

# Using Near-Infrared Spectroscopy to Select for Resistance to FHB – Various Applications

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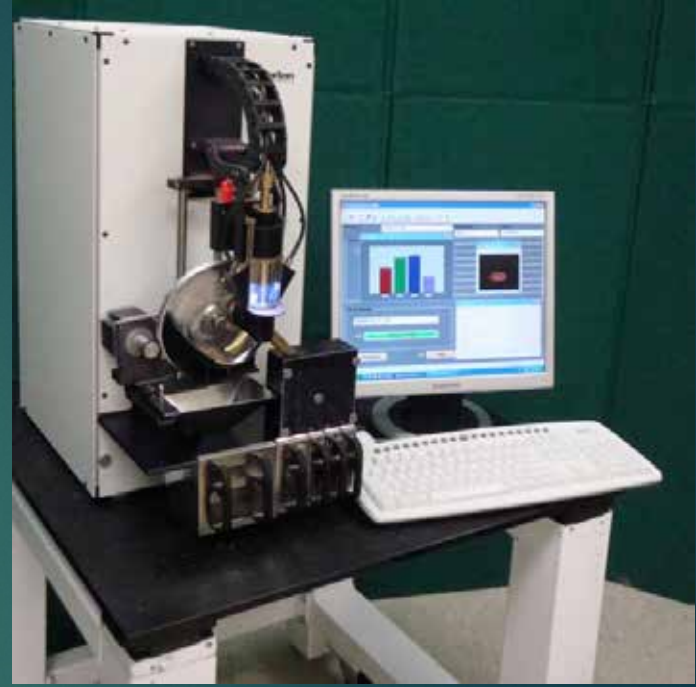
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# Key Points

- Analyze single kernels
- Non-destructive
- Can measure:
  - DON
  - FHB
  - Protein
  - Hardness
  - Color
  - Starch
  - Amylose
  - Moisture
  - Etc

