



Relaxation of wheat cultivar release  
requirements

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Sensako

**SA WHEAT INDUSTRY**



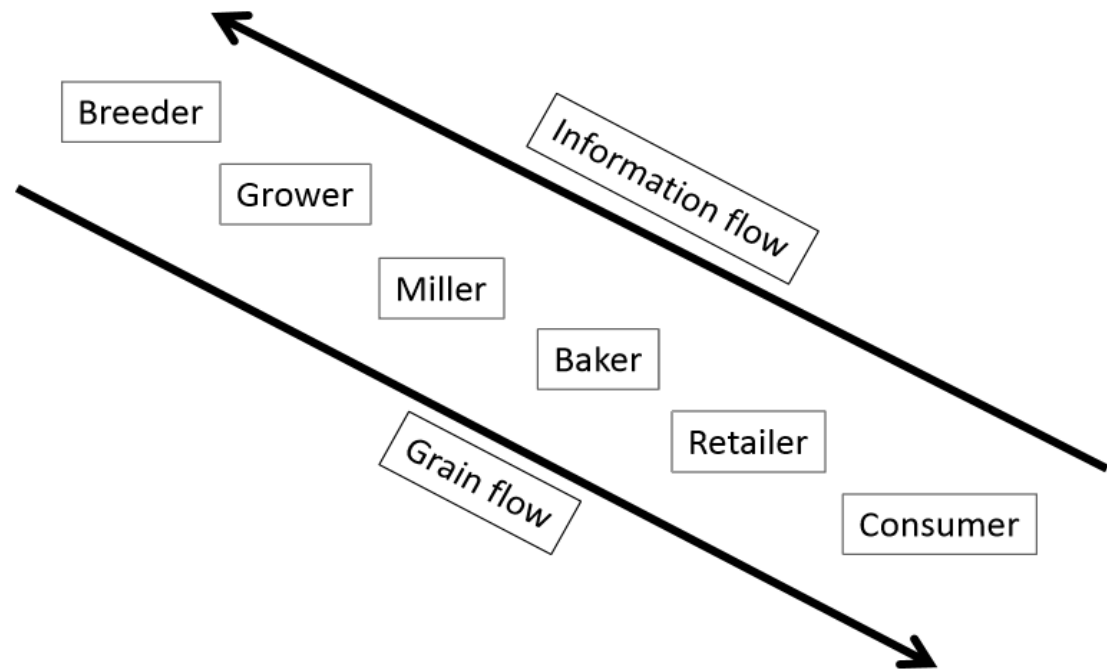
# SA WHEAT INDUSTRY

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

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



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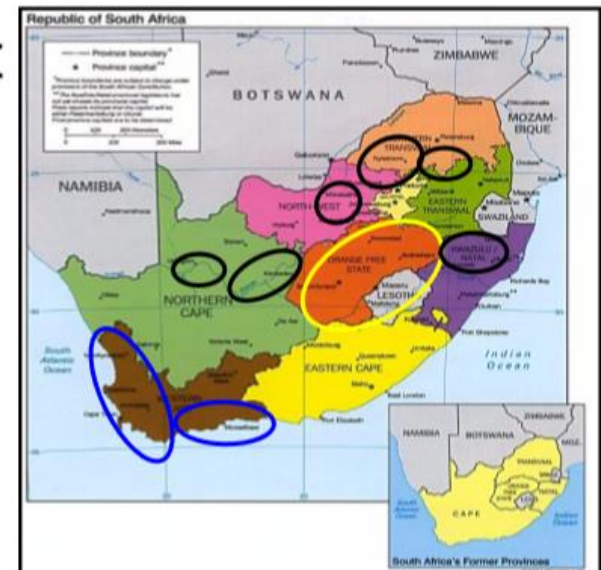
# Role of the wheat breeder

