# Relaxation of wheat cultivar release requirements

Dr Francois Koekemoer

Sensako

SA WHEAT INDUSTRY

# SA WHEAT INDUSTRY

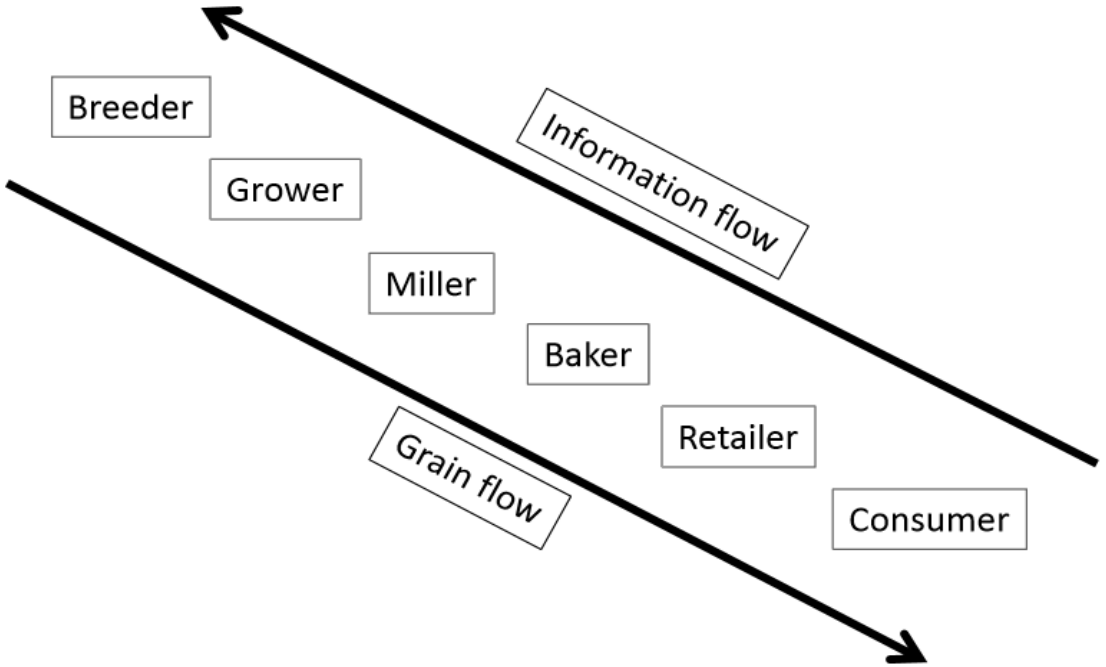
## Goals to be addressed during the talk

- Explain the role of the wheat breeder to obtain results
- Evaluate SA quality release system
- Benchmark SA quality with international quality brands
- Indicate shortfalls and propose alternatives
- Breeders perspective of wheat quality and food security

# Role of the wheat breeder

SA WHEAT INDUSTRY

**Wheat quality means different things for each role player in the value chain**



# Role of the wheat breeder

SA WHEAT INDUSTRY

- The breeder must also understand the impact of the production environment has on quality
- Types of quality possible in an environment
- The impact of Genotype x Environment interaction
- The annual regional variability
- Influence on breeding and selection

● - Irrigation areas

○ - Dryland

● - Dryland

# Role of the wheat breeder

SA WHEAT INDUSTRY

## Influences on wheat quality

- Know your environment
- Climatic effects (rainfall and temperature)
- Soil effects (fertility, pH, toxicities, deficiencies)
- Biological effects (Stresses, viruses, insects, pathogens, etc.)

# Role of the wheat breeder

## Environmental influences on wheat quality

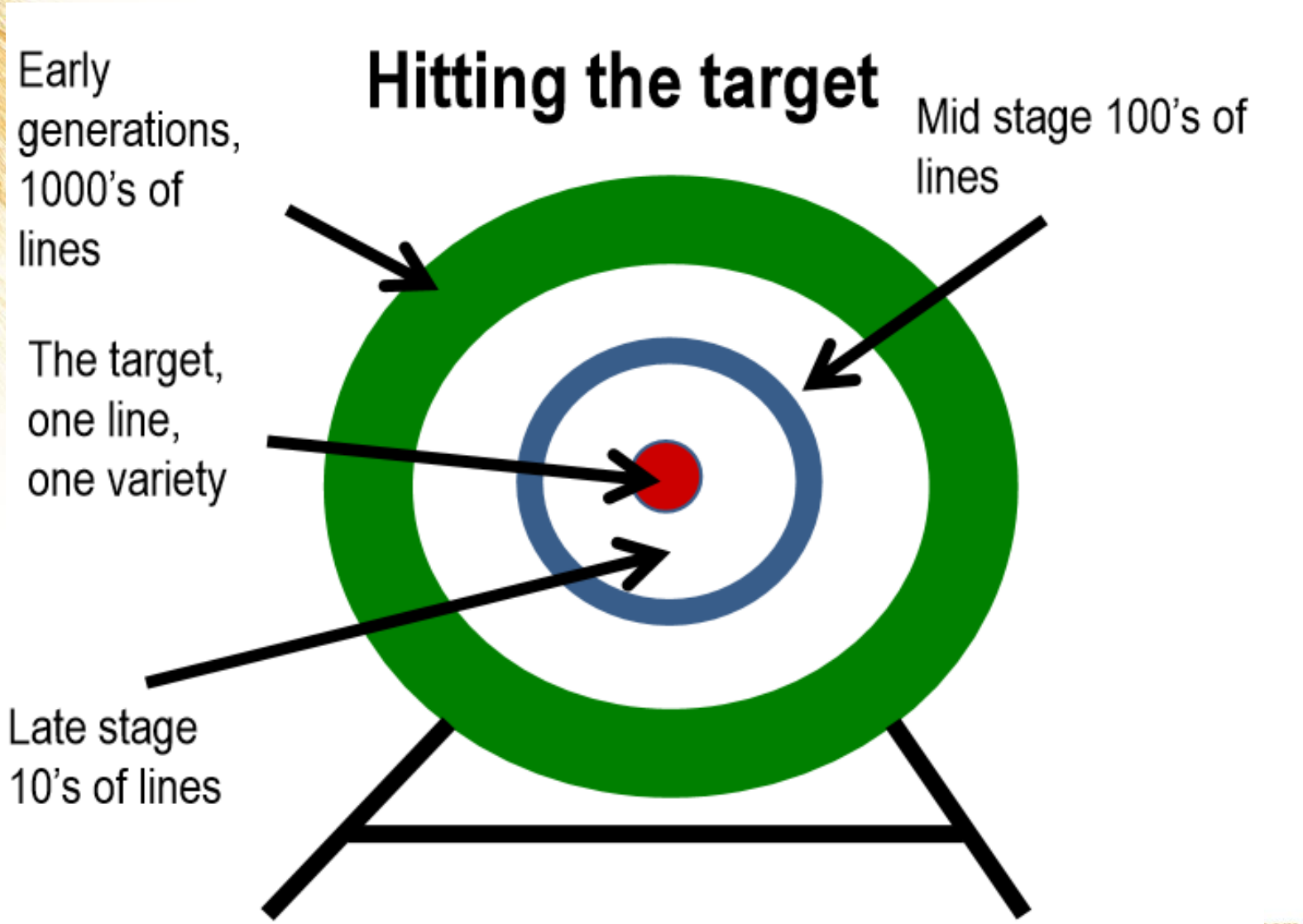
- Change in WRA environment last 3 years
- Variation in localities
- Need to have reference when evaluating quality performance
- Do we need to breed for stronger quality, permanent tendency

