

KWS UK Hybrid Rye Development

2017 - 2018

SEEDING
THE FUTURE
SINCE 1856



Presentation Contents:



■ UK Strategy

- Team Contacts & Support
- Benefits for UK farmers
- Ergot Resistance + PollenPlus®

■ End Market

- Biogas
- Feed Grain - Pig Finishing
- Food - Baking or Distilling

■ 17/18 Portfolio & Agronomy

- Seed Rates + Drilling
- Blackgrass & Take-all

■ Website resources

- Seed rate tool
- Quick links and info
- Videos and downloads
- [Link: www.kws-uk.com](http://www.kws-uk.com)



KWS' Hybrid Rye strategy – developing UK acreage



Segment & expand portfolio

- **Wholecrop** for AD
- **Grain** for feed & food use
- UK Seed Production
- UK Trials

➤ 2-3 Year focus;

- Expand rye in pig finishing diets
- Maintain leadership in AD
- Promote rye as a 'heart healthy' grain for food use

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Rye – a multifunctional hybrid cereal !



KWS - a long term player in rye breeding

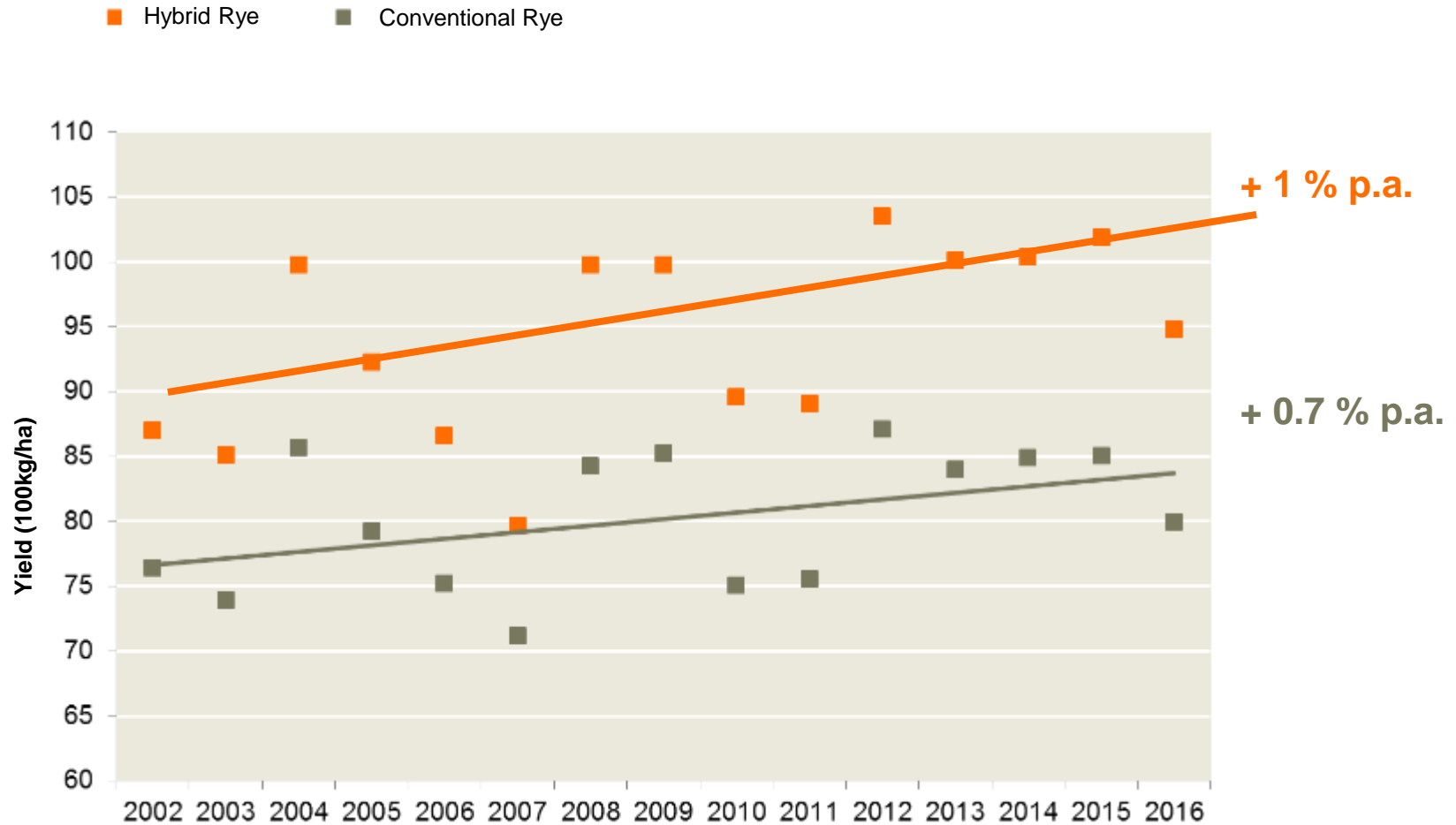


Rye – the benefits of a hybrid cereal

- **Consistent** yield progression
- Extreme **winter hardiness**
- Superb **drought tolerance**
- **Growing acreage** in many cereal markets – EU, UK, USA, CANADA
- International development of the RYEBELT Project www.ryebelt.com



Rye Breeding – Focus on Hybrids



Eigene Verrechnung der Wertprüfungsergebnisse 2002 - 2016
(KWS LOCHOW, 2016)

Hybrid Rye – benefits for UK farmers



Hybrid Rye - a place in UK rotations

- **Outyields** wheat, barley or oats as a 2nd/3rd cereal & **Extends crop rotation**
- **Ultra low ‘take-all’** susceptibility (2nd only to oats)
- Excellent **blackgrass suppression**
- **Adaptable** to all soils (light esp).
- **Minimal ergot risk** – PollenPlus®





Hybrid Rye – Ergot
resistance through
breeding

Ergot resistance through breeding



■ Ergot

- Infection > **spores invade stigma at flowering**
- Affects **outcrossing species** (such as rye)
- Also effects **triticale, wheat & barley**
- **Toxic** to livestock and humans
- **Blackgrass** is a common host

■ Breeding goal >

- **Prevent ergot access** to the stigma
- Aim for 100% pollination
- Obtain **rapid pollination** + closed stigma

