Wheat for distilling and bioethanol: Developments in 2007

Richard Weightman, ADAS Boxwort

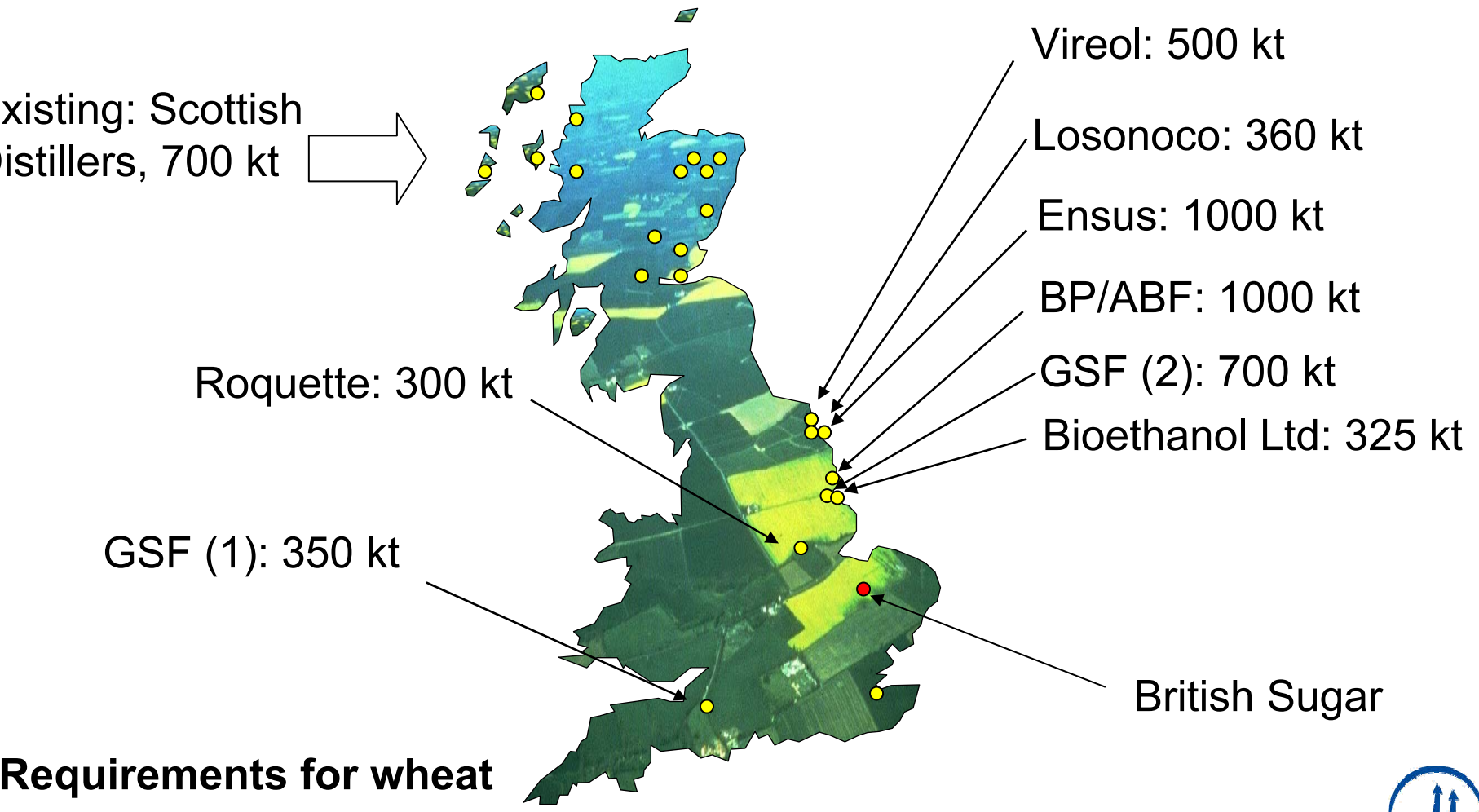
WIGN Stakeholder meeting 29/11/0

ADAS

Agenda

- Development in the biofuels market
- Progress understanding variety effects
- Alcohol productivity and N effects
- Summary of projects completed in 2007
- New bioethanol projects

Planned UK bioethanol plants



Requirements for wheat

Planned UK bioethanol plants

Company	Req for wheat (kt)	Predicted EtOH prod (kt)	Expected
GSF (1)	350	105	Late 2008
GSF (2)	700	210	Late 2009
Roquette	300	100	Late 2008
Bioethanol Ltd	325	100	2008 ??
Vireol	500	150	2008
Losonoco	360	110	2008
Ensus	1,000	325	Late 2008
BP/ABF	1,000	330	Late 2009
Total	*4,535*	*1,430*	
British Sugar	-	55	Late 2007

Spain - Abengoa

- Plans next year for purchase of 250,000 tonnes of UK wheat under contract

- An existing market which justifies understanding the quality of wheat for bioethanol

Will premia be paid for high AY ?