- 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

## 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

# Role of the wheat breeder

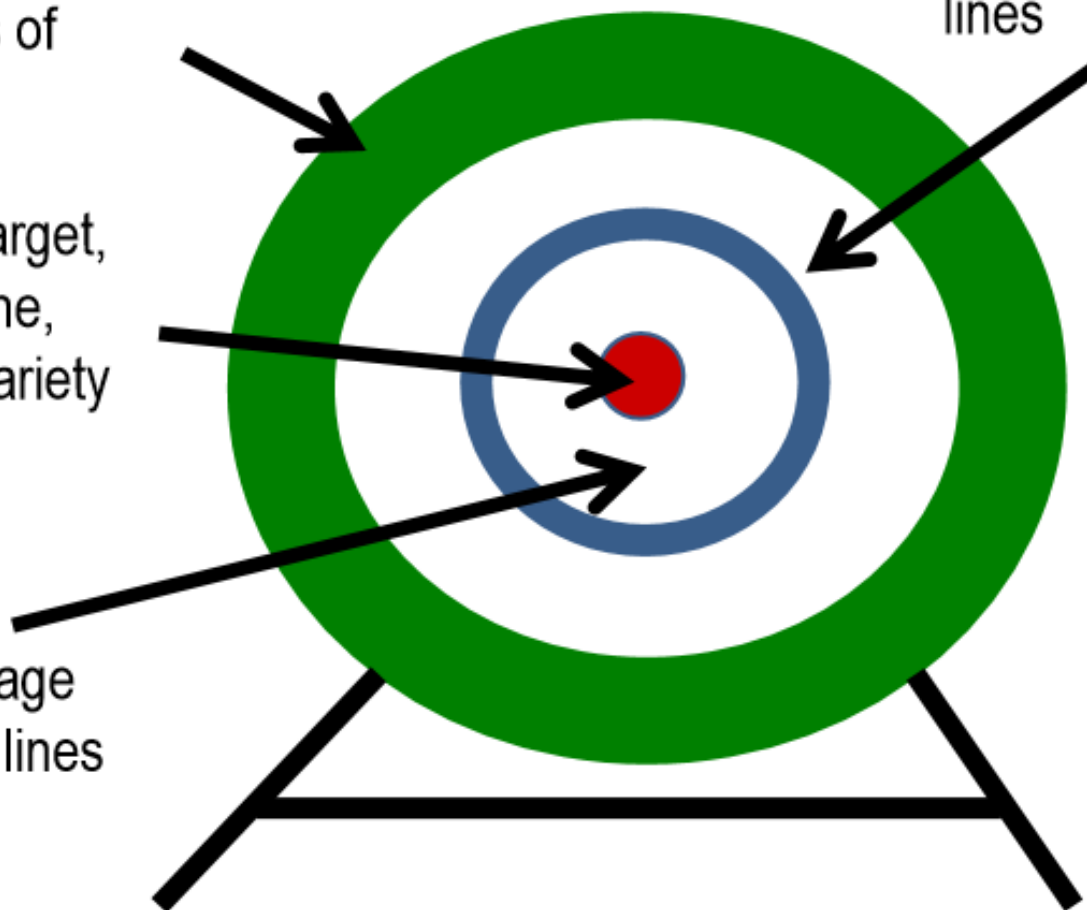
Early generations, 1000's of lines

The target, one line, one variety

Late stage 10's of lines

## Hitting the target

Mid stage 100's of lines



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# Role of the wheat breeder

## 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



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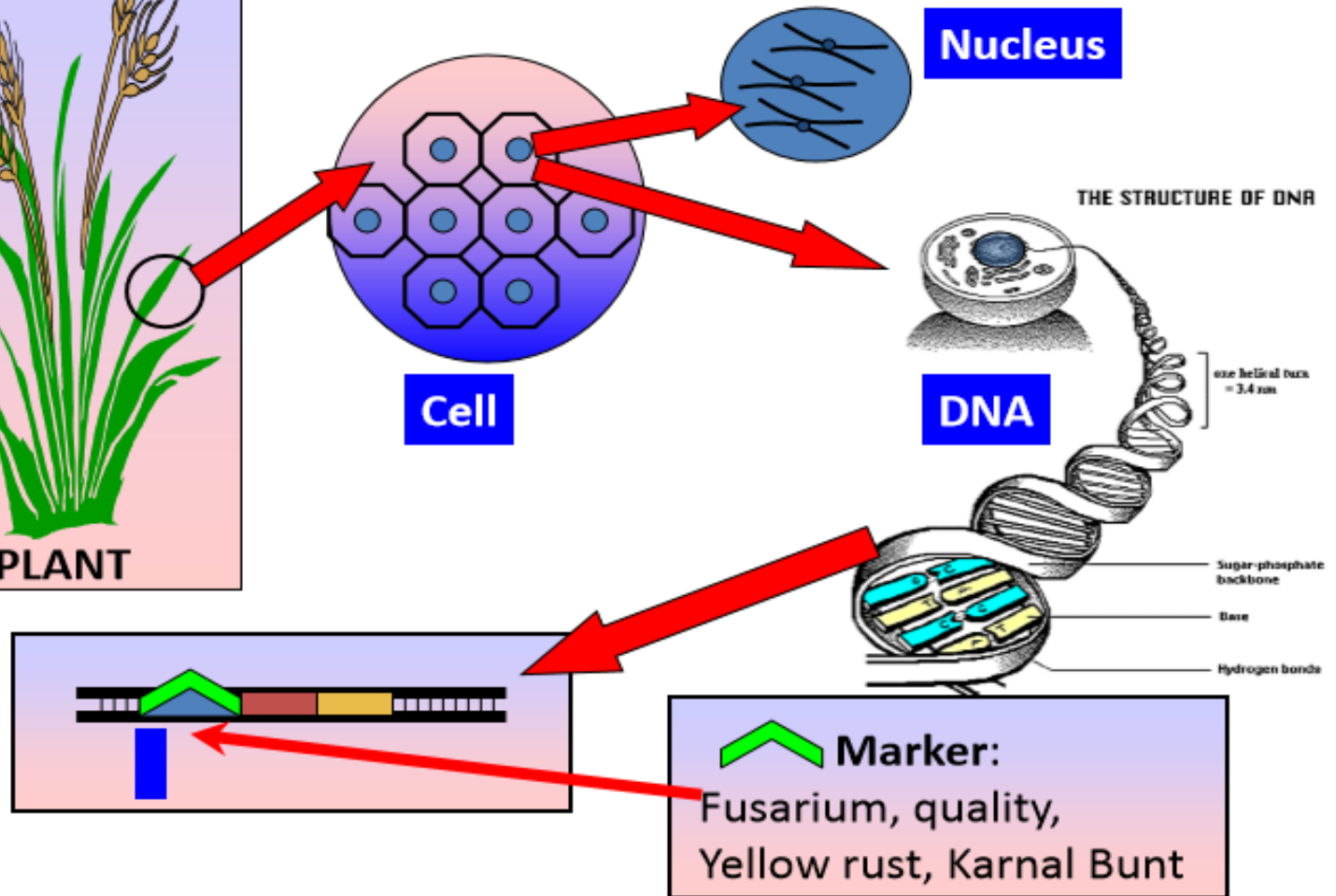


# Role of the wheat breeder

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## What is a molecular marker?



# Role of the wheat breeder

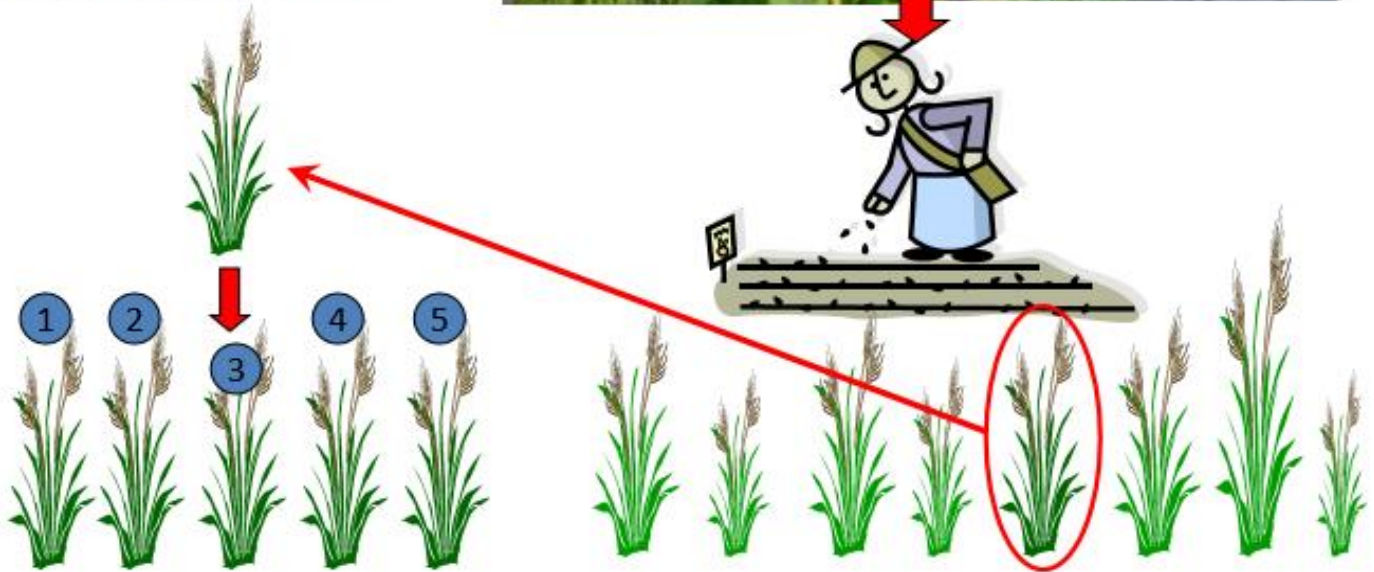
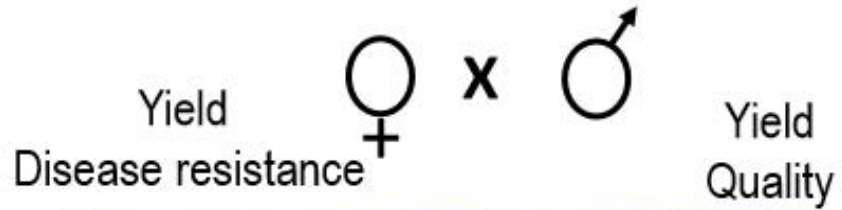
## Breeding for quality

