

# **A wheat breeders' perspective on NIR application**

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# Introduction

- Wheat breeding is a multi-faceted discipline
- The breeder has to juggle the competing requirements from different sectors in the value chain
- Needs to be within the operational constraints of available resources

# Demands on Breeding

- Grower
  - High and stable yield
  - Agronomical superior genotypes
  - Resistance to the biotic and abiotic threats in the target region
  - Best **quality** classification possible
- Millers
  - High yield of white flour that meets customer **quality** requirements.
- Bakers
  - Flours that give high yield of consistently high quality product.
- Processors
  - High product yield of consistent quality at each step in the process chain.
- End users
  - The consumers, who ultimately drive the value chain demand consistently high quality products at a competitive price.
- Feed formulators
  - Competitively priced grain of consistent **quality** and high energy value.

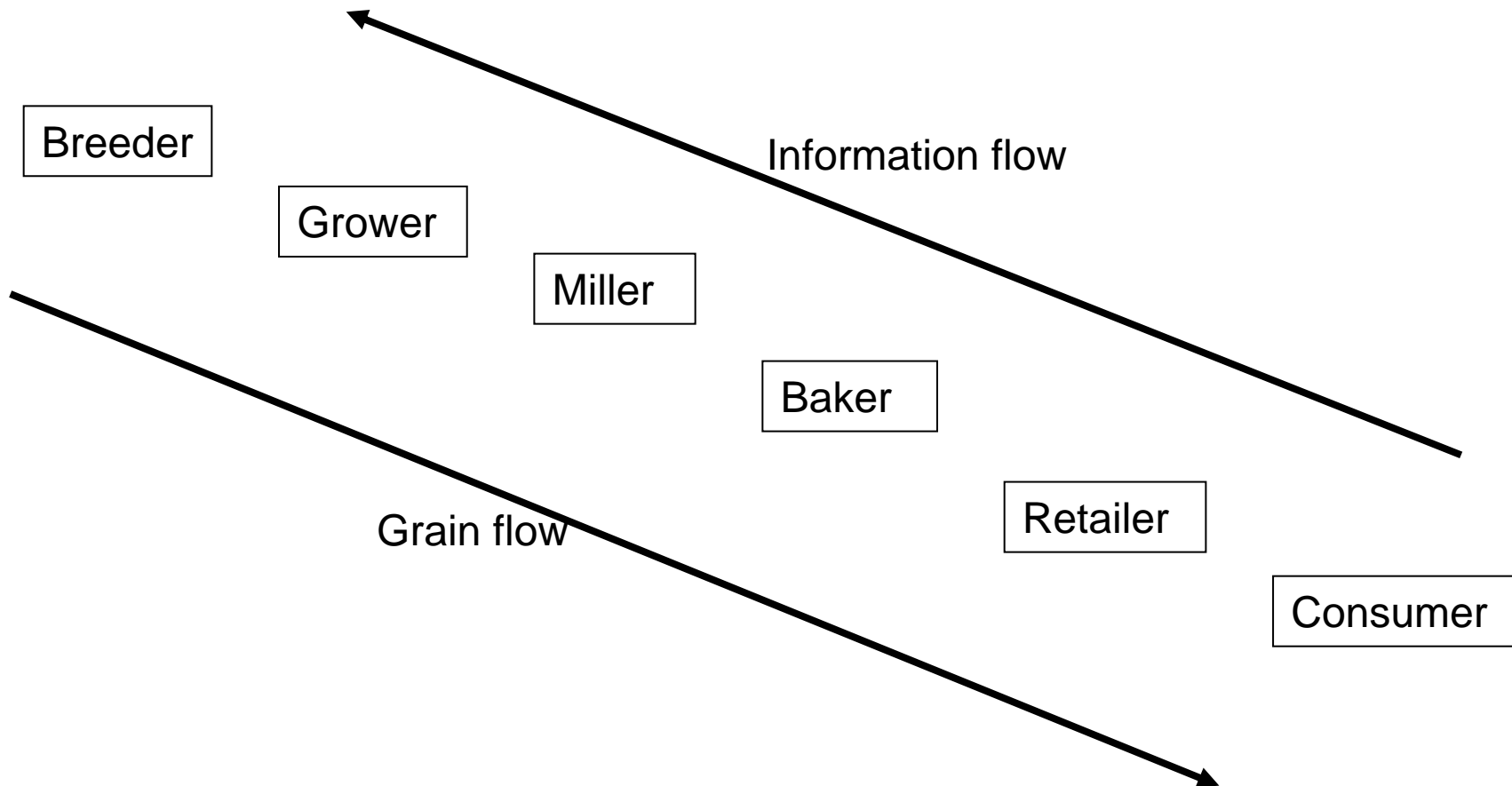
# Grain quality

- This presentation will focus on the area of grain quality and how NIR fulfils the needs of the breeder.

# Grain quality

**What is grain quality?**

**It means different things, depending who you are in the wheat processing chain**



# Quality Targets

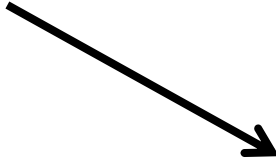
- The different demands for each quality target
- Two noodle types as examples:
- Australian Prime Hard:
  - Hard grained wheat of protein content  $>12.8\%$
  - Very high milling quality (high flour yield at low ash content and flour colour)
  - Strong and extensible dough properties
  - Good baking quality over a range of baking technologies
  - High quality yellow alkaline noodles, (colour development and stability are critical)
- Australian Noodle Wheat:
  - Soft grained wheat of protein content of  $10.5\%$
  - Creamy coloured flour preferred for Japanese market, whiter flour acceptable for Korean market.
  - Colour development and stability critical
  - Must have high starch paste viscosity for preferred noodle texture



