

Grain and End Product Quality Issues in Wheat

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Why is wheat such an important food?



- Wheat has unique functional properties due to gluten – protein network
- When you mix wheat flour with water it produces an elastic extensible dough, due to the gluten, which can be
 - Rolled
 - Extruded
 - Moulded
- Into a wide range of products



Breads and Pasta



Cakes and biscuits



Noodles



Why is wheat quality important to a grower?



Important determinant of price which in turn is a significant component of profit \$

What defines price?

- Within an Australian context, grade and delivery standards largely determine price
 - Very small quantities of wheat traded outside of grade system in Australia and even less without use of delivery standards.

To a grower, wheat quality is:

- Selecting a variety with a suitable wheat quality classification (Grade)**
- Delivering a parcel of grain that meets grain delivery standards.**

AH2 Receival Standards

• Variety	Only approved varieties eligible
• Grain protein	11.5% min
• Moisture	12.5% max
• Test weight	76.0 kg/hl
• Screenings	5.0%
• Falling number	300 sec
• Un-millable material	0.6%
• Foreign seed contams.	X count/0.5l
• Other contaminants	0.1%

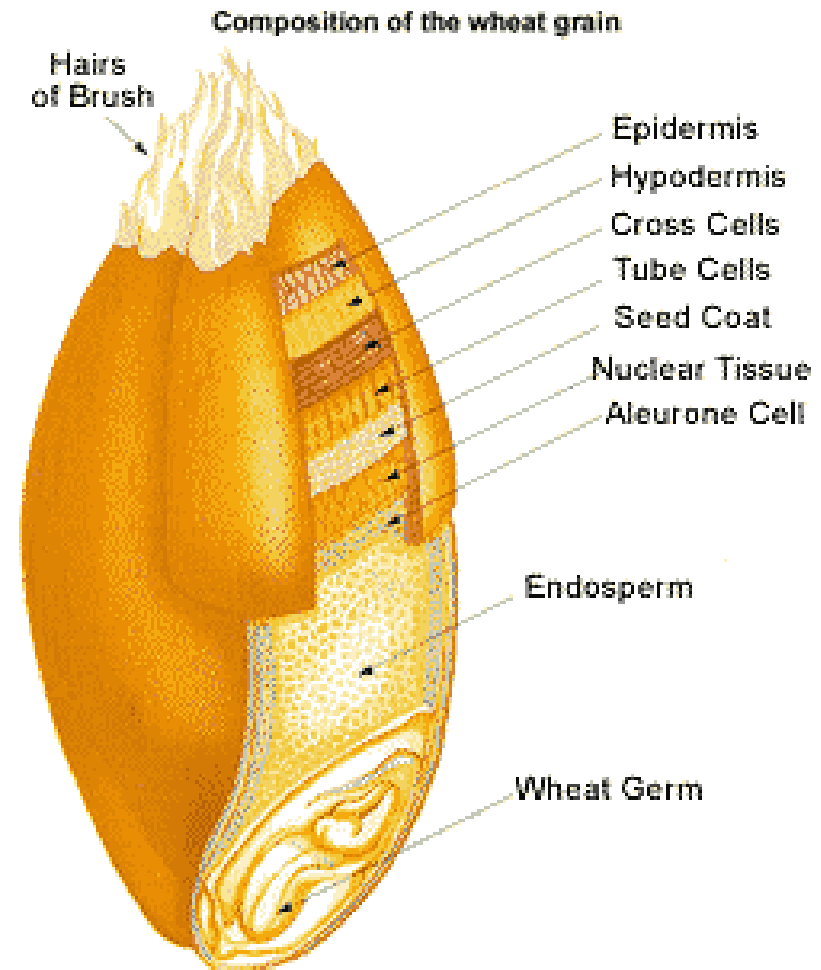
Who is responsible for grain Quality



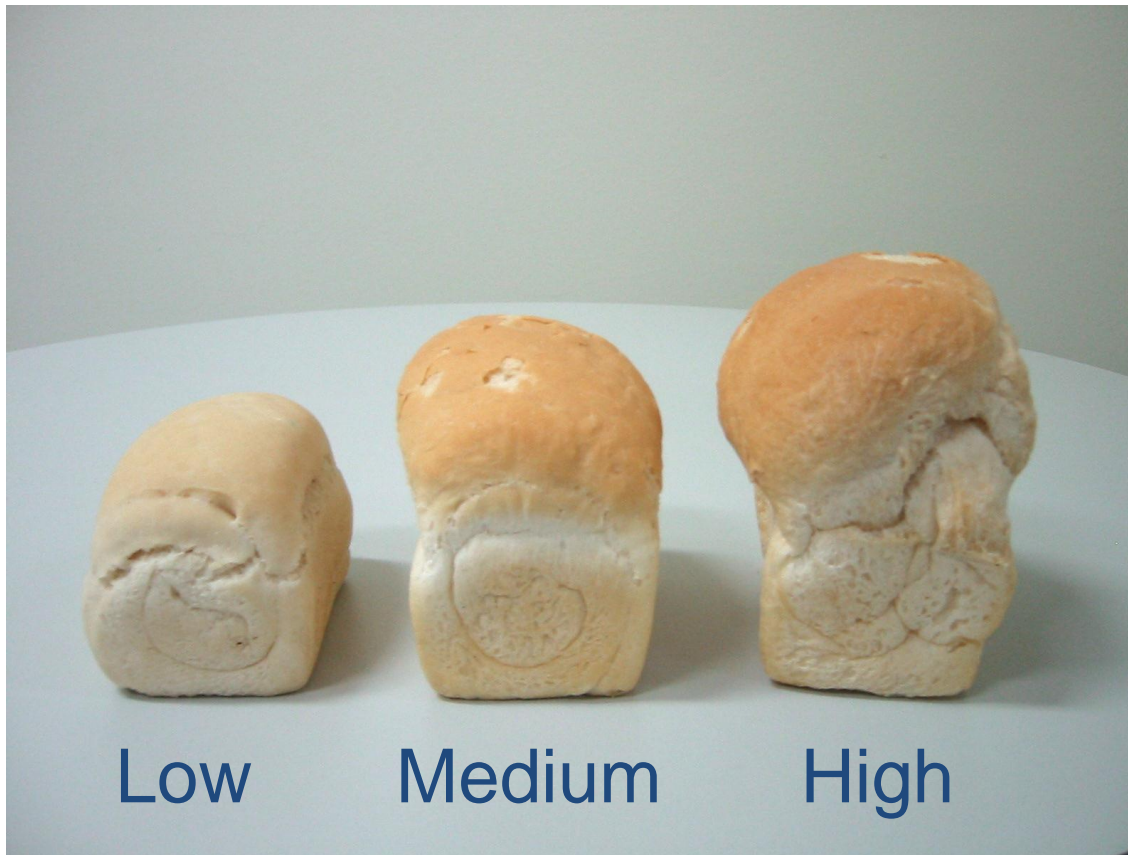
Variety	Breeder		
Grain protein	Environment	Grower	Breeder
Moisture	Grower	Environment	
Test weight	Environment	Breeder	Grower
Screenings	Environment	Breeder	Grower
Falling number	Environment	Grower	Breeder
Stained (Black Point)	Environment	Breeder	Grower
Un-millable material	Grower		
Foreign seed	Grower		
Other contaminants	Grower		

- Variety is a critical component to grade eligibility.
 - It is the major determinate of protein and starch quality.
 - Together with protein content variety essentially defines the functionality of the grain

- Unique functional properties of wheat are due to storage proteins (Glutenins) in wheat endosperm
- Loaf volume directly related to protein content and variety (other genetic factors)
- Protein also important for noodle bite characteristics
- Protein content strongly influenced by environment and crop management (TOS, N₂ fertiliser, rotations)