| | 1998-1999 | 2012 |
|---|---|---|
| MDT | 3.31 | 1.79 |
| AS | 53.5 | 21.5 |

Data for Kariega

SA WHEAT INDUSTRY

# Role of the wheat breeder




SA WHEAT INDUSTRY

# Role of the wheat breeder

SA WHEAT INDUSTRY

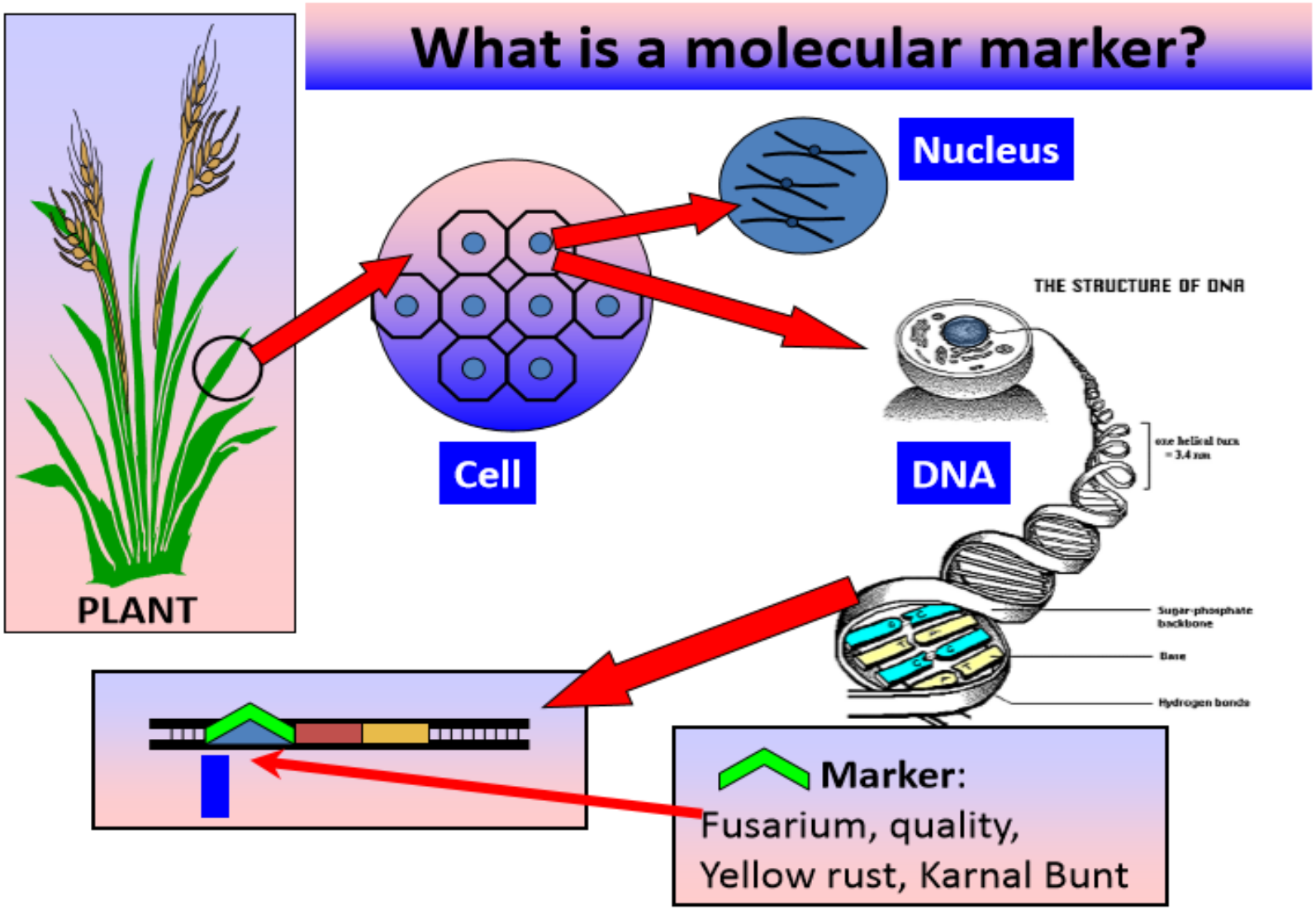
## Hitting the target

**Must have the ability to test for quality in :**

- Early generations, rapid, small scale
- Mid generations, still predictive tests
- Final stages, full end product testing

