BPEX Innovation Conference 2014

“What answers might plant breeding provide to pig nutrition?”

Chris Tapsell - KWS

KWS

Seeding the future
since 1856

Crops Are Commodities
- The 'Cost' Mindset

- Most, if not all, crops used for animal feed are commodities, with price driving the market
- Feed producers will switch between crops dependent on global prices and mix crops with other additives to produce the required feed
- This is the skill of the feed producers and totally understandable
- In the UK feed rations are typically wheat-based

Crops As Commodities - 'Yield is King'

- Inevitably this has had a major impact on the supply chain
- Farmers are focussed on yield and their suppliers, including breeding, companies do the same

Large scale farming

Yield testing of winter wheat

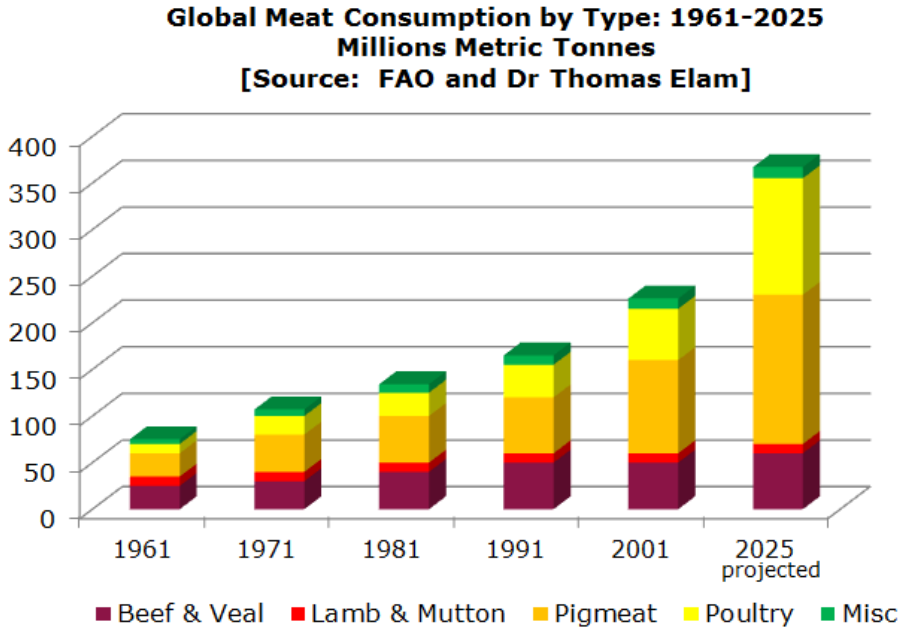
Intensive production

Crops As Commodities
- Innovation is neglected

- It is difficult to get the supply chain interested in exploring opportunities for improving the nutritional quality for feed of an individual crop
- Many involved may not even be aware of the variation that exists in the crop and certainly they would not be expecting to pay extra for it
- In addition, the supply chain itself may not be able to easily adapt to segregating specialist crops

Crops As Commodities
- But opportunities do exist

- But unlike others, I do not see the feed market as where the ‘waste’ crops with no premium opportunity are ‘dumped’
- I see it as a market, which is growing with global population growth and increased consumption of meat products and full of opportunities
- The key question is how to capture these



Commodities For ‘Quality Markets’

- Historically, processors involved in ‘quality’ markets (bakery, brewing etc) have defined specifications and have been willing to pay for crops achieving these
- As a consequence the supply chain up to and including the farmer has focussed on these and improved quality through investment
- Whilst crops grown for these markets may still be commodities, there are premium opportunities for farmers and niche supply chains also develop

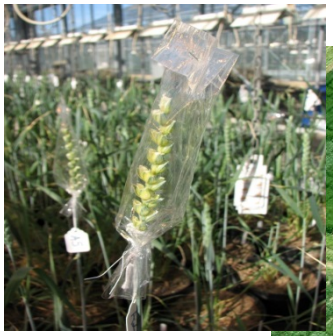
Commodities For 'Quality Markets' - Shared profit drives investment

