



Canadian Grain
Commission

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des grains



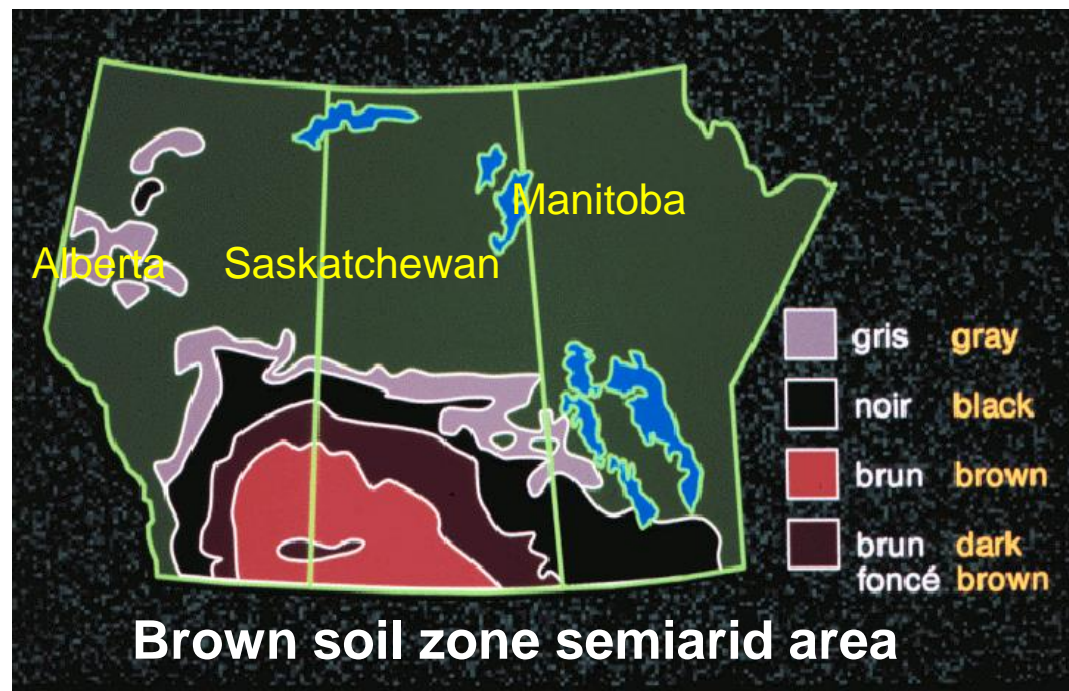
Canada Western Amber Durum (CWAD): Quality Objectives and Parameters

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Durum Wheat Production in Western Canada

- Semiarid area, low input production
- Annual production: 5.0-7.5 million tons
- > 50% global durum trade
- Supplier of choice for premium quality



CWAD Quality Objectives

- Requirements for releasing new varieties
- Carefully defined with changing market demands and advances in processing technologies
- Guidelines for selection in breeding programs
- Check varieties approved with required quality characteristics
- Candidate lines compared against checks in registration trials
- New registered variety must meet the class-specific quality requirements

Quality Parameters & Guidelines for Assessment

- Quality objectives are defined with quality parameters

| VarietyYr in Test | | Wheat Characteristics | | | | Milling Performance | | | Protein Content and Gluten Strength ¹ | | | | Semolina Pigment ¹ and Pasta Colour | | |
|-----------------------------------|--------------|-----------------------|-----------|-----------|----------|---------------------|---------------------------------|---------------|--|---------------|------|------|--|------|-----|
| | | Grade | FN sec | Cd ppb | HVK % | Milling Yield % | Semo Yield ² % | Semo Ash % | Wht Pro % | Semo Pro % | GI % | P/L | TYP ppm | b* | a* |
| GUIDELINES (Values ≥ or ≤) | | | | | | | | | | | | | | | |
| Excellent | | | - | - | 11 | 2.1 | 2.1 | -0.06 | 0.9 | 0.9 | - | - | 1.6 | 2.6 | - |
| Improvement | | | - | - | 7 | 1.1 | 1.1 | -0.03 | 0.4 | 0.4 | - | - | 1.1 | 1.6 | - |
| Flag | | | -50 | - | -7 | -1.1 | -1.1 | 0.03 | -0.4 | -0.4 | - | 0.36 | -1.1 | -1.6 | - |
| Poor | | | -100 | - | -11 | -2.1 | -2.1 | 0.06 | -0.8 | -0.8 | - | 0.70 | -1.6 | -2.6 | - |
| Mean of Checks | | | 465 | 102 | 96 | 75.3 | 66.7 | 0.60 | 14.3 | 13.1 | 80 | 0.61 | 9.9 | 65.7 | 4.6 |
| RATING RELATIVE TO MEAN OF CHECKS | | | | | | | | | | | | | | | |
| DT673 | AC Navigator | No.1 | 500 | 203 | 95 | 76.3 | 67.5 | 0.61 | 13.8 | 12.8 | 76 | 0.61 | 10.4 | 66.5 | 4.8 |
| DT773 | Brigade | No.1 | 460 | 69 | 96 | 74.7 | 66.7 | 0.59 | 14.1 | 13.0 | 92 | 0.50 | 10.0 | 65.5 | 4.4 |
| DT712 | Strongfield | No.1 | 430 | 71 | 95 | 75.1 | 66.3 | 0.61 | 14.7 | 13.6 | 77 | 0.56 | 9.1 | 63.9 | 4.7 |
| DT840 | AAC Cabri | No.1 | 470 | 63 | 97 | 74.9 | 66.1 | 0.58 | 14.4 | 13.1 | 73 | 0.44 | 10.2 | 66.8 | 4.5 |
| DTXXX | 1 | No.1 | 470 | 68 | 94 | 74.5 | 66.6 | 0.59 | 14.3 | 13.1 | 86 | 0.86 | 10.5 | 65.2 | 4.7 |
| DTXXX | 1 | No.1 | 420 | 51 | 94 | 74.2 | 66.5 | 0.59 | 14.7 | 13.5 | 68 | 0.41 | 9.1 | 64.0 | 4.6 |
| DTXXX | 1 | No.1 | 425 | 68 | 99 | 75.0 | 66.6 | 0.61 | 14.7 | 13.9 | 75 | 0.47 | 9.6 | 65.2 | 4.4 |
| DTXXX | 1 | No.1 | 440 | 70 | 93 | 74.7 | 66.6 | 0.60 | 14.3 | 13.1 | 87 | 0.75 | 10.2 | 64.9 | 4.8 |
| DTXXX | 1 | No.1 | 460 | 62 | 97 | 75.4 | 68.1 | 0.59 | 14.2 | 12.9 | 78 | 0.54 | 9.3 | 64.3 | 5.0 |
| DTXXX | 1 | No.1 | 430 | 65 | 96 | 74.1 | 66.3 | 0.60 | 14.6 | 13.8 | 76 | 0.46 | 10.0 | 66.6 | 4.9 |
| DTXXX | 1 | No.1 | 430 | 81 | 96 | 74.4 | 66.0 | 0.58 | 14.4 | 13.4 | 78 | 0.54 | 10.6 | 66.0 | 4.9 |
| DTXXX | 1 | No.1 | 455 | 75 | 97 | 74.9 | 67.3 | 0.66 | 15.1 | 13.8 | 70 | 0.50 | 8.5 | 62.9 | 4.4 |