US - Monsanto/FOSS

- **Significant developments in 2007**

UK- Centaur

Sweden – Agroetanol

Spain - Abengoa

Sweden – Agroetanol

Protein: 9-11%

Moisture: below 15% at harvest (or 14.5% post harvest) no correction

Specific weight: over 750 g/l no correction

Starch: up to 71.0% = base price

- From 71.1% added payment of 1.5% per % starch
- 71.1-71.5% starch = +0.75%
- 71.6-72.0% starch = +1.5% etc

UK Centaur bioethanol contract

Starch premium

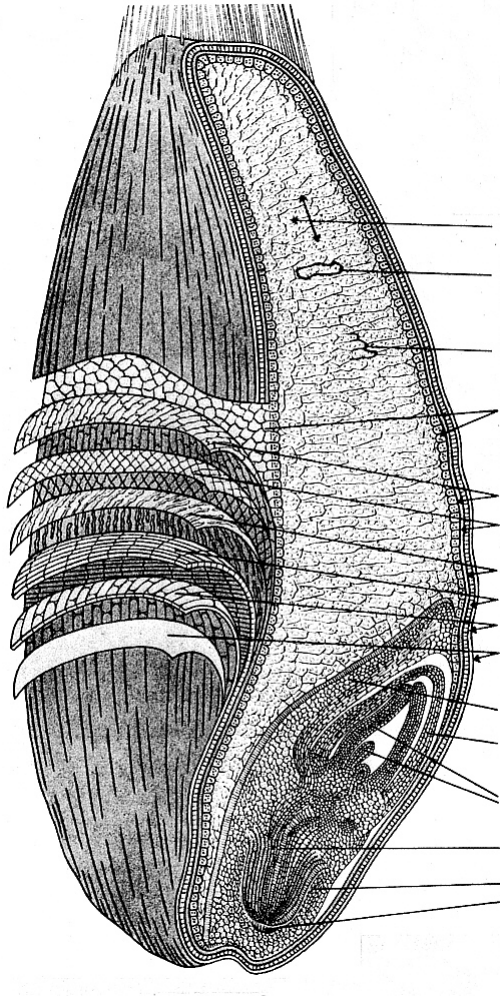
- **Basic starch content 60% (no premium)**
- **Premium £0.25 per 0.5% starch (up to max of 70% starch)**

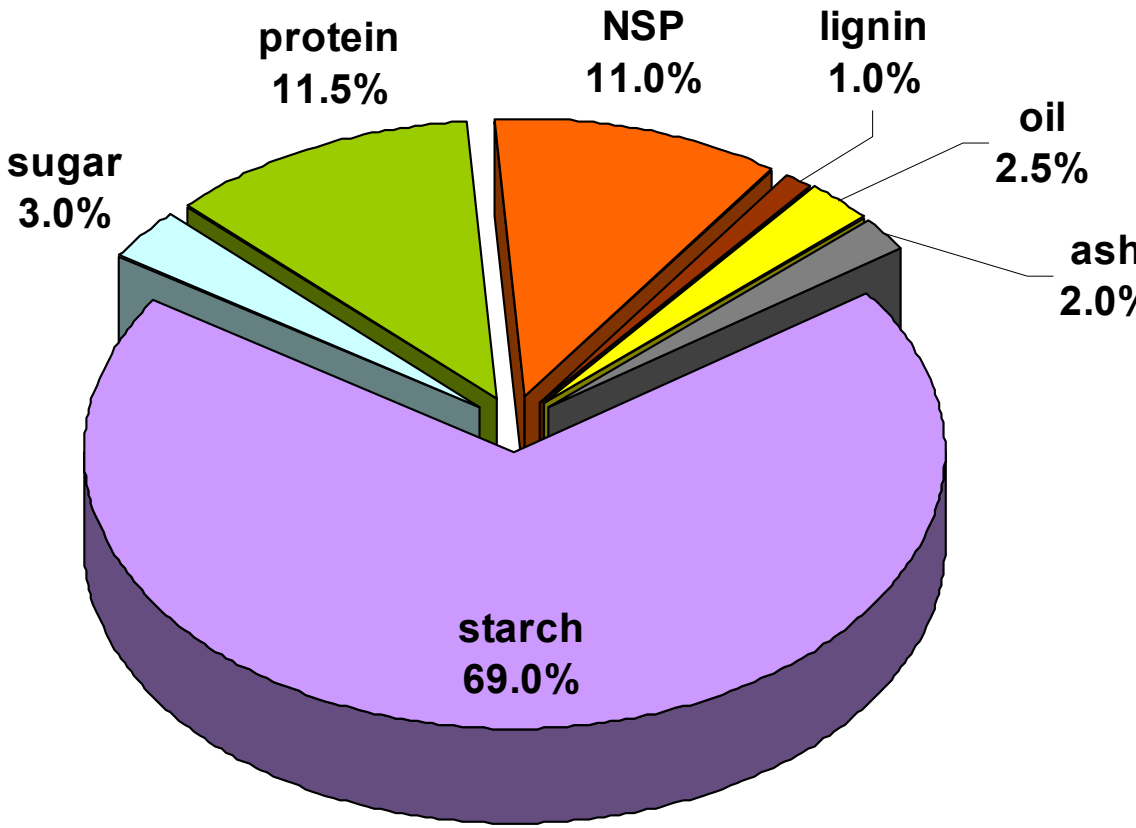
… assume these are on an ‘as is’ basis (85%DM)