- The additional value in the quality markets enables significant investment in crop research and the development of varieties with enhanced quality

- From the university and research institute to the breeder, to the farmers agronomic management, all are able to invest and profit from the added value generated in the raw material itself

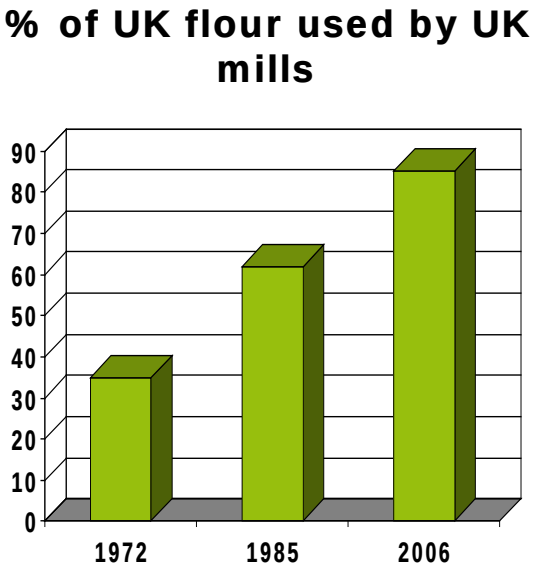
JOHN INNES CENTRE

ROTHAMSTED RESEARCH

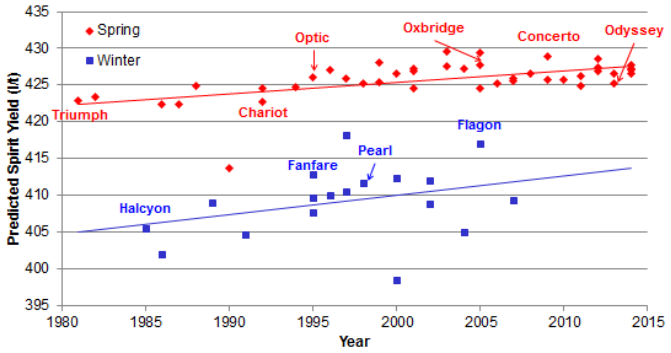


Commodities For 'Quality Markets' - And what can be achieved?

- By exploiting research outputs and breeding for quality markets in the UK alone, plant breeders have
  - Reduced the need for large imports of bread quality wheat
  - And have increased the productivity for distillers with higher alcohol yield from modern varieties



Breeding progress for spirit yield



Commodities For 'Quality Markets' - And what can be achieved?

- Furthermore, specialist products have been produced, which serve relatively niche market segments and the opportunity to innovate further is a key driver for researchers and breeders alike

Yields of HOLL (high oleic, low linolenic) OSR varieties have caught up with conventional types and they also come with a useful premium.

