Paul Williams,[a] Marena Manley,[a,*] Glen Fox[a,b] and Paul Geladi[c]

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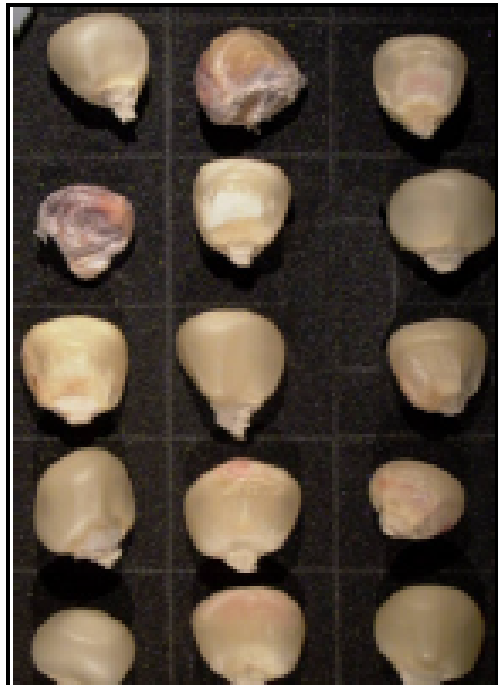
[b]Agri-Sciences, Queensland, Queensland Grains Research Laboratory, PO Box 2282, Toowoomba, Queensland 4350, Australia

[c]Unit of Biomass Technology and Chemistry, Swedish University of Agricultural Sciences, KBC huset, Linnaeus vaeg 6, SE 901 87 Umeå, Sweden

(a)



(b)

N	I	A
I	A	N
A	N	I
N	A	I
N	A	N

(a)

(b)

N1	I2	A3
I4 I5	A6	N7
A8	N9	I10
N11 N12	A13	I14
I15	I16 N18	N17
I19	N20	A21

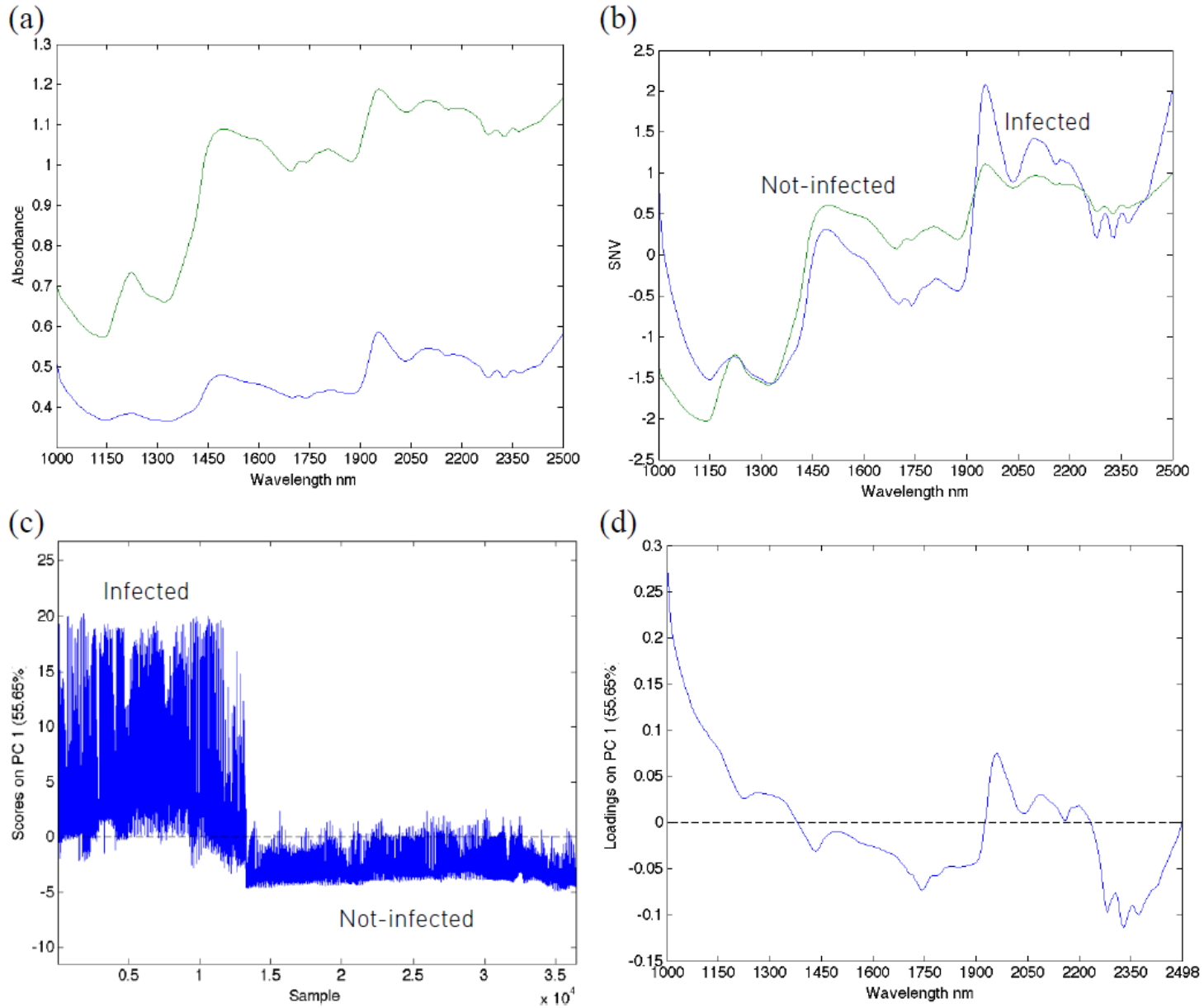


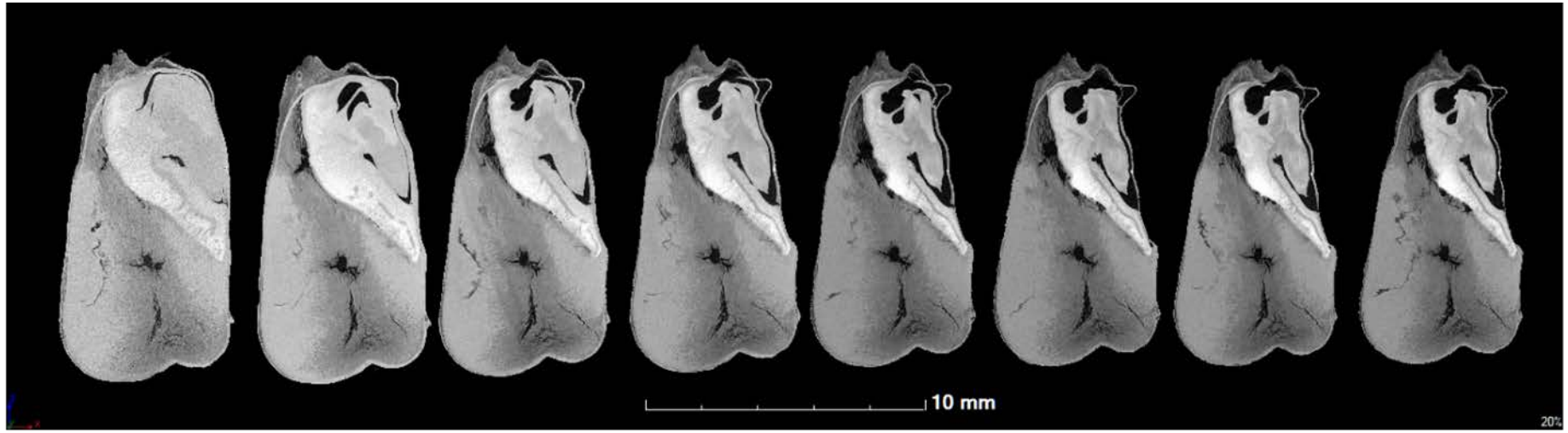
Figure 7. (a) Mean spectra of infected (bottom) and non-infected (top) kernels without SNV and (b) with SNV with main difference at 1960 nm indicating a difference in starch for the S21 image. (c) Score plot showing difference between infected and non-infected classes; positive score values relate to infected and negative score values relate to non-infected and (d) corresponding loading line plot of first PC loading of SNV corrected data.