Same variety different protein content

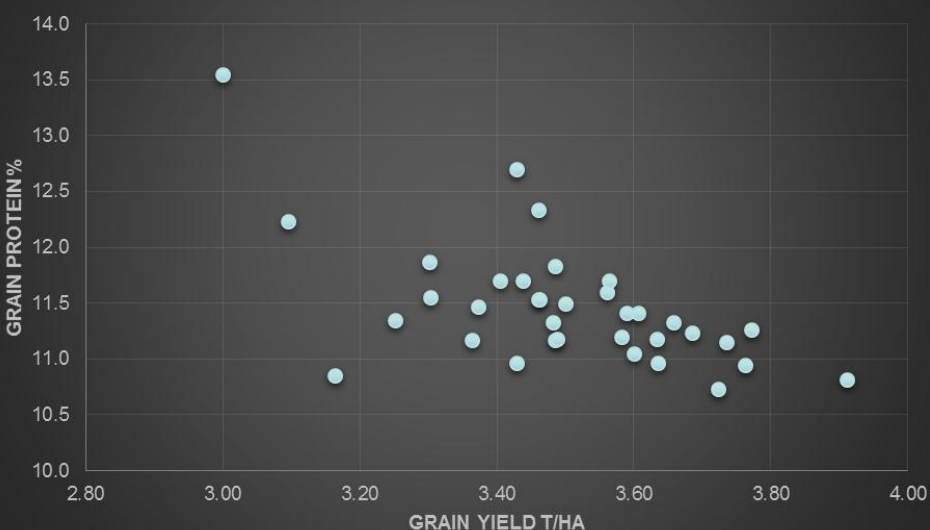


Grain protein content

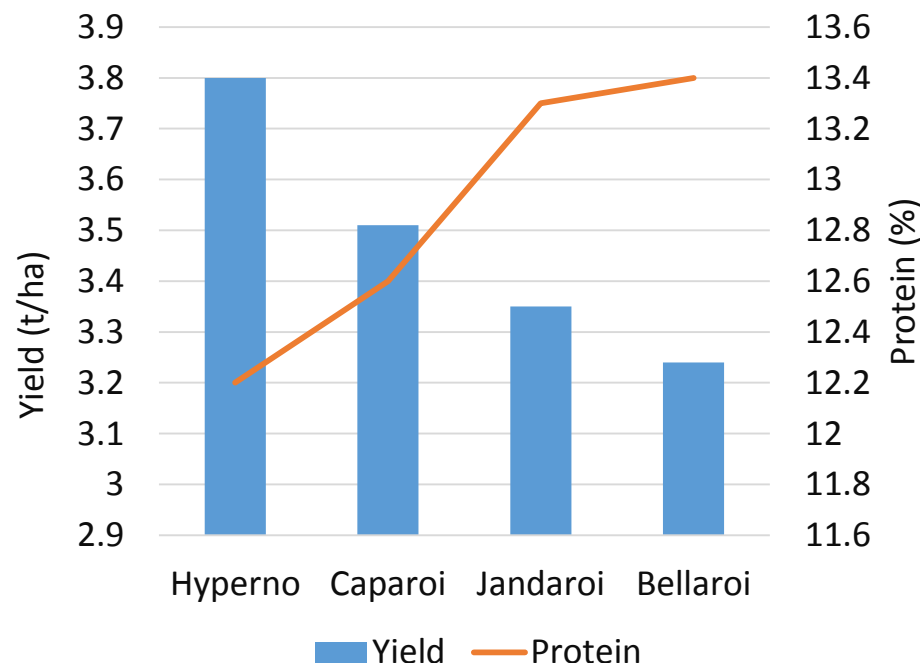


- Inversely related to grain yield, ie high yield low protein
- \$ return is calculated as price * yield
- Yield is more important in \$ return than price/t
- Adding nitrogen to increase protein is generally not economic, to increase yield is.
- Protein achievement should be on the basis of protein yield per ha, but \$ return/ha is a more important measure for a grower.
- Agronomic management should be to optimise \$ return/ha not to achieve a protein to meet a specific grade