Previous WIGN meeting 2006

- What drives alcohol yield ?
- Measuring and Predicting alcohol yield
- Effects of Variety
- Environmental influences

Wheat: benchmark analysis

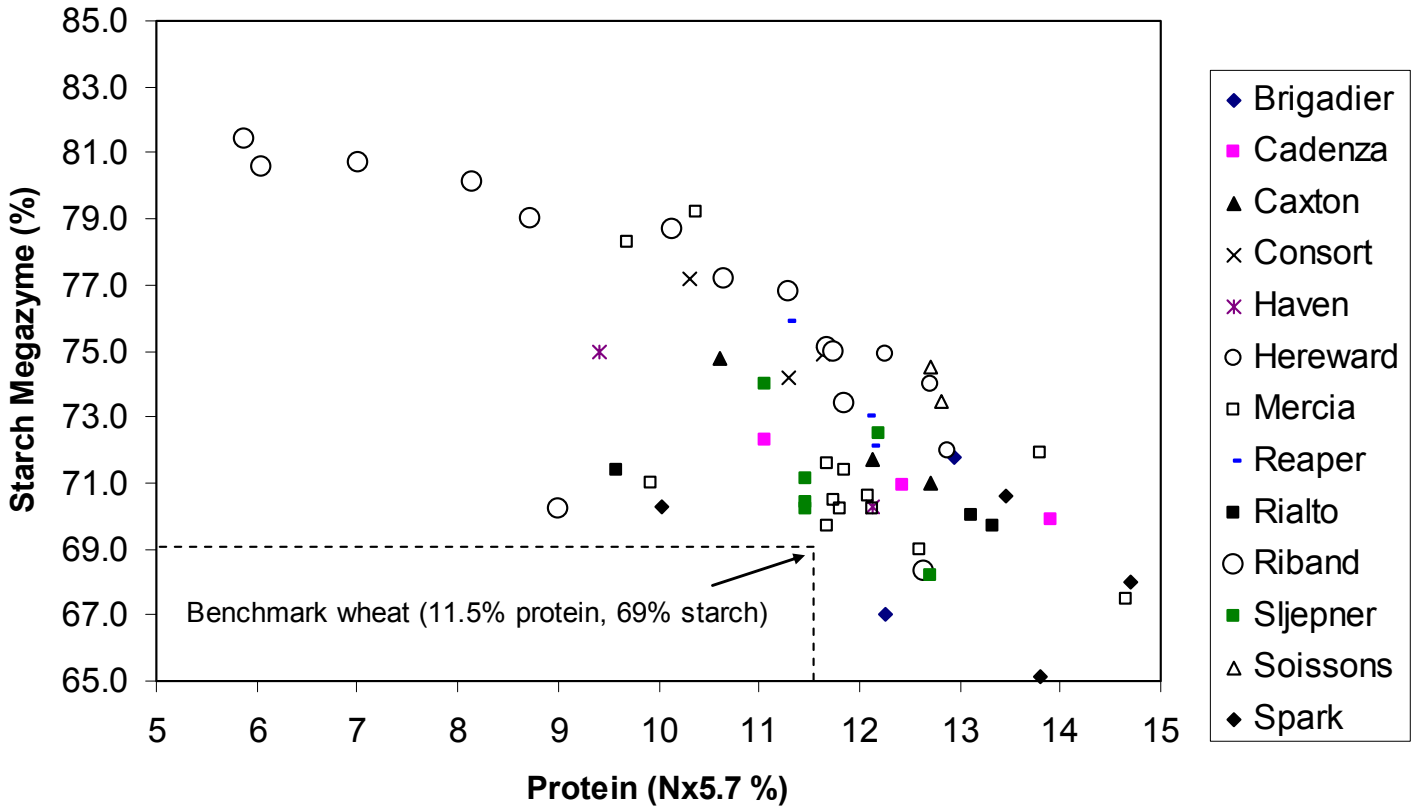




HGCA review no 61

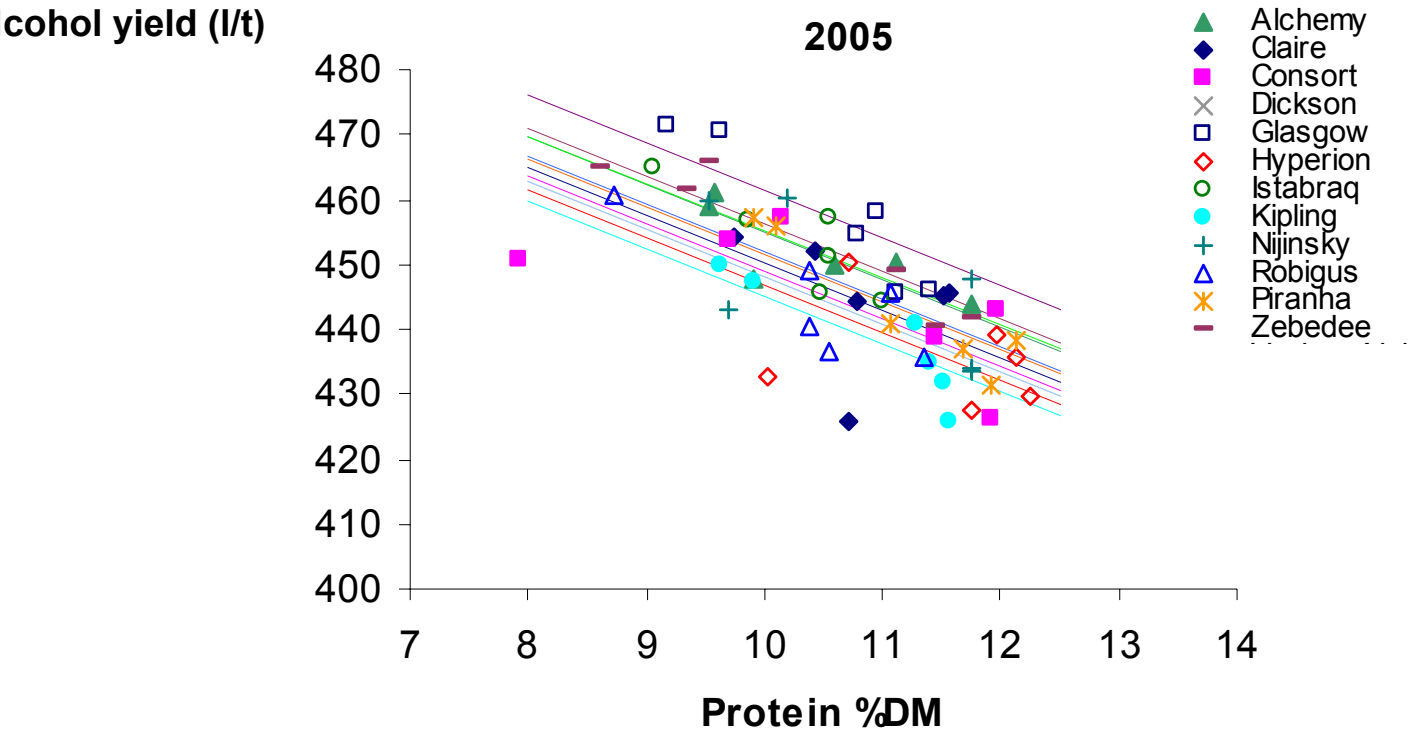
ADAS

Varieties and starch vs protein



Source: Moss et al. (1999) HGCA report 182