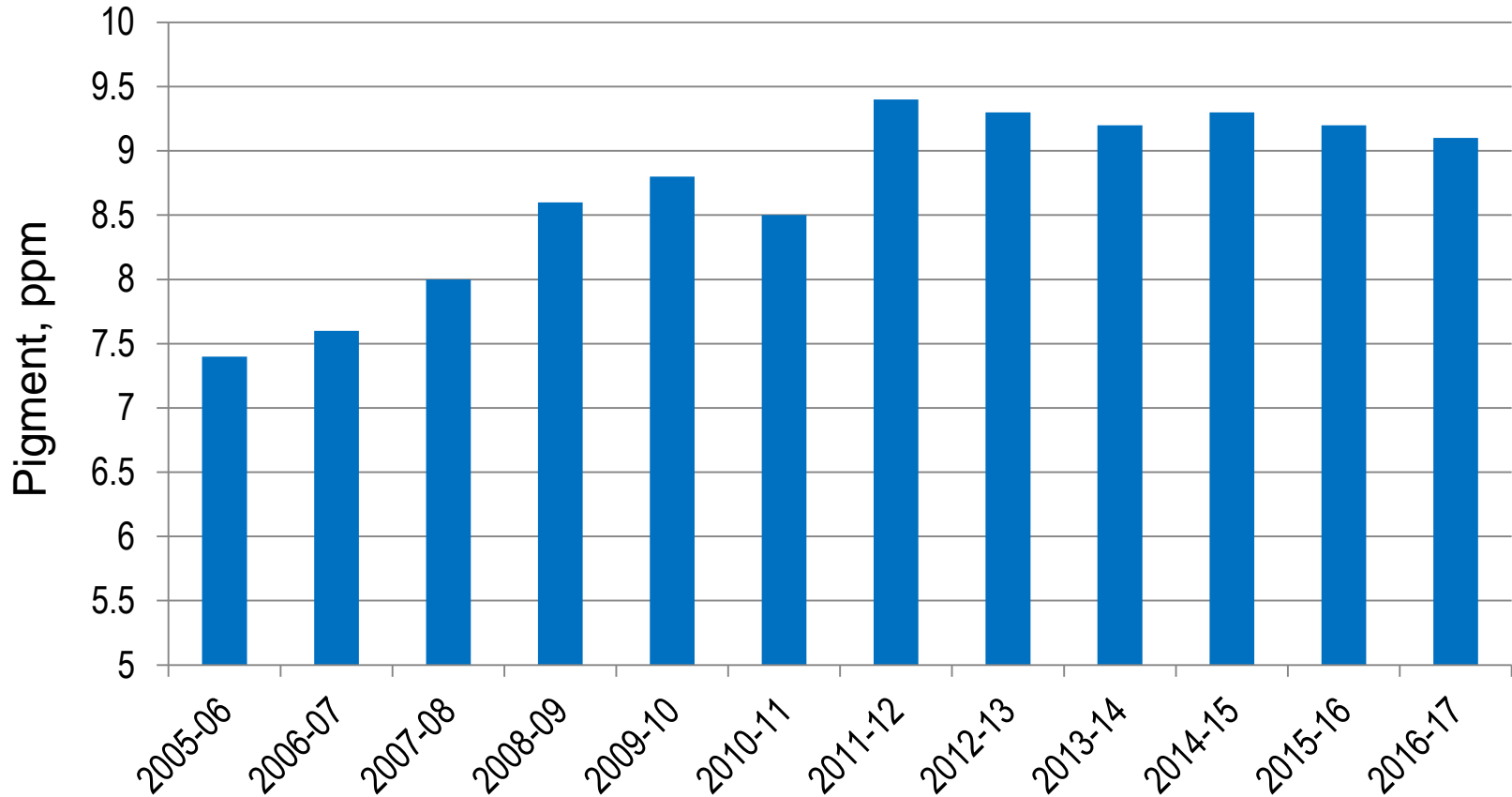
Key Quality Objectives & Parameters for CWAD