Ergot in grassweed infested fields

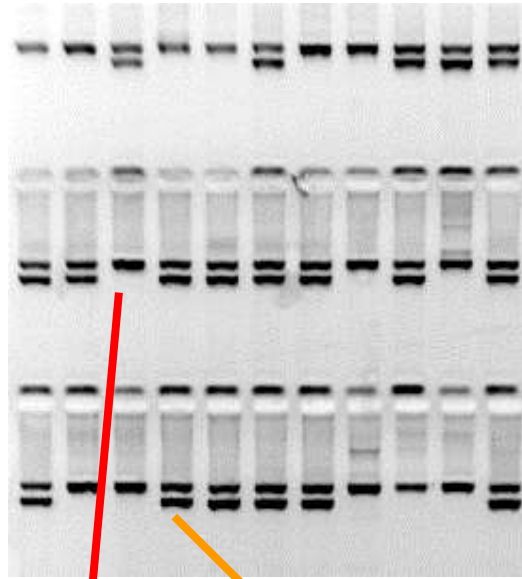


Pictures from Wimpole, (Sadeik) Agrii & BCS trials, 2016

PollenPlus® - QTL marker selection in Hybrid Rye



1. Identifying candidate lines

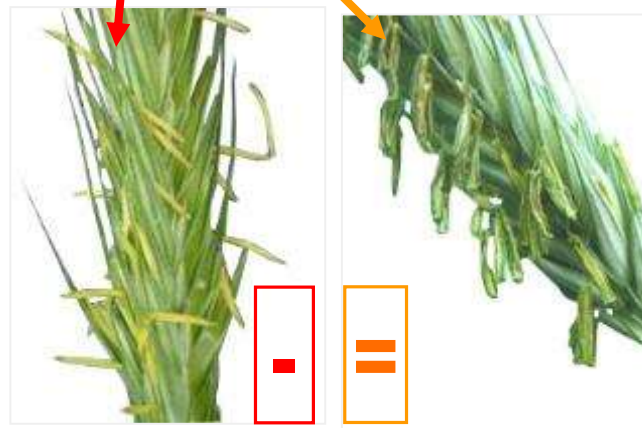


2. Marker selection



3. Ergot screening

- High speed line development
- Accurate screening + QTL
- Breeders „eye“



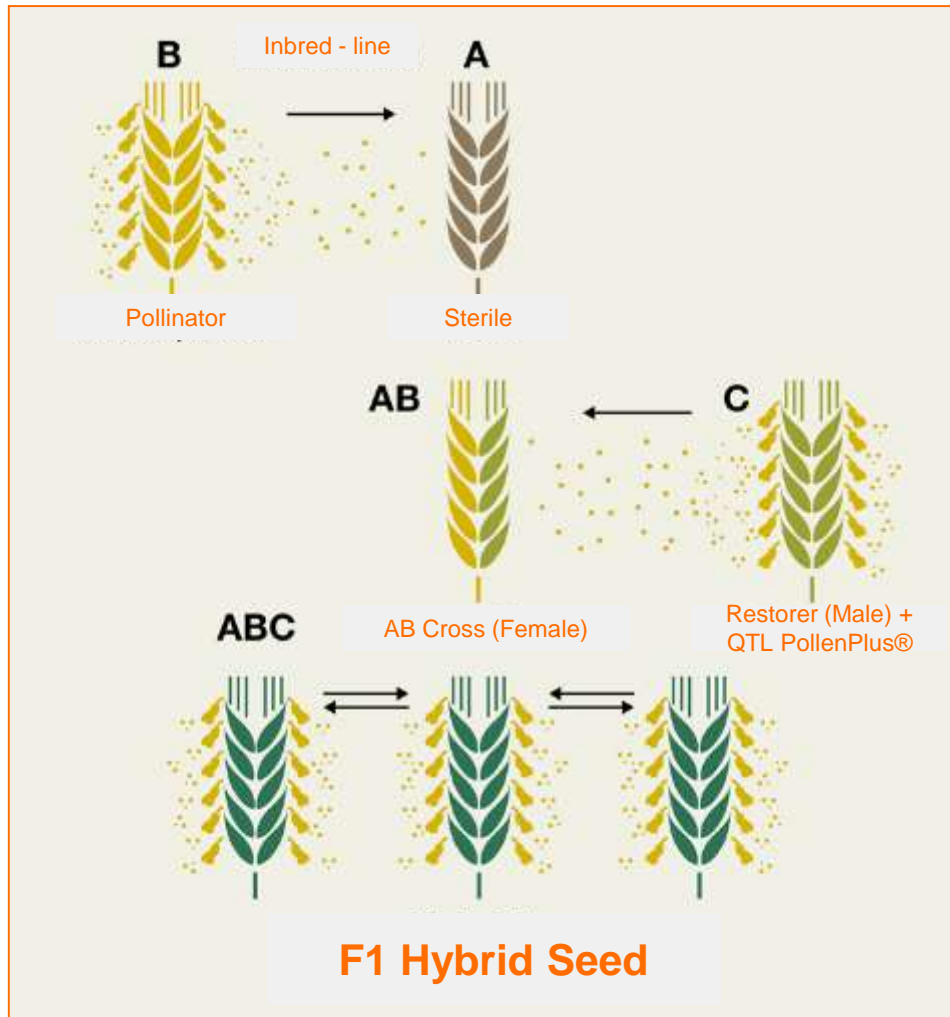
Normal pollen production

QTL selected -
PollenPlus®



KWS Seed Production in Rye

Ergot control ready at the F1 Stage



90% + 10% Pollinator v. 100% F1 Hybrid



Ergot control – linked to pollination technique



Results Grain – 2016 Germany (North)