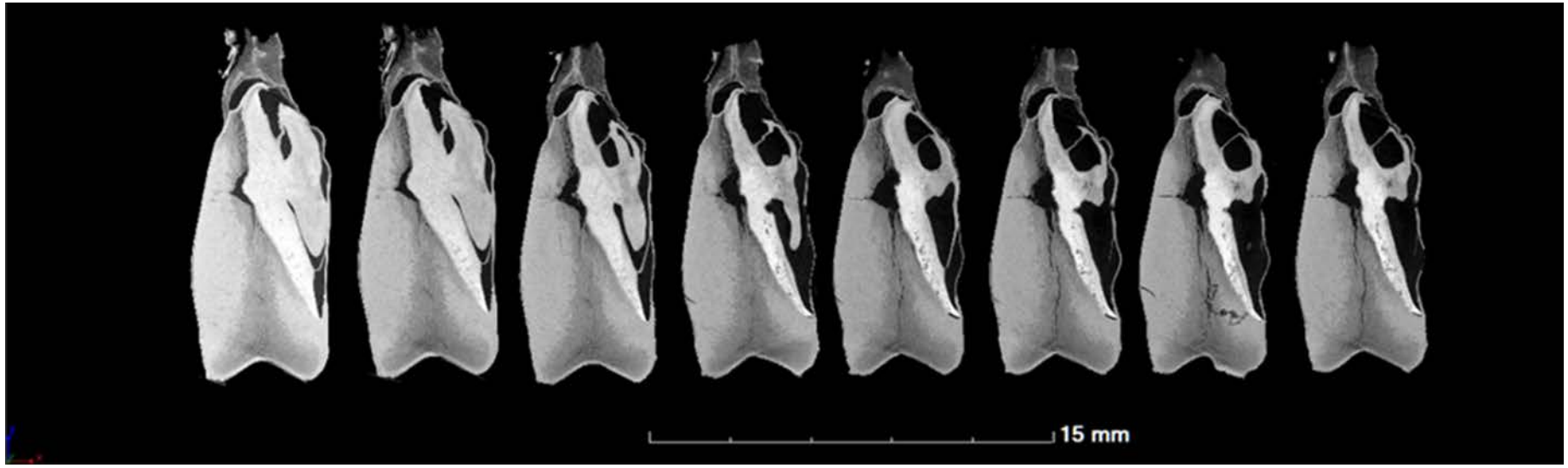
Classes	Pre-processing	Classification rate (%)
Infected	No pre-processing	97.6
	MSC	97.7
	SNV	97.4
Not infected	No pre-processing	99.2
	MSC	94.0
	SNV	94.2

Food Anal. Methods
DOI 10.1007/s12161-017-0831-4

Use of High-Resolution X-Ray Micro-Computed Tomography for the Analysis of Internal Structural Changes in Maize Infected with *Fusarium verticillioides*

Irene Orina[1] · Marena Manley[1] · Paul J. Williams[1]


10 mm
20%


15 mm

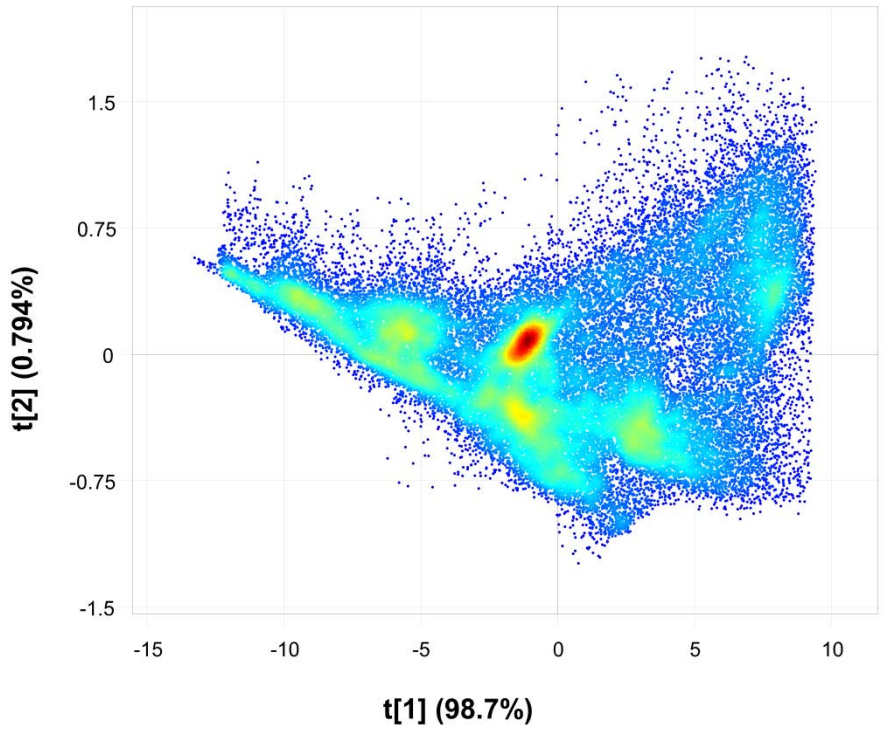
Identifying cereal killers

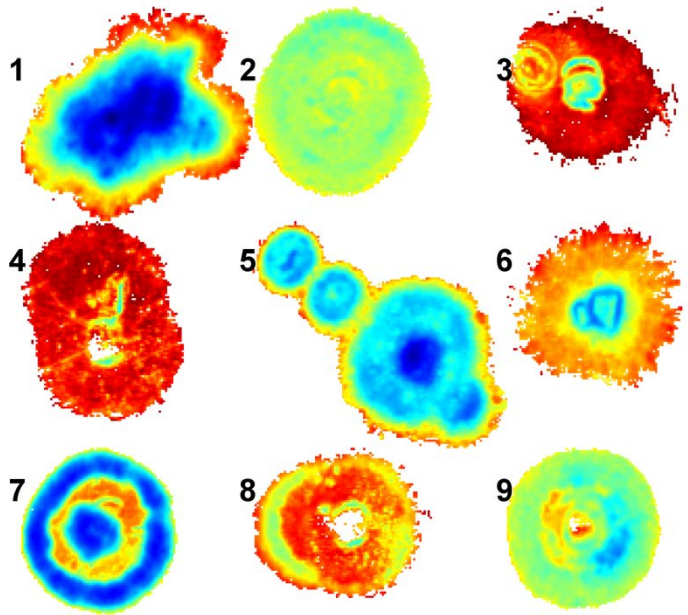
Anal Bioanal Chem (2012) 404:1759–1769
DOI 10.1007/s00216-012-6313-z