Varietal effects on alcohol-protein relationship



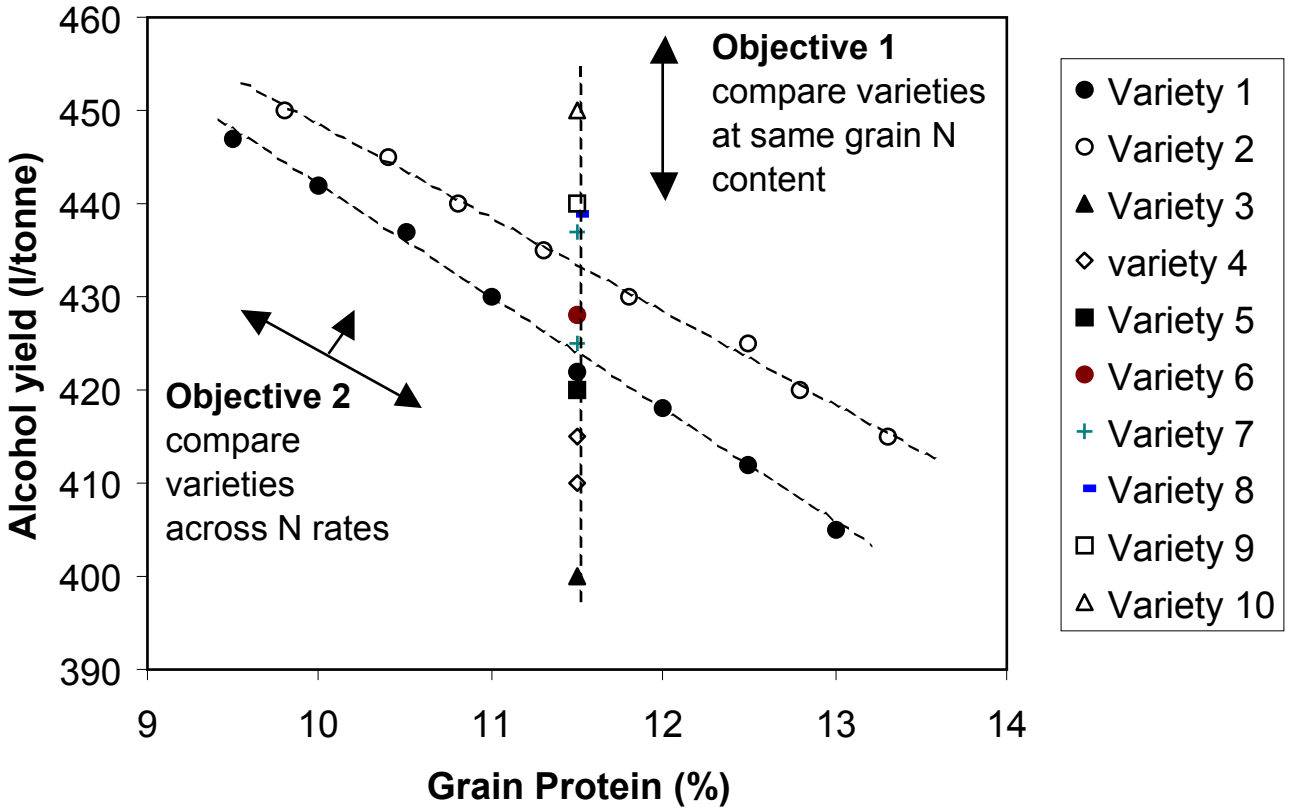
We assume the alcohol yield:protein relationship is the same for all varieties

[Data: SWRI, 2005; analysis DK]

