Technology to predict browning in table grapes

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Thursday, 12 August 2021

SASEV, SATI & RaisinsSA Table and Raisin Grape Virtual Information Day

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Introduction











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Levels of table grape quality

Before harvest

Post harvest

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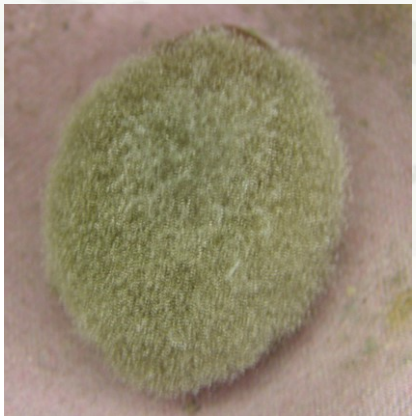
Quality Defects

- Grey mould rot
- Berry crack
- SO_2 damage
- Stem browning
- Berry browning



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Browning in table grapes

- Browning - complex biological process
- Healthy/unaffected to brown
- Occurs over gradient

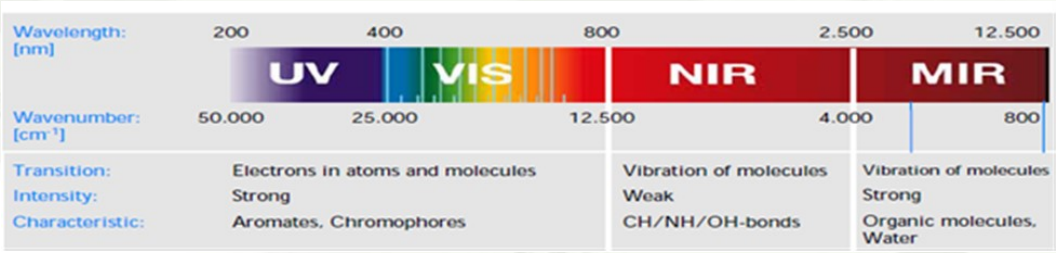
Problem with old method of measuring qualitative aspects

- Traditionally only preventative measures are put into place to ensure that table grape quality remains the same from harvest up until it reaches the market or the consumer
- Also, the fact that table grape quality is a multi-faceted aspect that does not just stop at harvest but is followed through postharvest, complicates things further…

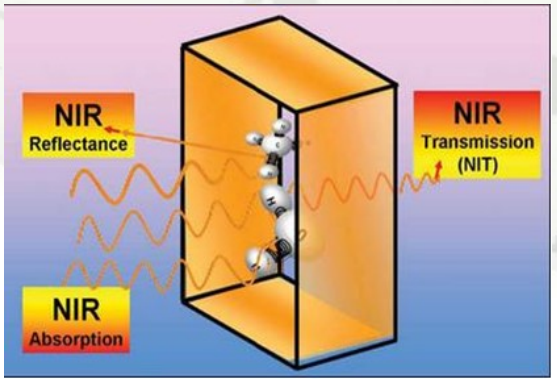




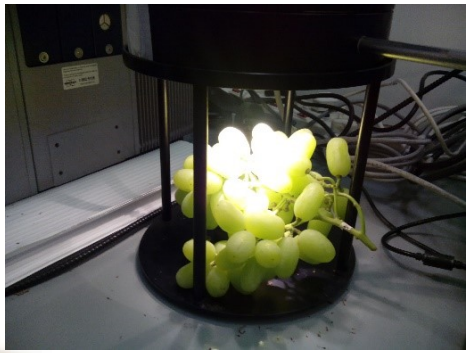
New Method - NIR spectroscopy

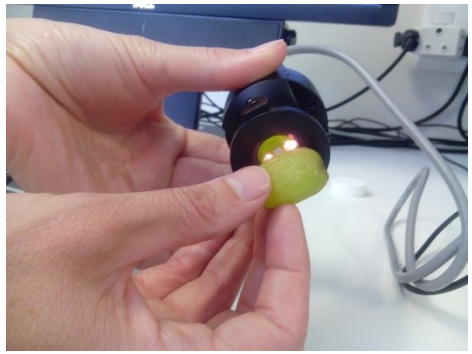


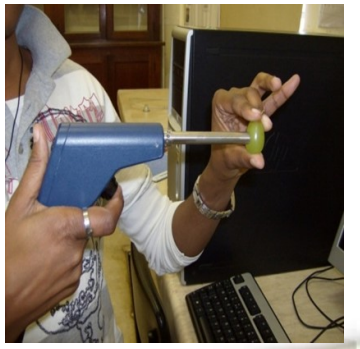
- Cutting edge technology
  - Used with great success
  - On different products
  - To determine wide range of attributes



- Sensors, optical fibers, handheld devices, online instruments
- Visible + NIR







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Overall aim & Objective

- To determine as early as possible
- During which storage week the browning develops
- See how well the affected and non-affected bunches could be classified
- Partial least squares discriminant analysis (PLS-DA)
- Qualitative analysis
- Grading & classification
- In the production line