ORIGINAL PAPER

Near-infrared (NIR) hyperspectral imaging and multivariate image analysis to study growth characteristics and differences between species and strains of members of the genus *Fusarium*

Paul J. Williams · Paul Geladi · Trevor J. Britz · Marena Manley

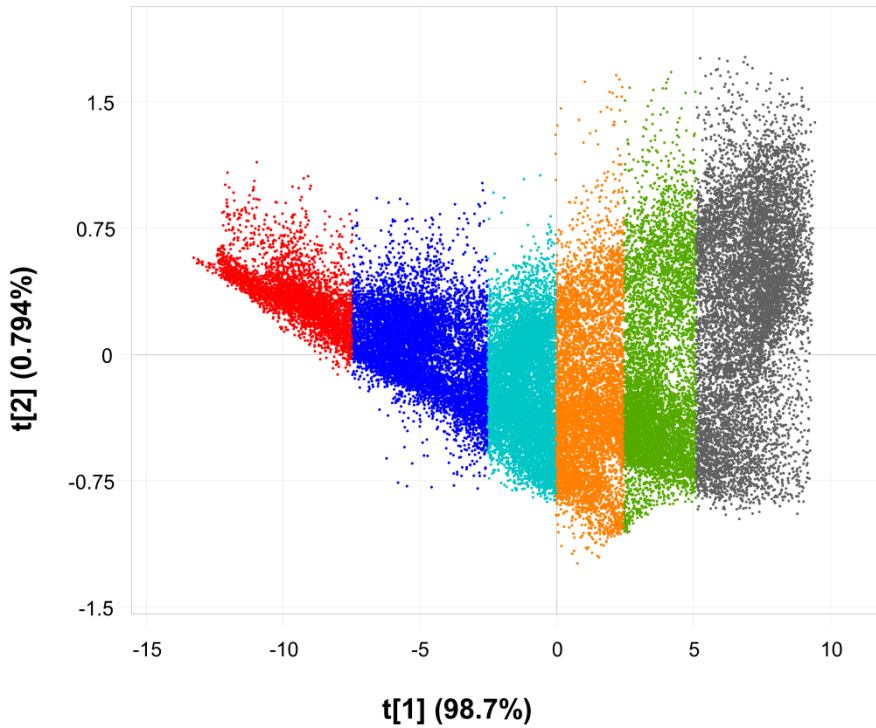


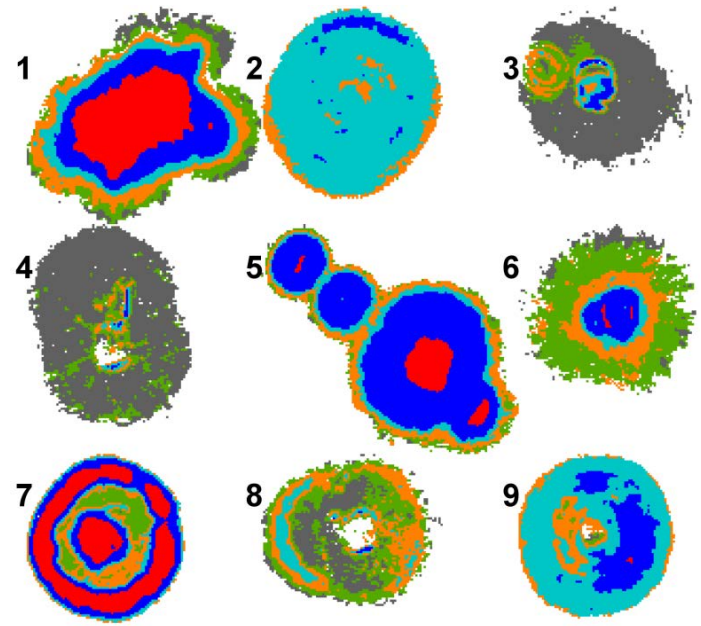


F. subglutinans

F. proliferatum

F. verticillioides

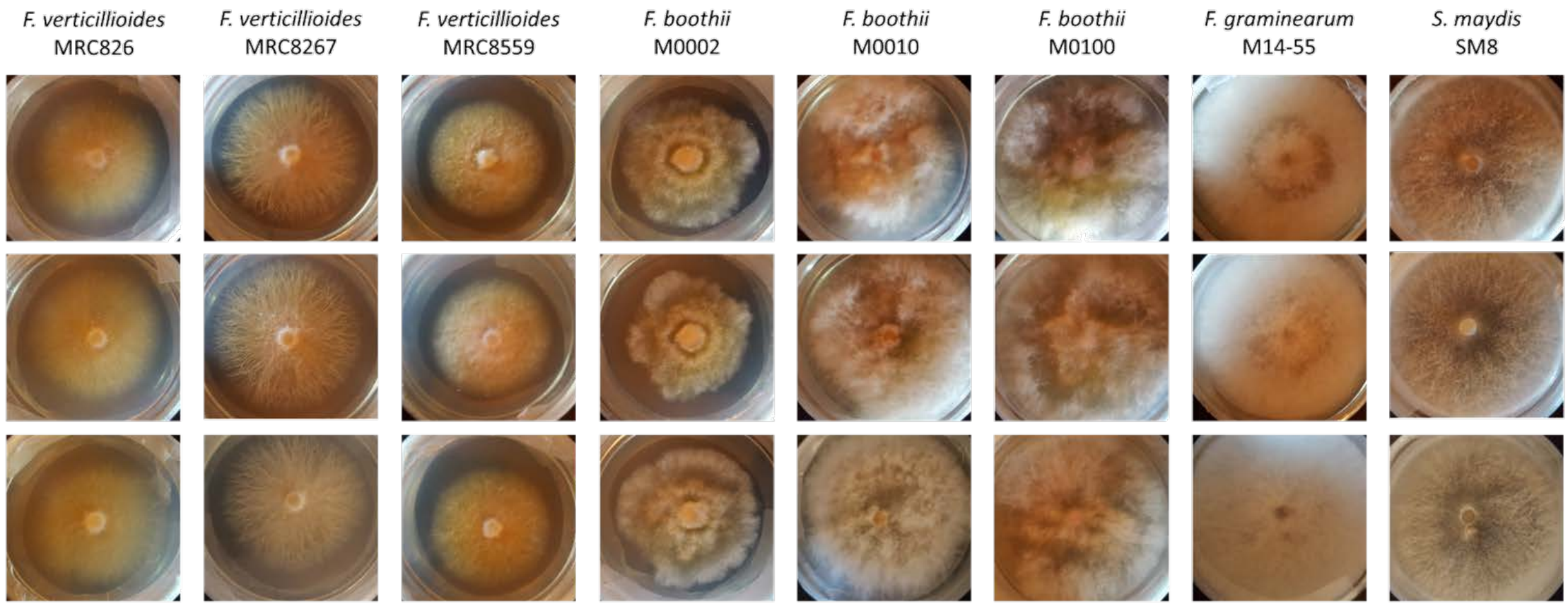

1.5
0.75
0
-0.75
-1.5
t[2] (0.794%)
-15
-10
-5
0
5
10
t[1] (98.7%)