# Hitting the target

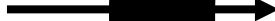
**Early generations**

**1000's of lines**



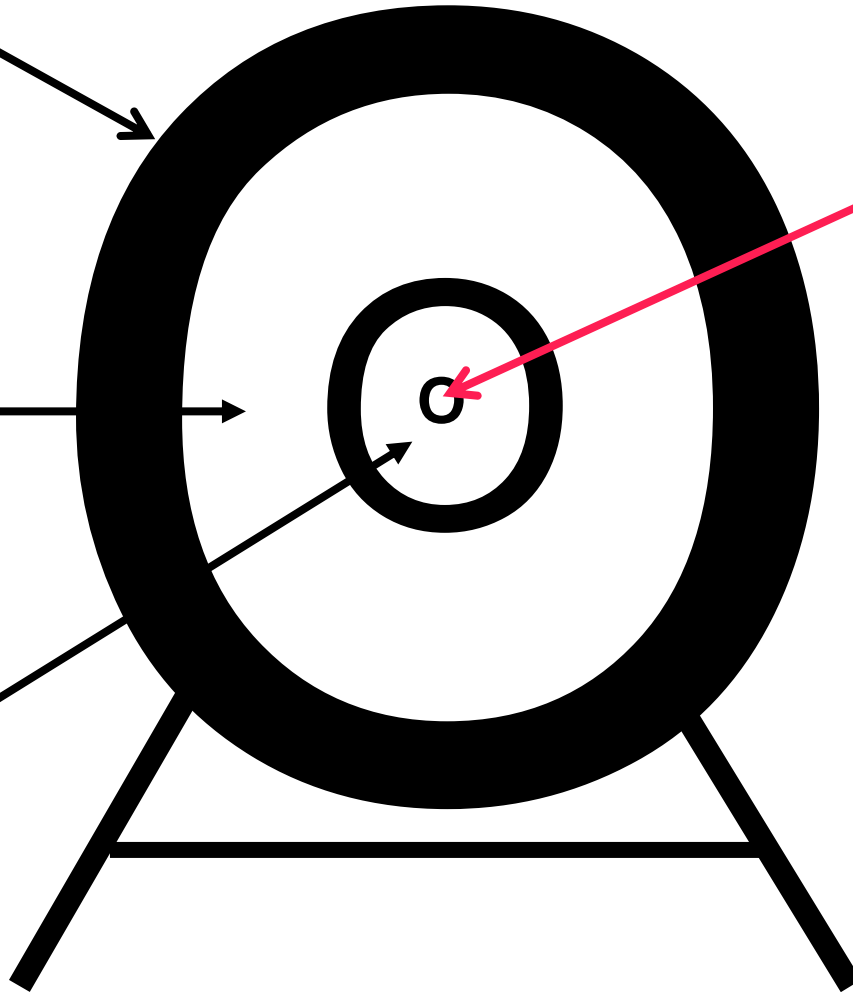
**Mid stage**

**100's of lines**



**Late stage**

**10's of lines**



**The target, one  
line, the variety**

# Quality Testing

- Wheat breeders handle thousands of breeding lines annually, so it is not feasible to use end-product evaluations until only a relatively few elite lines have been identified.
- Requirements of an early generation quality test
  - Small sample size
  - Rapid and repeatable so as to result in a high daily throughput
  - Correlated with and predictive of end-use quality that will result in genetic advance
  - Ability to reliably predict real differences in quality among breeding materials within and over seasons.
  - Demonstrating that its application results in response to selection producing genetic gain

# Quality Testing

- Many traditional early generation tests use grain or flour, which requires a relative large sample size
- Examples of early generation quality tests are:
  - Test milling:
    - Gives an estimate of potential flour yield.
    - The resultant flour can be assessed for flour colour
    - and used for tests of potential end-use quality, such as.
  - Physical tests:
    - Mixograph, micro- farinograph and extensograph
  - Chemical tests:
    - SDS or Zeleny sedimentation volume
  - Physico-chemical tests:
    - Pelshenke fermentation time

# NIR

- NIR meets all of the requirements of an early generation quality test with one additional advantage:
  - Small sample, quick, correlate with end-use quality
  - Ability to predict real differences in quality among breeding materials
  - Results in response to selection producing genetic gain
  - **Testing can be non-destructive, leaving the grain for planting the next breeding cycle**
- The application of NIR in breeding for wheat quality began in the early 1980's with the development of calibrations for the fixed filter instruments of the time for:
  - Moisture content
  - Grain and flour protein content
  - Grain hardness

# NIR

- As the power of the instruments and interest in its applications developed, calibrations emerged for the prediction of:
  - Flour yield
  - Flour colour
  - Dough properties
  - Ratio of glutenin to gliadin
  - Ratio of UPP to total glutenin content