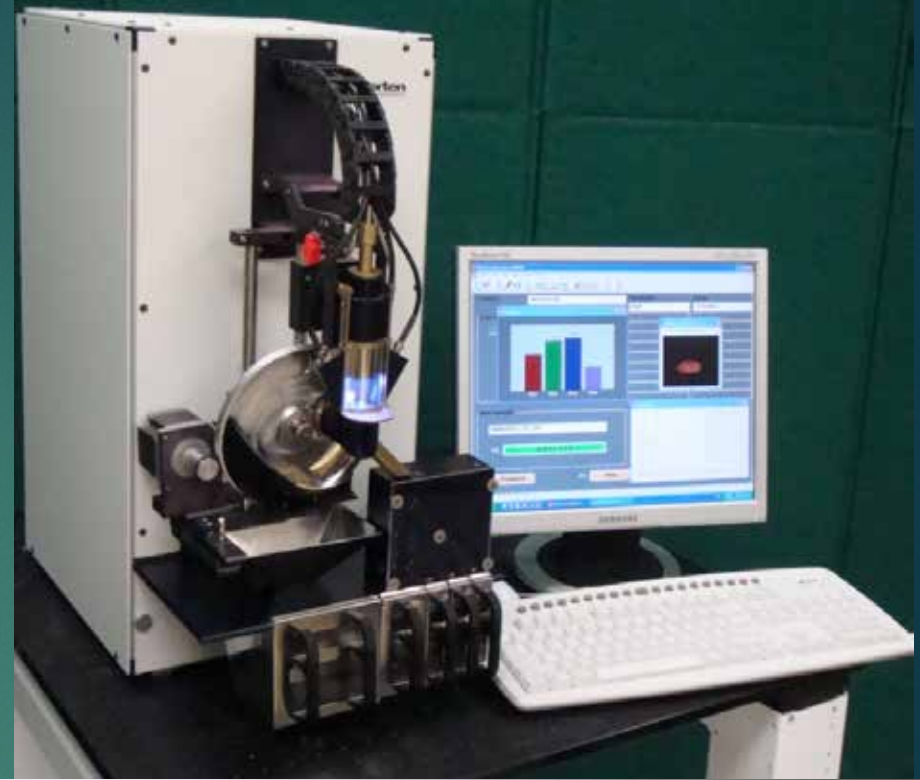




## Key Point

- **I am an Engineer and NOT a wheat breeder!**

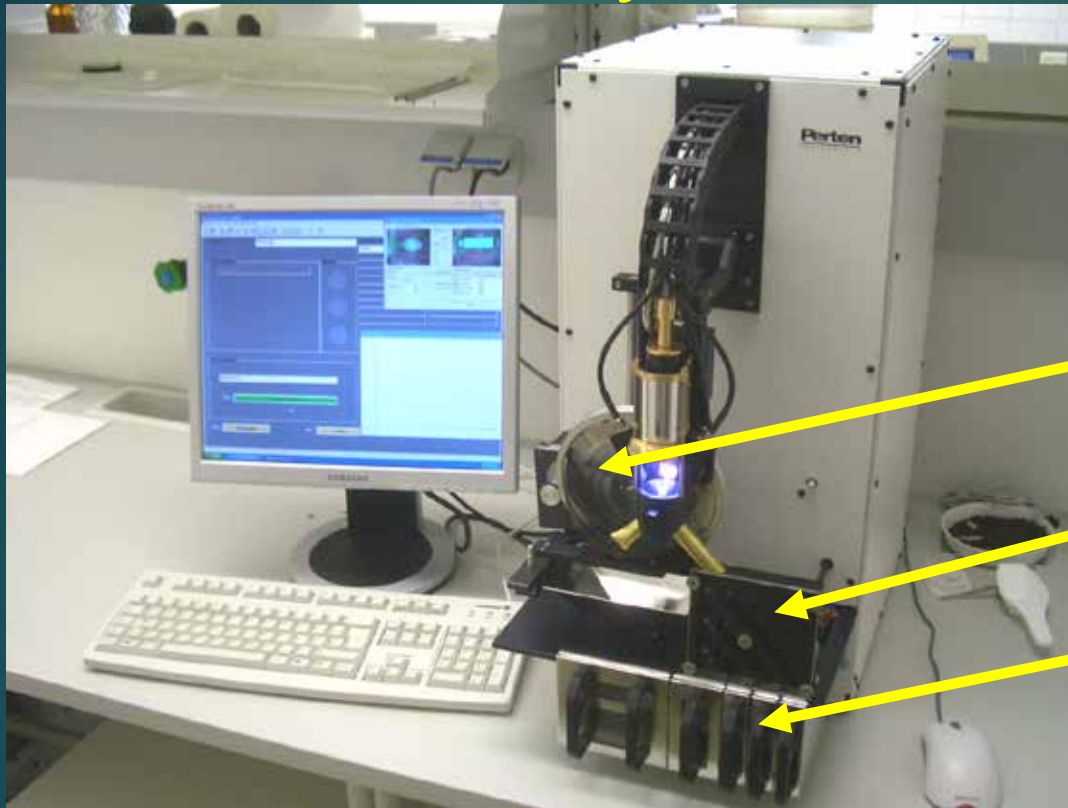
# Automated Single Kernel NIR System (SKNIR)



# PerkinElmer FT-NIR System



# Automated Single-Kernel NIR System



Kernel Feeder

Sorting Block

Sorting Bins

- 1 kernel/2 seconds
- Sort by non-visible characteristics (protein, hardness, amylose content, scab, DON, etc)

# Types of Resistance

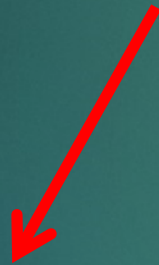
- Type I – Resistance to initial infection.
- Type II – Resistance to fungal spread within a spike.
- Type III – Resistance to toxin accumulation.
- Type IV – Resistance to kernel infection.
- Type V – Resistance to yield loss.