### 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

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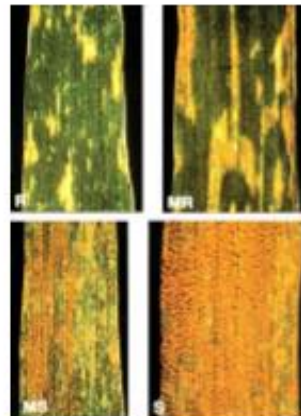


# Role of the wheat breeder

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15 000 plants/year

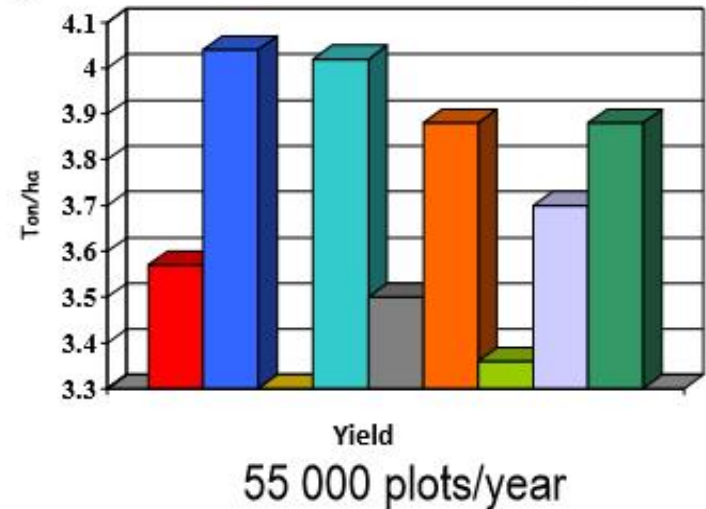


85 000 readings/year

## Evaluataion



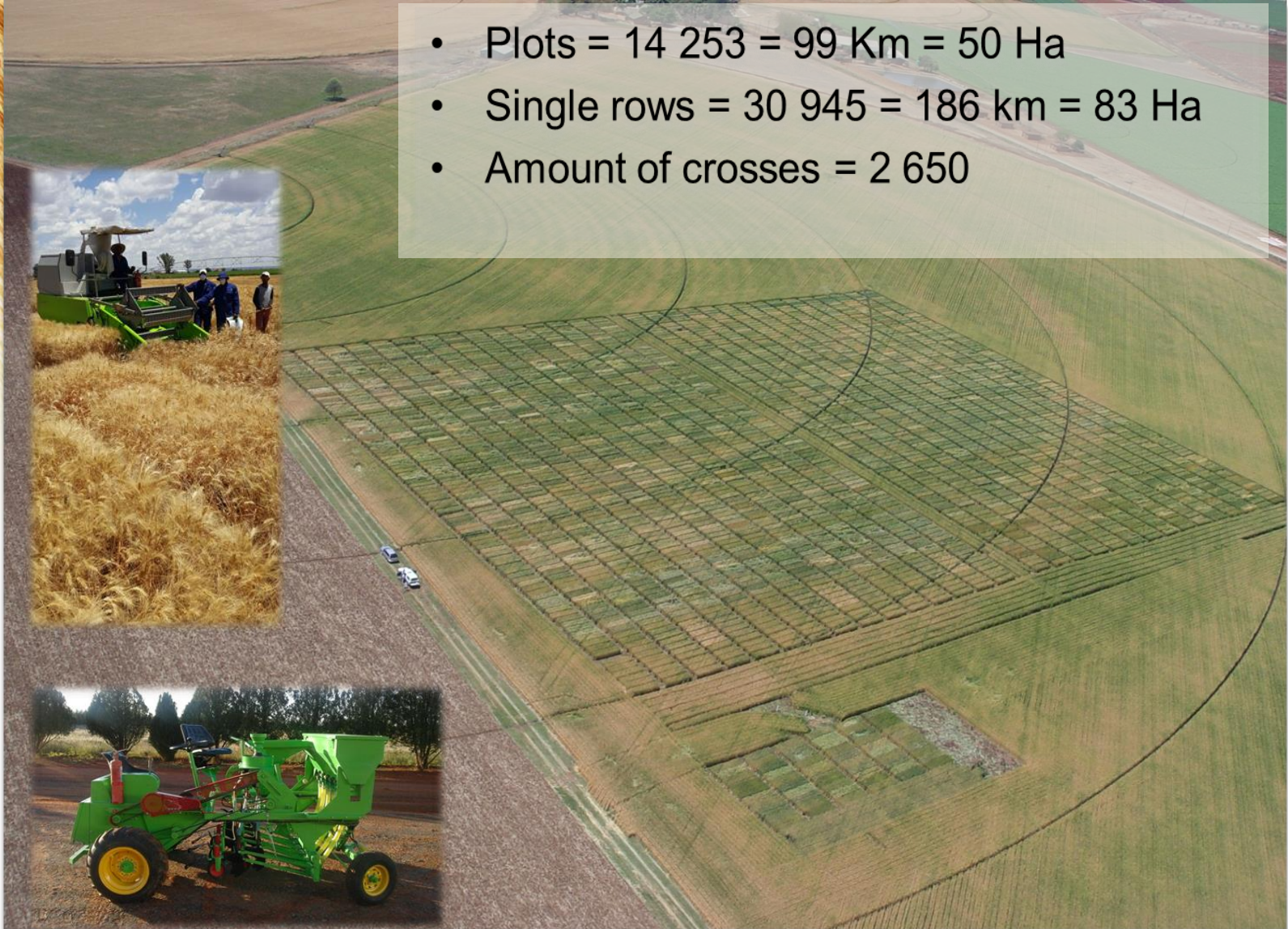
22 000 tests/year





# 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



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# Role of the wheat breeder

## NEW CULTIVAR



8-12  
years



10-12  
MILLION  
RANDS



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## Evaluate SA quality release process

