

New technology to salvage grain from FDK and ergot infested cereals.

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Kernels of single
head of wheat
can vary by >6%
in protein.



VARIABILITY!

- IF YOU CAN MEASURE IT YOU CAN PAY FOR IT! SELECT FOR IT, **ADAPT PROCESSES TO ACCOMMODATE IT**, ADJUST OTHER NUTRIENTS, SELECT ADDITIVES...

MAKE IT MORE CONSISTENTLY BETTER!

Canadian Grain Commission Grade



- **47 grading factors are assessed in a single sample of wheat**
- **3 more assessments**
 - **Dockage**
 - **Test weight**
 - **Moisture Test**
- **NIR**
 - **Crude Protein**
 - **Moisture**
 - **Bushel weight**

Grading Factors

Subjective

- Factors that are visually assessed – using the definition of the degree of soundness and visual aids such as Standards and Guides
- Minimal Nutrition
 - Crude protein
- Functional Characteristics for end product



CANADA WESTERN FEED (CWFW) WHEAT

Export grade specifications*

	CWFW
Minimum test weight, kg/hL	73.0
Total foreign material including other cereal grains	(Max.) 5% including 0.5% other seeds
Wheats of other classes or varieties	No limit but no more than 10% amber durum
Fusarium damage, %	5
Heated, %	2.5
Shrunken and broken	
Shrunken, %	4
Broken, %	13
Total, %	15

← 56.7 lb/bu

~20% of grain downgraded
= ~8 MMT/yr in Canada
~\$1B in lost value



- Only a low amount of grain is typically cause of downgrading
- If it could be removed it would significantly improve value, consistency and safety
- **Individual seed sorting moves grain from a mass commodity to an individual kernel commodity!**
- **This will change the face of Agriculture!**



2014-15 Maximum limits of FDK (%)

Grade	CWAD	CWRW
No. 1	0.5	0.8
No. 2	0.5	1.0
No. 3	2.0	1.5
No. 4	2.0	-
No. 5	4	-
Feed	-	4
Grade, if lowest grade specs not met	10% or less, Sample Canada Account Fusarium Damage, Over 10%, Wheat Commercial Salvage	10% or less, Sample Canada Account Fusarium Damage, Over 10%, Wheat Commercial Salvage

EU regulations for DON

Product	DON limit (ppm)
• Unprocessed Wheat	1.25
• Unprocessed Durum	1.75
• Cereals intended for direct consumption and flour/semolina/pasta	0.75
• Bread	0.50
• Baby food	0.20

Visual differences in FDK

1. Scabby seeds or “tombstones”
2. Intermediate FDK seeds
3. Intermediate seeds in sound fraction
4. Sound seeds

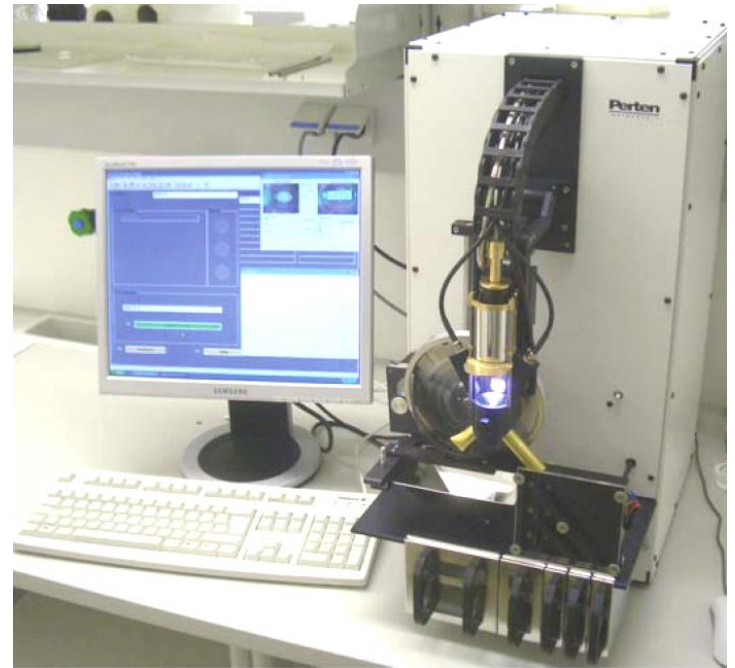
Peiris et al. (2010)



SKNIR

- Indicates that NIR is capable of identifying FDK and DON to a moderate degree
- Does not necessarily measure the fungi or the toxin directly, but estimates it based on other changes to the kernel

- Capacity, 1 seed / sec.
- May have use in:
 - Selection for resistant strains of grain
 - Grading grains, as an assessment of both damage and toxin