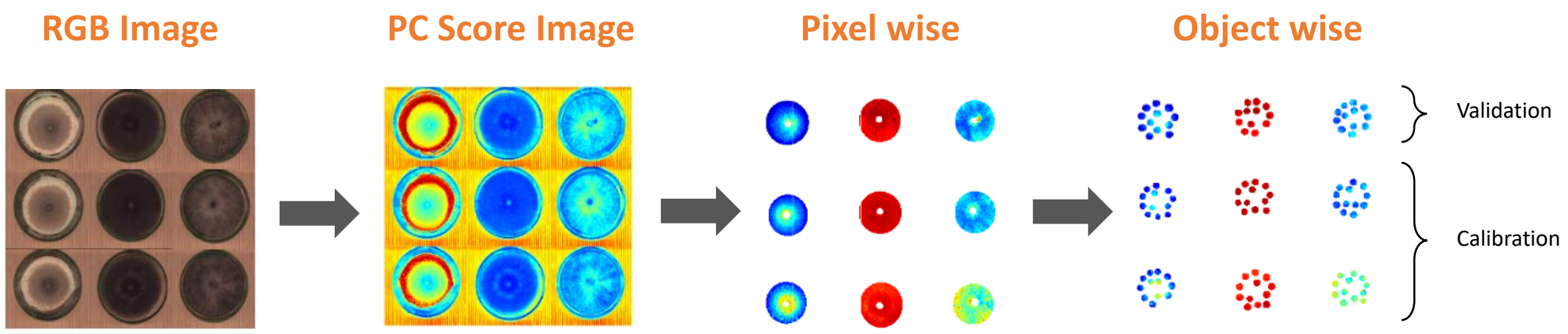

1
2
3
4
5
6
7
8
9

Food Analytical Methods (2019) 12:1556–1570
https://doi.org/10.1007/s12161-019-01490-y

Differentiation of Maize Ear Rot Pathogens, on Growth Media, with Near Infrared Hyperspectral Imaging

Paul J. Williams [1] · Cenette Bezuidenhout [1] · Lindy J. Rose [2]


F. verticillioides MRC826
F. verticillioides MRC8267
F. verticillioides MRC8559
F. boothii M0002
F. boothii M0010
F. boothii M0100
F. graminearum M14-55
S. maydis SM8


RGB Image
PC Score Image
Pixel wise
Object wise
Validation
Calibration

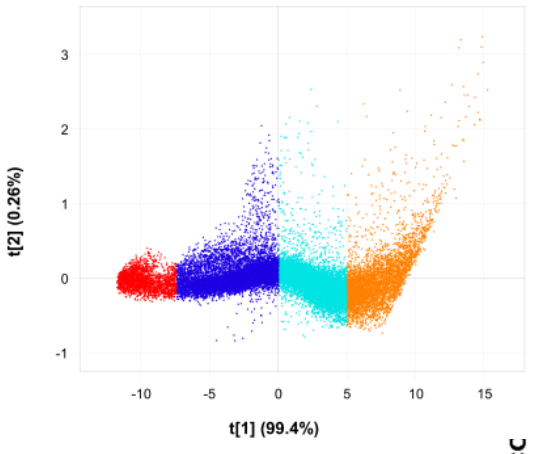
Analysis	Mosaic	R^2	Q^2	Classification accuracy (%)	Misclassification rate (%)
Pixel wise	1	0.9242	–	99.72	0.49
	2	0.6682	–	82.05	34.82
Object wise	1	0.9702	0.9590	100.00	0.00
	2	0.8680	0.8410	86.11	16.13
	3	0.8943	0.8783	100.00	0.00
	4	0.8562	0.8081	88.89	25.00

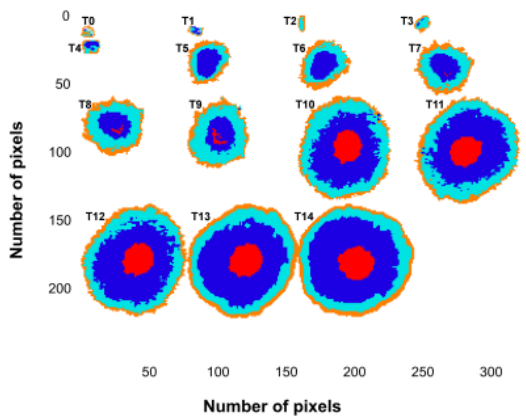
Appl Microbiol Biotechnol
DOI 10.1007/s00253-012-4380-x