# 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<sup>3</sup> per 1%)

# Evaluate SA quality release process

## 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

## 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	99.88	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

# Evaluate SA quality release process

## 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

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

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# Evaluate SA quality release process

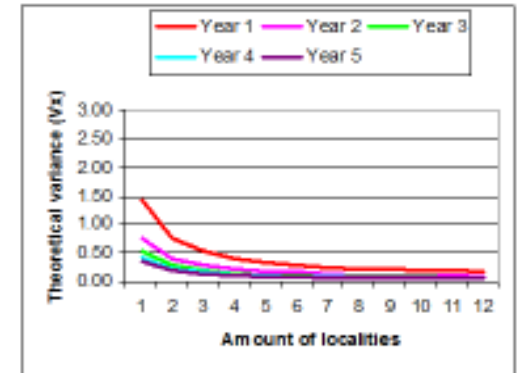
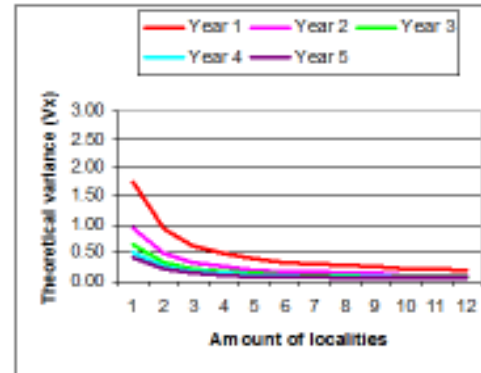
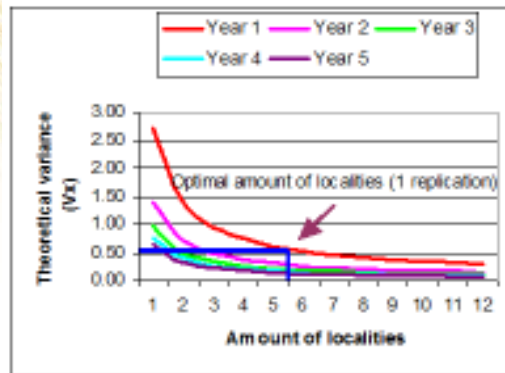
## SAGL Procedure Baking characteristics

			FLN	GPC	MDT	AS	AD	ASTAB	P/L	LFV(12)
Area	Tol	Std	(s)	(%)	(min)	(cm2)	(mm)	(mm)		(CM3)
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	

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# Evaluate SA quality release process

## 1. SAGL PROCEDURE STD -BAKING



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# Evaluate SA quality release process

## 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

## 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 <sup>2</sup>	3.2cm <sup>2</sup>	10.2cm <sup>2</sup>
AD	-62.5cm	12cm	2.6cm
ASTAB	-78.9cm	-1.8cm	13.5cm
P/L	-1.4	0	0,3
LFV	62cm <sup>3</sup>	33cm <sup>3</sup>	50m <sup>3</sup>

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# Evaluate SA quality release process

## Selection procedure for high yield

Amount of lines



Quality /yield

Amount of lines



Quality/yield

Yield

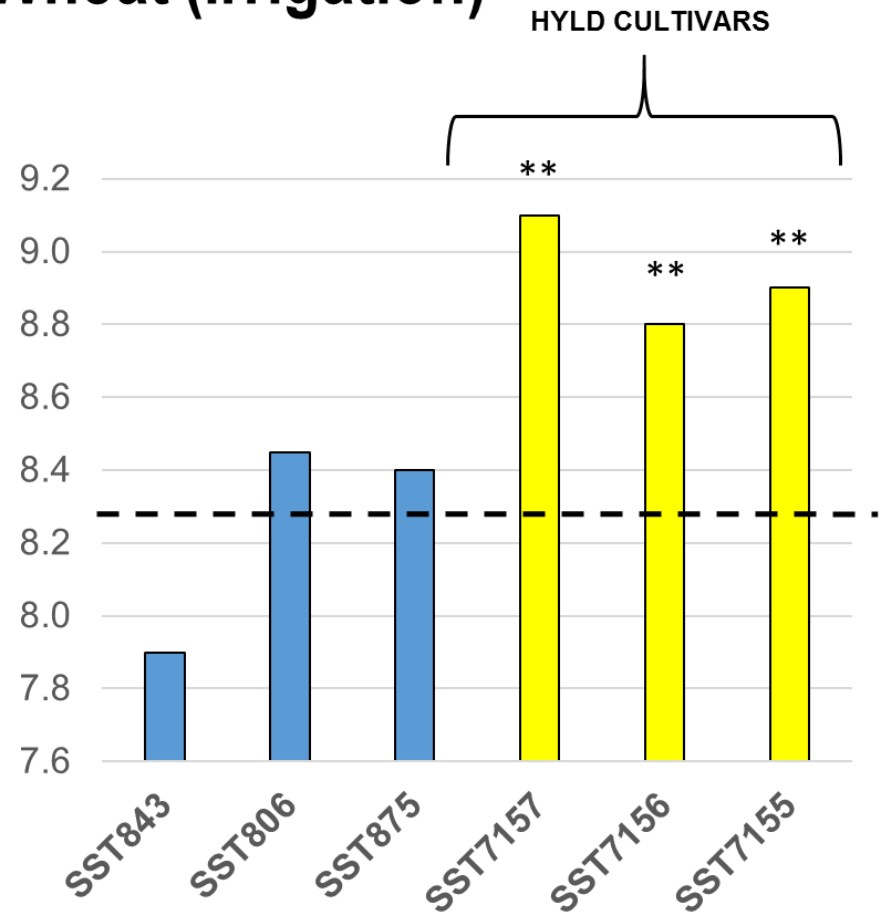
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# Evaluate SA quality release process