BoMill IQ – NIR Individual Kernel

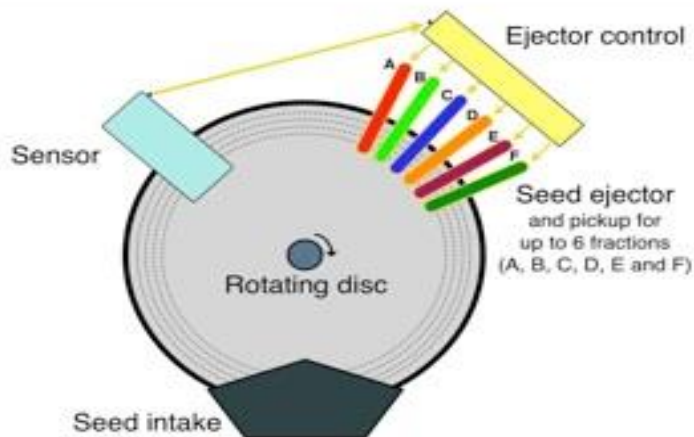


- Laboratory model
 - 1000 kernels / min
 - Individual singulators for wheat, barley or durum, can be modified for other grain
 - Sort into 6 fractions

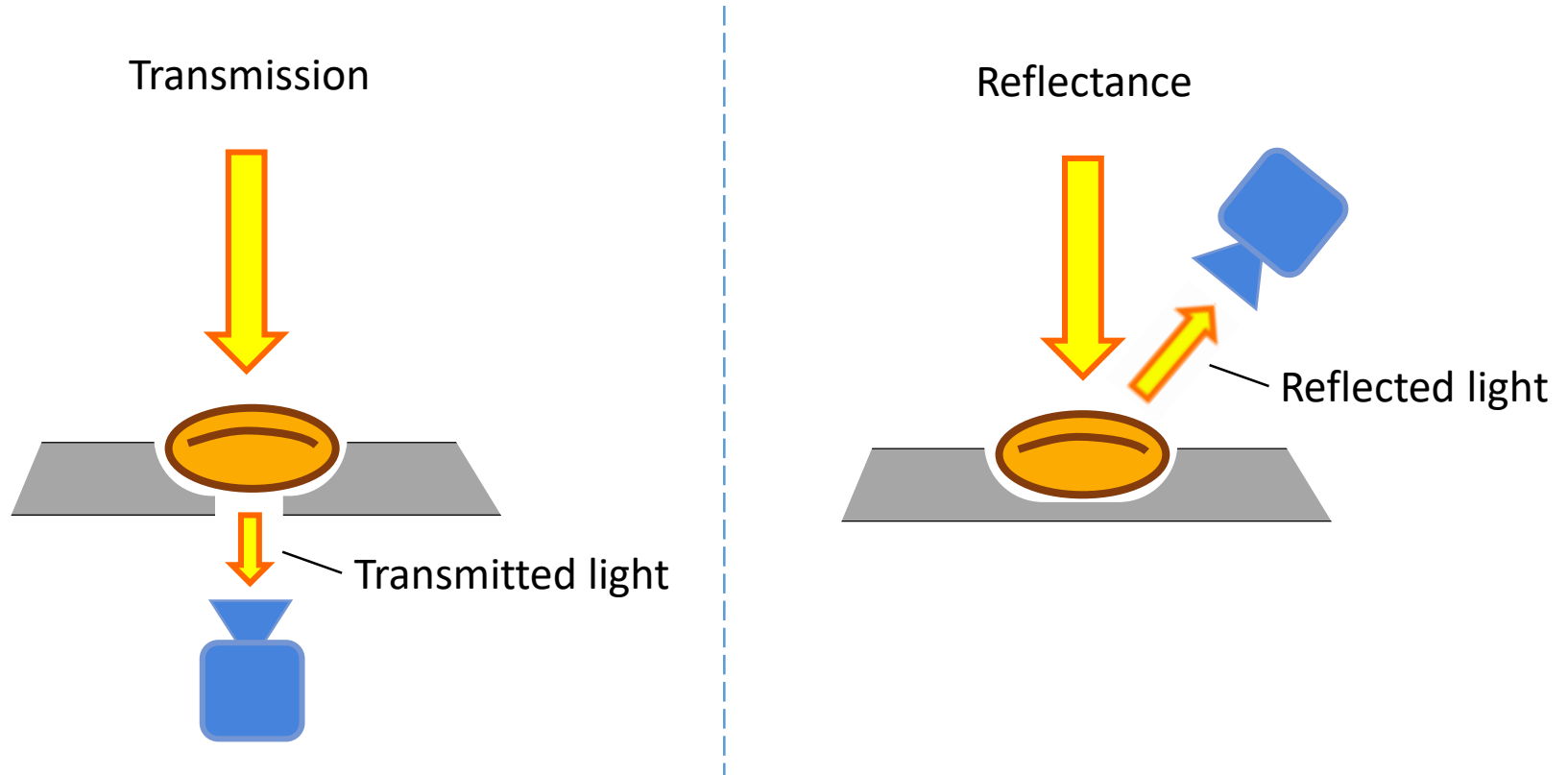
• Sorting Criteria

- Protein, Hardness, Vitreousness, Pearl yield, Viability and Disease damage

IQ Seed Sorter



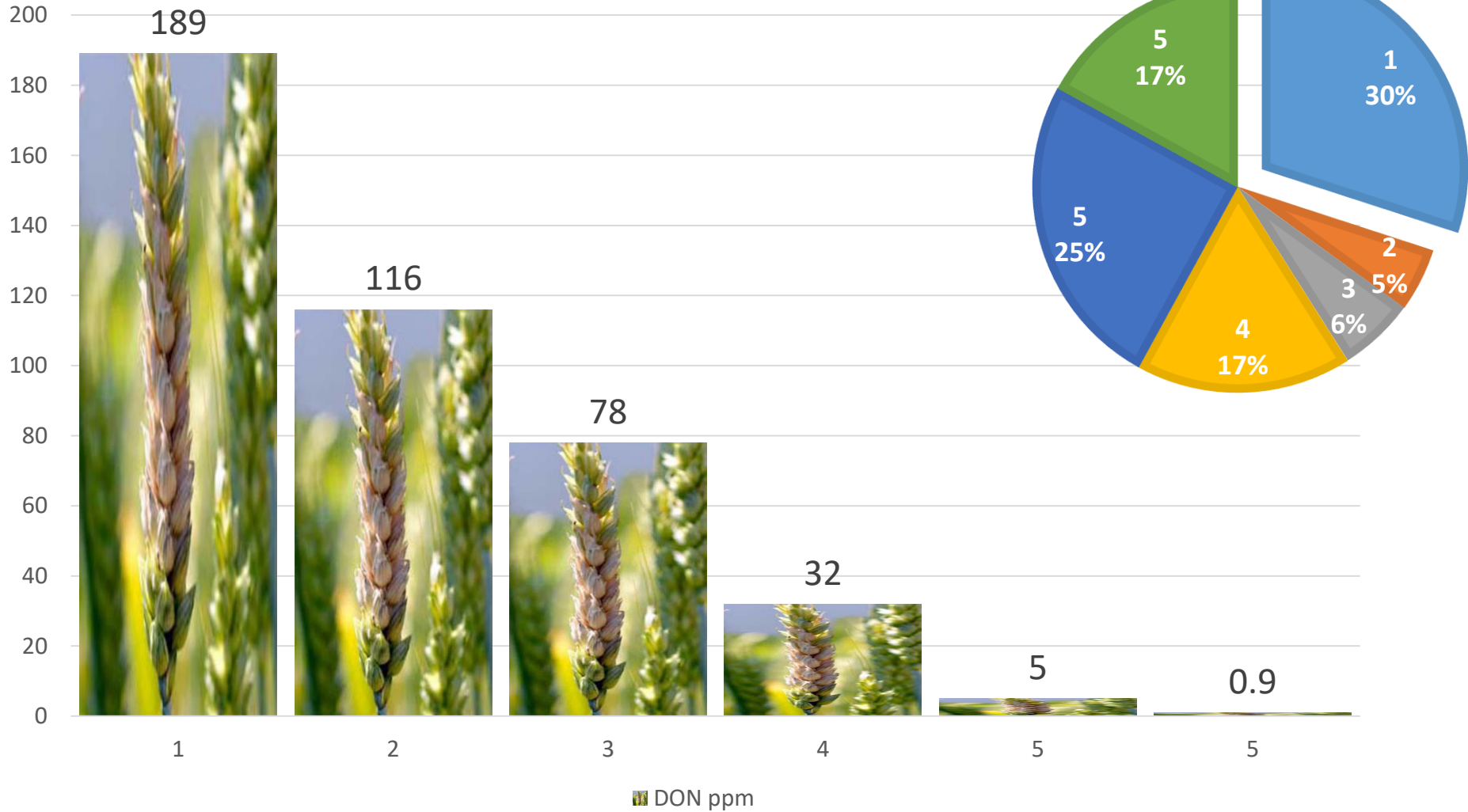
Near Infrared - Transmission vs Reflectance



Dowell et al. (2006) evaluated the use of NIR to predict **186** factors in grain important to baking quality and concluded that crude protein was a major component predicting most criteria. Sprouting / Falling Numbers not related to CP, but were predicted with NIR.

BoMill IQ sort of CWRW – 30% FDK

DON ppm





TECHNOLOGY!
WHERE WOULD WE BE WITHOUT IT?
Now how do we sort
20 MMT of grain/yr?