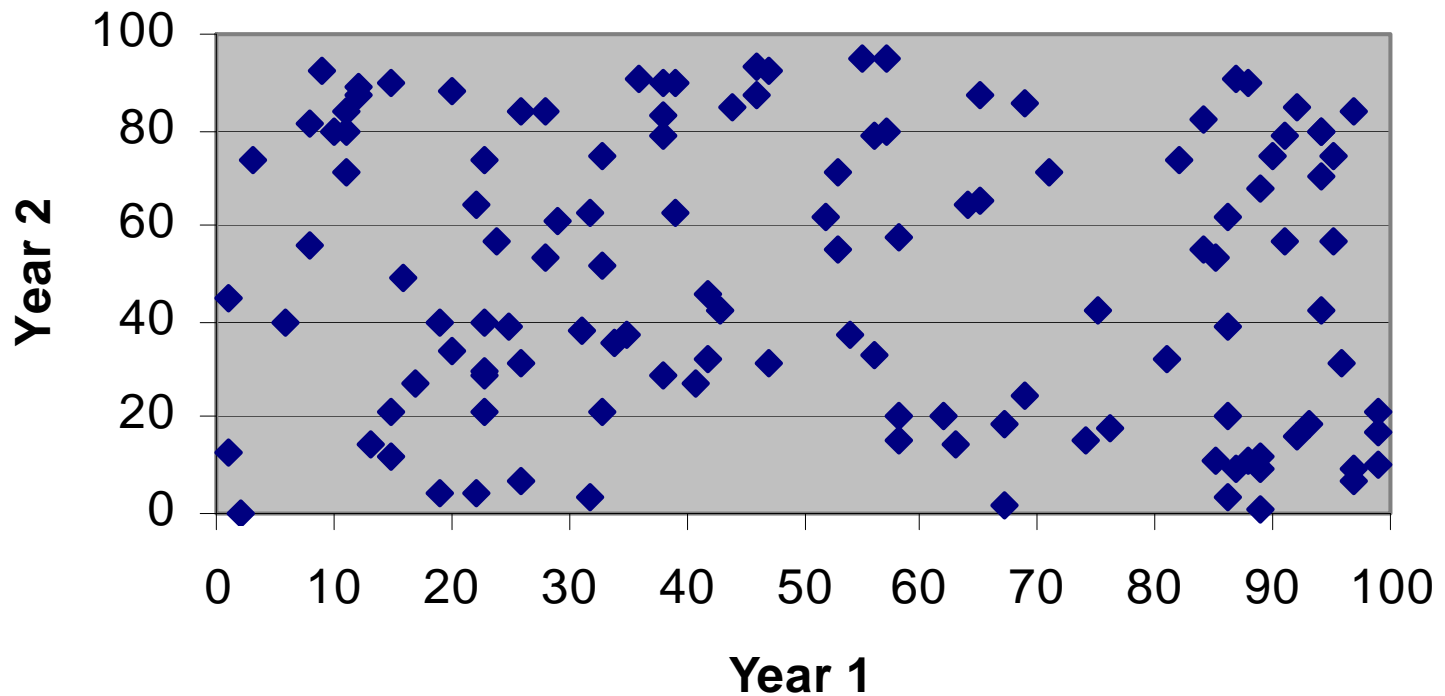
## Some NIR predicted quality data

<b>Quality measure</b>	<b>Mean</b>	<b>Max</b>	<b>Min</b>
<b>Grain protein content (%)</b>	<b>13.8</b>	<b>17.2</b>	<b>11.7</b>
<b>Particle size index (w/w)</b>	<b>20.2</b>	<b>32.5</b>	<b>11.5</b>
<b>Milling yield (%)</b>	<b>74.7</b>	<b>76.5</b>	<b>73.3</b>
<b>Flour b* (CIE)</b>	<b>10.6</b>	<b>12.7</b>	<b>8.8</b>
<b>Water absorption (%)</b>	<b>63.0</b>	<b>67</b>	<b>55.8</b>
<b>Dough development time (min)</b>	<b>5.9</b>	<b>7.9</b>	<b>3.0</b>
<b>Extensibility (cm)</b>	<b>22.2</b>	<b>24.2</b>	<b>20.0</b>
<b>Maximum resistance (BU)</b>	<b>366</b>	<b>470</b>	<b>299</b>

## Summary of ANOVA's of NIR predicted quality data

Quality measure	F Ratio	Pooled sd
Grain protein content (%)	***	0.68
Particle size index (w/w)	***	2.18
Milling yield (%)	***	0.38
Flour b* (CIE)	***	0.27
Water absorption (%)	***	0.99
Dough development time (min)	***	0.49
Extensibility (cm)	***	0.56
Maximum resistance (BU)	***	29.3