## 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

	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

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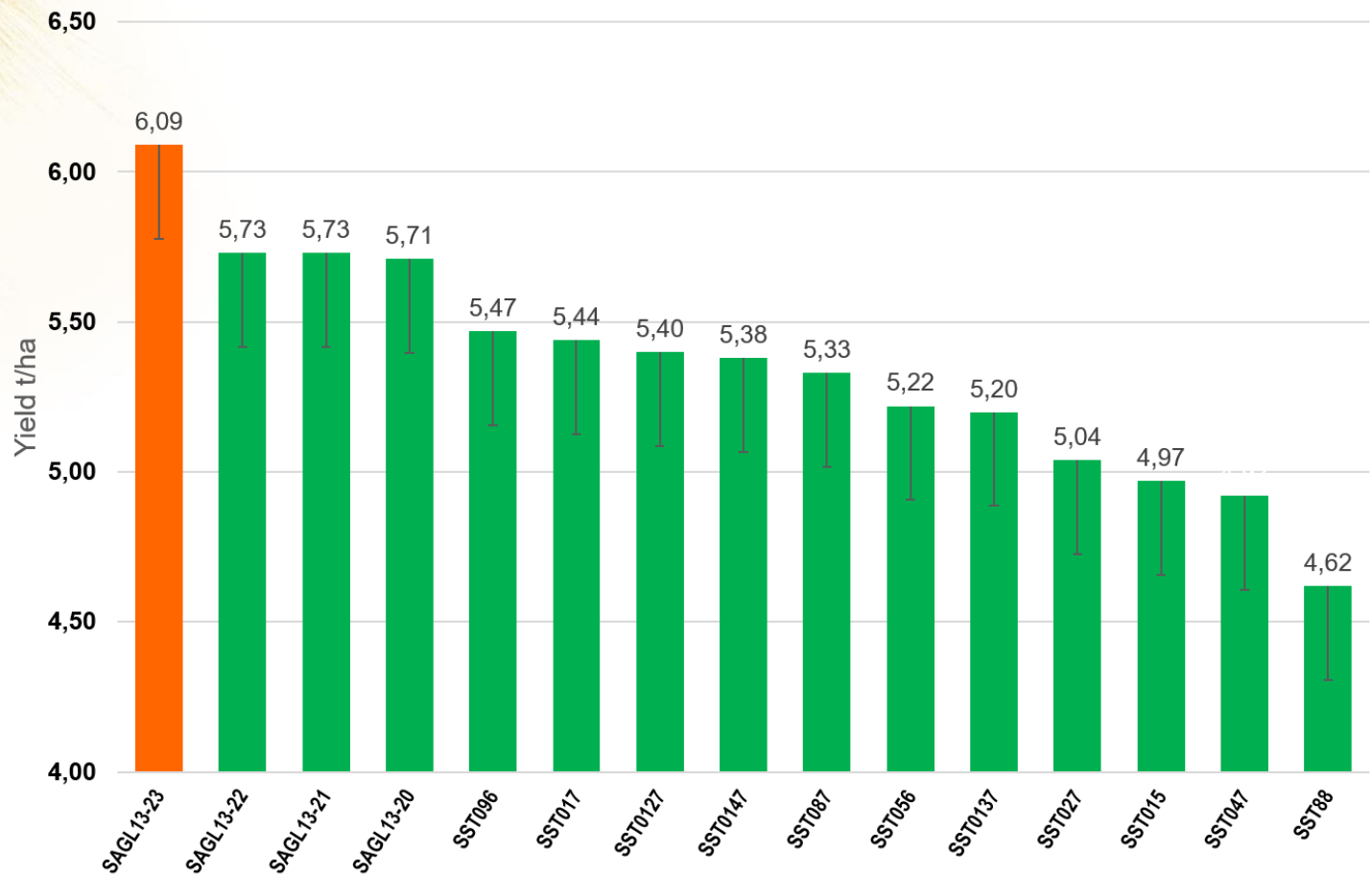


# Evaluate SA quality release process

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

# Evaluate SA quality release process

## SWARTLAND KPT-2013

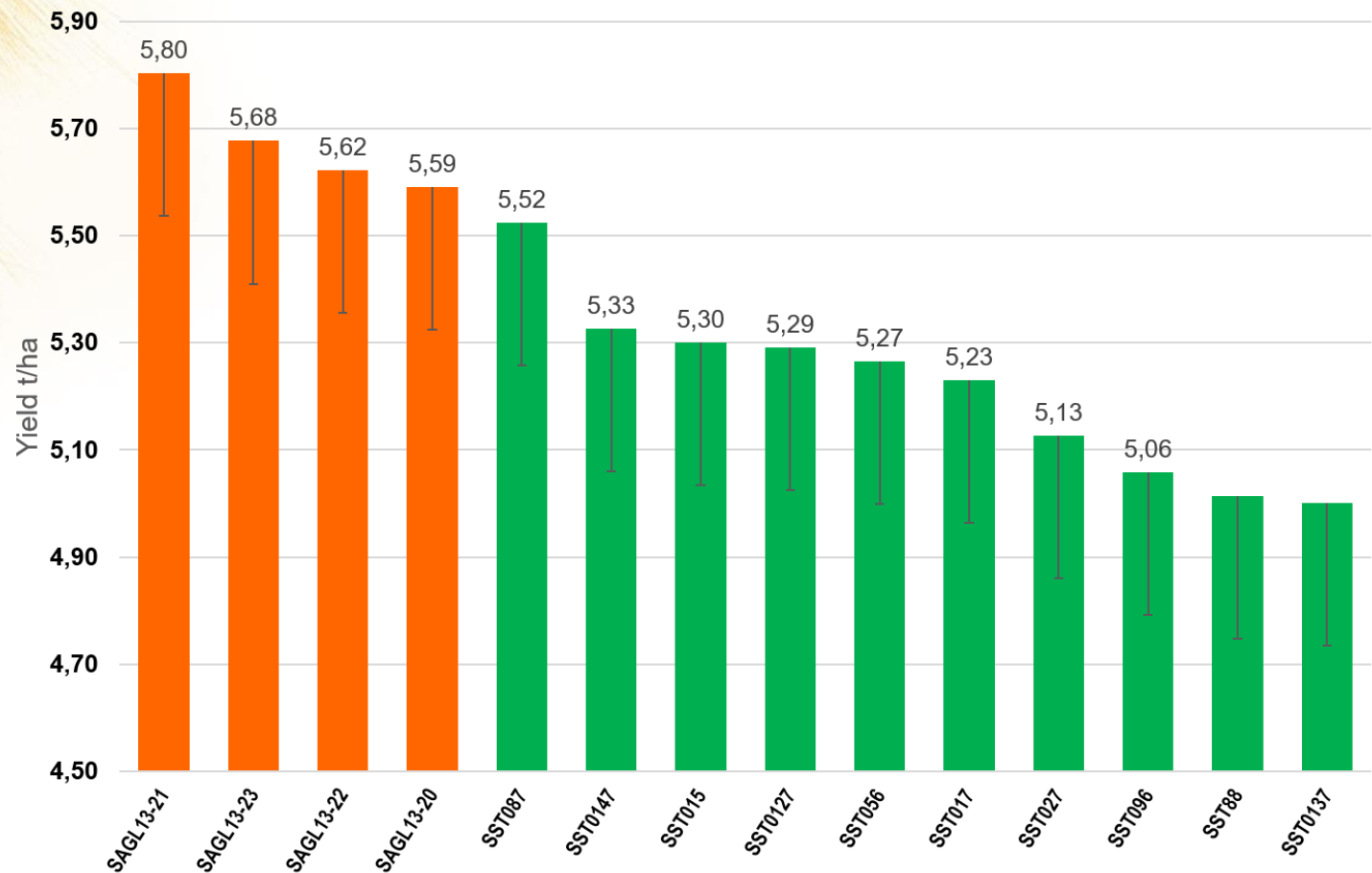


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# Evaluate SA quality release process