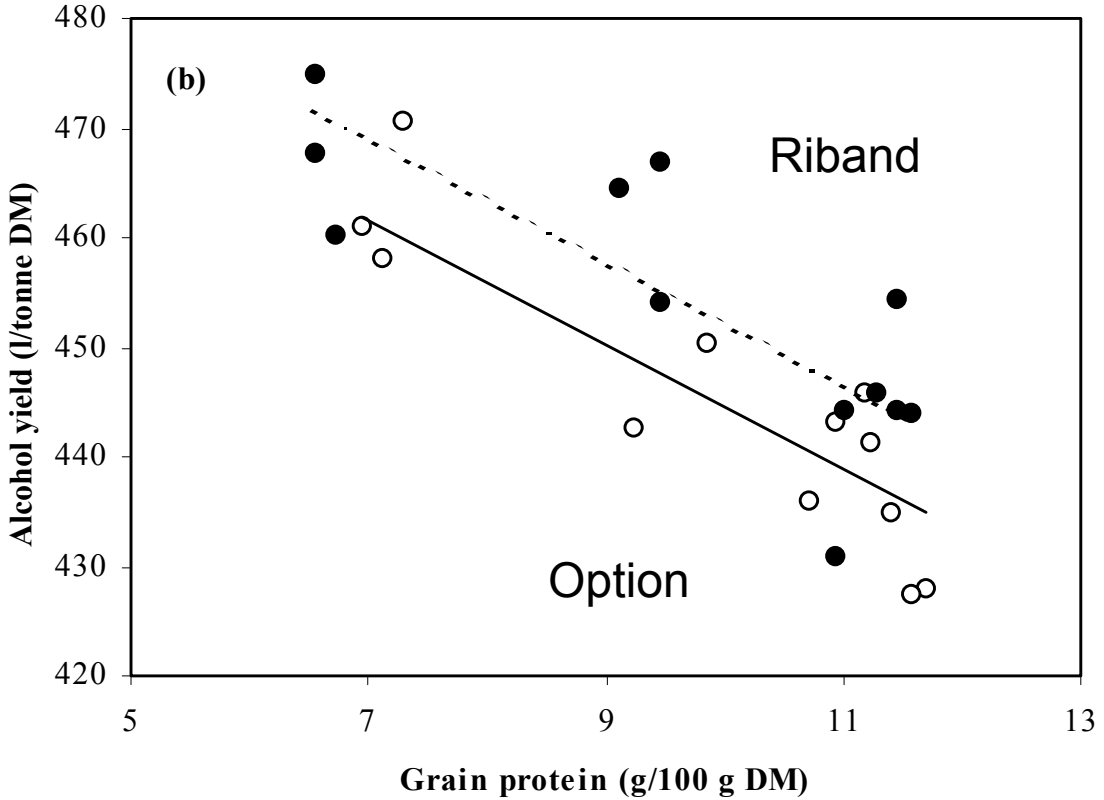
Variety effects

- **Why do some varieties consistently outperform in terms of alcohol yield ?**

Assessing wheat varieties for alcohol yield



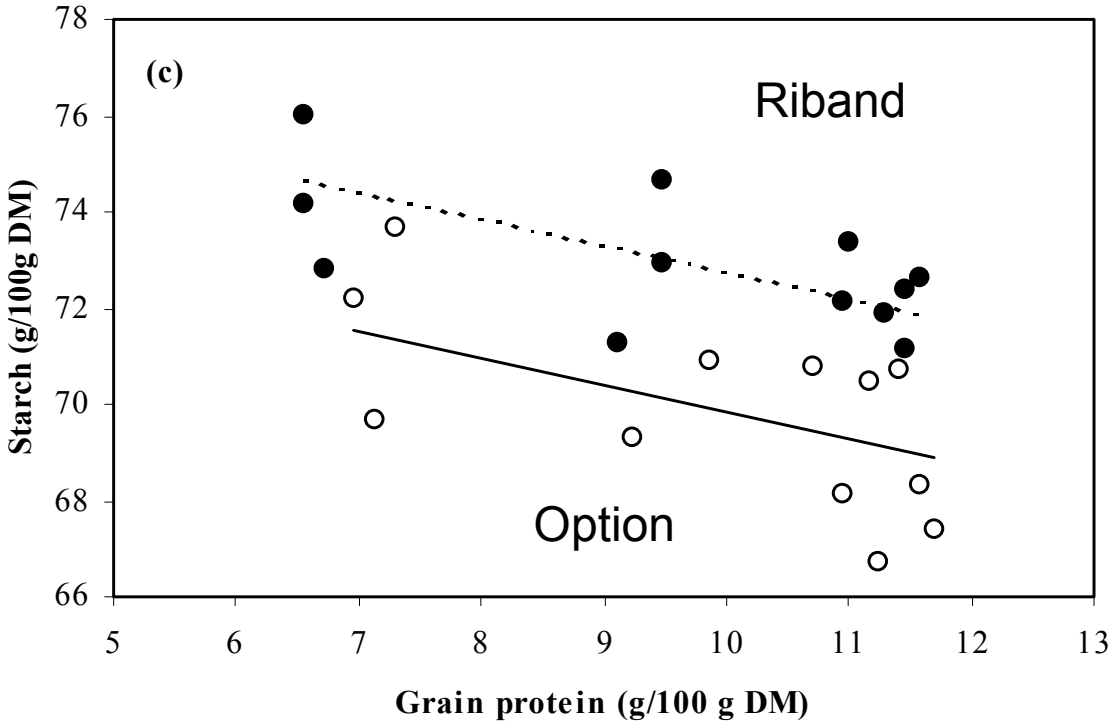
Why is Riband a good distilling wheat ?



Riband – good, traditional soft distilling variety

Kindred et al. 2007, J. Cer. Sci doi 10.1016/j.jcs.2007.07.010

Why is Riband a good distilling wheat ?