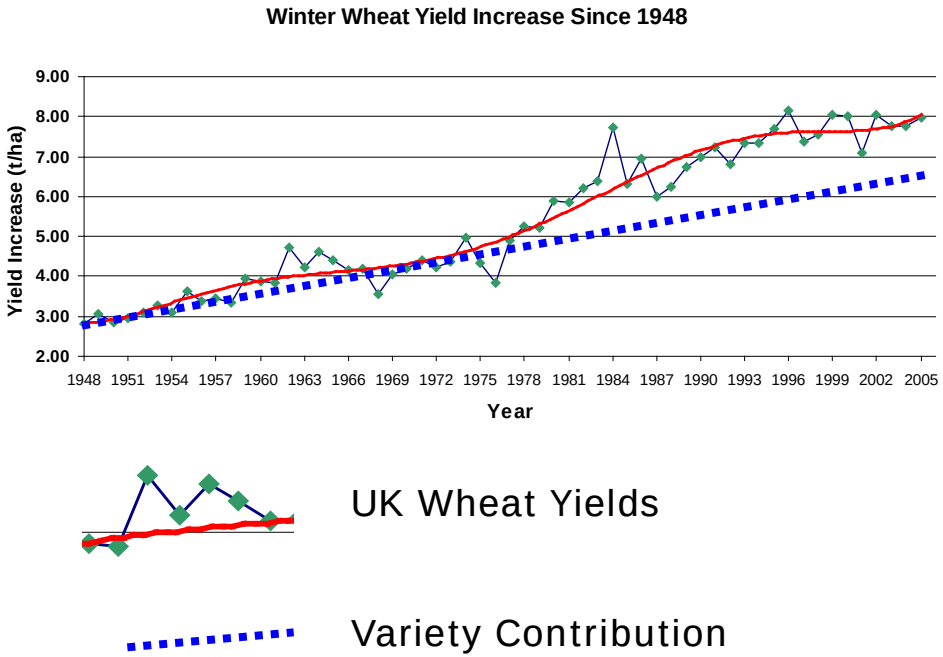
Farmers Guide 2014

ZIRCON

White wheat for special purposes

Animal Feed
- What are the opportunities?

- Whilst Breeders can still continue to increase yield
  - Maize >2% per annum
  - Wheat ~1% per annum
  - Rye >1% per annum
  - etc.
- There are opportunities for a real focus on nutrition in animal feed
- If the market wants it and is willing to join the innovation effort
- Breeders need to have defined needs to turn into breeding targets



Animal Feed
- What are the opportunities?

- KWS has been looking at what has been done in the past and what might be possible for the crops it breeds

- Importantly, we believe that partnerships with feed compounders and animal producers will offer the greatest opportunity for innovation

Hybrid Rye

Maize Hybrids

Wheat

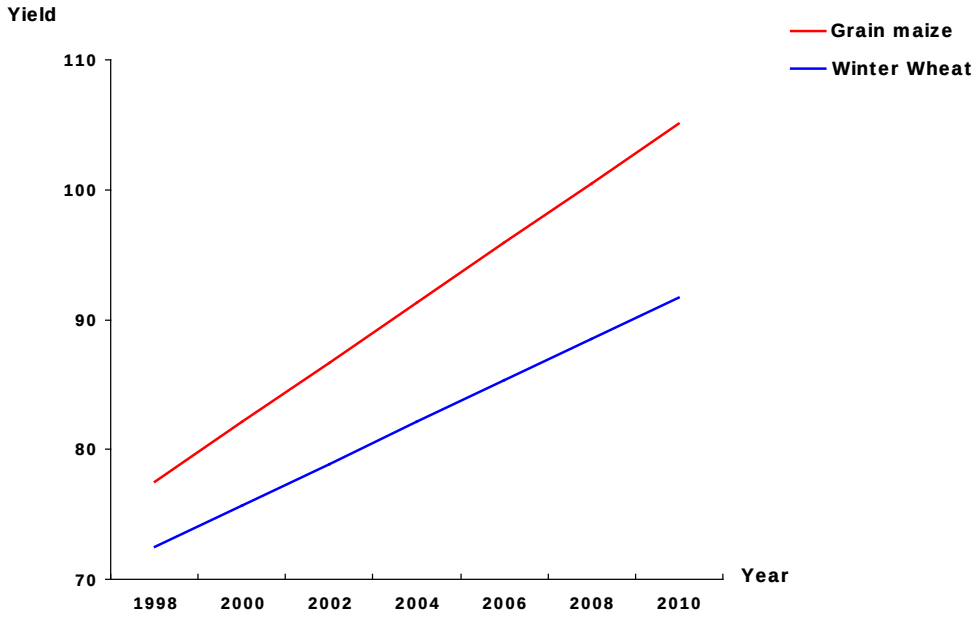
Animal Feed
- What are the opportunities?