- Pigment concentration and pigment loss
- Protein content
- Milling performance
- Gluten strength
- Cadmium level

CWAD Quality Objectives – Pigment Concentration & Pigment Loss

- **Semolina and pasta products with bright yellow colour, a desirable feature appreciated by customers.**
 - Concentration of yellow pigment in grain
 - Loss due to oxidative degradation
 - Processing conditions

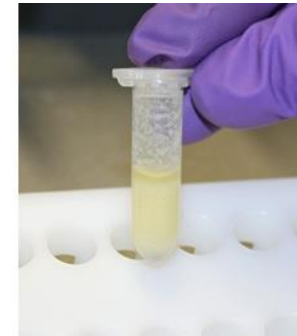
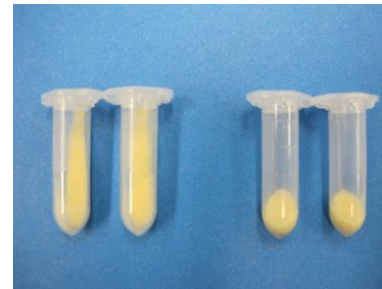
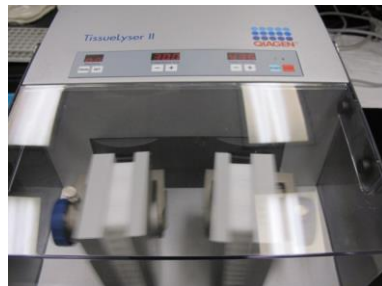
Yellow Pigment: CGC Export Cargo Composites



CWAD Quality Objectives - Pigments

■ Recent revisions

- Removed cap on pigment content
 - Increase in pasta yellowness more than compensated for the elevation in redness (a^*)
 - Many use Canadian durum for blending to improve colour
- Low pigment loss
 - Noted as a positive trait
 - Selection for *Lpx-B1.1* deletion
 - Pigment loss by micro-dough method (wholemeal or semolina)



Pigment Loss in Durum Wheat

- Physicochemical basis of pigment loss
 - Loss due to milling – pigment distribution
 - Oxidative degradation – selection tool for low LOX

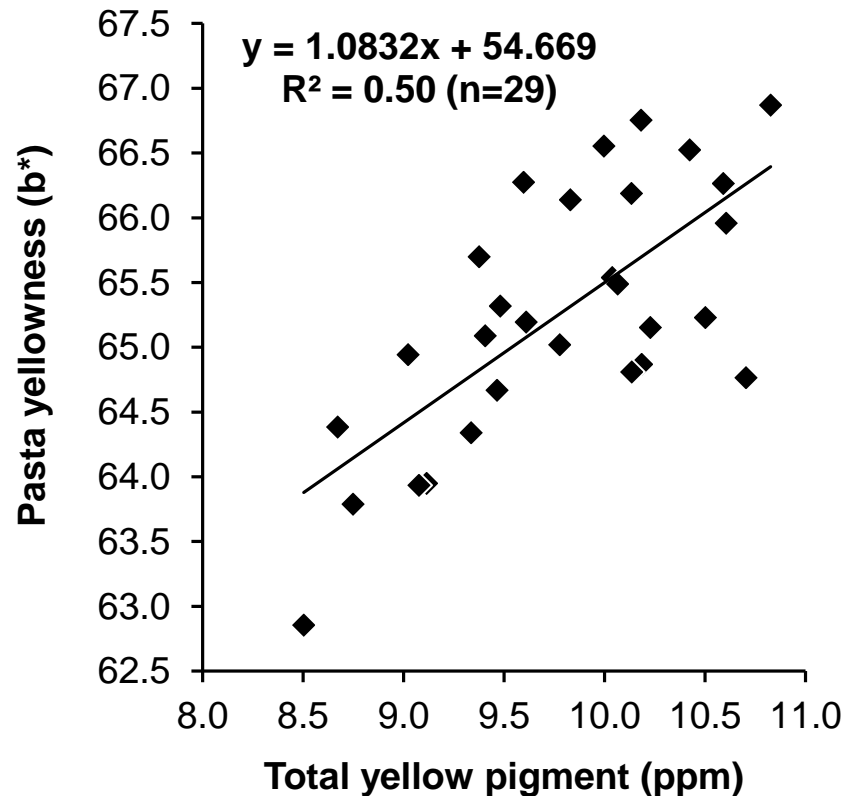
| Variety | 2014 | | | 2013 | | | 2012 | | |
|-------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | Wheat | Semo. | Dough | Wheat | Semo. | Dough | Wheat | Semo. | Dough |
| Strongfield | 10.1 | 9.0 | 8.3 | 10.0 | 9.3 | 8.6 | 10.3 | 9.2 | 8.5 |
| Navigator | 10.4 | 10.1 | 9.8 | 10.3 | 10.3 | 10.1 | 10.6 | 10.1 | 9.9 |