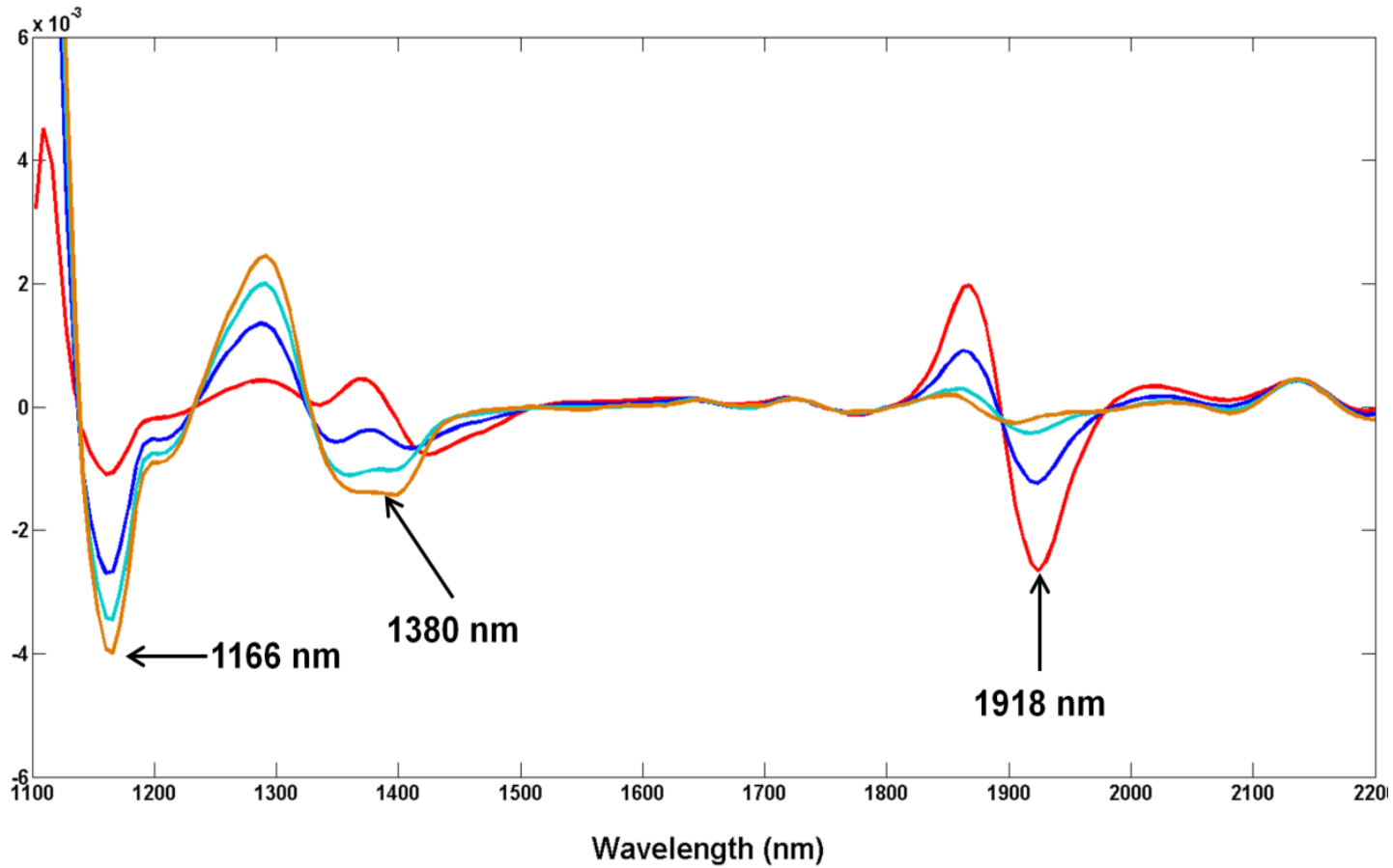
METHODS AND PROTOCOLS

Growth characteristics of three *Fusarium* species evaluated by near-infrared hyperspectral imaging and multivariate image analysis

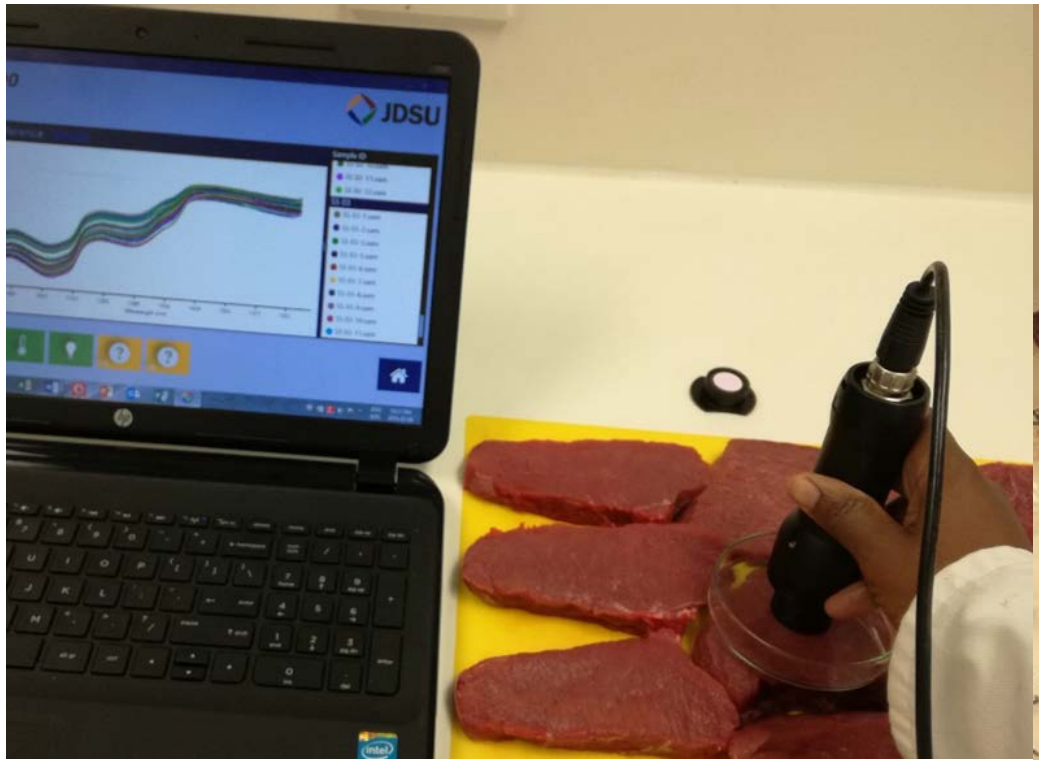
Paul J. Williams · Paul Geladi · Trevor J. Britz · Marena Manley

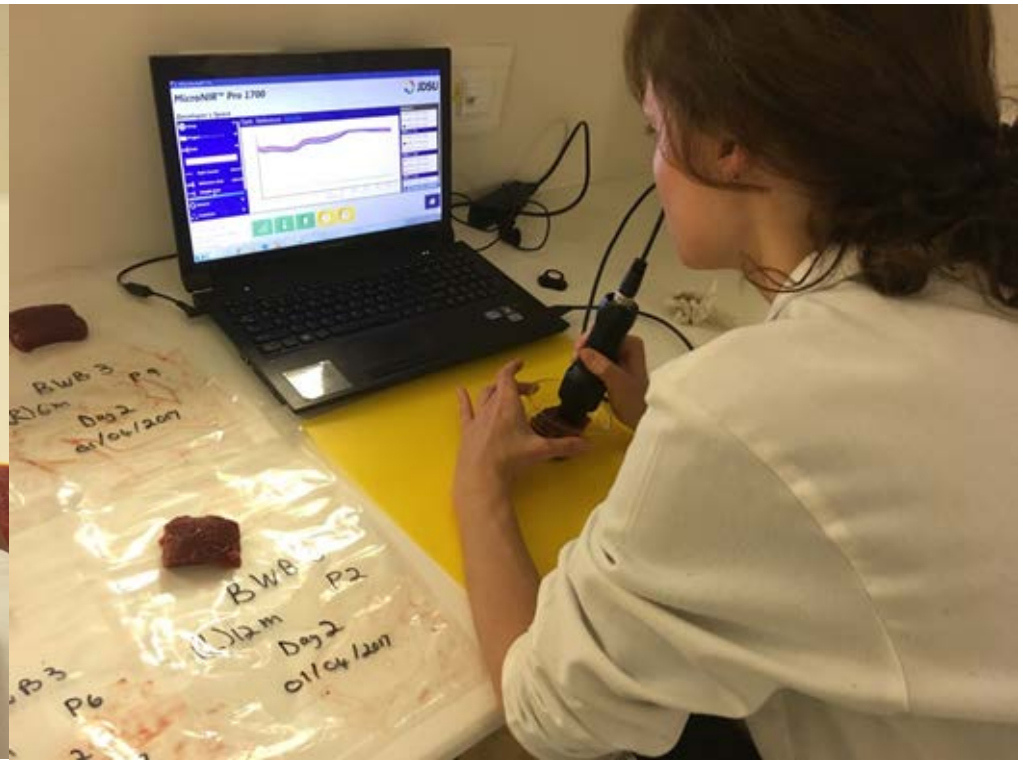

t[2] (0.26%)
t[1] (99.4%)


