Non-Destructive Brix Sensing of Florida Grapefruit & Honey Tangerine

- *William M. Miller, CREC- University of Florida, Lake Alfred, FL*

Acknowledgments

- *Dr. Manuela Zude, Dept. of Hort. Engineering, ATB-Potsdam, Germany for providing technical equipment and data analysis*
- *Harbor Island Citrus (Mr. Don Groves, General Mgr., and Mr. Eugene Thornbrue, Technical Mgr.) for their time, consultation and equipment utilization*
- *Ms. Sherrie Buchanon, Sr. Engr. Tech. for data collection and analysis. CREC pilot plant group for fruit acquisition and packingline use.*

Objectives

- *Establish accuracy of NIR measurements for measuring Brix levels of whole citrus fruit by both handheld instrumentation and commercial on-line equipment*

Other Technologies

- *Sonic/ ultrasonic transmission*
- *Fluorescence*
- *Dielectric*
- *Density*
- *Nuclear magnetic resonance*
- *X-ray/gamma-ray*
- *Other (laser induced breakdown spectroscopy)*

Scientific Qualifiers

- *NIR phenomena is not new. Technology is well established.*
- *In some instance, measurements may actually be (1 – major constituent)*
- *Response (absorption, body reflectance, transmission) is an integrated measurement over sampled media*

H2O Absorption

700 to 2500 nm

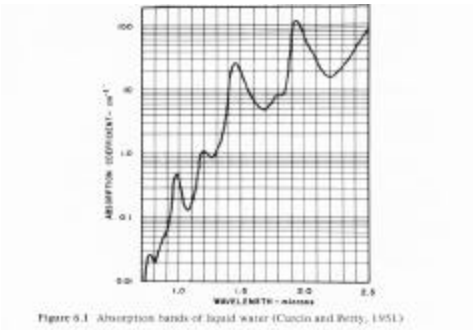
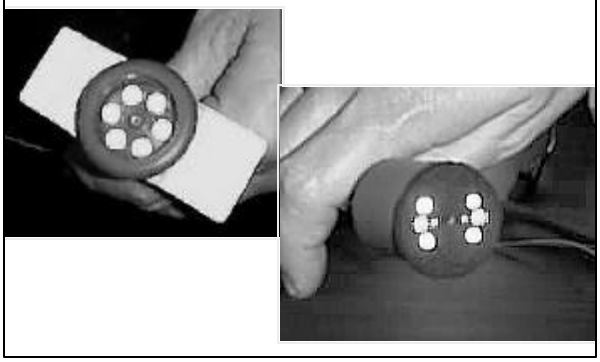


Figure 6.1 Absorption bands of liquid water (Curcio and Petty, 1951)

Test equipment

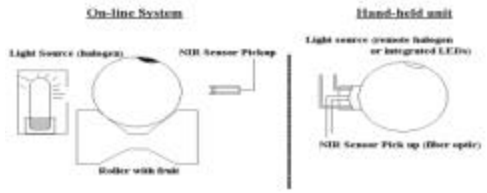
- *Mitsui Q-Scope, on-line, ~ 5.5 objects/s, NIR transmittance, halogen light source*
- *ATB-Hand-held NIR unit, body reflectance, 400-1100 nm scan analyzed by PLS, 2 light sources tested: halogen and white LEDs*
- *Mark II Abbe Refractometer, temperature-compensated, 0-85 deg-Brix, +/-0.1% rms accuracy*

Hand-held units
ATB- Potsdam

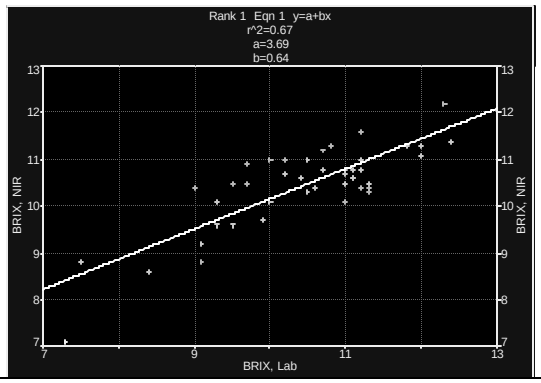


On-line Unit
Mitsui
at Harbor Island Citrus

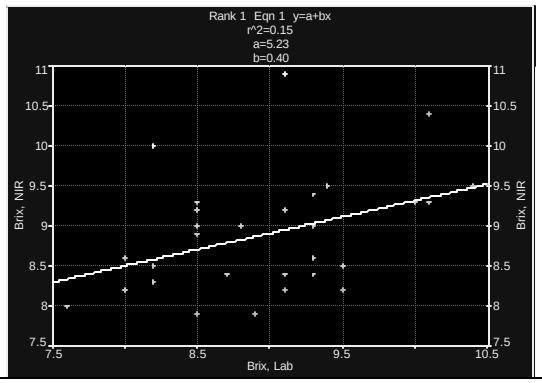
Schematics-NIR Systems



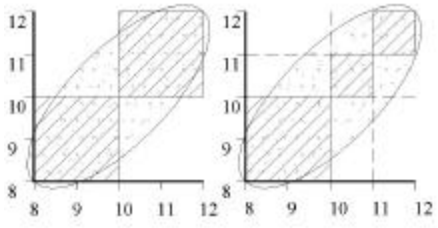
Indian River red grapefruit , on-line, size 40, 25- 30 deg-C