Hybrid	Breeder	Registration	Character 9 = Worst, 1 = Best							
			Ripening	Plant Height	Lodging	Bracking	Mildew	Rhynchosporium	Brown Rust	Ergot
KWS Bono	KWS SAAT	2014	5	4	5	5	5	5	5	4
KWS Daniello	KWS SAAT	2016	5	4	4	5		3	3	4
KWS Gatano	KWS SAAT	2016	5	3	5	5		3	3	3
SU Cossani	Saaten Union / HYBRO Saatzucht	2014	5	4	4	4	3	5	4	5
SU Forsetti	Saaten Union / HYBRO Saatzucht	2013	5	4	4	6	5	5	5	5
SU Mephisto	Saaten Union / HYBRO Saatzucht	2011	5	5	4	5	3	5	5	6
SU Nasri	Saaten Union / HYBRO Saatzucht	2015	4	5	4	5		4	4	5
SU Performer	Saaten Union / HYBRO Saatzucht	2013	5	4	4	6	4	4	4	6

Impact of Ergot – benefit of PollenPlus®



Left: KWS Magnifico (100% Hybrid Seed + PollenPlus®)

Right: SU Mephisto (90%)+Dukato (10%)

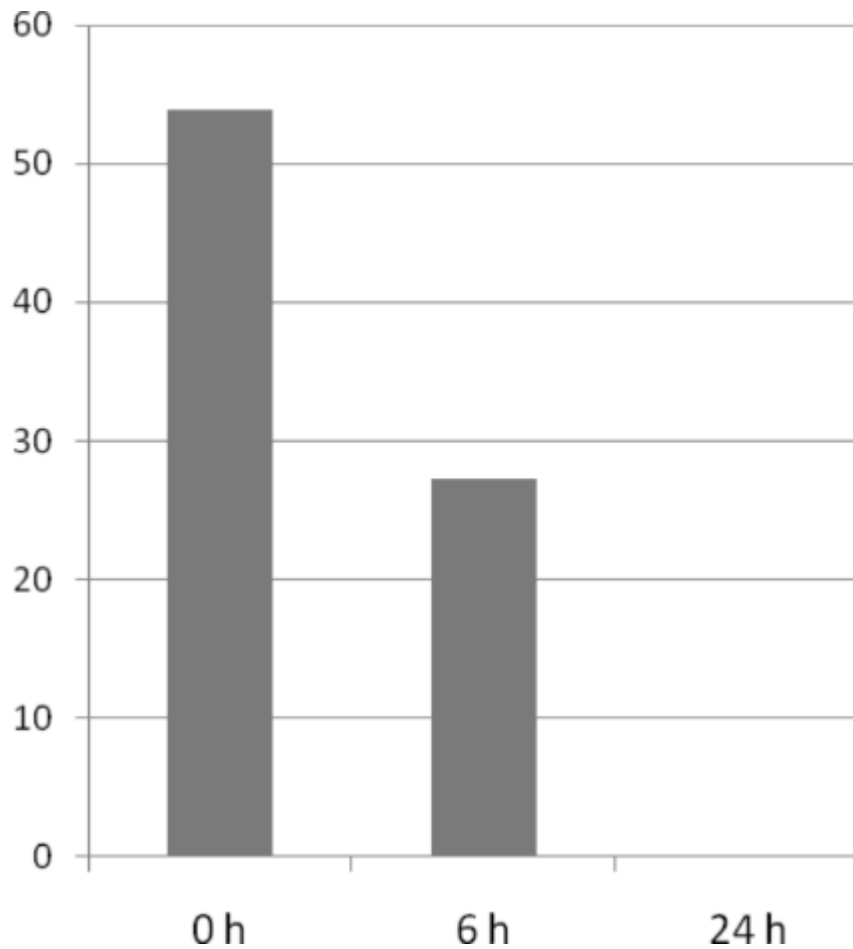
PollenPlus® in action!