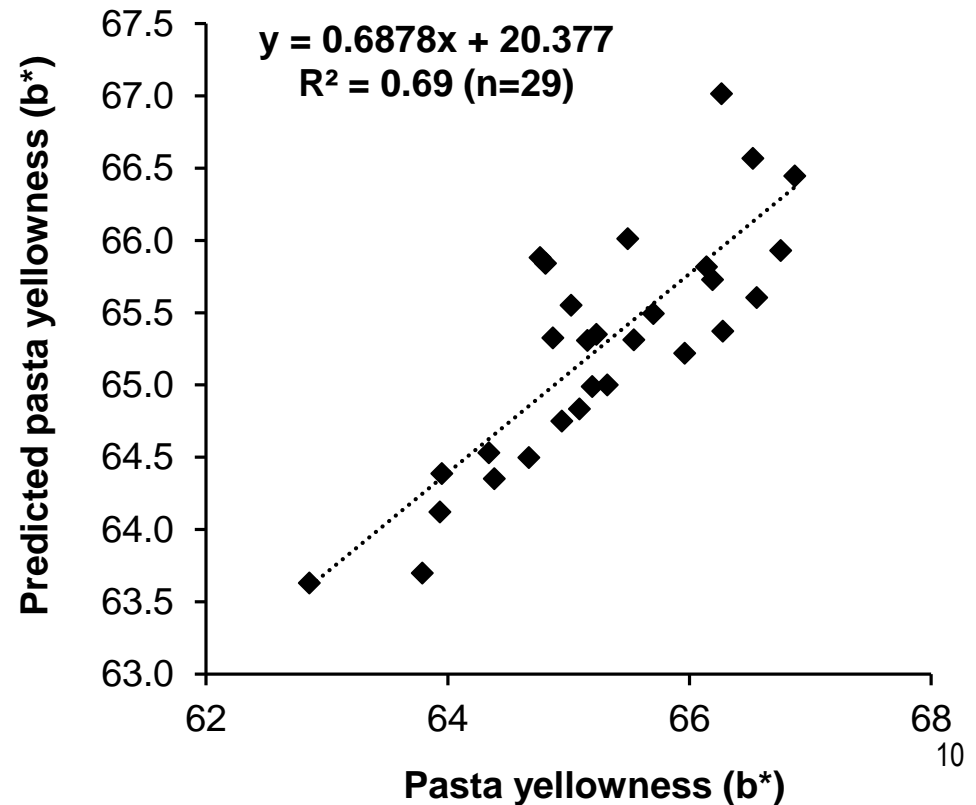
From seed to pasta

Impact of Pigment Loss on Pasta Yellowness (2017 CWAD registration trial)

Relationship between semolina TYP and pasta yellowness (b*)



Multi-variate (TYP & pigment loss) analysis Pasta b* = 54.84 + 1.17 x TYP -0.1 x Pigment loss



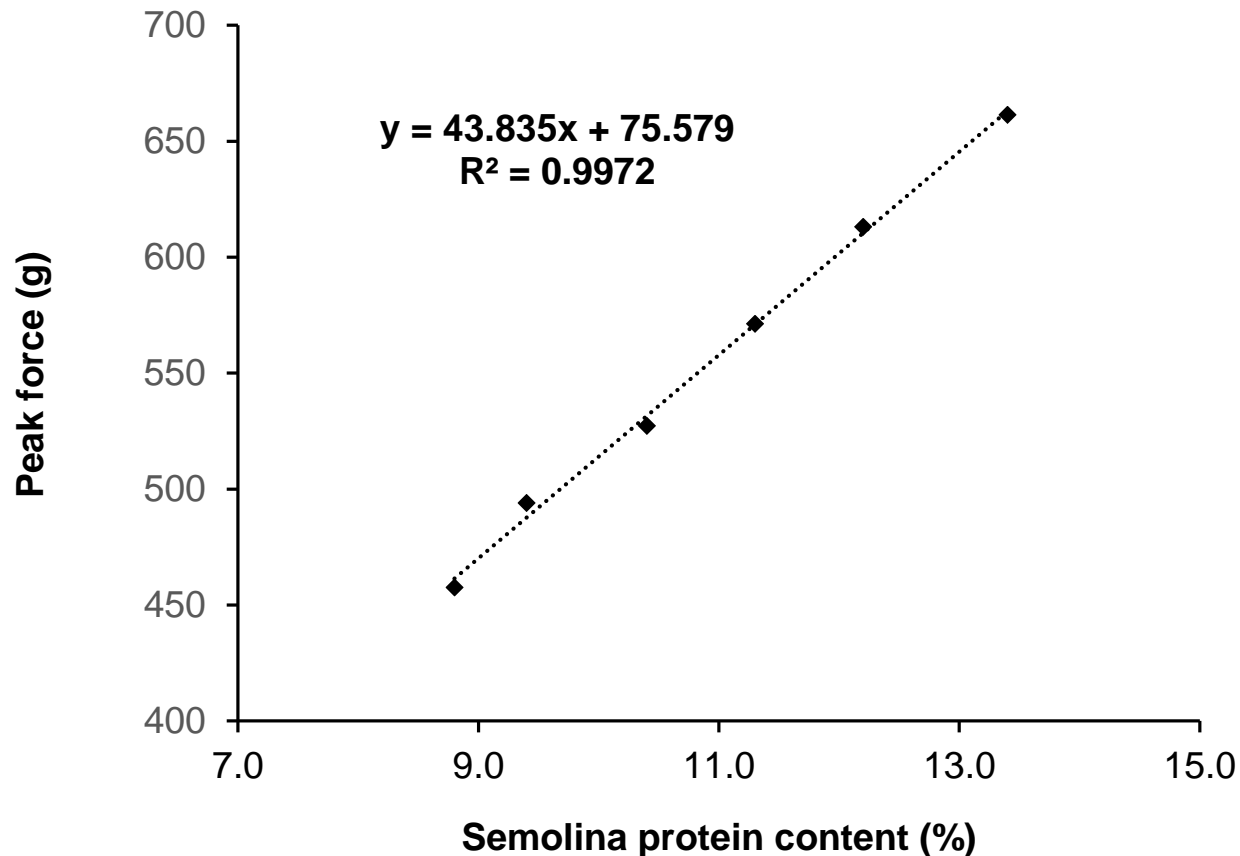
CWAD Quality Objectives – Protein Content