## Response to selection - None



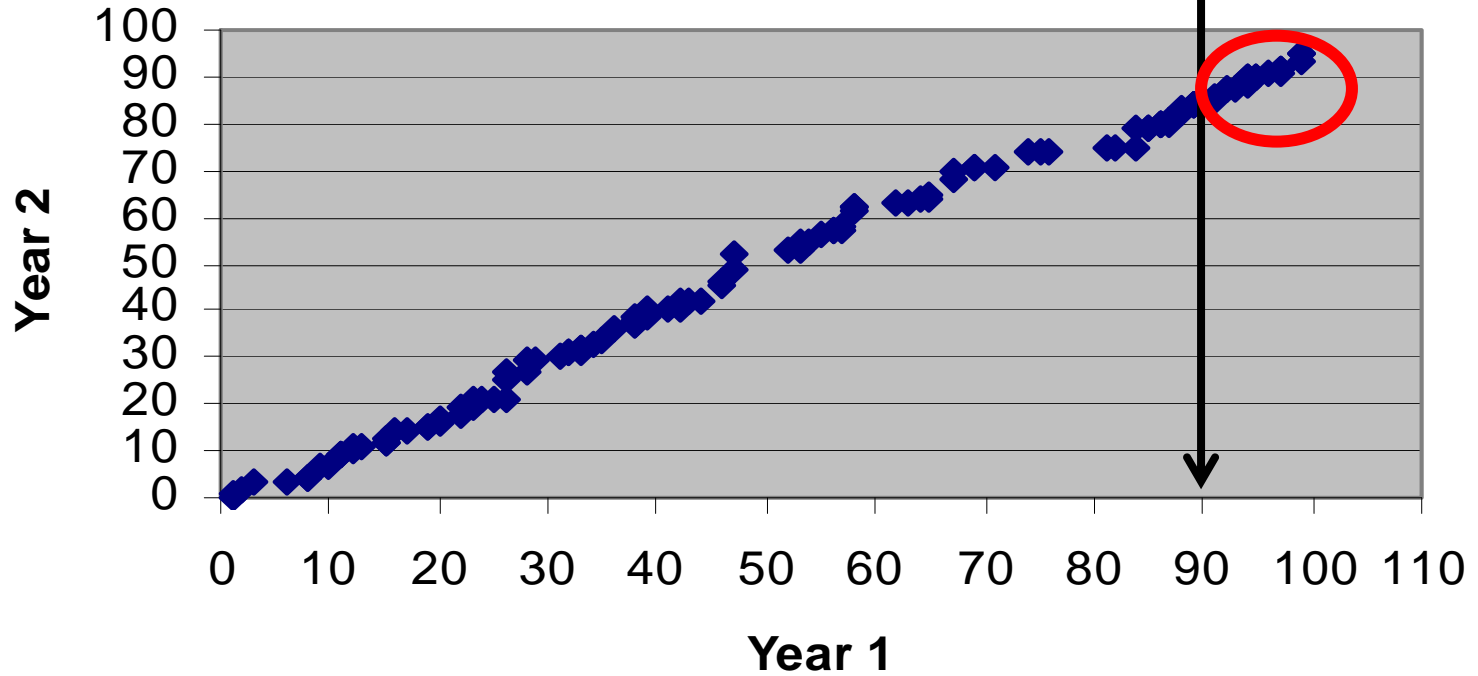


Selected high yield lines year 1,  
also yield better than those  
discarded in year 2

Discarded year 1

Selected year 1

## Response to selection - Excellent



# Conclusion

- LongReach Plant Breeders have produced two high yielding varieties suited to production in high yielding regions targeting feed grain use
- **Sentinel<sup>3R</sup>**
  - Resistant to prevalent field strains of the three rust diseases, with high yield potential when planted in early May over a target production area from southern Queensland to Western Victoria
- **LongReach Beaufort**
  - A very high yielding wheat suited to early plantings in the higher rainfall production zones of NSW and Victoria
- LongReach is committed to work with the different sectors of the grains industry to develop new varieties suited to their needs