Molecular markers

# Role of the wheat breeder




SA WHEAT INDUSTRY

# Role of the wheat breeder

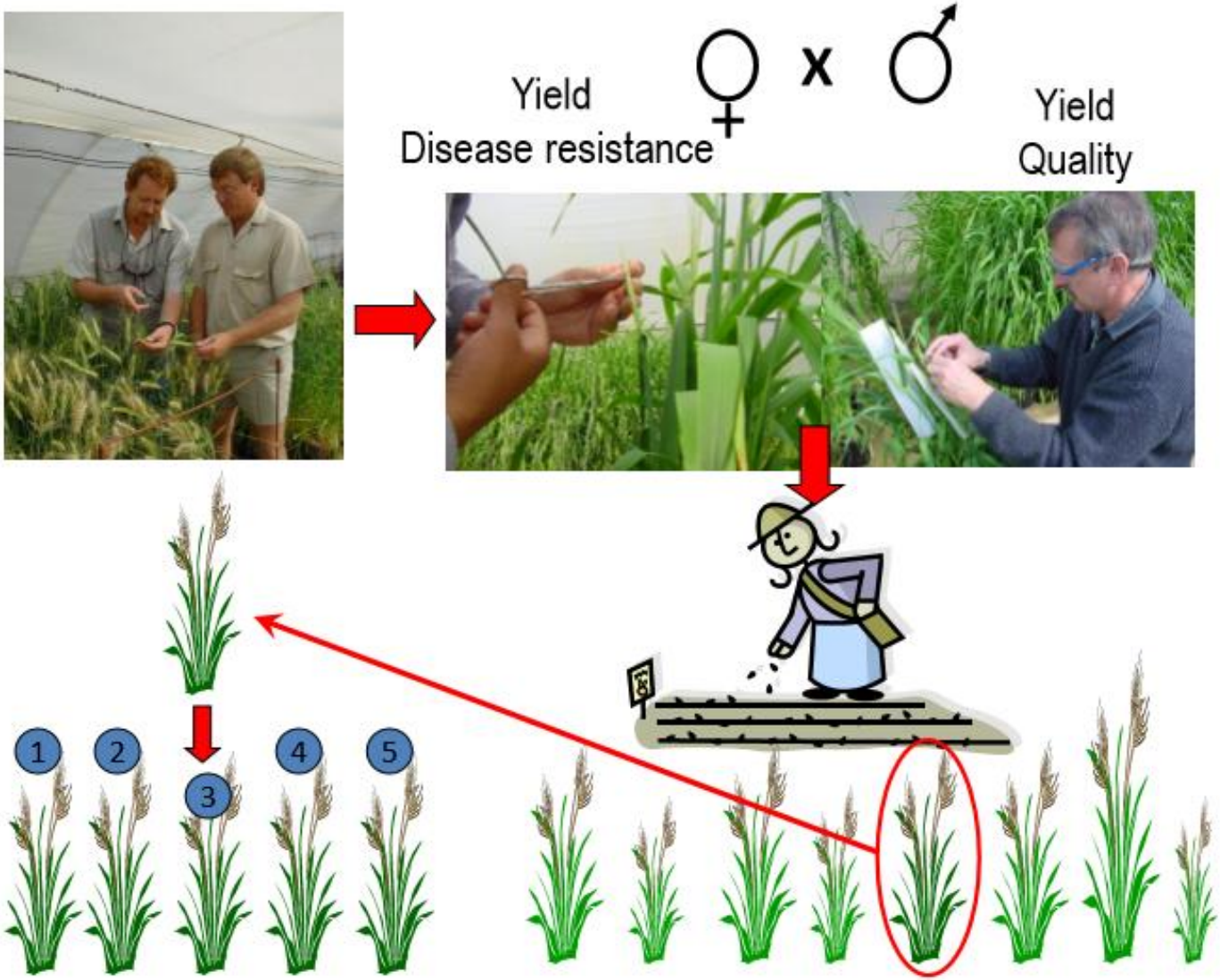
SA WHEAT INDUSTRY

## Breeding for quality

**Early generation quality tests:**

- Simple
- Rapid, high daily throughput
- Correlated with and predictive of end-use performance (medium to high $h^2$)
- Cost effective

# Role of the wheat breeder



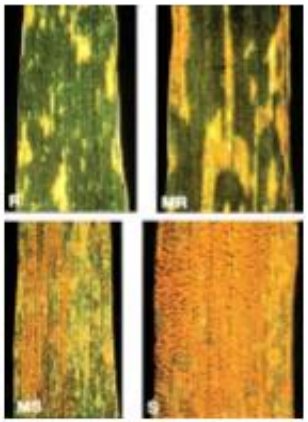

SA WHEAT INDUSTRY

# Role of the wheat breeder

SA WHEAT INDUSTRY


?

15 000 plants/year

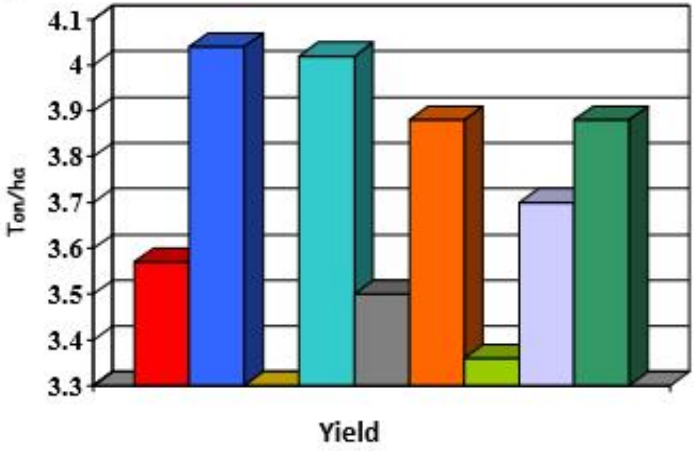


85 000 readings/year

+

Evaluataion

22 000 tests/year




55 000 plots/year

# Role of the wheat breeder

- Plots = 14 253 = 99 Km = 50 Ha
- Single rows = 30 945 = 186 km = 83 Ha
- Amount of crosses = 2 650

SA WHEAT INDUSTRY

# Role of the wheat breeder

SA WHEAT INDUSTRY

NEW CULTIVAR

=

8-12 years

=

10-12 MILLION RANDS

# Evaluate SA quality release process

SA WHEAT INDUSTRY

## RSA, cultivar release system

- Wheat technical committee
- Biological standard, min and max values for characteristics
- Biol Std commercial cultivar, good agronomical and quality
- Two years 5 localities = provisional release
- Three years 5 localities = final release
- Cultivar purity 95% pure, seed and SDS-Page
- Colour standardized at 76% (0.4 KJ units/1% FLY)
- Bread volume standardized at 12% protein ($40cm^3$ per 1%)

# Evaluate SA quality release process

SA WHEAT INDUSTRY

## Milling and baking worth project

- Unique set of data over years and localities for same cultivars
- Cultivars
- Years
- Localities
- Quality traits, milling – HLM, TKM, VK, FABS, BFLY, FCL (C76), FLY
- Quality traits, baking – FLN. GPC, FPC, MDT, AS, AD, ASTAB, P/L, LFV-12%