- Provides the structure for pasta; high protein is the prerequisite for superior pasta cooking quality
- Ensure good milling performance
- Negative relationship between yield and protein



Protein Content in Relation to Pasta Firmness

- Six composites of different protein levels from a single variety (Strongfield) grown in 2013



Protein Content, HVK, and Semolina Yield

- Four CWAD composites of different grades (No. 1-4) with HVK as the sole grading factor, prepared from 2015 harvest survey samples



Protein Content, HVK, and Semolina Yield

| <i>Parameters</i> | No. 1 | No. 2 | No. 3 | No. 4 |
|--|--------------|--------------|--------------|--------------|
| Required HVK, % | > 80 | > 60 | > 40 | - |
| Actual HVK, % | 90 | 68 | 42 | 30 |
| Composite protein, % | 13.3 | 12.2 | 11.8 | 11.3 |
| Semolina yield, % | 68.0 | 67.2 | 65.8 | 64.3 |
| Varieties with lower protein potential,* % | 0 | 0 | 27.1 | 40.6 |

* Kyle, Navigator, and Brigade

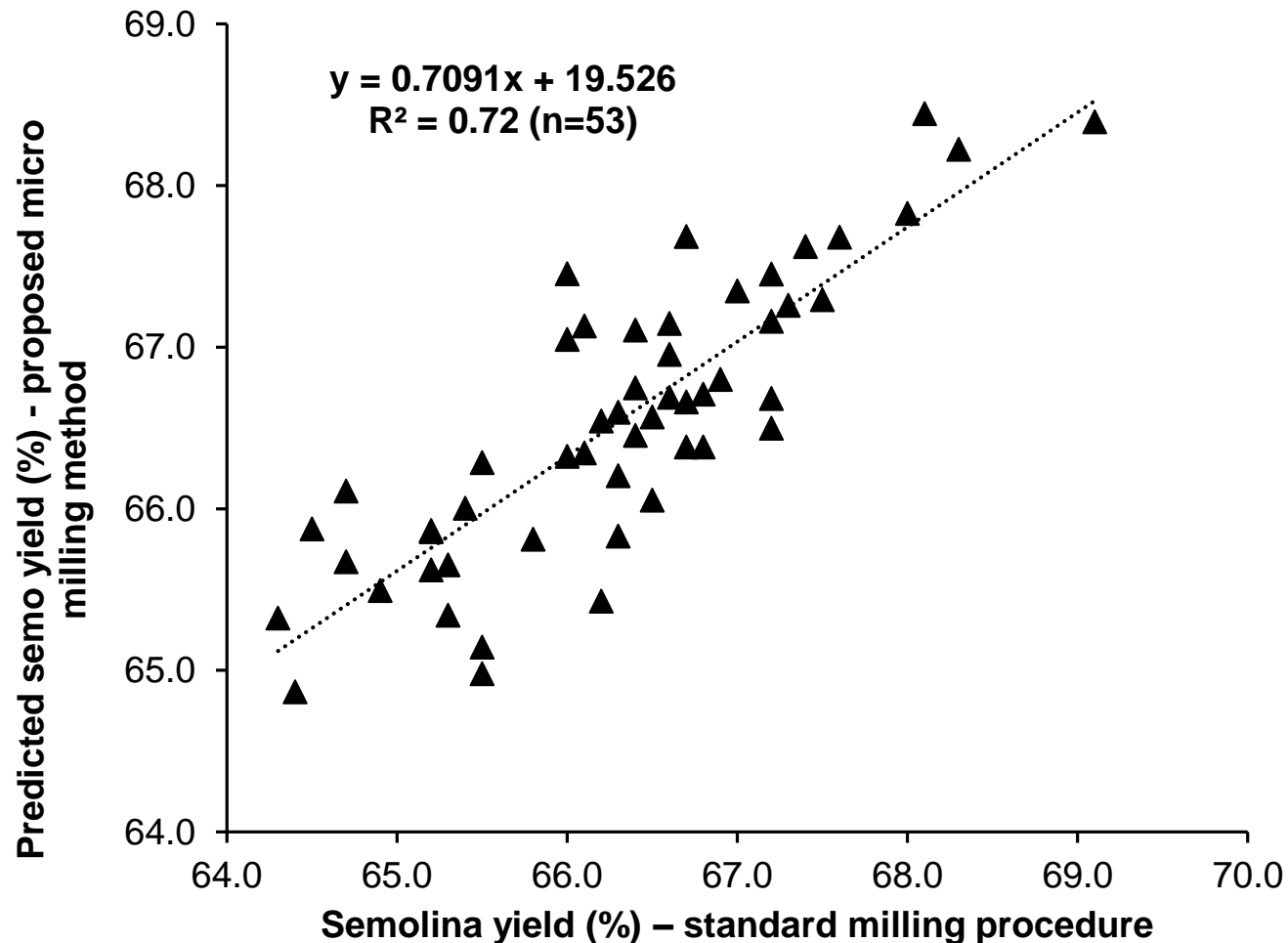
CWAD Quality Objectives – Milling Performance

- Yield is a key indicator of profit for a durum mill.
- Legal limit for semolina ash content in some countries.
- Speck count is a deciding factor of consumer acceptance for many durum products.