- We of course continue to focus on yield as a key driver for all markets and are introducing new technologies to speed up the yield progress
  - High Throughput Phenotyping
  - Genomics
  - Bioinformatics
- We are breeding for disease and pest resistance and crops resilient to climatic stress
  - Use of conventional breeding and plant genetic resources
  - GM technology

Animal Feed
- What are the opportunities? Maize

- Historically, breeders have not generally focussed on increasing particular nutritional components on maize. But it is possible.

- The focus has however been on other characteristics such as disease and yield.



Assumption: Continuation of the realized selection gain in the past
(Winter wheat 1,6 dt/year; Grain maize 2,3 dt/year;
Average Yield 2004 D: Winter wheat = 82,1 dt/ha; Grain maize = 91,3 dt/ha)

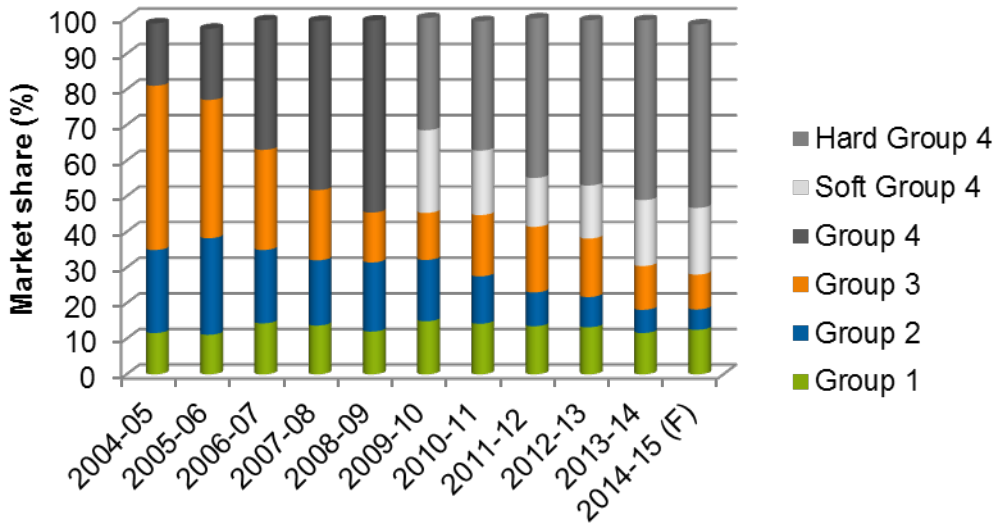
Animal Feed
- What are the opportunities? Maize

- For example there were efforts in the 1990's to develop maize with modified amino acid levels through use of GM (although conventional breeding may also be a solution with modern techniques).
  - Nobody was willing to pay for the improvements
  - So focussed on disease resistance and yield

- There are also current discussions about enhancing protein content, through targeted activities. However, there is limited active work going into this.
  - Increase ratio of embryo to starch
  - Problem of negative impact on starch

Animal Feed
- What are the opportunities? Wheat

- We are looking at how to increase protein content
- It is possible to modify starch, with amylose or high amylopectin



Animal Feed
- What are the opportunities? Wheat

- Researchers have looked at producing high phytase wheat
- We are willing to look at other nutritional factors and whether they can be increased
- We can also look at anti-nutritional factors and see if they can be reduced or eliminated

Animal Feed
- What are the opportunities? Rye

- We have a major focus on hybrid rye for animal feed, since we believe it offers significant benefits that have not been appreciated historically

- In addition, there is particular environmental benefit with rye, since it is able to grow in more marginal land and using less water than other arable crops

- In addition, we have reduced significantly the risk of ergot in rye

	Rye	Triticale	Barley	Wheat
Start of growth °C	2 - 3	3 - 4	3 - 5	3 - 5
Winter hardiness (without snow cover) °C	- 25	- 18	- 15	- 20
Water demand in l/kg DM	250 - 300	280 - 380	250 - 350	300 - 400

Source: GEISLER, 1980

N demand in kg/100 kg grain	2,0			2,5

Pollen

Animal Feed
- What are the opportunities? Rye

- We have started to analyse the relative amounts of different components of the grain and animal feed value