T0
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
T13
T14
Number of pixels
Number of pixels


x 10-3
1166 nm
1380 nm
1918 nm
Wavelength (nm)

It’s all in the game


JDSU


JDSU
Day2
01/04/2017
P2
P6

Food Analytical Methods (2020) 13:1220–1233
https://doi.org/10.1007/s12161-020-01739-x

Near-Infrared (NIR) Spectroscopy to Differentiate *Longissimus thoracis et lumborum* (LTL) Muscles of Game Species

Pholisa Dumalisile[1] · Marena Manley[1] · Louwrens Hoffman[2,3] · Paul J. Williams[1]

Table 4 Calibration (Cal) and validation (Val) accuracy (%) results of LDA, PLS-DA and SIMCA models, for classification of meat from medium-sized antelopes and large-sized species using pre-processed spectral data (combination 1: smoothing and SNV-Detrend; combination 2: SNV-Detrend and 2nd derivative)

Category	Species	LDA		PLS-DA		SIMCA	
		Cal (%)	Val (%)	Cal (%)	Val (%)	Cal (%)	Val (%)
Combination 1							
Medium-sized antelopes	Blesbok	91	72	84	66	91	70
	Impala	94	100	89	84	98	100
	Springbok	78	90	73	47	70	67
Large-sized species	Black wildebeest	88	68	100	83	90	96
	Eland	90	87	82	91	75	100
	Zebra	86	82	72	57	78	69
Combination 2							
Medium-sized antelopes	Blesbok	89	86	90	70	57	60
	Impala	98	95	90	89	85	80
	Springbok	80	93	72	77	65	80
Large-sized species	Black wildebeest	88	72	90	71	78	84
	Eland	83	83	87	96	50	50
	Zebra	83	82	75	76	71	57

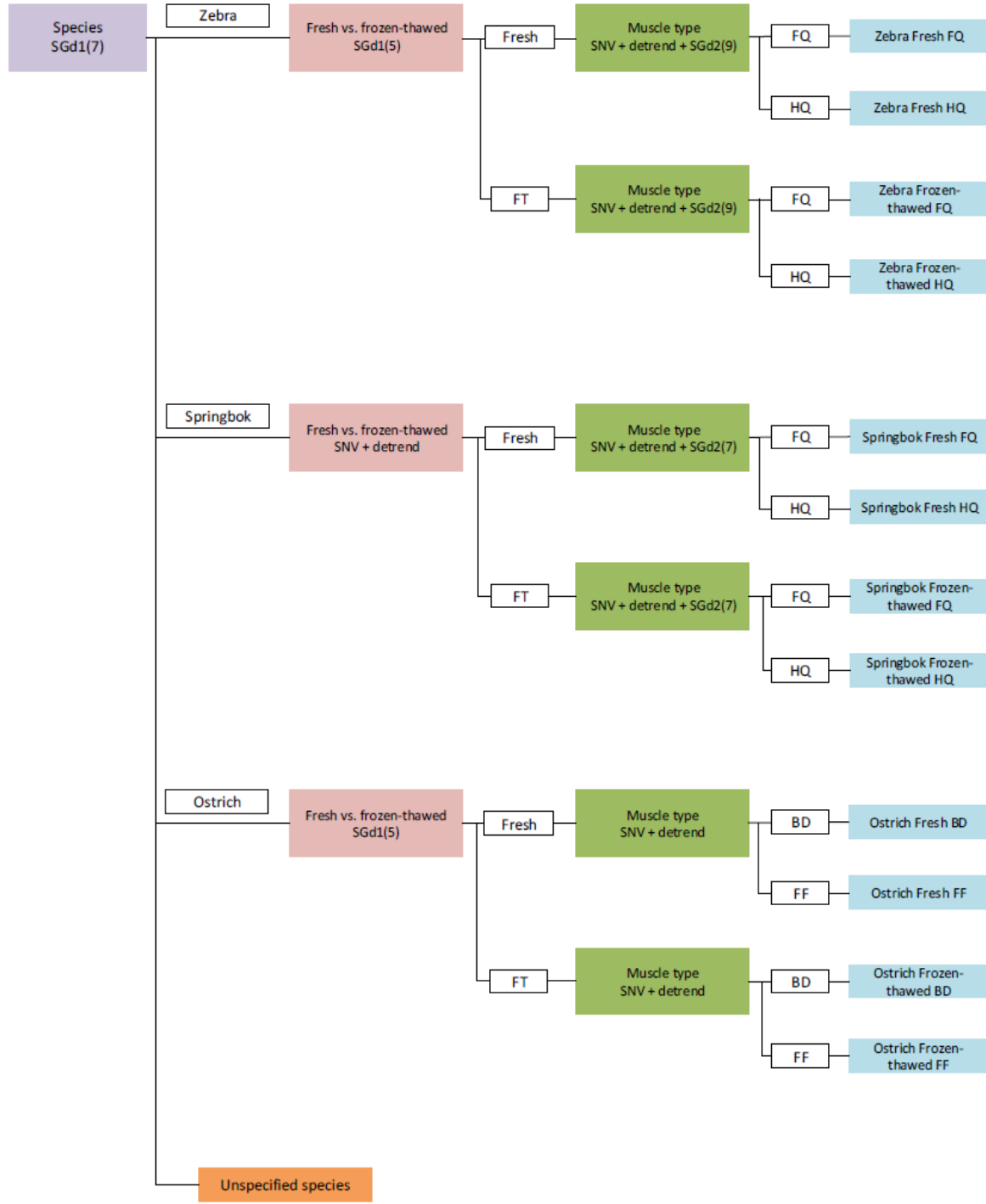
molecules

MDPI

Article

Differentiation of South African Game Meat Using Near-Infrared (NIR) Spectroscopy and Hierarchical Modelling

Kiah Edwards [1], Marena Manley [1], Louwrens C. Hoffman [2,3], Anel Beganovic [4], Christian G. Kirchler [4], Christian W. Huck [4] and Paul J. Williams [1,*]


Species
SGd1(7)
Zebra
Fresh vs. frozen-thawed
SGd1(5)
Fresh
Muscle type
SNV + detrend + SGd2(9)
FQ
Zebra Fresh FQ
HQ
Zebra Fresh HQ
FT
Muscle type
SNV + detrend + SGd2(9)
FQ
Zebra Frozen-thawed FQ
HQ
Zebra Frozen-thawed HQ
Springbok
Fresh vs. frozen-thawed
SNV + detrend
Fresh
Muscle type
SNV + detrend + SGd2(7)
FQ
Springbok Fresh FQ
HQ
Springbok Fresh HQ
FT
Muscle type
SNV + detrend + SGd2(7)
FQ
Springbok Frozen-thawed FQ
HQ
Springbok Frozen-thawed HQ
Ostrich
Fresh vs. frozen-thawed
SGd1(5)
Fresh
Muscle type
SNV + detrend
BD
Ostrich Fresh BD
FF
Ostrich Fresh FF
FT
Muscle type
SNV + detrend
BD
Ostrich Frozen-thawed BD
FF
Ostrich Frozen-thawed FF
Unspecified species

Vibrational Spectroscopy

The CAF Vibrational Spectroscopy Unit houses the hyperspectral imaging equipment which can be used for assessing the chemical, physical or biological differences of an organic sample.