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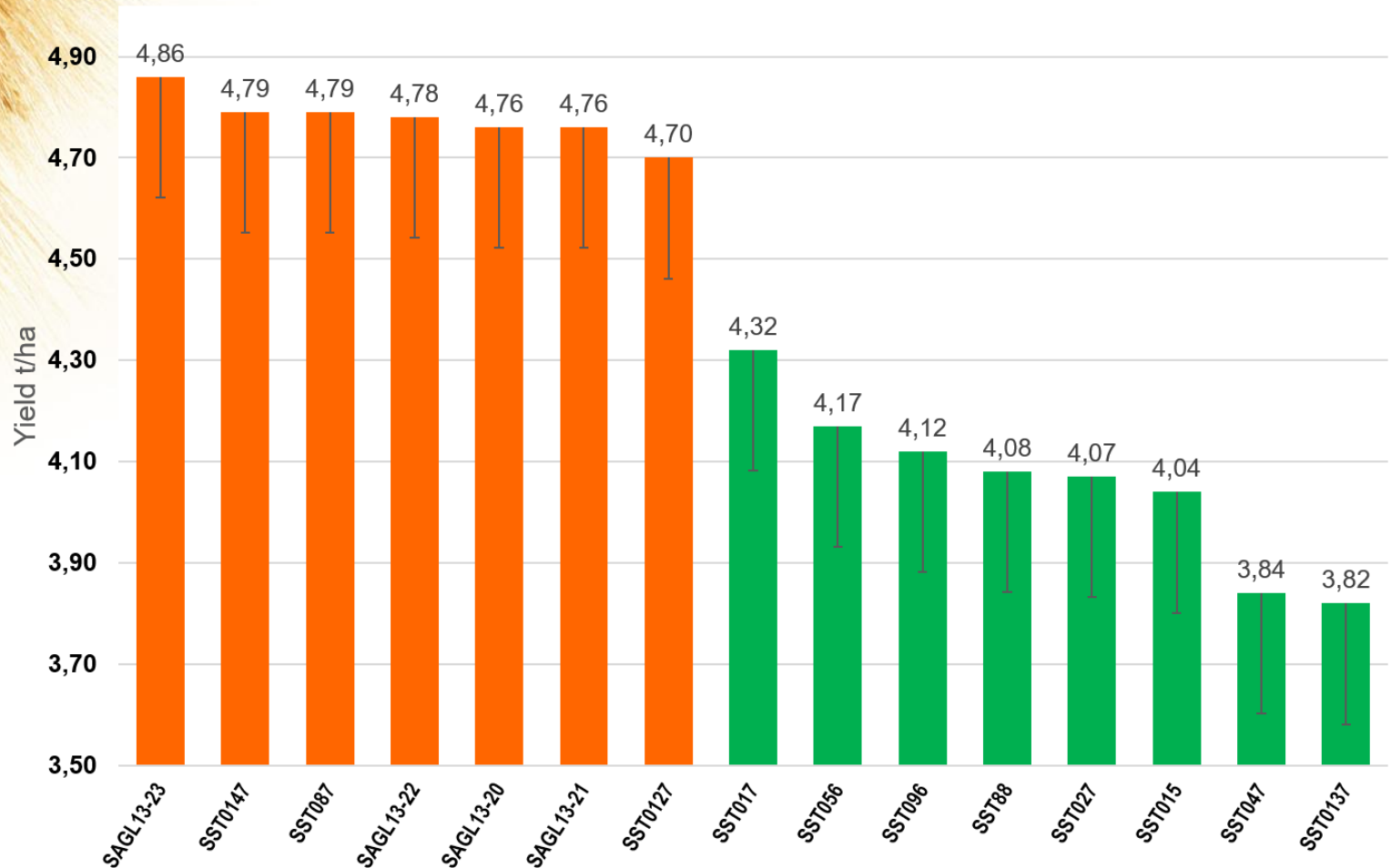
## SWARTLAND KPT-2014