# Evaluate SA quality release process

SA WHEAT INDUSTRY

## Variance components irrigation

| Source | HLM | TKM | SKCS-G | SKCS-DIA | VK | SKCS-HI | FABS | BFLY | FLY |
|---|---|---|---|---|---|---|---|---|---|
| Genotype | 16.22 | 8.57 | 6.09 | 30.36 | 1.07 | 24.53 | 43.15 | 54.25 | 24.25 |
| Genotype x years | 1.99 | 13.78 | 18.47 | 7.14 | 10.70 | 16.78 | 0.00 | 0.43 | 14.67 |
| Genotype x localities | 3.11 | 0.00 | 0.00 | 0.00 | 9.16 | 3.97 | 0.97 | 0.00 | 0.00 |
| Genotype x localities x years | 18.98 | 17.24 | 21.20 | 8.93 | 3.61 | 17.69 | 28.04 | 27.62 | 29.59 |
| Error | 59.70 | 60.40 | 54.24 | 53.57 | 75.45 | 37.02 | 27.70 | 17.78 | 31.22 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 99.86 | 100.08 | 99.73 |

| | FLN | GPC | FPC | WGC-12 | SDSS | MDT | AS | AD | ASTAB | P/L | LFV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Genotype | 2.17 | 10.50 | 1.08 | 33.40 | 43.67 | 57.65 | 45.22 | 31.74 | 44.29 | 31.90 | 0.70 |
| Genotype x years | 6.06 | 13.17 | 10.81 | 5.43 | 6.13 | 2.52 | 8.68 | 0.00 | 3.15 | 3.68 | 11.66 |
| Genotype x localities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Source | 30.64 | 4.90 | 11.89 | 7.09 | 16.15 | 21.90 | 10.16 | 21.92 | 24.79 | 36.81 | 22.29 |
| Error | 61.13 | 71.43 | 76.22 | 54.08 | 34.05 | 17.92 | 35.94 | 46.35 | 27.77 | 27.61 | 65.35 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

# Evaluate SA quality release process

## Variance components Winter Rainfall Area (WRA)

| Source | HLM | TKM | SKCS-G | SKCS-DIA | VK | SKCS-HI | FABS | FLY | FCL |
|---|---|---|---|---|---|---|---|---|---|
| Genotype | 0.00 | 18.57 | 16.83 | 22.22 | -5.69 | 18.46 | 34.70 | 6.65 | 2.06 |
| Genotype x years | 16.04 | 9.37 | -5.20 | 5.56 | 20.41 | 61.41 | 0.00 | 0.00 | 0.31 |
| Genotype x localities | 6.33 | 0.00 | -6.10 | 0.00 | -6.46 | 0.00 | 0.00 | 0.00 | 0.00 |
| Genotype x localities x years | 42.22 | 35.24 | 48.76 | 47.22 | 61.11 | 12.41 | 42.99 | 38.35 | 0.00 |
| Error | 35.41 | 36.82 | 45.71 | 25.00 | 30.63 | 7.72 | 22.31 | 4.18 | 87.55 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 49.18 | 89.92 |

| Source | FLN | GPC | FPC | WGC-12 | MDT | AS | AD | ASTAB | P/L | LFV |
|---|---|---|---|---|---|---|---|---|---|---|
| Genotype | 36.72 | 8.13 | 5.14 | 14.58 | 3.42 | 37.41 | 17.47 | 23.29 | 38.24 | 3.76 |
| Genotype x years | -6.42 | -6.71 | -3.01 | -6.09 | 15.09 | 4.70 | 3.21 | -0.51 | 7.00 | 4.30 |
| Genotype x localities | -7.88 | 10.16 | 24.47 | 9.82 | 9.05 | -0.11 | 7.19 | 1.71 | 29.17 | -1.19 |
| Genotype x localities x years | 33.93 | 38.11 | 33.88 | 42.61 | 18.11 | 20.73 | 32.73 | 7.55 | -2.69 | 40.33 |
| Error | 43.65 | 50.31 | 39.52 | 39.08 | 54.33 | 37.25 | 39.40 | 67.96 | 28.28 | 52.81 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 99.98 | 100.00 | 100.00 | 100.00 | 100.01 |

SA WHEAT INDUSTRY

# Evaluate SA quality release process

SA WHEAT INDUSTRY

## Variance components dry land

| Source | HLM | TKM | SKCS-G | SKCS-DIA | VK | SKCS-HI | FABS | BFLY | FLY | FCL |
|---|---|---|---|---|---|---|---|---|---|---|
| Genotype | 27.60 | 40.93 | 32.66 | 36.13 | 4.01 | 48.48 | 36.63 | 51.92 | 43.70 | 11.59 |
| Genotype x years | 15.73 | 6.68 | 8.66 | 12.61 | 13.07 | 1.69 | 0.00 | 0.00 | 0.00 | 0.82 |
| Genotype x localities | 6.83 | 0.21 | 6.37 | 8.40 | 0.00 | 4.99 | 17.31 | 0.00 | 0.00 | 0.00 |
| Genotype x localities x years | 31.73 | 33.46 | 31.40 | 16.39 | 20.63 | 16.54 | 30.01 | 9.41 | 38.35 | 0.00 |
| Error | 18.11 | 18.73 | 20.92 | 26.47 | 62.89 | 27.94 | 16.06 | 38.70 | 17.95 | 87.66 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

| Source | FLN | GPC | FPC | WGC-12 | SDSS | MDT | AS | AD | ASTAB | P/L | LFV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Genotype | 0.00 | 10.41 | 13.10 | 21.98 | 50.69 | 58.94 | 57.13 | 46.60 | 78.95 | 76.98 | 8.74 |
| Genotype x years | 10.84 | -3.98 | -4.65 | -2.55 | 5.02 | 2.04 | -1.42 | 3.49 | -0.47 | -0.69 | 4.32 |
| Genotype x localities | 14.83 | 2.58 | 0.51 | 0.77 | 2.08 | 3.39 | -0.59 | 0.77 | -2.62 | 0.64 | 3.55 |
| Genotype x localities x years | 9.04 | 25.79 | 14.61 | 19.56 | 10.73 | 11.63 | 14.41 | 19.90 | 13.63 | 5.77 | 25.53 |
| Error | 65.29 | 65.20 | 76.44 | 60.25 | 31.48 | 24.00 | 30.48 | 29.24 | 10.51 | 17.30 | 57.86 |
| Total | 100.00 | 100.00 | 100.01 | 100.01 | 100.00 | 100.00 | 100.01 | 100.00 | 100.00 | 100.00 | 100.00 |

# Evaluate SA quality release process

SAGL Procedure Milling characteristics

| | | | HLM | TKM | FABS | BFLY | FLY | FCL |
|---|---|---|---|---|---|---|---|---|
| Area | Tol | Std | (kg/hl) | (g) | (%) | (%) | (%) | (C76) |
| Current | min | | -1.5 | | -2 | -5 | -1.2 | |
| | | | (-1.8) | | (-2.5) | | (-1.8) | |
| | max | | | 4 | 2 | 5 | | 0.5 |
| | | | | | -2.5 | | | 1.0 |
| Irrigation | min | SST806 | -1.8 | | -2.4 | -3 | -1.1 | |
| | max | | | 4 | 2.4 | 3 | | 1.5 |
| WRA | min | SST027 | -1.9 | | -2.9 | | -1.6 | |
| | max | | | 1.6 | 2.9 | | | 1.5 |
| Dry | min | Elands | -1.8 | | -2.5 | -2 | -1.7 | |
| | max | | | 4.9 | 2.5 | 2 | | 0.6 |