Measuring scab and DON levels in single kernels may help investigate some of these resistance types

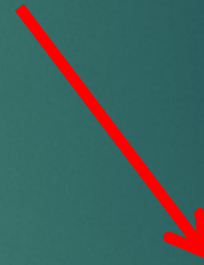


# SKNIRS Case Studies

- System to measure and select kernels based on traits such as hardness, protein, starch, moisture, scab, color, toxins, etc.



Quantify Scab

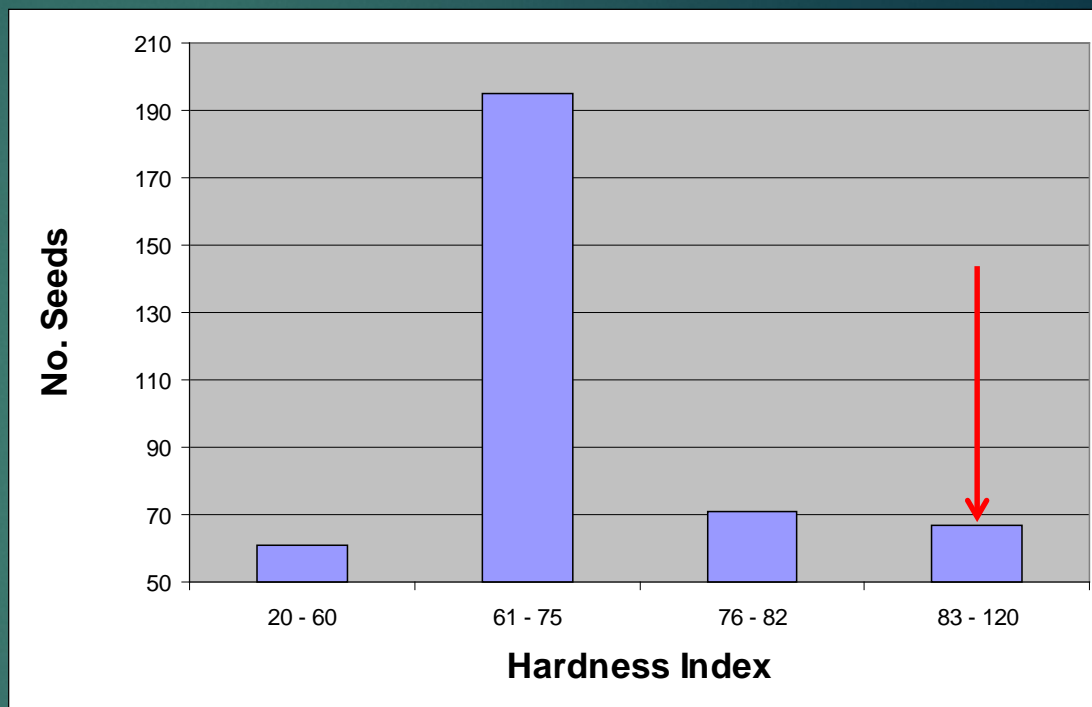


Measure DON



SKNIRS can be used to select seeds from various crosses. Can select for hardness, color, protein, FHB, DON, etc.

For example, we can select the high protein, hard, red kernels with no DON or FHB from a (HRS x SRW) x HWW cross.



*Dowell, F.E., Maghirang, E.B., and Baenziger, P.S. 2009. Automated single-kernel sorting to select for quality traits in wheat breeding lines. Cereal Chem. 86(5):527-533.*