Riband – 3% higher starch content at a given level of protein

Kindred et al. 2007, J. Cer. Sci doi 10.1016/j.jcs.2007.07.010

Summary of variety effects

	Option	**Riband**	sig
Alcohol yield (L/t)	445	454	(***)
Starch (g/100g)	69.9	73.0	(***)
Total protein (g/100g)	9.93	9.63	(*)
TGW (g)	44.8	50.0	(***)
Grain width (mm)	3.9	4.2	(***)
Grain *l:w* ratio	1.72	1.62	(***)
Vitreous grains (%)	16.3	12.2	(ns)
Alcohol/starch (L/10kg)	6.37	6.23	(*)
Gliadin (%)	42.5	40.9	(*)

Conclusions: Riband

- High alcohol yield in Riband associated with:
  - More starch at a given level of protein
  - Large well filled grains
  - Small grain l:w ratio

- No interactions between variety and N for any trait

but…

Glasgow (good distilling wheat) does not have large grain

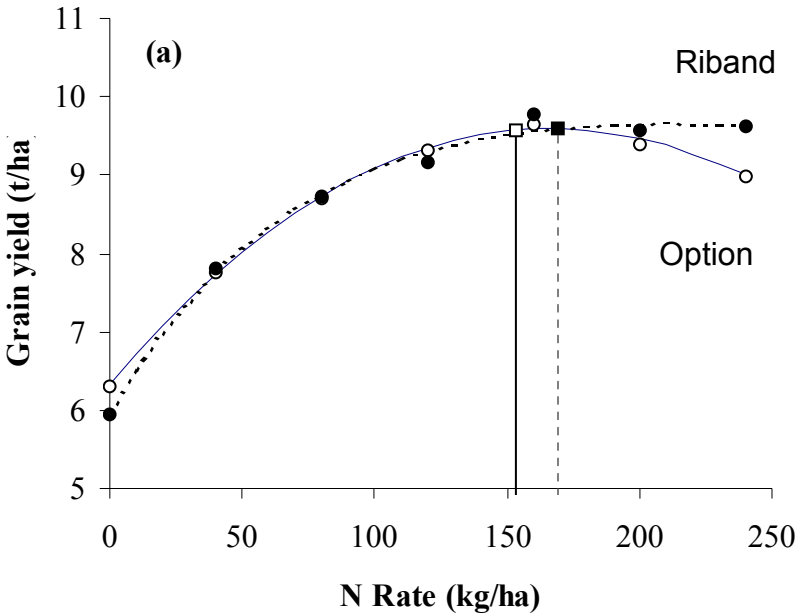
Variety effects

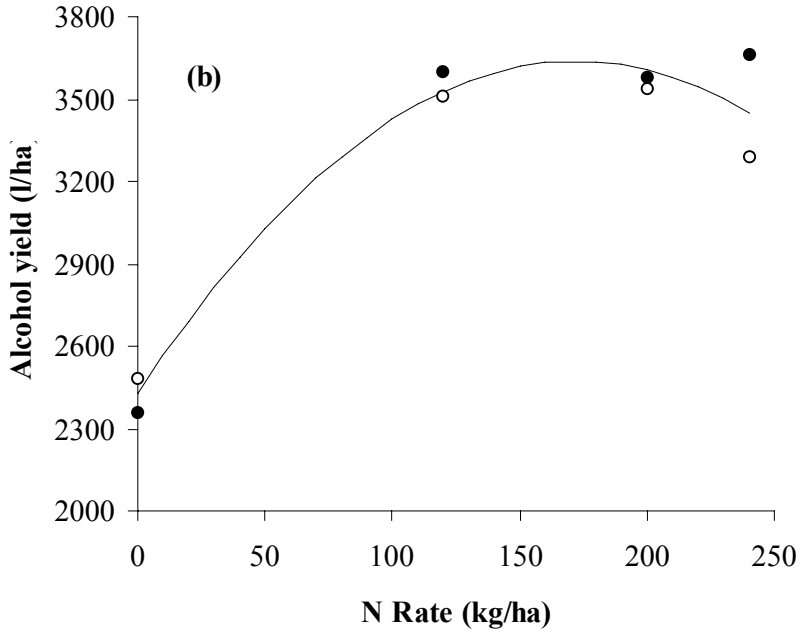
- **More work required to understand variety effects……**

Sustainable biofuel production

- **Alcohol yield per tonne, or per hectare ?**

Alcohol yield/ha driven by grain yield





Kindred et al. 2007, J. Cer. Sci doi 10.1016/j.jcs.2007.07.010

Sustainable biofuel production

- Fertiliser very important for GHG emissions (manufacture & in-field GHG emissions)
- Optimum N rates to maximise GHG savings substantially lower than to optimise yield
- Increasing productivity (e.g. by breeding) will be very important in reducing GHG intensities per t of grain, and getting maximum production off limited land area
- Displacement of agricultural activity onto virgin lands (e.g. forest or grassland) gives enormous CO2 releases