SA WHEAT INDUSTRY

# Evaluate SA quality release process

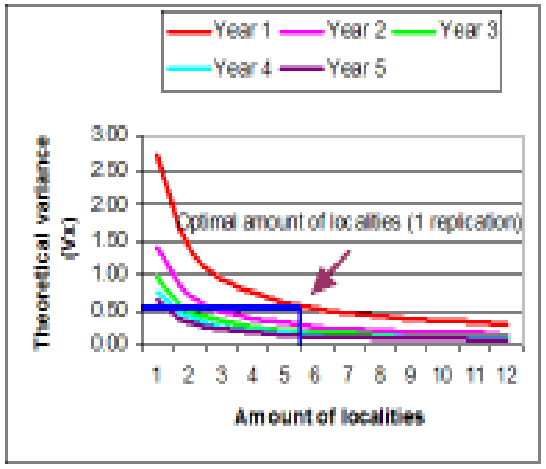
SAGL Procedure Baking characteristics

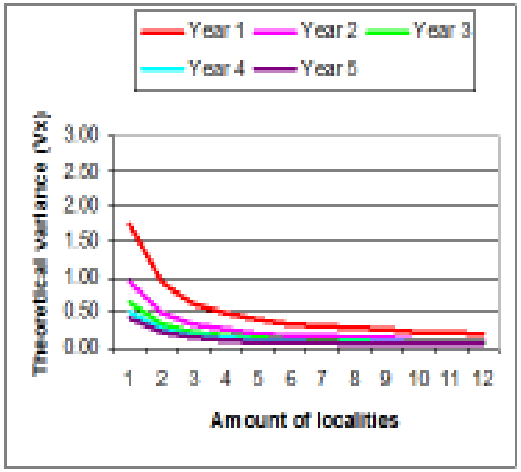
| | | | FLN | GPC | MDT | AS | AD | ASTAB | P/L | LFV(12) |
|---|---|---|---|---|---|---|---|---|---|---|
| Area | Tol | Std | (s) | (%) | (min) | ($cm^2$) | (mm) | (mm) | | ($CM^3$) |
| Current | min | | -15 | -1 | -10,-5, -25 | -20 | -10 | -10 (-20) | -20 (-25) | -10 |
| | max | | | | 35, 45,15 | 20 | 20 | 20 | 20 (25) | |
| Irrigation | min | SST806 | -22 | -1 | -20 | -29 | -18 | -14 | -39 | -4 |
| | max | | | | -10 | 29 | 18 | 20 | 39 | |
| WRA | min | SST027 | -5 | -1.4 | -15 | -15 | -18 | -13 | -17 | -15 |
| | max | | | | 15 | 15 | 18 | 13 | 17 | |
| Dry | min | Elands | -16 | -1 | -14 | -15 | -15 | -13 | -20 | -6 |
| | max | | | | 14 | 15 | 15 | 13 | 20 | |

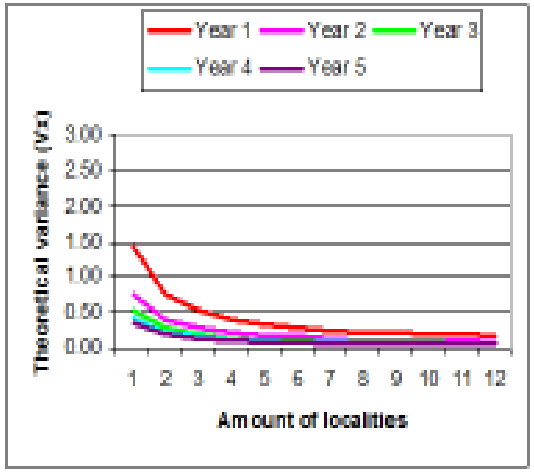
SA WHEAT INDUSTRY

# Evaluate SA quality release process

## SAGL PROCEDURE – STD BAKING




SA WHEAT INDUSTRY

# Evaluate SA quality release process

SA WHEAT INDUSTRY

## Amount of localities irrigation

| Amount of years | Amount of replicates | HLM | TKM | VK | BFLY | FLY | Total |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 6 | 6 | 8 | 6 | 5 | 6 |
| 2 | 1 | 3 | 2 | 3 | 3 | 2 | 3 |

| Amount of years | Amount of replicates | FLN | GPC | MDT | ASTAB | AS | AD | P/L | LFV12 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 7 | 6 | 6 | 7 | 5 | 6 | 7 | 6 | 7 |
| 2 | 1 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |

# Evaluate SA quality release process

SA WHEAT INDUSTRY

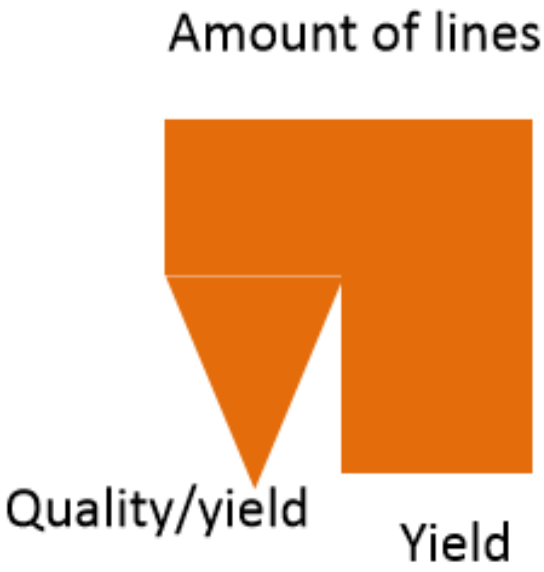
## Improvement in quality traits since 2000

| | Dryland | Irrigation | WRA |
|---|---|---|---|
| SKCS-HI | -7 units | -5 units | 15 units |
| FLY | 2.1% | 2.6% | 2.0% |
| FCL | 0.8 units | 1.2 units | 0.8 units |
| FABS | 4.6% | 2.3% | 0.6% |
| MDT | -1.8min | -0.1min | 0.8min |
| AS | -26.5cm$^2$ | 3.2cm$^2$ | 10.2cm$^2$ |
| AD | -62.5cm | 12cm | 2.6cm |
| ASTAB | -78.9cm | -1.8cm | 13.5cm |
| P/L | -1.4 | 0 | 0,3 |
| LFV | 62cm$^3$ | 33cm$^3$ | 50m$^3$ |