# Distinguishing FDK from Healthy Kernels

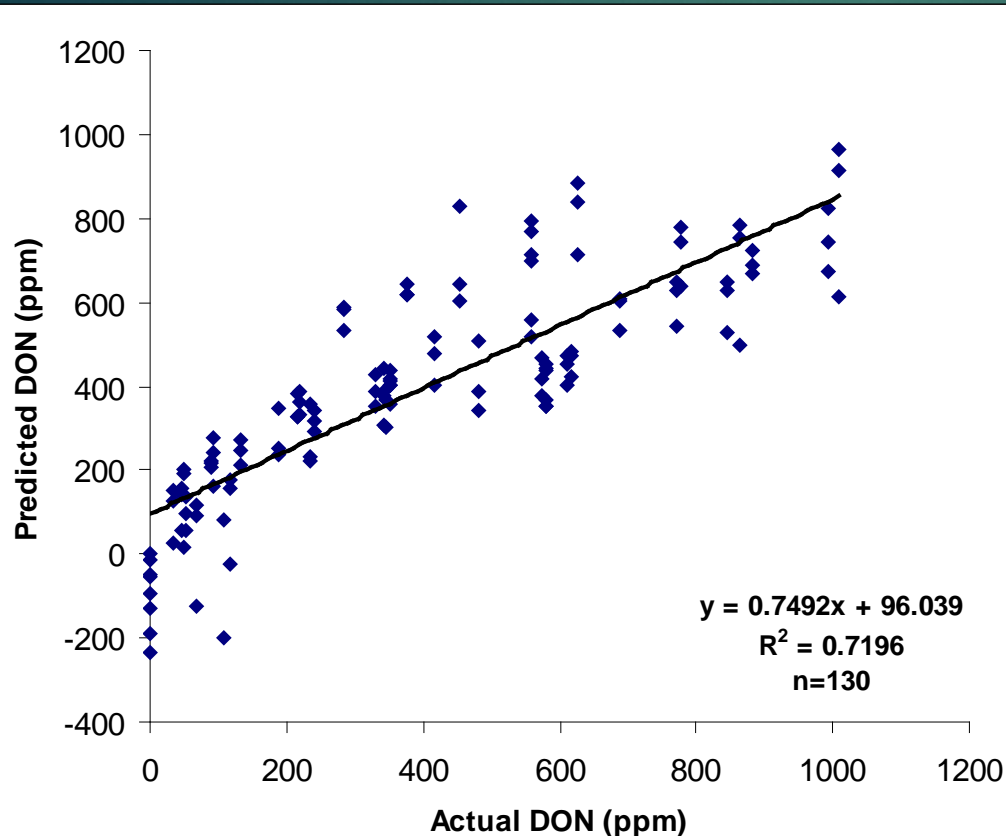
- Can sort FDK from asymptomatic kernels.
- Enrich breeding populations.
- Objectively evaluate lines for %FDK
- We've evaluated 1000's of samples for USWBSI cooperators

*Wegulo, S.N., Dowell, F.E. 2008.  
Near-infrared versus visual sorting of  
Fusarium-damaged kernels in winter  
wheat. Canadian Journal Plant  
Science. 88(6):1087-1089.*