Development of Micro Milling Protocol to Predict Semolina Yield Without Purification

- Samples from Canadian durum registration trials (n=53)



Ash Content in Wheat and Semolina

| Variety | 2014 | | 2013 | | 2012 | |
|-------------|-------|------|-------|------|-------|------|
| | Wheat | Semo | Wheat | Semo | Wheat | Semo |
| Strongfield | 1.53 | 0.63 | 1.50 | 0.61 | 1.62 | 0.66 |
| Navigator | 1.59 | 0.68 | 1.55 | 0.67 | 1.72 | 0.74 |

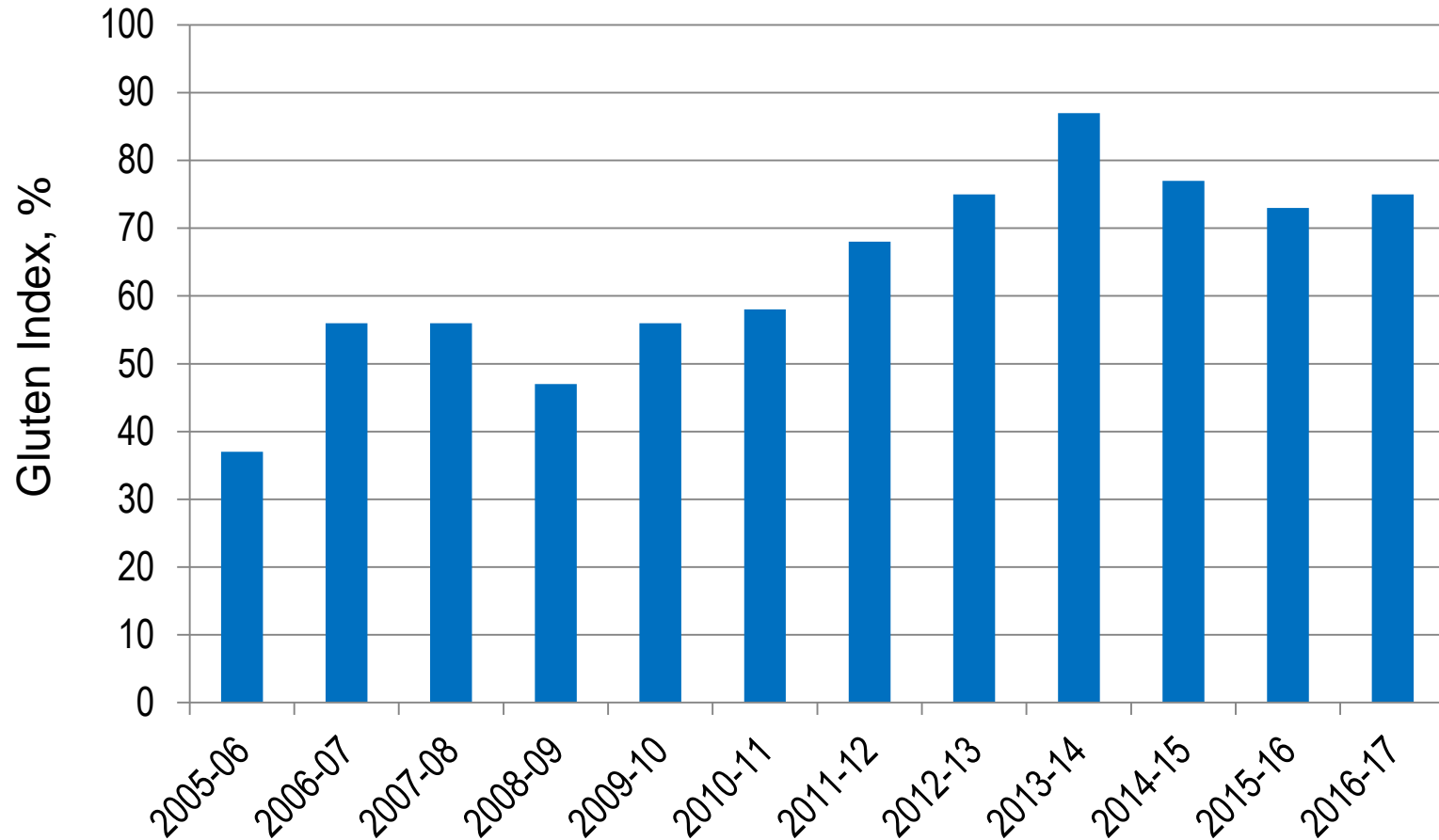
| Variety | Wheat | Semolina |
|-------------|-------|----------|
| Strongfield | 1.59 | 0.67 |
| Verona | 1.57 | 0.74 |