- **Rapid fertilisation** minimises the opportunity for ergot to infest the ear
- The picture is pollination in a commercial crop in Yorkshire spring 2015

Photo courtesy of Agrii

Ergot in the Biogas Process – % Viability



(Source: DE - Abschlussbericht zum Forschungsprojekt „Untersuchungen zum phytosanitären Risiko durch die anaerobe Vergärung von pflanzlichen Biomassen in Biogasanlagen“; Rodemann, Pottberg und Pietsch, 2012)



Hybrid Rye for Biogas

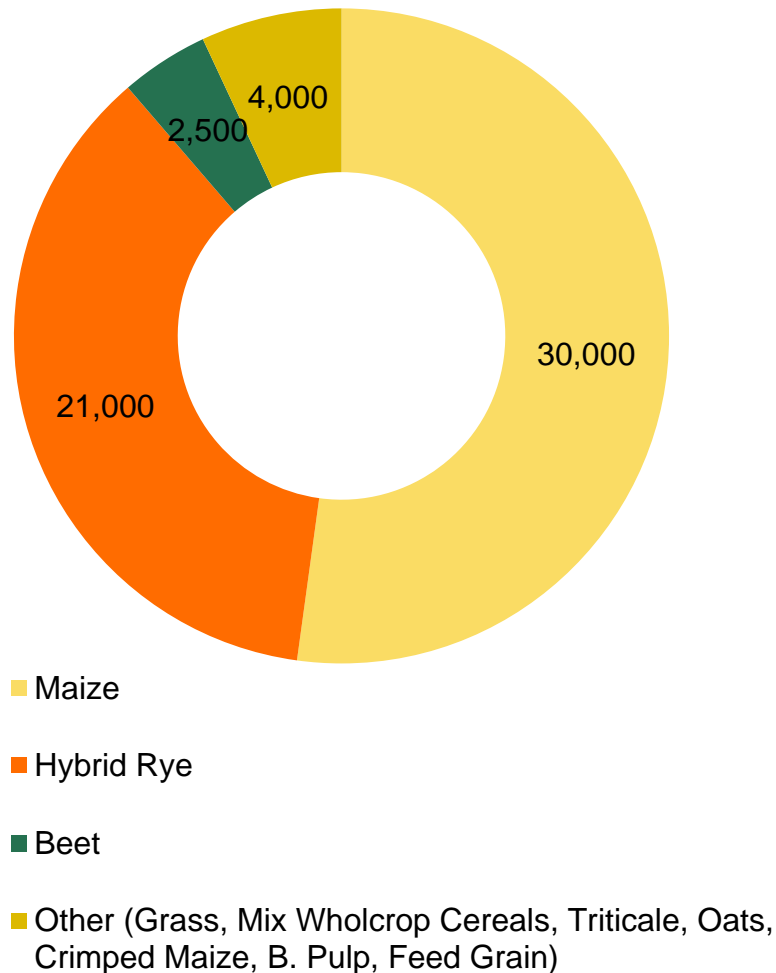
Hybrid Rye for Biogas

KWS launched the first hybrid rye for biogas in the UK in 2010 (500 ha).

- Spread harvest/ feedstock risk
 - **Blackgrass** control
 - **Light land** yield performance
 - UK wide adoption
-
- Today's area ca. 20 - 23,000 ha +/-
 - Dedicated hybrids for biogas, and launch of new dual-purpose hybrids



Share of UK Feedstock Use (ha)