# Measuring DON in Single Kernels

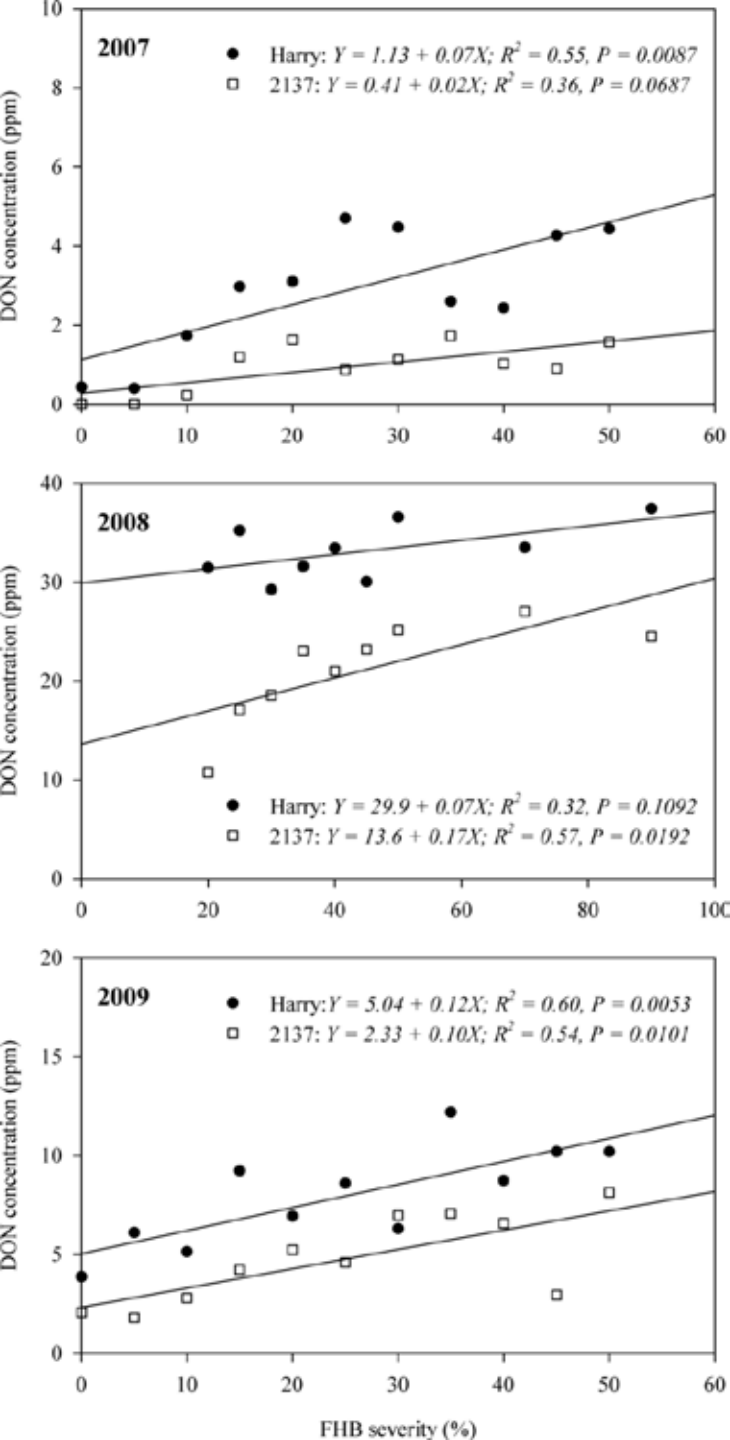
- $R^2=0.72$
- Not intended to replace a chemical test, but is rapid and non-destructive



*Peiris, K.H.S, Pumphrey, M.O., Dong, Y., Maghirang, E.B., Berzonsky, W., Dowell, F.E. 2010. NIRS method for identification of FHB and prediction of DON in single wheat kernels. Cereal Chem. 87(6):511-517.*