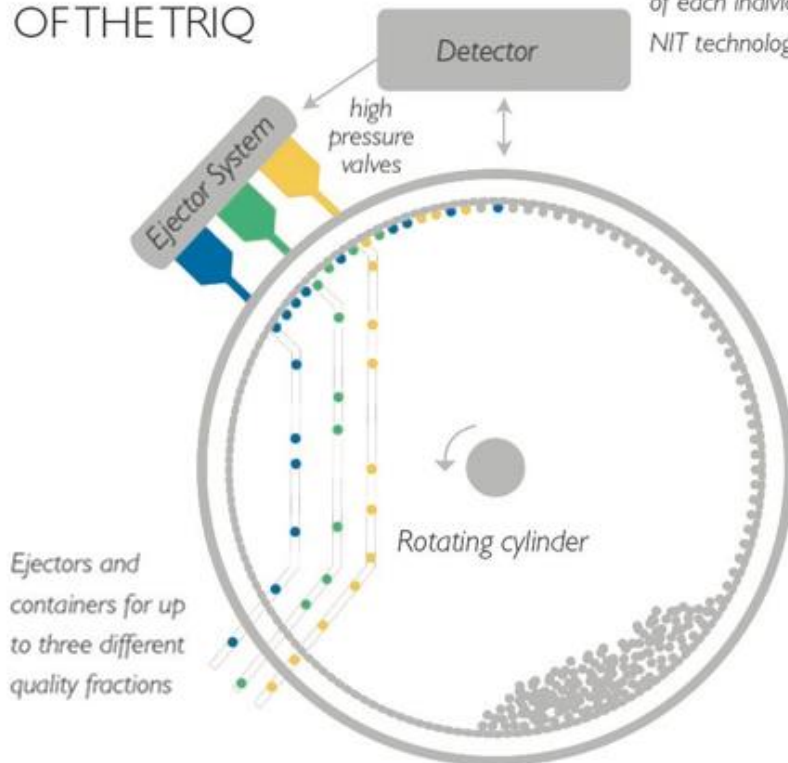
BoMill TriQ

A Positioning cylinder

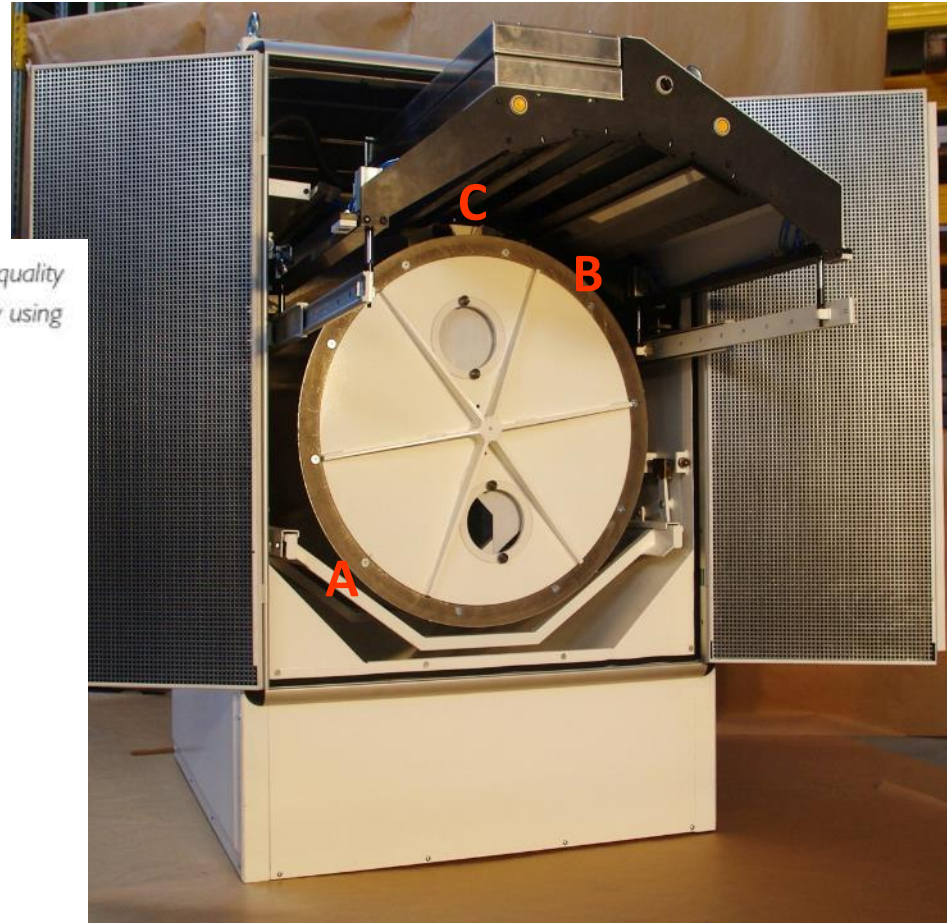
B Detector system

C Ejection system

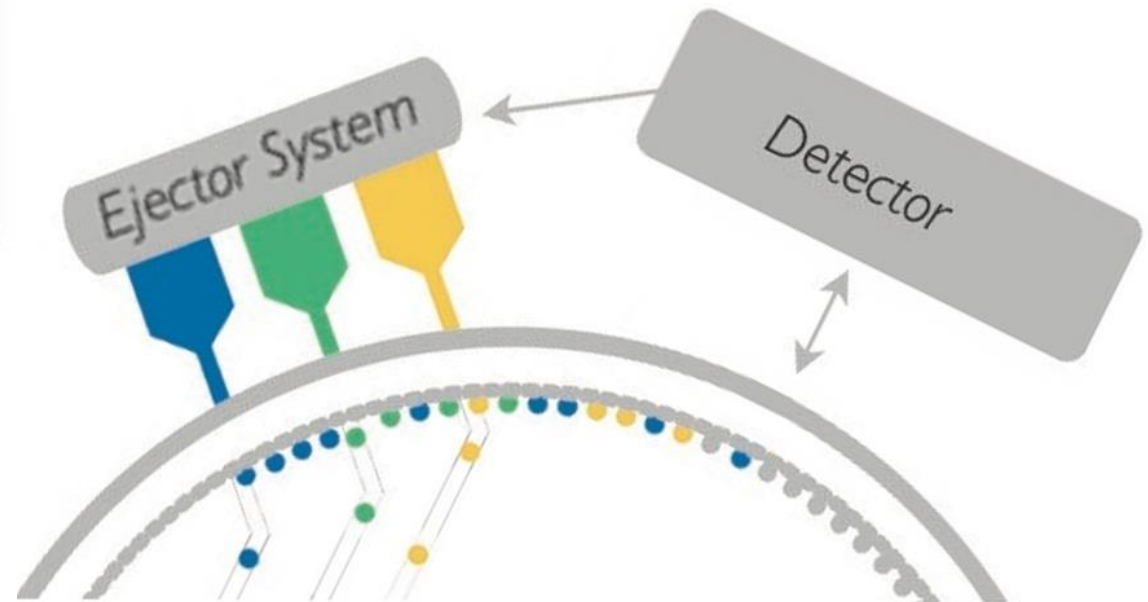
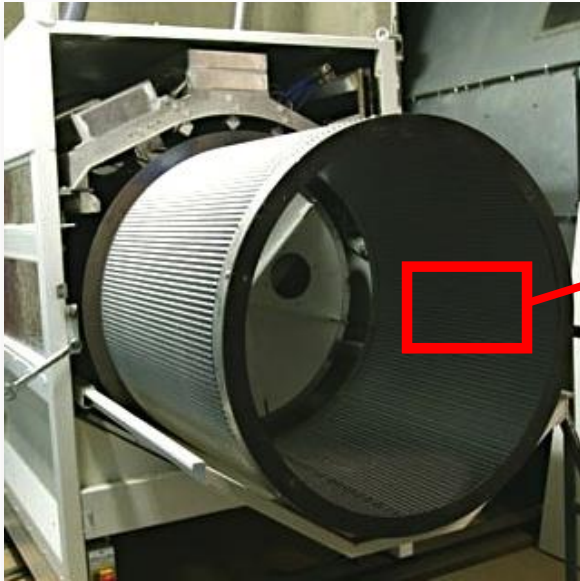
FUNCTIONALITY OF THE TRIQ



The detector analyzes the quality of each individual kernel by using NIT technology.



Singulation – Detection – Ejection



Crop year 2014 (CIGI / BoMill)

- High levels of Fusarium damage
- Identified sources of CWRW & CWAD
- Sorted samples (uncleaned or sized first) using the three commercial ports to:
 - Collect level of outliers (explain)
 - Minimum fraction to remove most FDK
 - Maximum fraction of saleable wheat
 - Grade
 - Value