Grain yield vs Protein. NVT SW NSW
2013, mean of 6 sites



Durum Wheat Average yield & Protein, 51 NVT sites in
NNSW, 2007-2013



- HGPC gene
 - Gpc-B1
 - Derived from wild emmer (*T. dicoccum*)
 - May increase grain protein content ~0.5%
 - Deployed in Canada, USA and other countries
 - No obvious effect on protein quality
 - is in premium quality varieties in Canada
 - Is being deployed into Australian varieties now

- Dough properties are strongly related to both protein quantity and quality
- Protein quality can be affected by heat during grain maturation
- Protein quality largely defined by the variety
 - Glutenins, gliadins
- Difficult for a grower to manage the environmental component of this.
 - Minimize heat stress during grain fill, sow on time!



Same protein %, different variety (Hardness & dough strength)



Bowie

Yitpi

- Both screenings and test weight are related to milling quality and most importantly milling yield
 - Small grain tends to have lower milling extraction
- Test weight also has implication on transport and storage
 - Low test weight less efficient transport and storage
- Environment has greatest influence on these traits
- Some impact of management (TOS, disease management, seeding rate, nutrition)
- There is however still a significant genetic component to these traits

Example, NVT physical grain quality



	Protein	Screenings	Test Weight
Total	8.2% - 17.2%	0.1% - 29.5%	61.5 - 86.7
Total Difference	9.0%	29.4%	25.2
Variety	11.1% - 12.5%	1.8% - 5.4%	78.0 – 82.4
Variety Difference	1.4%	3.6%	4.4
Site	9.4% - 15.6%	0.3% - 13.9%	72.9 – 84.8
Site Difference	6.2%	13.6%	11.9

Across site data from SA NVT, 2009

- Large environmental component, but are varietal differences
- low FN – associated with the commencement of germination.
Conversion of starch to sugar
- Two forms
 - Pre Harvest Sprouting
 - Dormancy in embryo and seed coat
 - Few highly susceptible varieties:
 - Axe, Correll, Espada, Gladius, Kord CL Plus, Lincoln
 - LMA (Late maturity amylase) expression
 - Variety classification standards demand low expression of LMA
 - Temperature shock induced
- Marketing and processing issue

- **Black Point**
 - Mostly environmental – moisture during grain fill
 - Genetic variation for expression
 - Sr36 source
 - Hartog source
 - Other minor variation
- **White Grain**
 - Fungal infection (*Botryosphaeria* sp)
 - Widely distributed, but low incidence
 - Can be detected with Predicta B test to give indication of level
- **Pink Staining**
 - *Fusarium* (head scab)
 - High levels can have toxins associated, but rare in Australia
 - Common in rotations with Corn (Maize)

Process

- Breeder submits to the wheat classification panel comprehensive quality data arising from samples sourced from a given classification zone (eg. South Eastern) these are assessed against the set criteria and check varieties to determine eligibility for a given grade ie APH, AH, APW, ASW, Feed
- Data consists of
 - 3 years of milling and dough property comparisons against benchmark varieties
 - 2 years of end product comparison against benchmark varieties
 - Eg AH grade – requires Bread baking export (Straight dough method) & domestic (straight dough method) and Yellow Alkaline Noodles.

- To be eligible for a classification a new variety must be shown to meet minimums for hardness, grain colour, free of LMA etc and also the following characteristics relative to regional checks for that grade;
 - Milling extraction
 - Yellow flour pigment
 - Water absorption
 - Extensibility
 - Dough strength
 - Starch quality
 - Noodle colour stability
 - Baking quality
- If the new variety is close to these minimums for two or more characteristics it is unlikely to achieve the grade.

- The bulk of Australian wheat is traded through the grade system
 - To a grower delivering into a particular quality grade is their measurement of grain quality.
 - It is critical we manage and protect the brand value of Australian grades
 - Protein, screenings and test weight important to grades and mostly influenced by the environment and crop management
 - Functionality essentially determined by variety (protein quality)
 - Variety classification plays very important role in managing grades
 - Correct variety declaration at point of sale/delivery essential to ensuring the integrity of the grades