# Measuring DON accumulation in cultivars

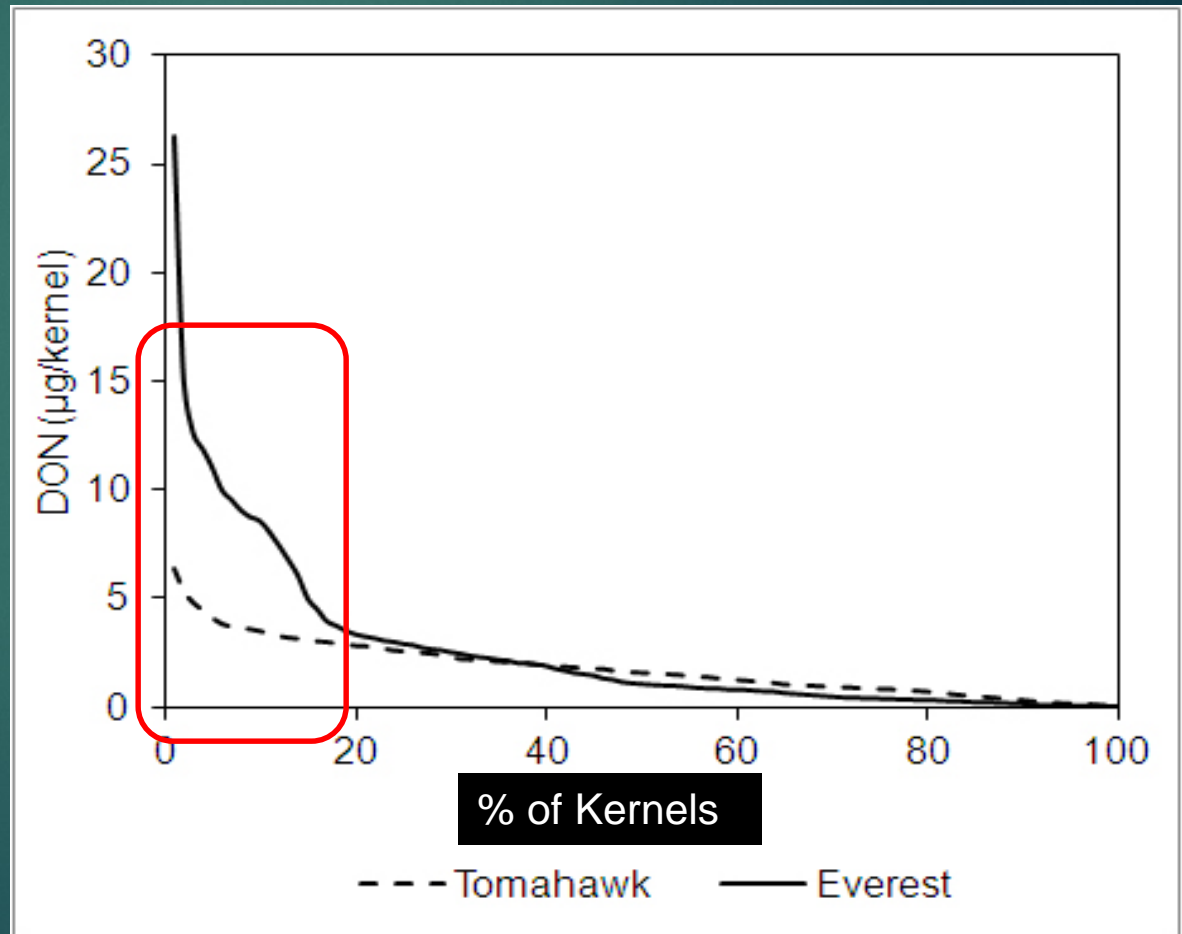
- Rapid, non-destructive measurement by SKNIR



Hernandez Nopsa, J.F., Baenziger, P.S., Eskridge, K.M., Peiris, K.H.S., Dowell, F.E., Harris, S.D., Wegulo, S.N. 2012. Differential accumulation of DON in two winter wheat cultivars varying in FHB phenotype response under field conditions. *Can. J. Plant Pathol.* 34:380-389.