In general, wheat ash is not reliable to predict semo ash

CWAD Quality Objectives – Gluten Strength

- **The continuity and strength of the protein matrix is important for pasta texture.**
- **The relationship between gluten strength and pasta cooking quality is complex and inconclusive.**
- **It is important to have strong resistance and extensible gluten for CWAD to be suitable for most products in major markets.**
- **The market demand is limited for extra-strong CWAD that possesses strong but very inextensible gluten.**

Gluten Index: CGC Export Cargo Composites



CWAD Quality Objectives – Gluten Strength

■ Recent revisions

■ Revised strength requirement

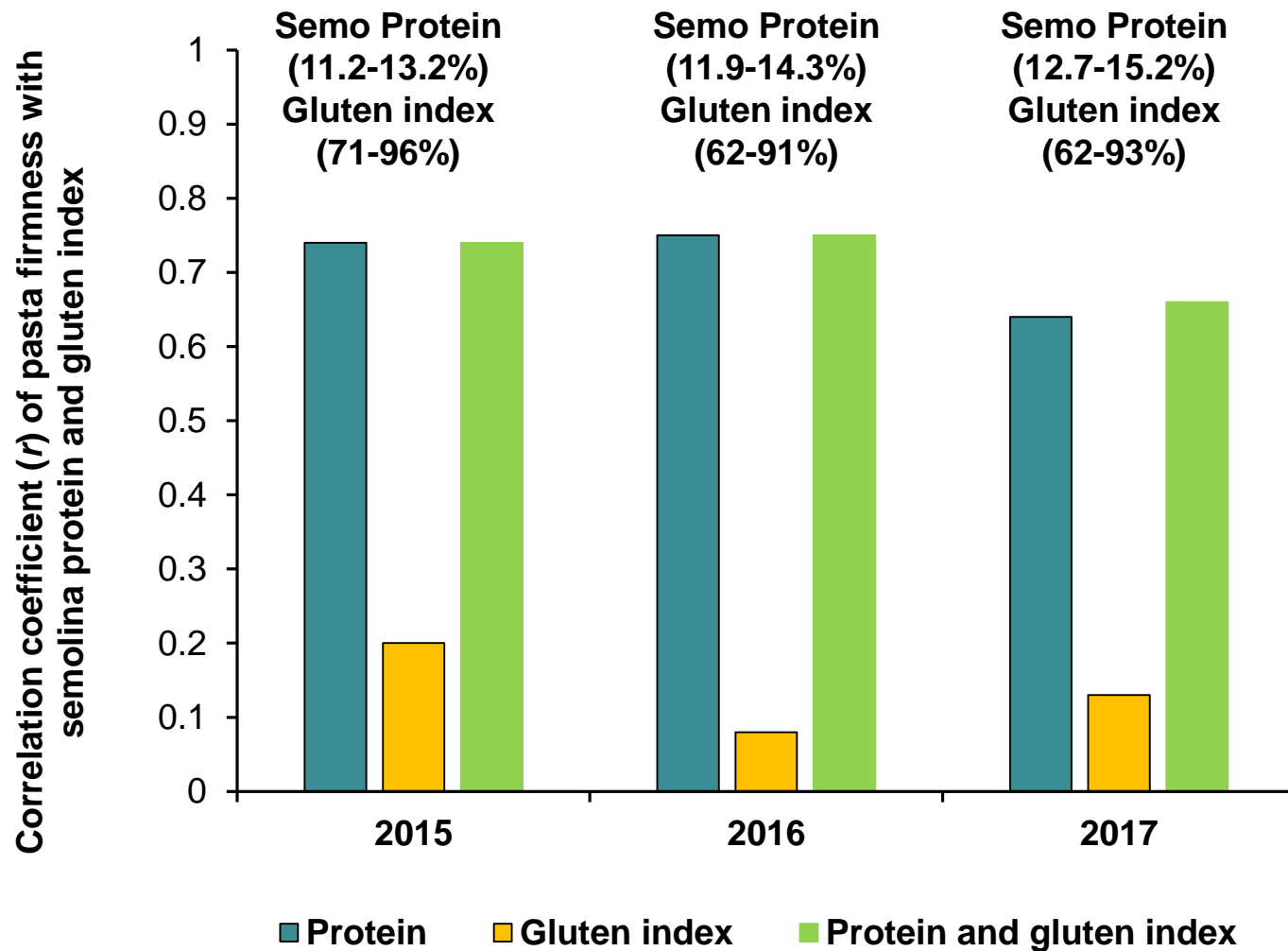
- Focus on medium to very strong but extensible type
- Limit extra strong and very inextensible type

■ Streamlining gluten strength evaluation

- Mostly based on gluten index
- Alveograph P/L, only for lines with high gluten index to examine extensibility

Pasta dough, with ~ 30% absorption, is only partially hydrated. How relevant is the gluten strength, as measured in fully hydrated state, to pasta quality?