# Evaluate SA quality release process

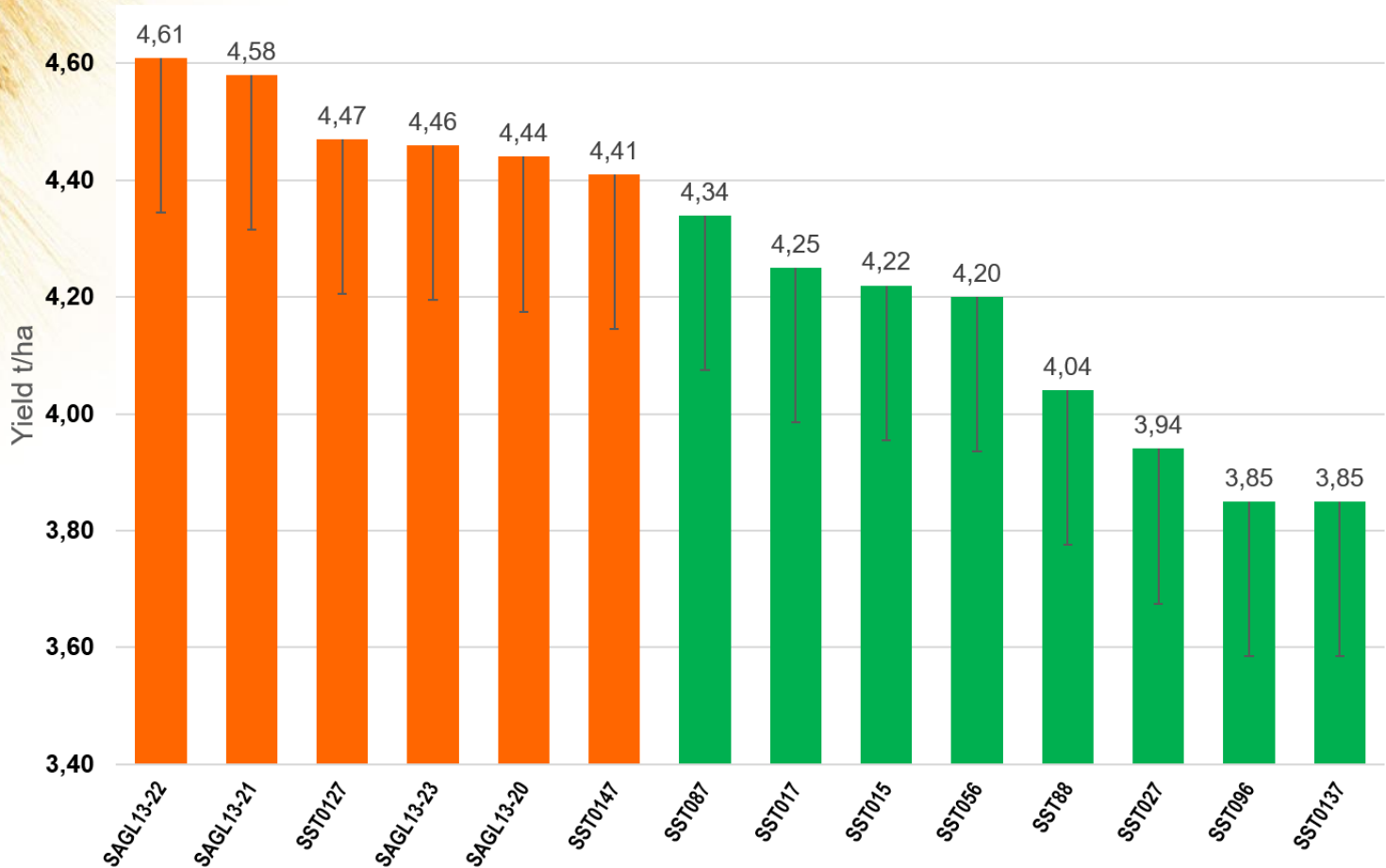
## RÛENS KPT-2013



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# Evaluate SA quality release process

## RÛENS KPT-2014



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Benchmark SA quality to international

# Wheat classes in RSA

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

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Benchmark SA quality to international