# Evaluate SA quality release process

SA WHEAT INDUSTRY

## Selection procedure for high yield

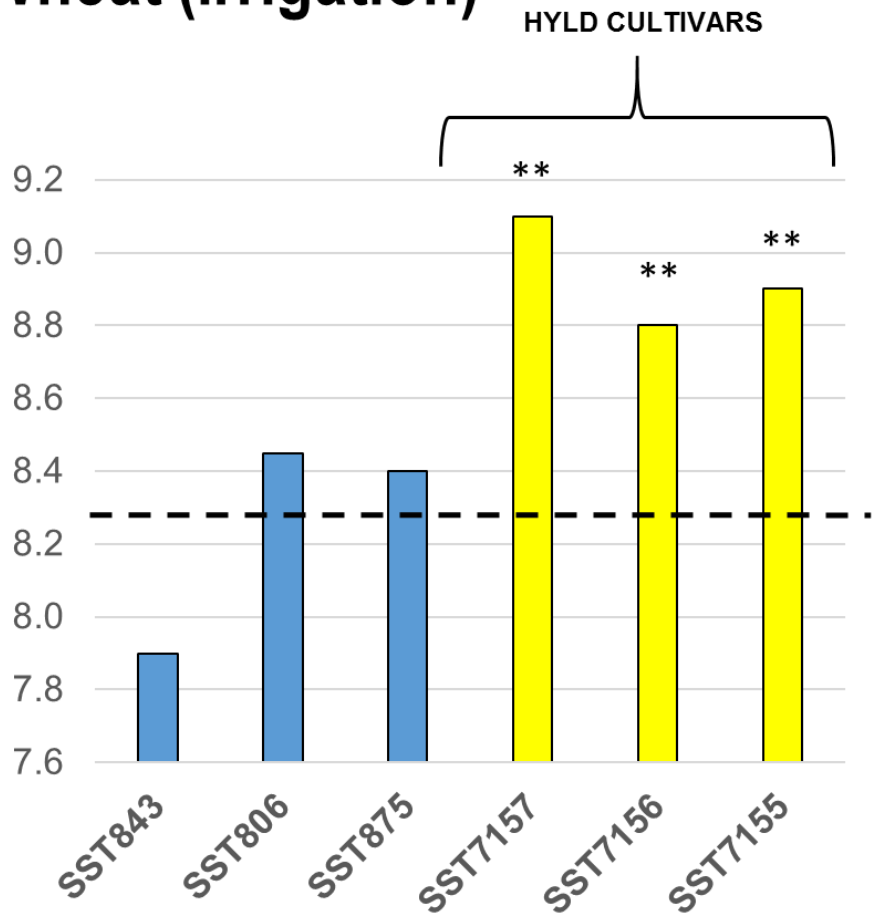
# Evaluate SA quality release process

SA WHEAT INDUSTRY

## High Yield Wheat (irrigation)

### Evaluation Objectives

- 10 – 20% Yield advantage over top SA bread wheat cultivars with lower emphasis on quality.
- Adaptability and stability
- Improved plant physiology
- Adaptation to SA conditions
- Straw strength
- Disease resistance
  - Bacterial blight
  - Rust
  - Powdery mildew
  - Fusarium



# Evaluate SA quality release process

SA WHEAT INDUSTRY

| | Bühler | Colour | Mixo | | Farino | | | Alveo | | | | BakingT | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EX | KJ | PT | ABS | ABS | DT | STAB | STR | STAB | DIST | P/L | VOL | EVAL |
| High yield | 76.1 | -3.2 | 2.4 | 60.8 | 59.9 | 5.1 | 8.3 | 27.6 | 62.4 | 114.8 | 0.6 | 920 | 0 |
| Germany | 75.6 | -1.3 | 3.4 | 59.8 | 60.5 | 1.9 | 4.0 | 33.3 | 106.0 | 54.0 | 2.0 | 729 | 3 |
| Australia | 74.5 | -2.6 | 2.8 | 61.2 | 61.9 | 3.9 | 8.7 | 49.5 | 112.0 | 89.0 | 1.3 | 833 | 2 |
| Argentina | 74.5 | -2.1 | 3.0 | 61.6 | 61.2 | 3.9 | 9.2 | 45.3 | 98.0 | 94.0 | 1.1 | 908 | 1 |

# Evaluate SA quality release process

- Relaxed criteria SAGL for high yielding material was implemented
- Most high yielding lines, although better quality than imported wheat, do not meet the relaxed criteria
- Need to reconsider system if want to make progress in this regard