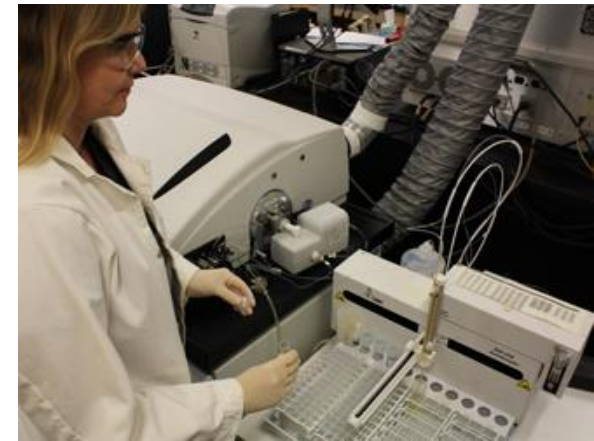
Protein Content and Gluten Index in Relation to Pasta Firmness



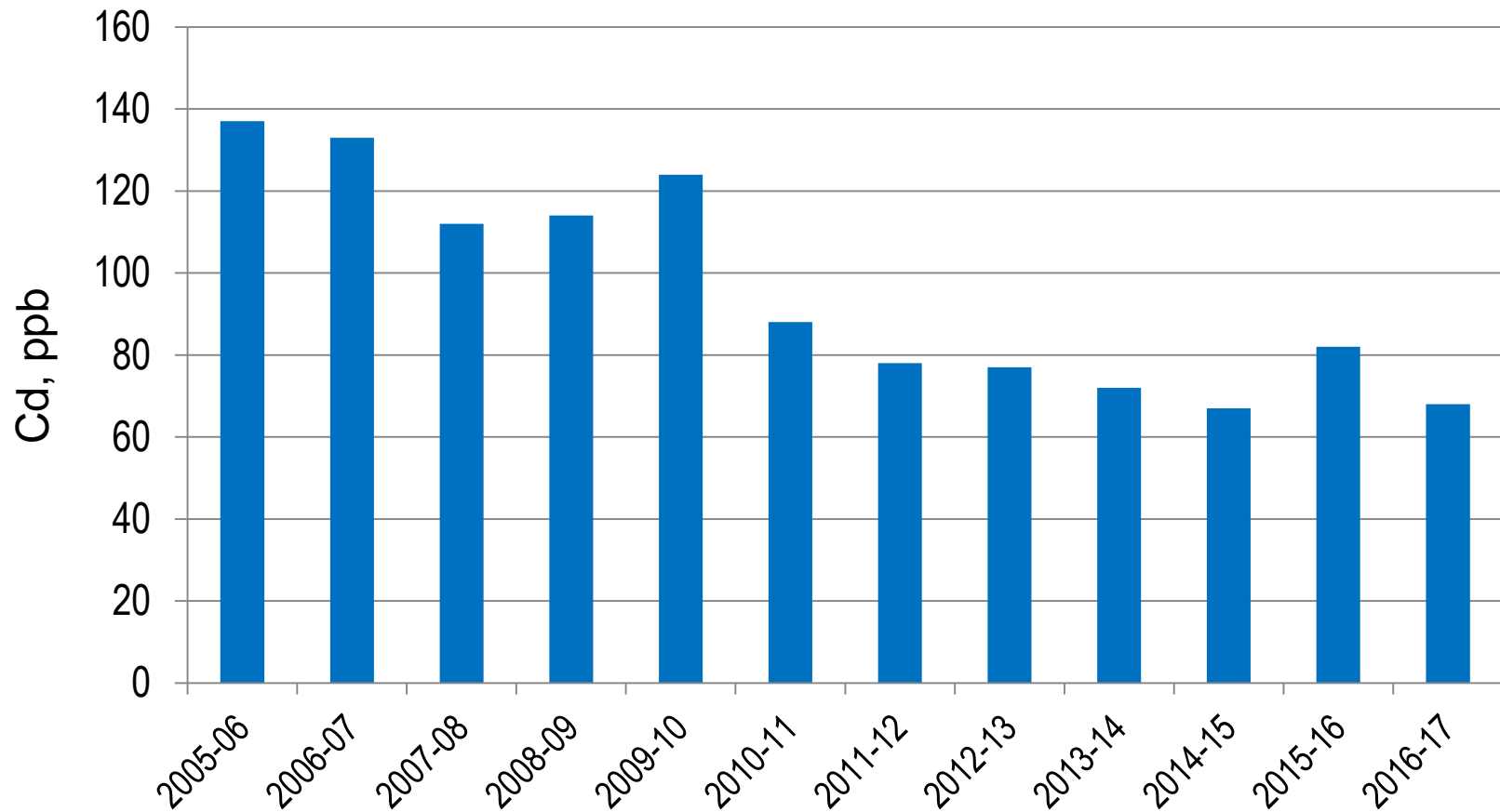
CWAD Quality Objectives – Cadmium

- High levels of Cadmium (Cd) in cereal grains are a health concern and limits are imposed for international grain trade.
- Low Cd is mandatory for registration of durum wheat cultivars in Canada since 2004.
- Candidate line entries must have Cd levels lower than 100 ppb.

Inductively coupled plasma mass spectrometry (ICP-MS)



Cadmium Content: CGC Cargo Monitoring



Improving Canadian Durum Wheat Quality

- Changing market demands satisfied by new durum varieties
 - Pigment concentration and pigment loss
 - Very high and increasing pigment content
 - Low pigment loss but can be further reduced
 - Protein content
 - Reasonable high genetic potential
 - Management by producers
 - Milling performance
 - Excellent yields with low ash
 - Has room to improve, Navigator yield, Strongfield ash

Improving Canadian Durum Wheat Quality

- Changing market demands satisfied by new durum varieties
 - Gluten strength
 - Strong and extensible gluten properties
 - Not overlooked, not overly emphasized
 - Safety
 - Very low cadmium level
 - Improve resistance to Fusarium Head Blight



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