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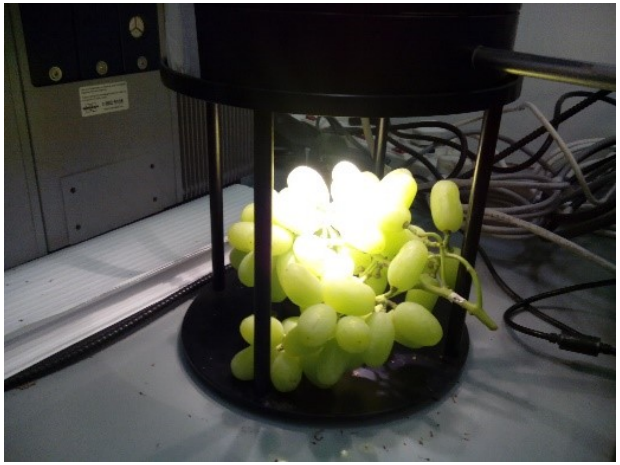
Materials and Methods

- Regal Seedless was harvested from two different vineyards
- The grapes were prepared in the vineyard according to the standard protocol for export table grapes
- Grapes bunches harvested, placed in individual plastic carry bag and packed in 4.5 kg closed-top corrugated fibre board cartons
- Spectral data of whole table grape bunches obtained contactless in diffuse reflectance mode with Bruker's MATRIX-F Fourier Transform (FT) NIR spectrometer



Materials and Methods continued…

- All 7 boxes from each vineyard were scanned immediately after harvest
- Of the 6 boxes that went into cold storage, one box was scanned again each week after cold storage
- That is after one week (W1), two weeks (W2)….(W6)
- Evaluation of each box was done immediately after scanning
- The evaluation data for W0, 1&2 were pooled together and also those for W3&4 and W5&6
- Since the level of defect/browning intensity were too low
- After each bunch had been scanned the loose berries in the carry bag were noted down as loose berries
- These berries were not evaluated for browning or any of the other defects

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Materials and Methods continued…

- All berries still attached to the bunch were removed with scissor
- Evaluated individually for specific defects (browning phenotypes)
- The incidence of every defect was noted down
- Contingency table was set up
- When a specific defect was present on the bunch, the defect was assigned a value of 1,
- And when it was absent it was assigned a value of 0

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Partial least squares discriminant analysis (PLS-DA)

- PLS-DA - derivative of the standard PLS regression algorithm
- Uses class variables instead of numeric variables
- In PLS-DA, dummy variable Y is used as a response variable
- Set to 1 if the sample is one of either class and 0 if not
- In our case the defects were then scored as
  - 0 = no defect and 1 = defect present
- A cut-off value was set at 0.5, above which the sample is predicted as 1 and below which it is predicted as 0
- In addition,
  - specificity - to correctly identify bunches without the defect
  - sensitivity - to correctly identify bunches with the defect
  - classification error rate (CER) - to evaluate model's performance

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Results:
PLS-DA Chocolate and Friction Browning

Table 1. The Classification error rate, Specificity and Sensitivity of the PLS-DA models constructed for Chocolate browning (CB) and Friction browning (FB) of Regal Seedless grapes.

Defect	Sample set	Class 0			Class 1		
		CER [c]	Spec [d]	Sen [e]	CER	Spec	Sen
CB:W3&4[a]	Calibration	0.15	0.865	0.815	0.15	0.815	0.865
CB: W3&4	CV	0.25	0.808	0.692	0.25	0.692	0.808
CB:W5&6[b]	Calibration	0.13	0.875	0.864	0.13	0.864	0.875
CB: W5&6	CV	0.22	0.722	0.818	0.22	0.818	0.722
FB: W3&4	Calibration	0.41	0.412	0.757	0.41	0.757	0.412
FB: W3&4	CV	0.46	0.353	0.714	0.26	0.714	0.353

[a] Weeks 3 and 4; [b] Weeks 5 and 6; [c] Class error rate defined as the mean of the false positive and false positive rates; [d] Specificity; [e] Sensitivity.