5 CWRW Samples



0.8% FDK
1 ppm DON



2.2% FDK
7 ppm DON



5.4% FDK
19 ppm DON



5.6% FDK
13 ppm DON



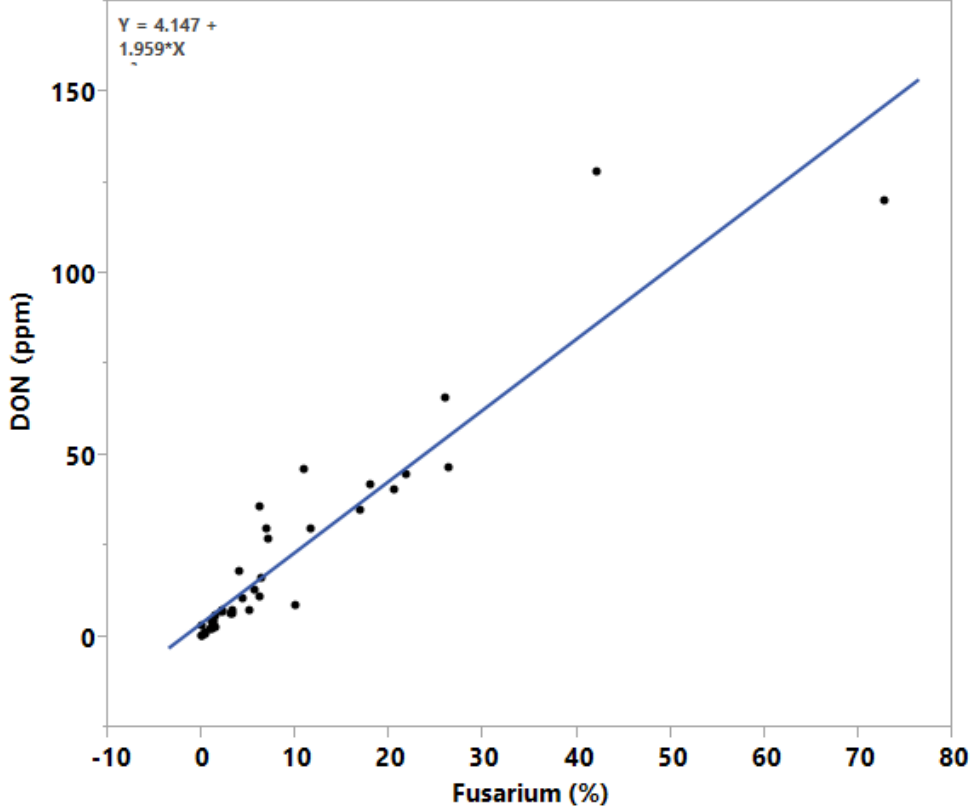
26.3% FDK
47 ppm DON



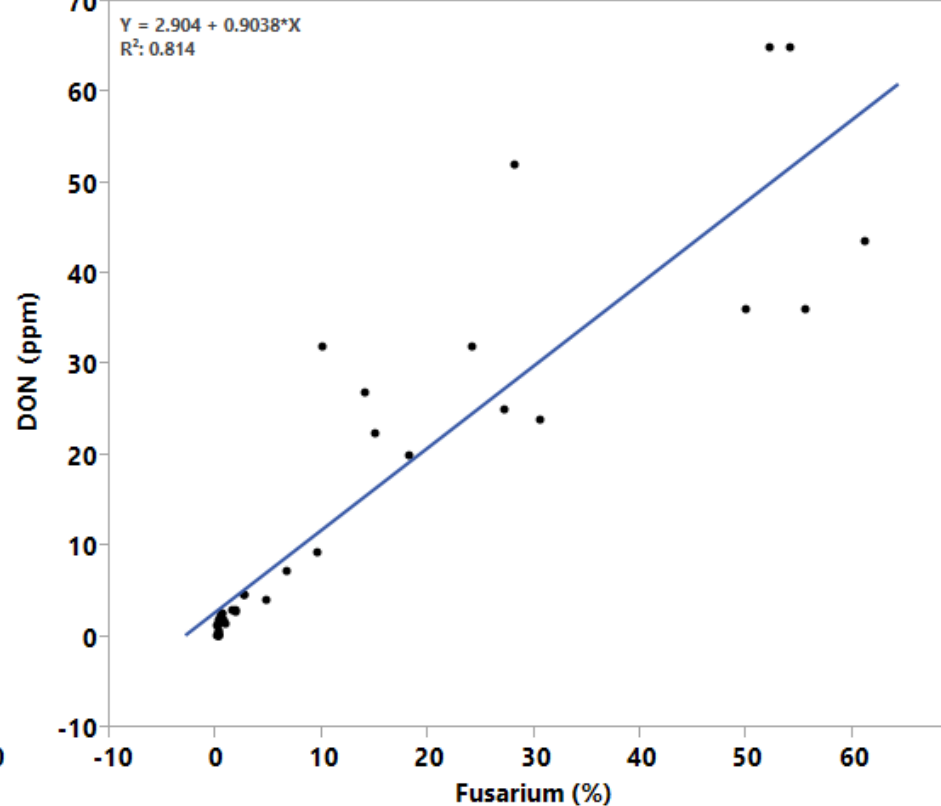
CIGI Data on DON (ppm) vs FDK %

Reasonable relationship between DON (ppm) and % FDK (R. Newkirk, 2015)