		Barley n=88	Rye n=39	Triticale n=46	Wheat n=50
Crude protein	%	**10,4** (8,7 - 13,7)	**8,4** (7,1 - 9,9)	**9,6** (8,0 - 13,2)	**10,8** (8,8 - 13,1)
Starch	%	**51,9** (47,8 - 56,2)	**55,1** (52,5 - 56,7)	**59,4** (55,1 - 60,8)	**59,6** (57,0 - 61,6)
ME	MJ/kg	**12,8** (12,3 - 13,2)	**13,5** 13,4 - 13,7)	**13,7** (13,4 - 13,9)	**13,8** (13,6 - 14,1)
Lysine	%	**0,36** (0,32 - 0,45)	**0,32** (0,28 - 0,36)	**0,33** (0,30 - 0,41)	**0,31** 0,28 - 0,35)

Energy (MJ/ME): High content like Wheat and Triticale

Lysine: High content of lysine (76% digestibility)

Animal Feed
- What are the opportunities? Rye

- We have looked at amino acid composition

harvest 2009 - 2011

Year		Lysine (%)*	Methionine+Cystine (%)*	Threonine (%)*	Trypthophan (%)*
2009	**RYE**	**0,31** (0,14 - 0,40)	**0,32** (0,23 - 0,42)	**0,27** (0,20 - 0,36)	**0,09** (0,07 - 0,11)
	WHEAT	0,31 (0,28 - 0,36)	0,43 (0,37 - 0,50)	0,31 (0,27 - 0,39)	0,14 (0,12 - 0,16)
	BARLEY	0,37 (0,31 - 0,45)	0,41 (0,34 - ,051)	0,35 (0,29 - 0,45)	0,13 (0,11 - 0,17)
	TRITICALE	**0,35** (0,29 - 0,47)	**0,41** (0,32 - 0,59)	**0,31** (0,24 - 0,47)	**0,11** (0,09 - 0,16)
2010	**RYE**	**0,37** (0,30 - 0,48)	**0,39** (0,30 - 0,53)	**0,33** (0,26 - 0,45)	**0,11** (0,09 - 0,14)
	WHEAT	0,33 (0,27 - 0,40)	0,46 (0,34 - 0,60)	0,34 (0,25 - 0,44)	0,15 (0,12 - 0,18)
	BARLEY	0,38 (0,30 - 0,50)	0,42 (0,33 - 0,57)	0,36 (0,28 - 0,5)	0,14 (0,11 - 0,19)
	TRITICALE	**0,37** (0,30 - 0,48)	**0,45** (0,34 - 0,61)	**0,35** (0,26 - 0,49)	**0,12** (0,09 - 0,16)
2011	**RYE**	**0,38** (0,30 - 0,48)	**0,40** (0,30 - 0,53)	**0,34** (0,26 - 0,45)	**0,11** (0,09 - 0,14)
	WHEAT	0,33 (0,29 - 0,39)	0,46 (0,37 - 0,43)	0,34 (0,27 - 0,43)	0,15 (0,12 - 0,17)
	BARLEY	0,39 (0,31 - 0,54)	0,44 (0,33 - 0,62)	0,38 (0,28 - 0,54)	0,14 (0,11 - 0,20)
	TRITICALE	**0,37** (0,31 - 0,43)	**0,45** (0,36 - 0,54)	**0,35** (0,27 - 0,43)	**0,12** (0,12 -0,17)

based on 88% dry matter

- Critically look at the ranges for each of these in the different crops. Some of this variation is genetic and theoretically varieties can be bred with high or low values