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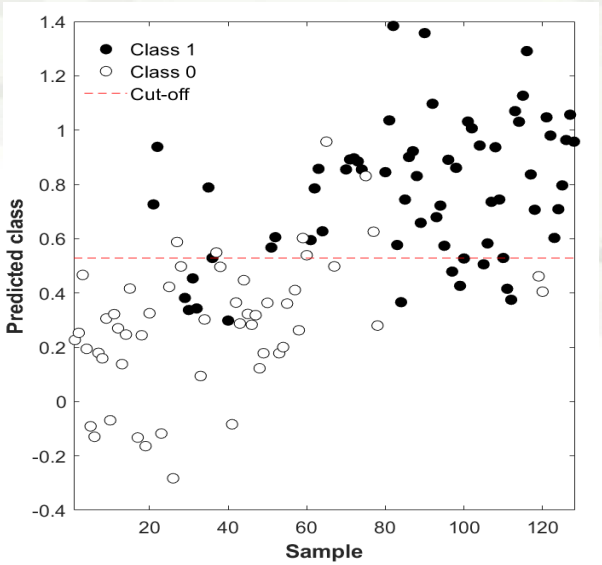
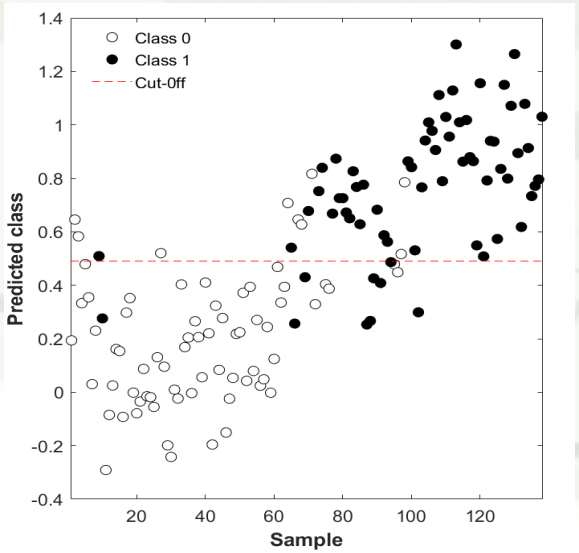
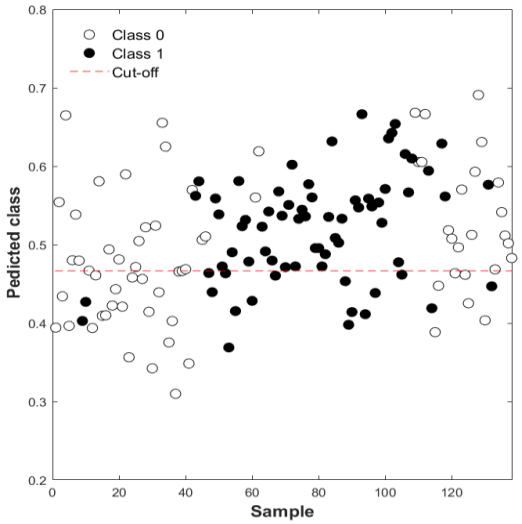
PLS-DA Chocolate and Friction Browning





PLS-DA model for **chocolate browning** Weeks 3&4 (left) and Weeks 5&6 (right). Absence (Class 0, open circle) or presence (Class 1, closed circle)



PLS-DA model for **friction browning** Weeks 3&4). Absence (Class 0, open circle) or presence (Class 1, closed circle)

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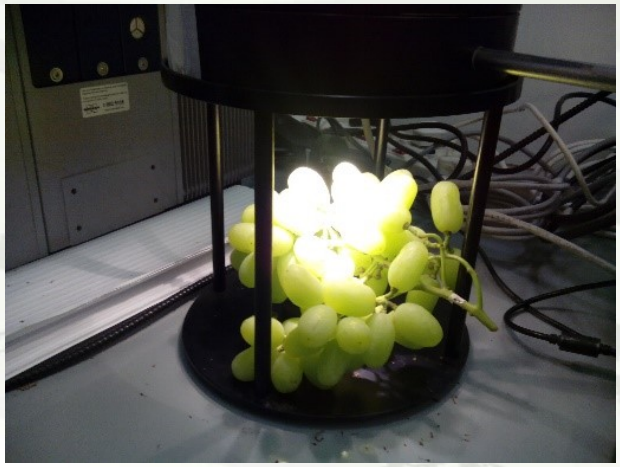
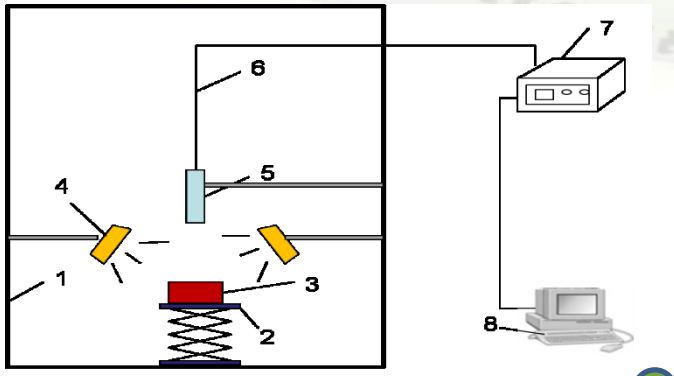
Conclusion

- Lots of variation in whole bunches
- Implication for setting up instrument in packing shed
- Sample presentation
- Instrument configuration
- Moving speed along conveyer belt
- Increase correct and accurate classification
- Enhance detection of possibility of the defect developing early enough
- Help with marketing decisions
- Technology couple with Machine Vision
- Real-time detection





Limit/Prevent/Stop Postharvest losses in table grapes throughout the quality chain

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Acknowledgements

SATI
SOUTH AFRICAN TABLE GRAPE INDUSTRY

PPECB

SARChI
Postharvest
South African Research Chair in Postharvest Technology

Department of
Viticulture and Oenology

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Thank you ☺

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