DON (ppm) vs. Fusarium (%) in Winter Wheat 2014 samples

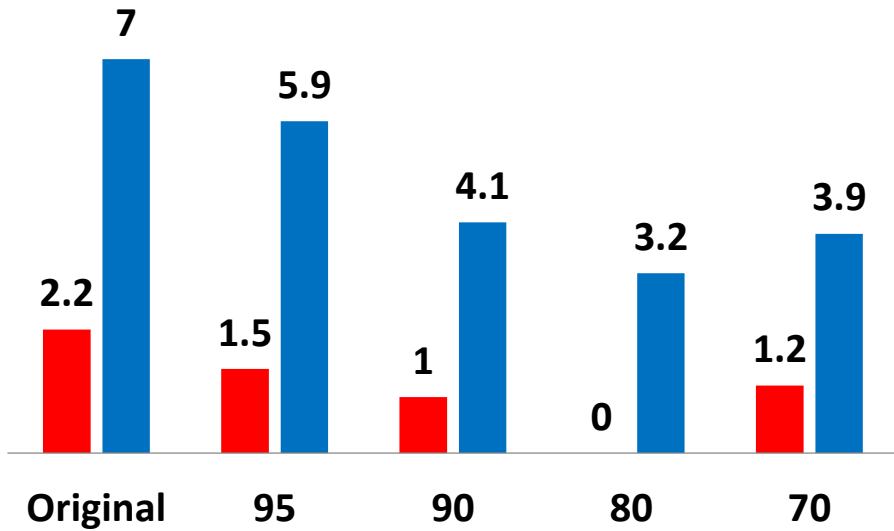


DON (ppm) vs. Fusarium (%) in Durum samples 2014



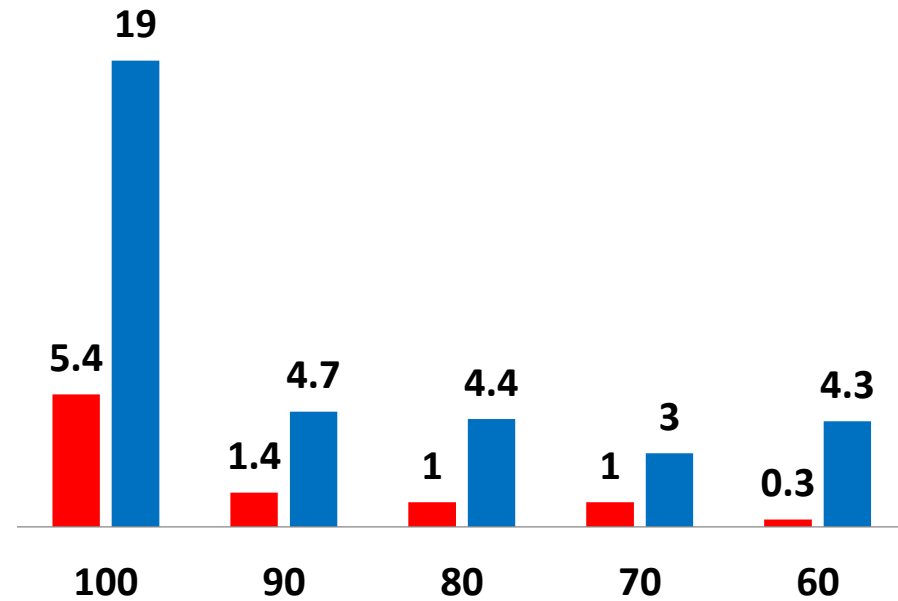
2.2% FDK CWRW

■ % FUS ■ DON ppm

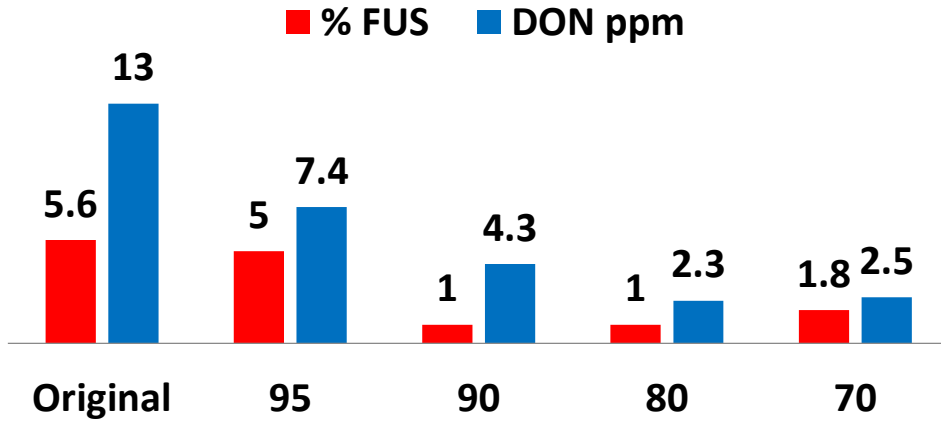


5.4% FDK CWRW

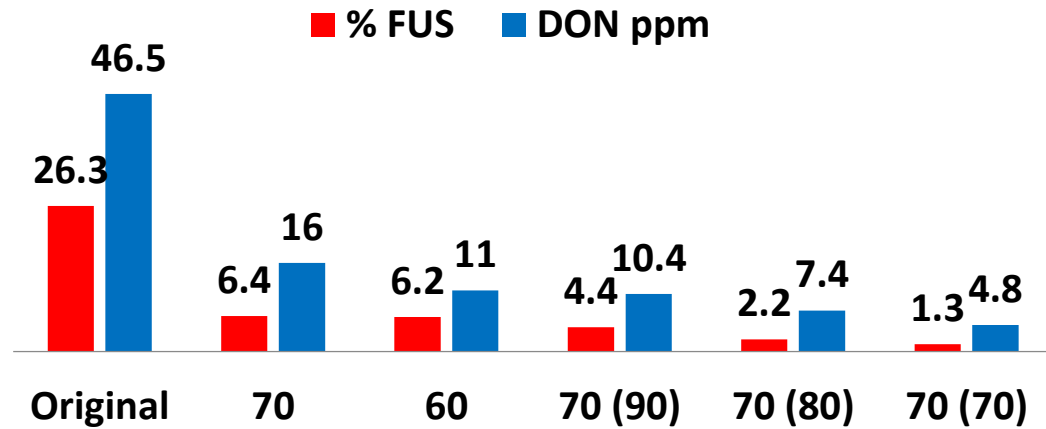
■ % FUS ■ DON ppm



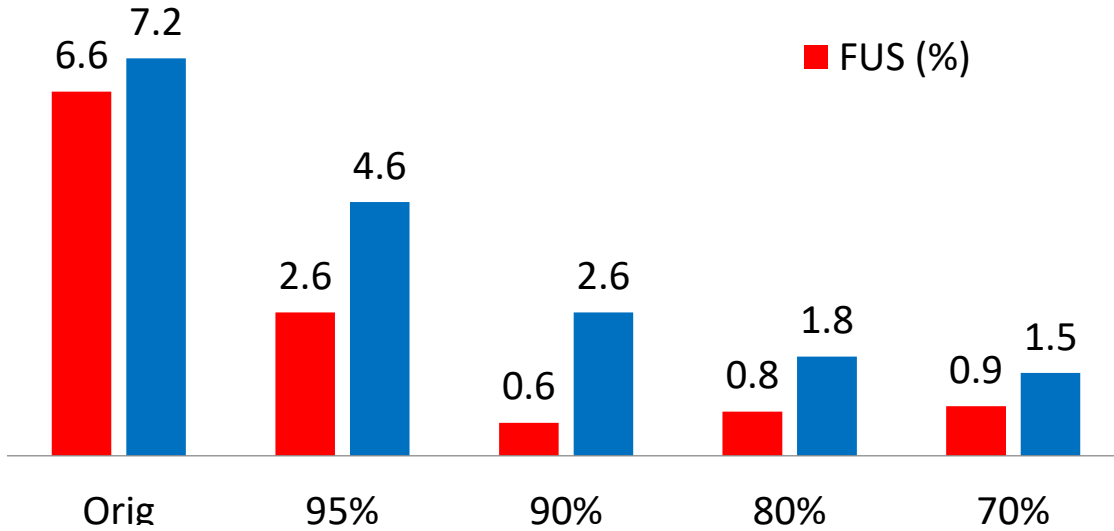
5.6% FDK CWRW



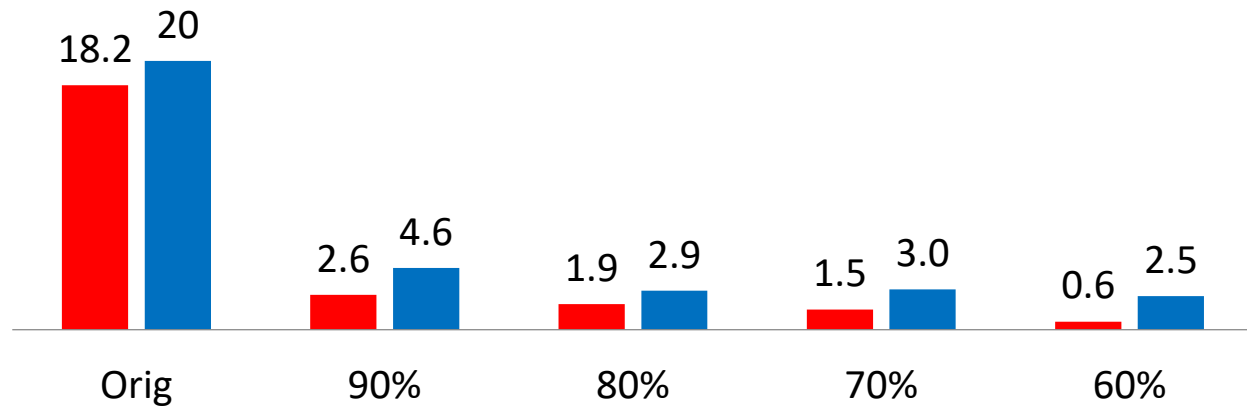
26.3% FDK CWRW



6.6% FDK CWAD



18.2% FDK CWAD



Economics of sorting (\$600K investment)

* 1 BoMill TriQ

* Operating 16hr/d x 5 days a week (3MT/hr)

R. Newkirk, 2015

CWAD – FDK%	Amount Salvaged	Grade	Profit M\$ over 3yrs	Pay Back (wk)
6.6% (Sample)	90% in 2fractions	#4	6	10
18.2% (Salvage)	60%	#5	3	20
9.5% (Sample)	51%	#1	5.5	11

What are we going to do with high *Fusarium* sorted grains?



- Burn it?
 - If 5% of seeds are removed, this is 50,000 MT/ 1MMT sorted (@ \$250 = \$12.5M/MMT)
- Ethanol?
 - Mycotoxins are concentrated in the DDGS (3 fold)
 - Some indications that some bacteria are able to detoxify some mycotoxins
 - Why ruminants tend to be less impacted?
- Feed
 - Feed additives to bind or detoxify effectively, not efficient for DON
 - Prairie Swine Centre
 - Natacha Hogan
 - Galactomannas (patent for DON decontamination for children, NL)
 - Insects?

Vienna – World
Mycotoxin Forum
2014



Meal worms grown on
DON-contaminated
flour (5ppm; NL, 2014)

- NO effect on larvae growth or survival
- No DON or metabolites measurable in the larvae or faeces.
- What happened to it?

Conclusions

- Potential to salvage high quality grain and increase value of FDK downgraded grain.
- Reduces mycotoxins measured in salvaged grain.
- Needs to be as “clean” as possible before sorting to increase throughput.
 - Not sure how this impacts levels of DON in salvaged grain
- Not extensively tested for ergot as yet.
 - Color sorters work well for ergot



Front Cover!

Questions?



Feeding Initiative
Annual Report 2011/12
March 31 2012