SA WHEAT INDUSTRY

# Benchmark SA quality to international

SA WHEAT INDUSTRY

## Wheat classes in RSA

- Bread wheat class
- Soft wheat class
- Durum wheat class
- Class other

# Benchmark SA quality to international

SA WHEAT INDUSTRY

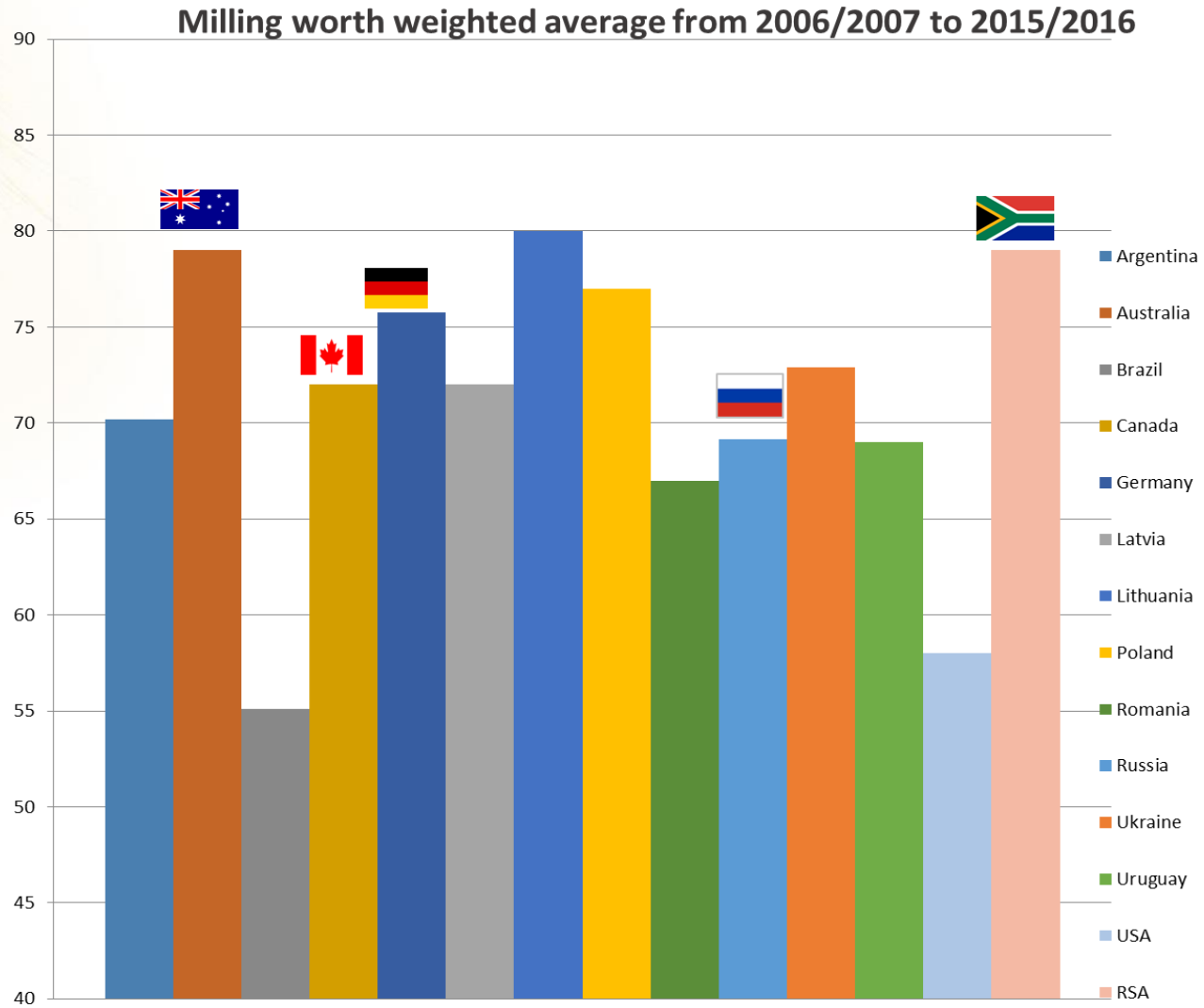
## Wheat classes internationally

- USA, various classes
- Canada, various classes
- Australia various classes
- UK, various classes
- France, various classes
- Germany various classes

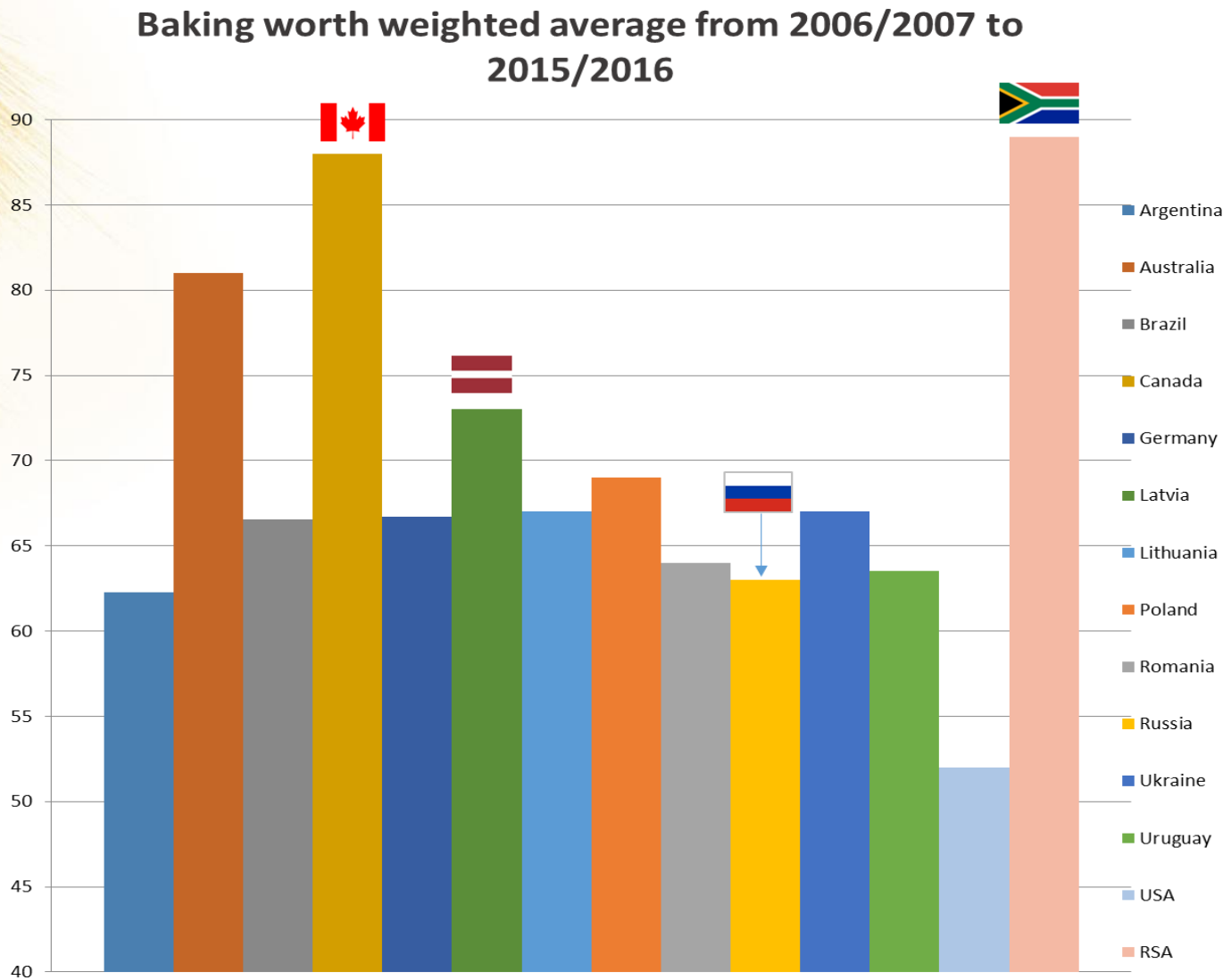
# Benchmark SA quality to international

SA WHEAT INDUSTRY

IMPORTED WHEAT – QUALITY ANALYSIS



# Benchmark SA quality to international




SA WHEAT INDUSTRY

# Indicate shortfalls and propose alternatives

SA WHEAT INDUSTRY

- Before regulation in 1997 South African quality similar to Argentinean and Kazakhstan quality
- In less than 13 year breeders improved quality to similar and even higher levels than that of Australian, Canadian and American wheat
- Wheat quality over the last decade spot on with demand from industry
- Thus breeding for quality survived the oven
- In spite of progress wheat quality and yield, hectares are the lowest in the history of wheat production in South Africa
- Biggest reason profitability due to price