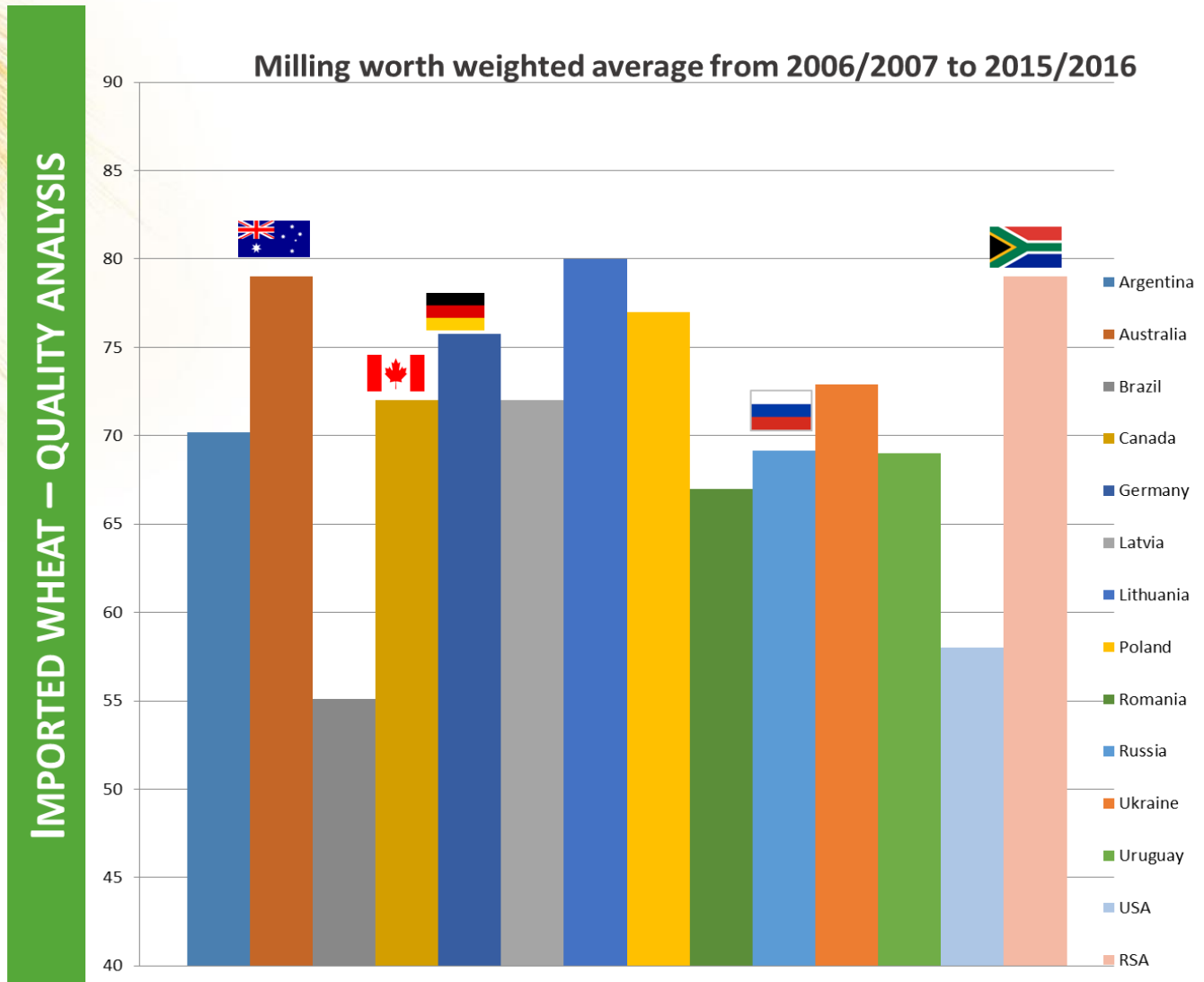
# Wheat classes internationally

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

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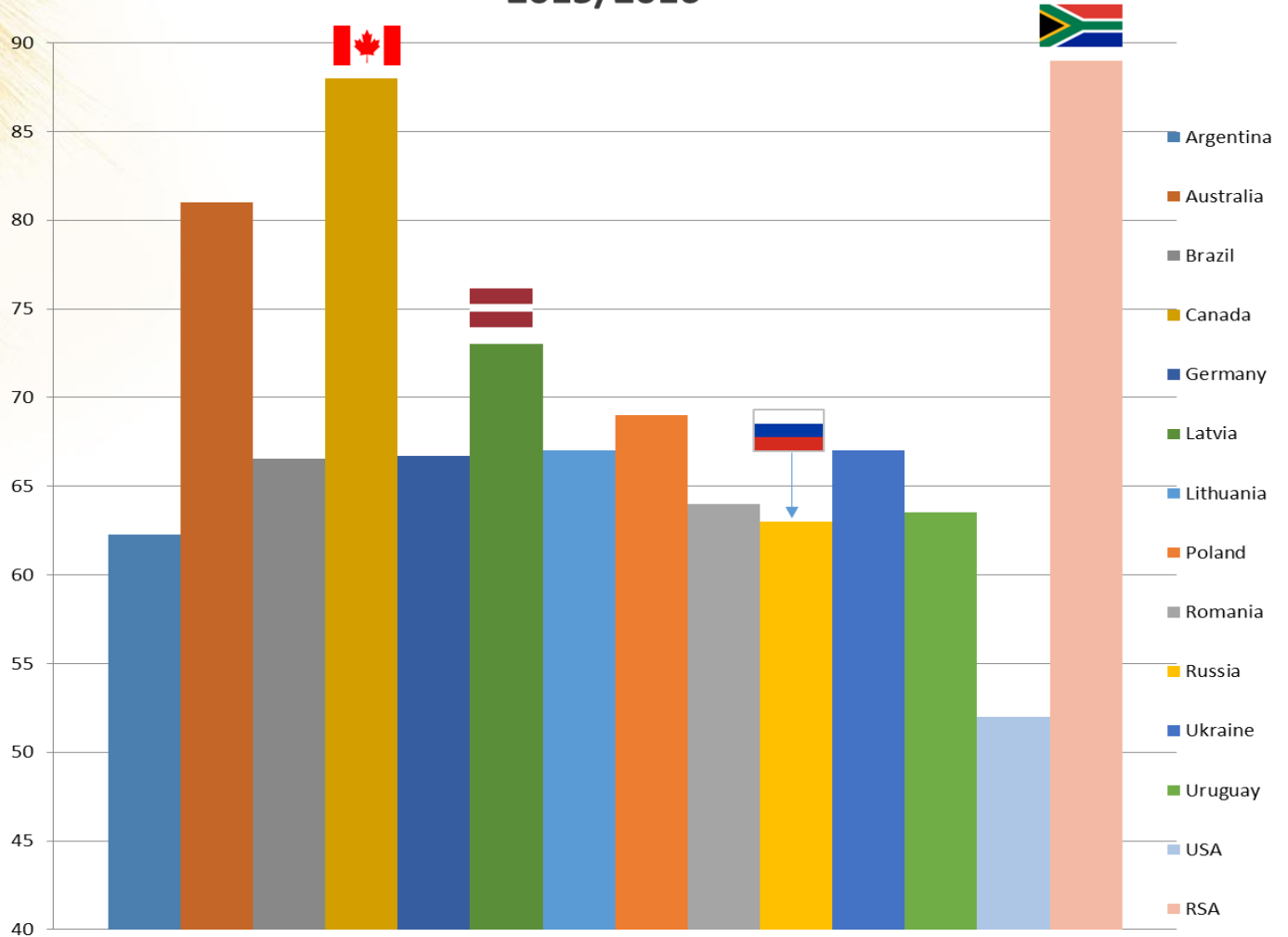
# Benchmark SA quality to international

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# Benchmark SA quality to international

Baking worth weighted average from 2006/2007 to 2015/2016



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## Indicate shortfalls and propose alternatives

- **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**

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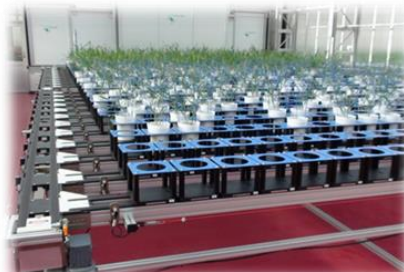
## Indicate shortfalls and propose alternatives

- **Wheat breeding is long term 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?**

## 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 germplasm.

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

# 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**



# Food for thought

## Global Food Security

### Borlaug's 1969 Prophecy



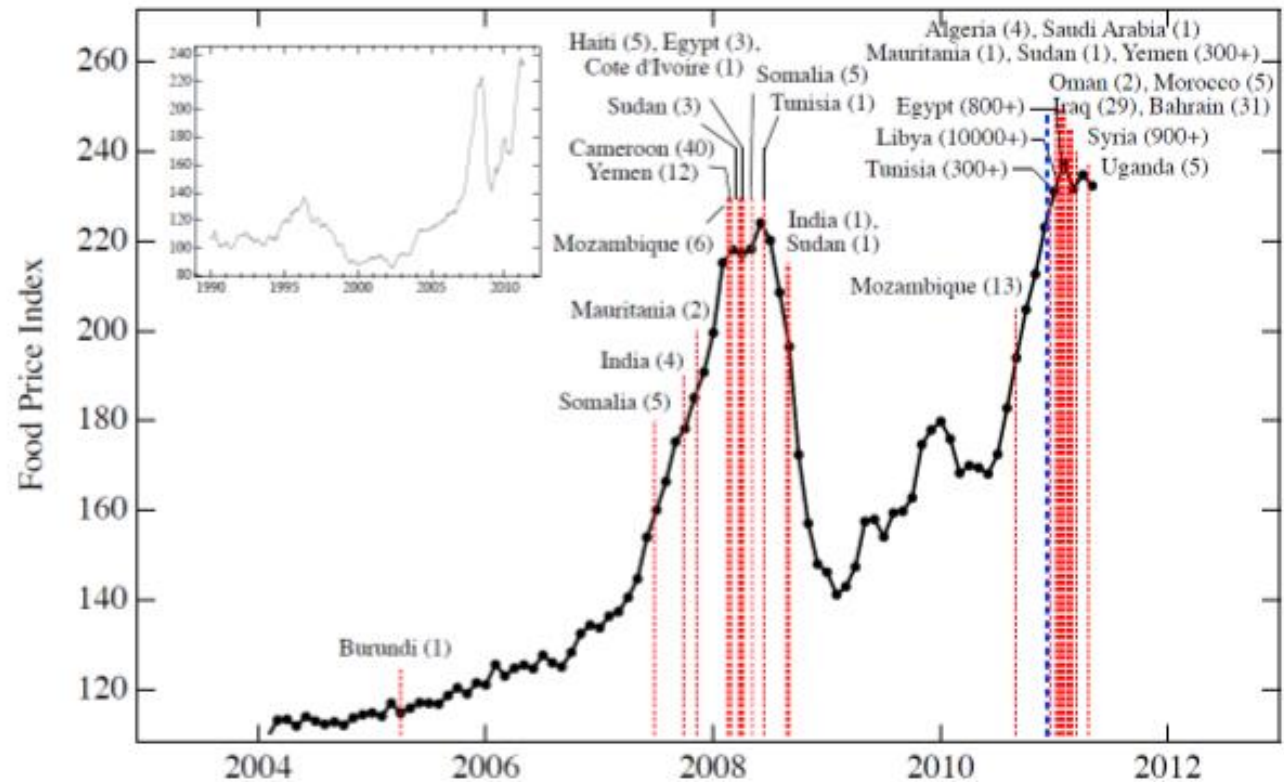
**“The seriousness or magnitude of the world food problem should not be underestimated. Recent success in expanding wheat, rice and maize production in Asian countries offers the possibility of buying 20-30 years of time”**  
N.E. Borlaug, 1969 – A Green Revolution Yields a Golden Harvest

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

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# 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 (?).