Recently completed ADAS projects on biofuels

HGCA project report No. 417

- Optimising nitrogen applications for wheat grown for the biofuels market

HGCA review No. 61

- Wheat as a feedstock for alcohol production

HGCA review No. 66

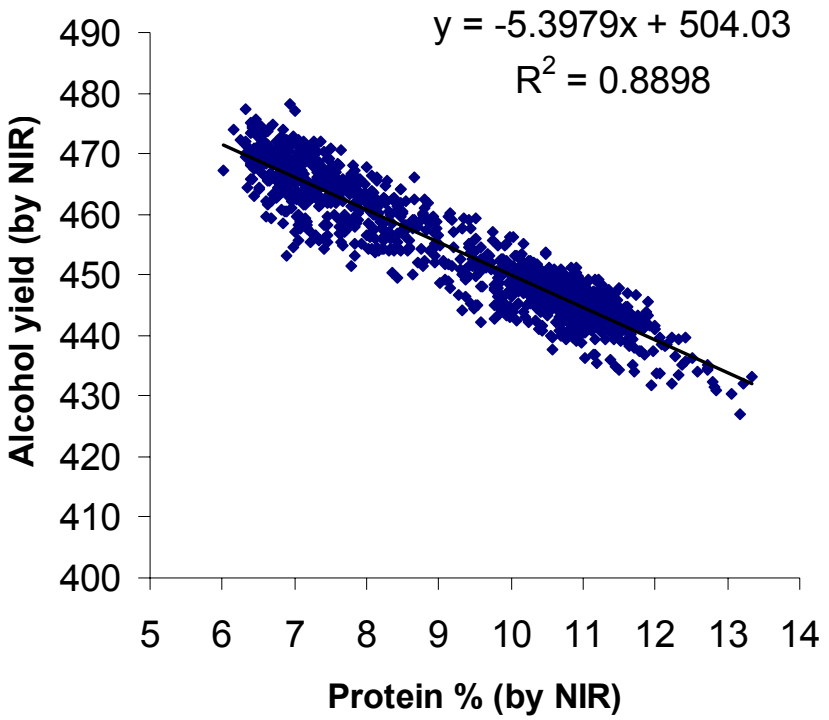
- Opportunities and implications of using the co-products from biofuel

  production as feeds for livestock

Levy funded

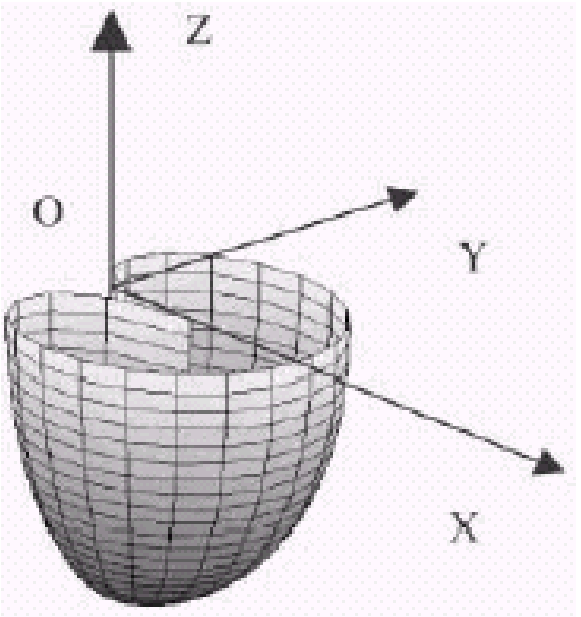
Ongoing: GREEN grain Project

Genetic Reduction of Energy use and Emissions of Nitrogen through cereal production



Ongoing: Grain size and shape

- **PhD studentship, University of Manchester**
- **'Understanding and predicting the determination of alcohol yield from wheat'**



Mabille & Abecassis model (2003) ⟶ volume & surface area

… can such models be adapted to predict alcohol yield

New ADAS projects on bioethanol

RD-2005-3176

- **Maximising the yield of high value components from wheat by fractionation**

RD-2006-3314

- **Maximising bioethanol yield of UK wheat: Effect of non starch polysaccharides in grain**

RD-2007-3348

- **Triticale – opportunities as a low input cereal for bioethanol production**

DANISCO
First you add knowledge...

MANCHESTER 1824

HGCA

The University of Manchester

SCGPE

frontier
reaching new horizons in food and farming

THE Scotch Whisky RESEARCH INSTITUTE

GreenSpirit

NICKERSON

senova

ADAS

Conclusions

- **UK wheat shows potential for high alcohol yields (*ca*. 480 L/tonne) – competitive with US maize**
- **NIR calibration for alcohol yield well advanced**
- **Agronomy key to maximising benefits of biofuels by min. GHG emissions**
- **Breeding for yield important for max alcohol production per hectare (and min GHG/t of grain)**
- **Breeding for starch content key to producing high quality feed stock**

Thank you

Green Grain analytical group, 2007

richard.weightman@adas.co.uk