# Study DON levels in single kernels

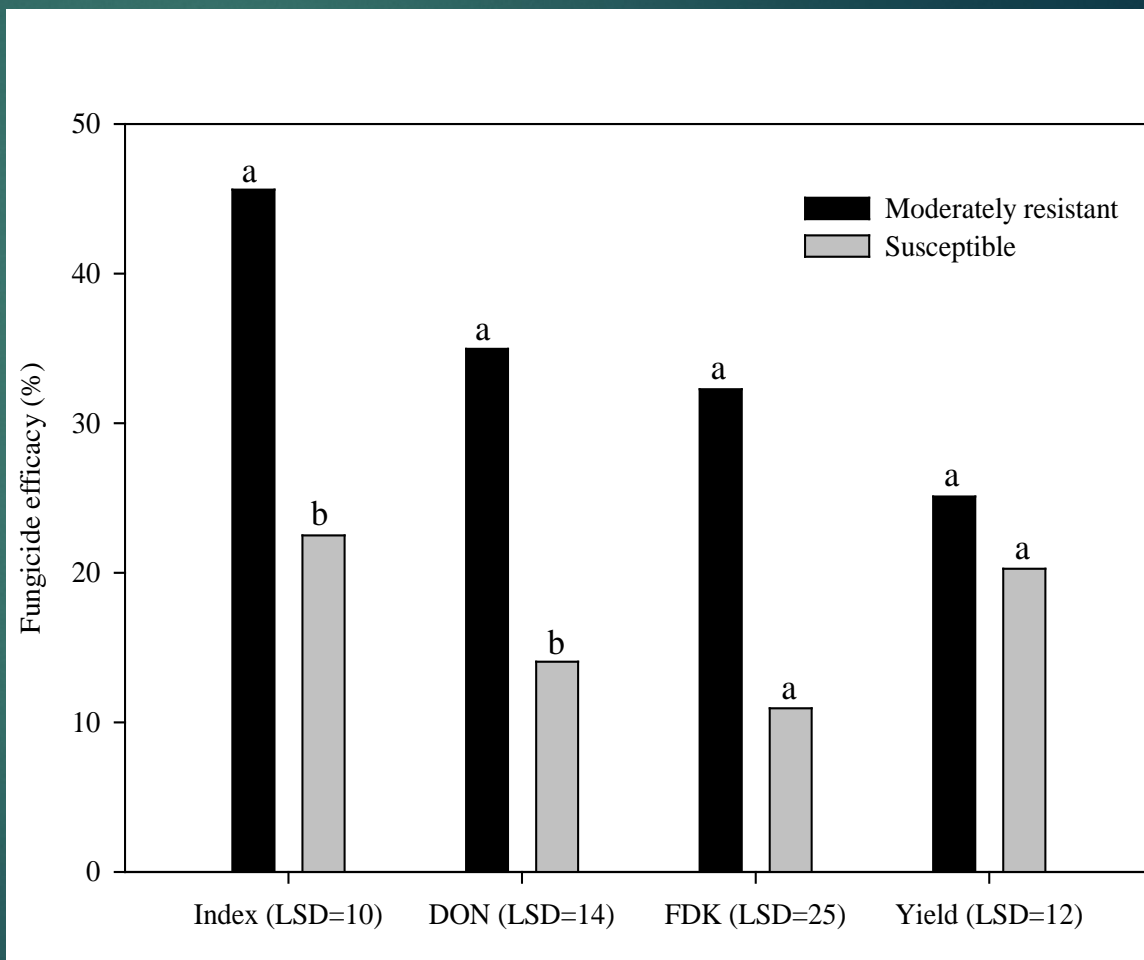
- In this study, we showed that 20% of kernels with DON from Everest have much more DON than Tomahawk kernels.



*Peiris, K.H.S., Y. Dong, W.W. Bockus, and F.E. Dowell. 2014. SKNIR analysis for evaluating wheat samples for FHB resistance. Cereal Chem. 91(1):35-40*

# Study effects of resistance and fungicides on FHB and DON

*Wegulo, S.N., Bockus, W.W., Nopsa, J.H., DeWolf, E.D., Eskridge, K.M., Peiris, K.H.S., and Dowell, F.E. 2011. Effects of integrating cultivar resistance and fungicide application on FHB and DON in winter wheat. Plant Disease. 95: 554-560.*



Kernel	DON (ppm)		
Position	Spike 1	Spike 2	Spike 3
10			
9			
8			
7	nd		
6	217.3		
5	342.3		
4	578.8	376.2	45.7
3	285.3	452.9	49.2
2	772.0	557.7	219.5
1			350.8
0			
-1	863.2	1008.4	573.5
-2	882.1	993.8	330.7
-3	846.7	626.0	240.9
-4	688.7	777.3	189.4
-5	579.4	557.8	116.3
-6	344.7	611.2	89.7
-7	nd	416.8	93.9
-8	nd	nd	69.0
-9			53.8
-10			33.5

## Measuring DON in spikes

*Peiris, K.H.S., Pumphrey, M.O., Dong, Y., and Dowell, F.E. 2011. Fusarium head blight symptoms and mycotoxin levels in single kernels of infected wheat spikes. Cereal Chemistry. 88(3):291-295.*

# Detecting FHB independent from DON

- Study asymptomatic kernels with DON, and vice-versa.



# Summary

- Single kernel NIRS can be used as a tool to help breeders develop FHB resistant lines.



THANKS USWBSI!

- Partial funding was provided by the USWBSI which provided much needed continuity for Dr. Peiris' salary as ARS budgets continue to be unpredictable.