The Unit

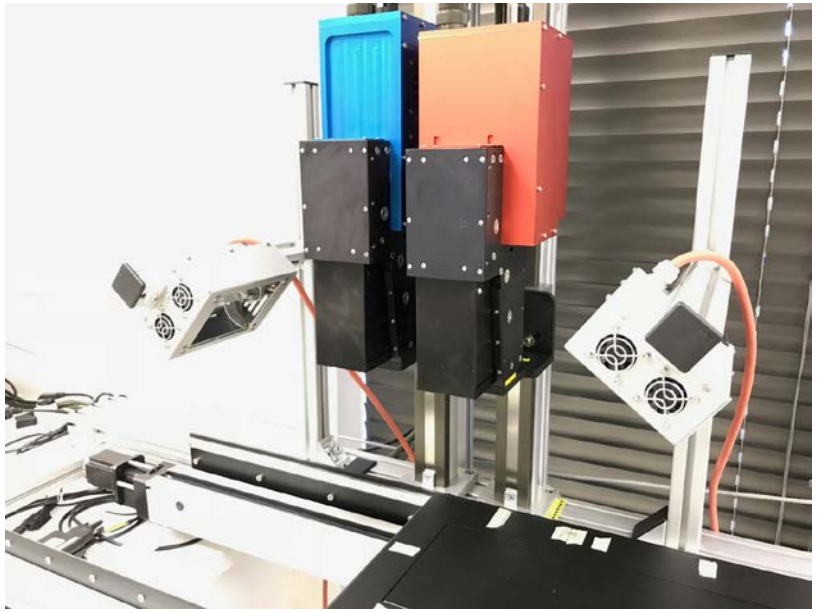
Equipment Gallery

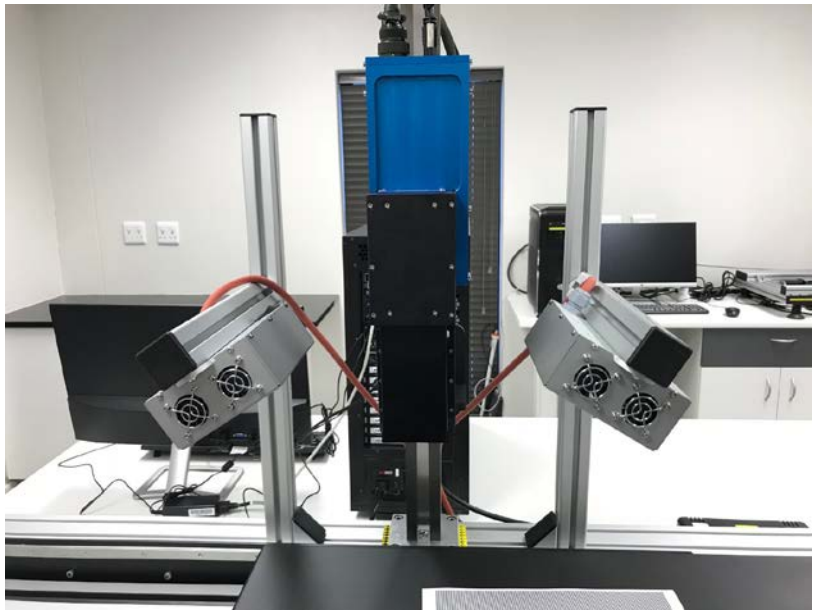
Prices

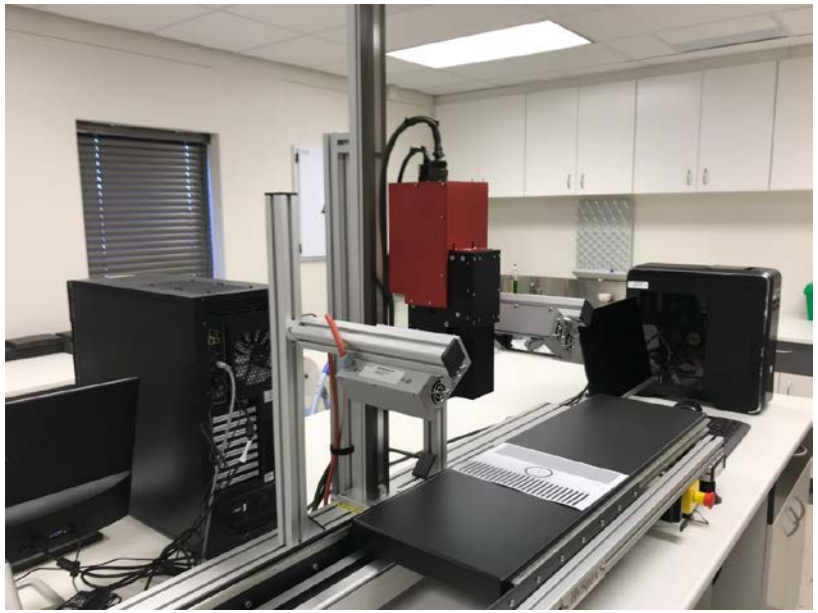
Register to make a Booking

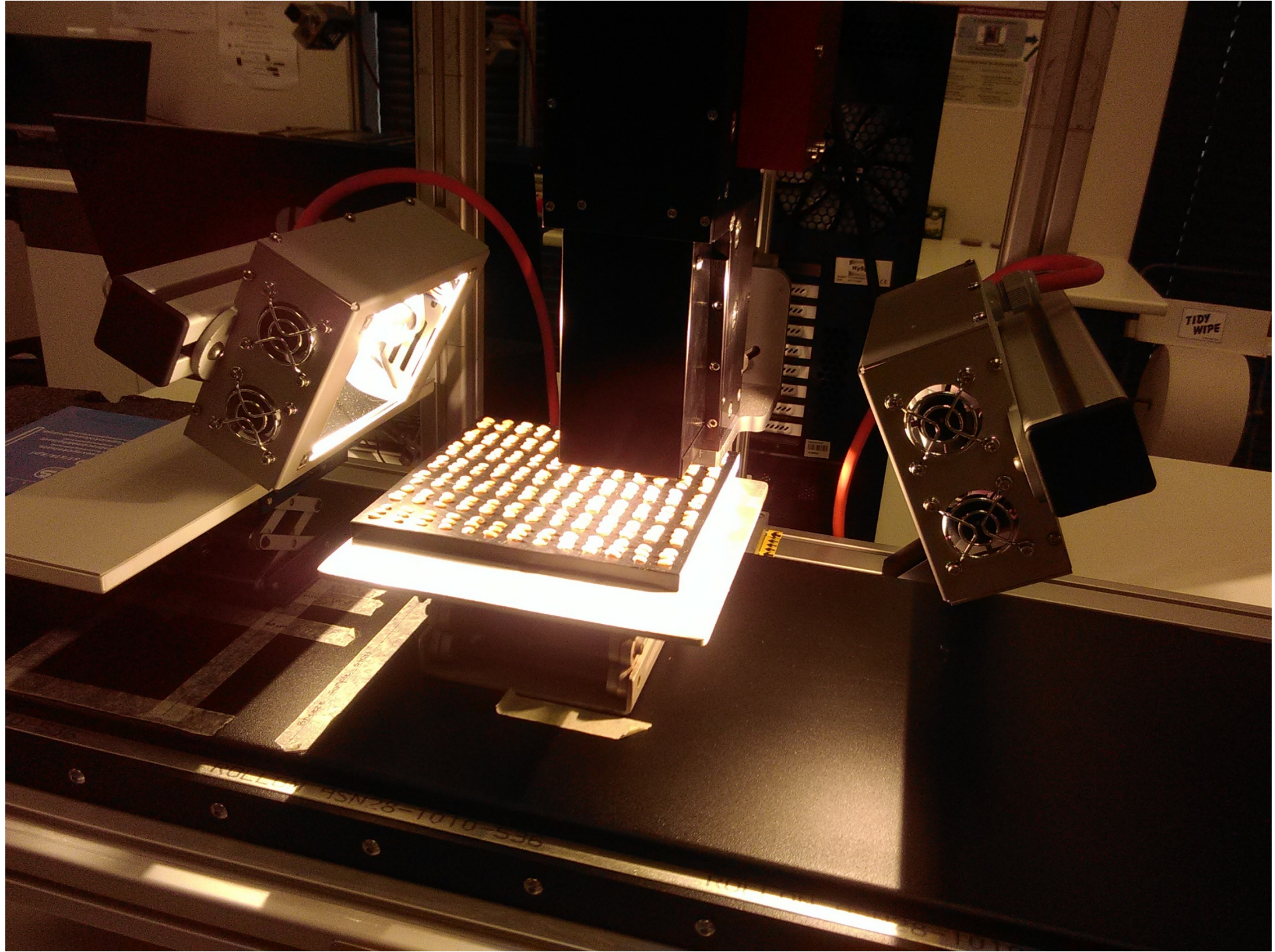
The dual VNIR/SWIR hyperspectral imaging system can be used to image samples simultaneously with the two cameras in the reflectance or the transmission mode. The Breeze software on this computer can be used to run your preferred routine applications in real time whilst imaging objects.