# Indicate shortfalls and propose alternatives

SA WHEAT INDUSTRY

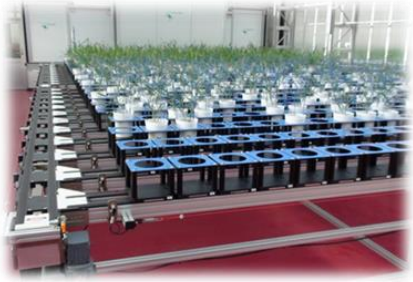
- Wheat breeding is long tem investment, with current trend must breeding programmes still invest?
- With current population growth and future shortages of wheat in the near future can the processing industry afford to loose wheat breeding programmes?

SA WHEAT INDUSTRY

## Indicate shortfalls and propose alternatives

- End Point Royalty system ( EPR) managed by SACTA implemented 2017
- Will increase income of Farm Saved Seed (FSS), only producers contribute currently
- Will enable breeding programmes to afford better equipment, tools, infrastructure and participate with international expertise
- Should benefit wheat industry in the whole, look at Australia a leading wheat producing country as an example
- Want to make plea to processing industry to re-consider their stance on EPR

# Indicate shortfalls and propose alternatives




The cultivar * SST843 has a unique genotype differ from Australia, Mexico (CYMMIT) and other SA germplasms.

Contain 3 major genes initiating the earlier start of tillering and flowering

Plants from the cultivar SST843 and five pedigree related breeding lines showed greater tolerance to drought

Based on experiments in hydroponics, the SST843 genotype can be deemed the most salt tolerant compared to all other studied

The highest level of Aox1 expression in the leaves of SST843 under salt stressed conditions

SA WHEAT INDUSTRY

SA WHEAT INDUSTRY

# Summary and conclusions

- RSA self sufficient, solutions must be find to improve wheat production
- Establish different wheat classes instead of only one bread wheat class (dual purpose)
- Develop cultivars similar than imported wheat to enable farmers to produce local wheat locally
- This wheat must be high yielding and identifiable

SA WHEAT INDUSTRY

Food for thought

# Global Food Security

## Borlaug's 1969 Prophecy

**"The seriousness or magnitude of the world food problem should not be underestimated. Recent success in expanding wheat, rice and maize production in Asian countries offers the possibility of buying 20-30 years of time"**
N.E. Borlaug, 1969 – A Green Revolution Yields a Golden Harvest

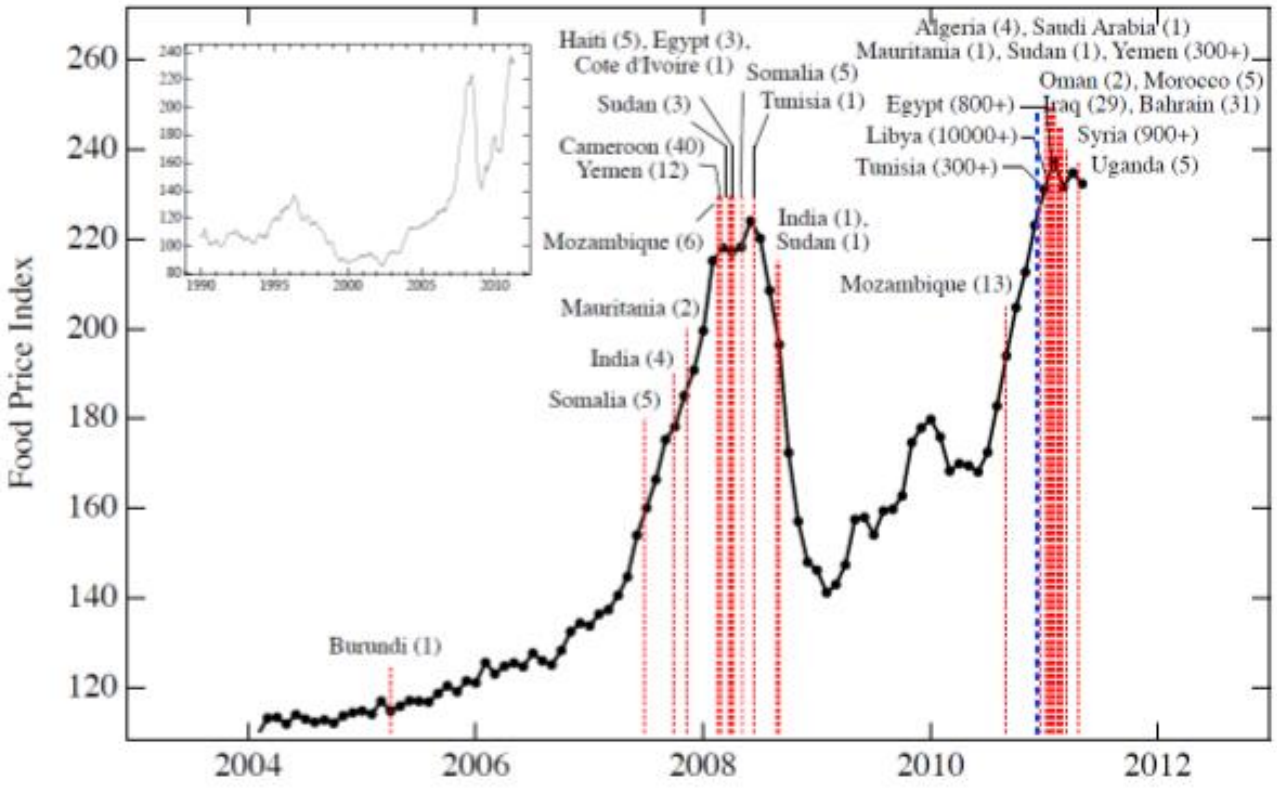
Wheat for Food Security in AFRICA
CONFERENCE
October 8-12, 2012, Addis Ababa, Ethiopia

SA WHEAT INDUSTRY

# Food for thought

## Global Food Security

### Food Prices and Social Unrest




Red dashed vertical lines correspond to beginning dates of "food riots" and protests associated with overall death toll reported in parentheses (?).

Wheat for Food Security in AFRICA
CONFERENCE
October 8-12, 2012, Addis Ababa, Ethiopia


Take pride in how far you've come and have faith in how far you can go