Interior white grapefruit, on-line@ 5 deg-C



Degradation with multiple classification



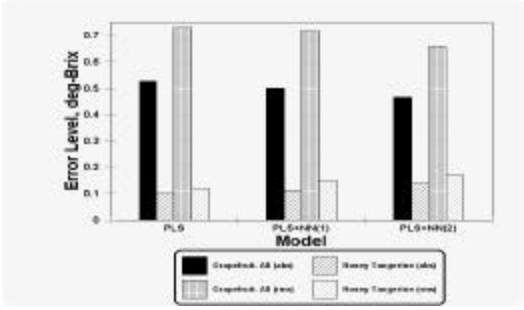
Correct classification of grapefruit comparing on-line NIR and laboratory Brix measurements

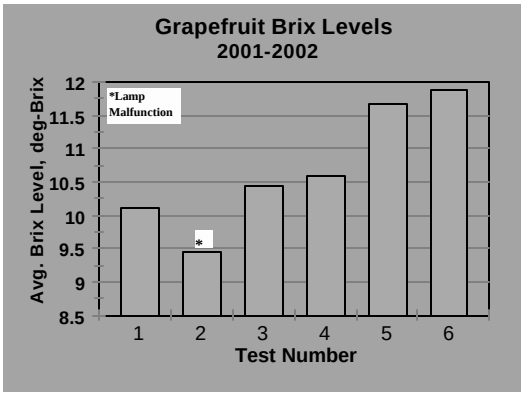
Test Set	Breakpoint	Correctly classified	Accepted (true state=reject)	Rejected (true state= acceptable)
Interior white g'fruit, 5 dg -C	9 deg Brix	62.1 %	17.2 %	20.7 %
Interior white g'fruit, 20 deg -C	9	78.6	7.1	14.3
Indian River red g'fruit, size 40	10	88.4	11.6	0.0
Indian river red g'fruit, size 32	10	77.4	9.7	12.9
Indian River, size 32 & 40 combined, NN Analysis	10	88.3	6.9	4.8

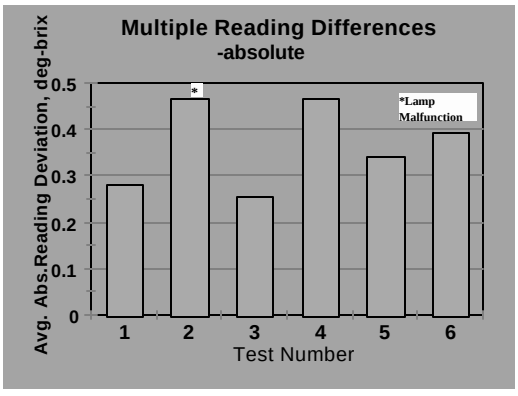
Correct classification of Honey tangerine: hand-held NIR, H-halogen, L-LEDs

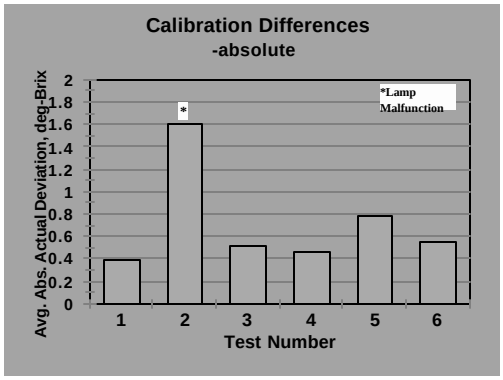
		Correctly Classified		Accepted	(true state = reject)	Rejected	(true state = acceptable)
Test set	Break-point	H	L	H	L	H	L
# 1	14 deg Brix	92	92	0	0	8	8
#2	14	88	84	12	12	0	4
#1 –NN	14	100		0		0	
#2-NN	14	92		9		0	

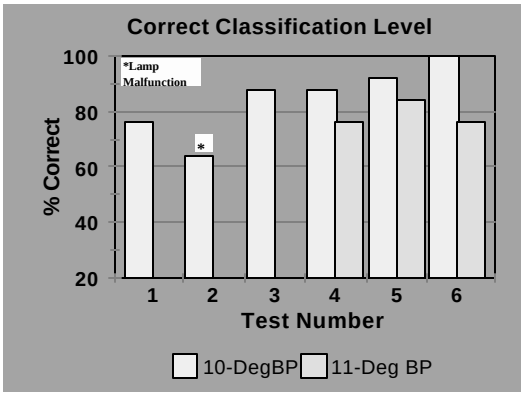
Error Levels- Grapefruit & Tangerines (avg. absolute and rms)











Conclusions

- On-line (OL) and hand-held(HH) NIR measurements significantly correlated with laboratory Brix measurements for individual grapefruit. Poorest results were fo r Interior fruit tested at 5 dg-C while highest correlations were for smaller size 40 Indian River grapefruit tested at ambient conditions.
- For commercial fruit samples, correct classification, based on s ingle breakpoint, were as follows:
  - 62-79 %, Interior grapefruit @ 9 deg -Brix (HH)
  - 77-84 %, Indian River grapefruit @ 10 deg-Brix (HH)
  - 84-100 %, Honey tangerine @ 14 deg-Brix (HH)
  - 64(78)-100 % Indian River grapefruit @ 10 deg -Brix (OL)
  - 76-84 % Indian River grapefruit @ 11 deg -Brix (OL)
- For handheld NIR testing of Honey tangerine, results with halogen and LED light sources were similar.
- Accuracy is not at level to detect Brix level changes in fruit during 1-month storage on Indian River grapefruit.

The End