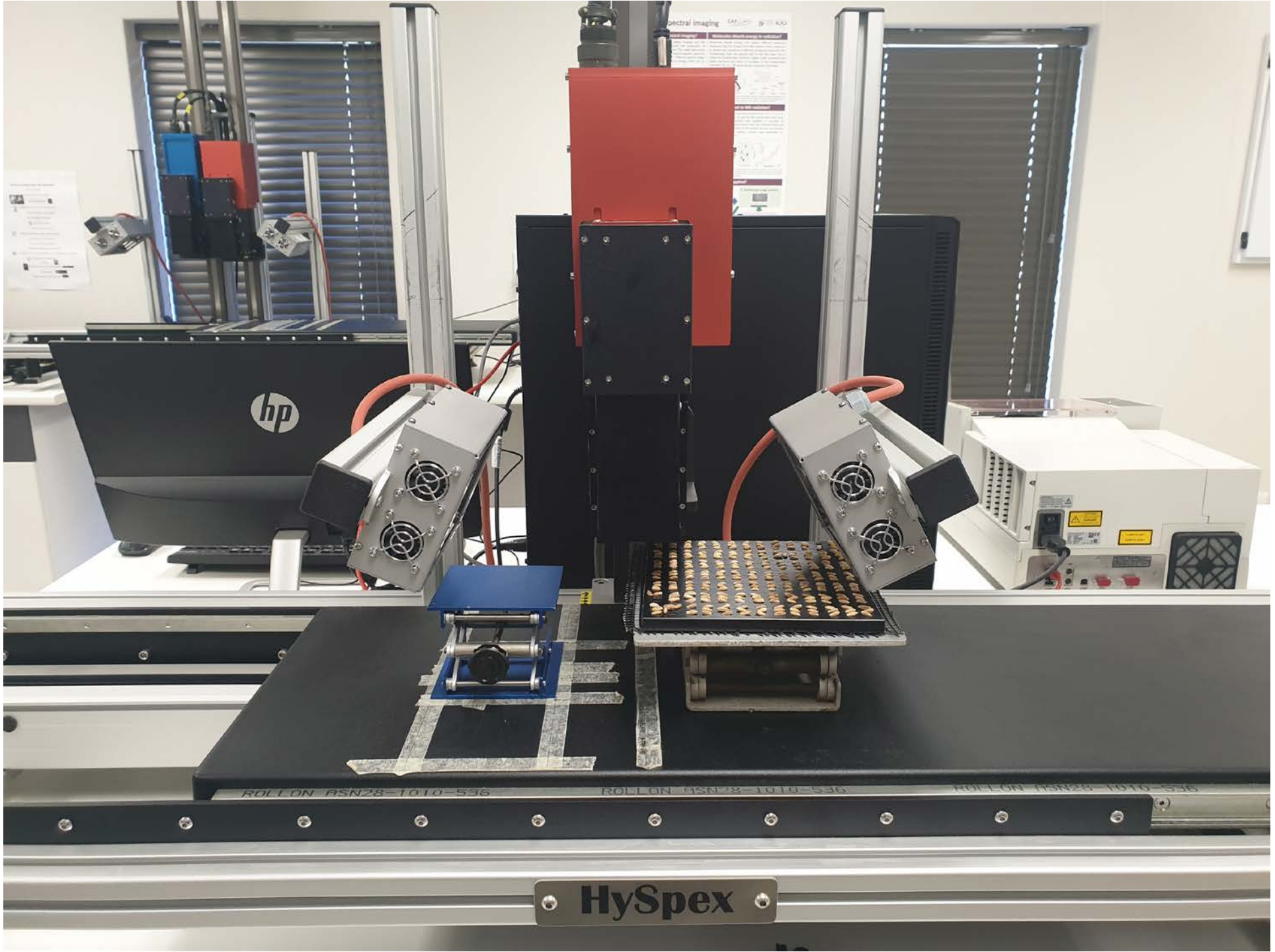
Computers for data processing and analysis: Four work stations with Evince and Breeze software are available for analysis of datasets after image acquisition. The PCs can be booked in advance for data processing.








TIDY
WIPE


HySpex

Acknowledgments

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iYUNIVESITHI
STELLENBOSCH
UNIVERSITY

100
1918 · 2018

forward together · saam vorentoe · masiye phambili

Thank you!

pauljw@sun.ac.za