Animal Feed
- What are the opportunities? Rye

- And we have looked at non-starch polysacharides

Parameter g/kg dm					
Year	**Grain**	**ß-Glucane**	**Pentosane**	**NSP total**	**Source**
1990	RYE	**11,5**	**89**		
	WHEAT	5	60,5		
	BARLEY	33,2	75,5		Choct und Annison
	TRITICALE	**6,5**	**69,7**		
2001	RYE	**5 - 30**	**75 - 91**	**107 - 128**	
	WHEAT	2 - 15	55 - 95	75 - 106	Lindermeyer
	BARLEY	15 - 107	57 - 70	135 - 172	
	TRITICALE	**2 - 20**	**54 - 69**	**74 - 103**	
2009	RYE	**24 (19 - 29)**	**87**		
	WHEAT	10 (6 - 14)	66		LfL Bayern
	BARLEY	49 (16 - 107)	66		
	TRITICALE	12	no data		
	RYE	**12 - 30**	**76 - 97**	**124 - 134**	
	WHEAT	5 - 10	54 - 66	106	
	BARLEY	33 - 52	65 - 71	172 - 212	Martin, Losand, Dreschel
	TRITICALE	**6 - 12**	**62 - 75**	**103**	
	RYE	**13 - 17**	**59 - 102**		
	WHEAT	3 - 11,5	35 - 70		
	BARLEY	31 - 55	58 - 77		
	TRITICALE	**4**	**91 - 140**		
2009	**RYE (Palazzo)**			**149.5** 122.7 - 163.1	W. von Gagern

- And again there is natural genetic variation that we believe can be utilised through breeding

Animal Feed
- What are the opportunities? Rye

64% Rye in the mixed feed for pigs from 40kg LW onwards; BHZP-Pigs

		0% Rye	64% Rye
Daily gain	g	795	809
Feed absorption	kg/day	2,33	2,27
Feed consumption/kg gain	kg/day	2,94	2,83
Index points	kg/SG	0,964	0,987

Source: Chamber of Agriculture, Lower Saxony 2002

One of many studies we have conducted with others show the benefits of adding rye to feed

Animal Feed
- What are the opportunities? Rye

		Mix feed without rye				Mix feed with rye			
feed components	Price	Prestarter	Starter	Grower	Finisher	Prestarter	Starter	Grower	Finisher
up...kg LW	€/dt	28	40	70	100	28	40	70	100
Rye	15	-	-	-	-	15	25	30	40
Wheat	18	40,5	47	53	52	27,3	22,5	27	21,2
Barley	17	31,5	30	30	30	30	29	25	20
SBM 43%	40	18,6	13,5	6,3	3,5	18,5	13,8	7	4
RSM	23	5	6	8	12	5	6	8	12
Mineral feed I	80	3	2,7			3	2,7		
Mineral feed II	60			2,2	2			2,2	2
Oil	120	1,4	0,8	0,5	0,5	1,2	1	0,8	0,8
Content DM 88%									
MJ ME, g		13,1	13	13,03	13	13	13	13	13
pcv Lysine		10,1	8,8	7,1	6,8	10	10	7,2	6,9
pcv Lysine: MJ ME,g		0,77	0,68	0,55	0,53	0,77	0,68	0,55	0,53
NDF,g		133	133	135	140	133	133	133	136
per dt €		**25,32**	**23,46**	**20,92**	**20,42**	**24,65**	**22,99**	**20,53**	**19,74**
per 10 MJ ME, €		0,193	0,18	0,161	0,158	0,19	0,177	0,158	0,153

Source: LZ Rheinland 40, 2013, Dr. Gerhard Stalljohann LWS NRW

Usage of Rye = Saving feeding cost !!

Animal Feed
- Conclusions

- Breeders have increased yield and greatly benefitted the Feed supply chain in terms of cost
- Breeders working on many different crops can change the balance of grain components
  - Increasing protein (changing the need for soya?)
  - Changing the nature of starch
  - Changing the content of amino acids
- Different crops have different opportunities in the Feed supply chain
- Farmers will go for yield if they see no opportunity for a premium for quality
- Importantly, working together in the supply chain is likely to be the ONLY way to capture opportunities that can be created through breeding

THANK YOU