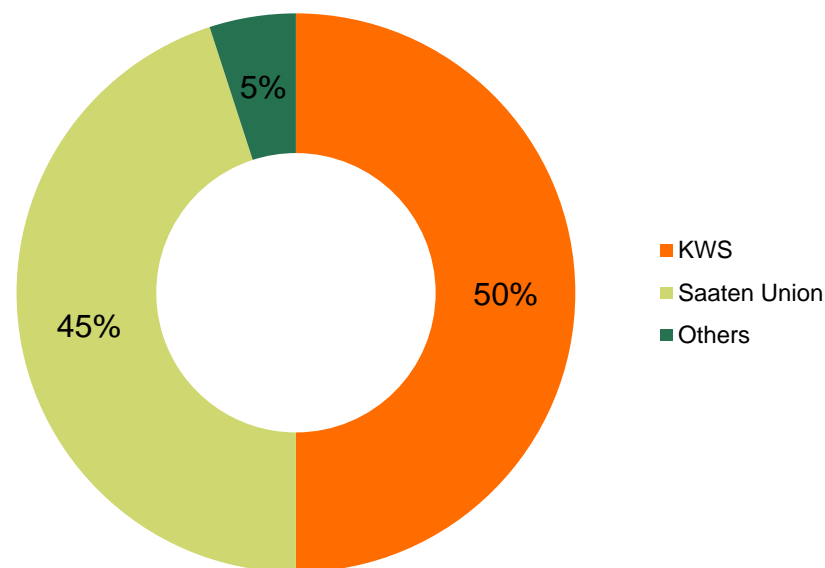
UK Biogas Market

- 210 on farm register AD installations active as of April 2016
- **Future expansion limited**
 - Subsidy uptake (FiT, ROC, RHI)
- Total deployed capacity
 - Biomethane: 17,000 (Nm³)
 - CHP: 110,200 (kWe)
 - **55K. ha** (1.2% of UK Arable)
- **20 Year CPI linked tariff**

KWS – dedicated breeding to biogas;

- Expert **knowledge** in biogas / feedstock production
- **Focus** on yield, straw strength, and disease tol.
- International development of the **RYEBELT** Project
 - www.ryebelt.com
- **UK seed production** to supply a growing market

Hybrid Rye (Biogas) – Breeders MS%



UK Trials Research + Selection

- **Ongoing** wholecrop trials in the UK since 2013
- **Select** and screen new hybrids
- **Assess** growth habit, ripening, lodging and disease tolerance
- **Advise** on drilling depth, seed treatment, seed rate, growth stage and input timing

UK Data





Hybrid Rye for Feed Grain (Pigs)

Hybrid Rye for Feed Grain (Pigs)



Unique characteristics of rye grain

- **Higher lysine:protein ratio** in comparison to other cereals
 - Low Glycemic Index (GI) and **high satiety**
 - **Decreased gut ulceration**
 - High dietary fibre %
 - Increased welfare + occupation & **reduced stress/boredom**
(nipping, bruising, mounting etc..)
- **Home Mixing Pig Units**
- **Reduced feed cost**
 - **Higher welfare**



Hybrid Rye for Feed Grain (Pigs)

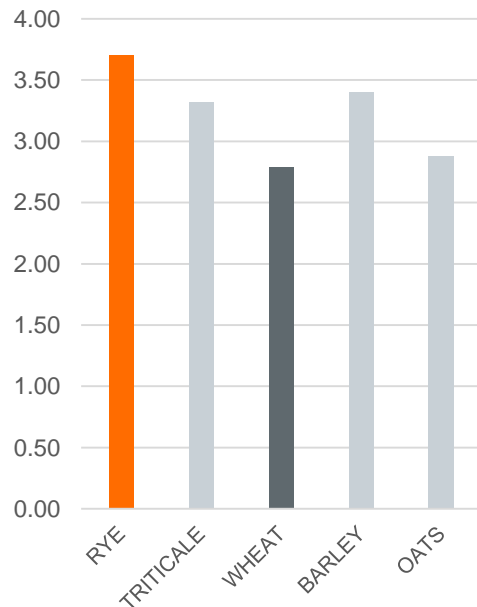


All monogastrics (inc. pigs) require essential amino acids (lysine + methionine esp.)

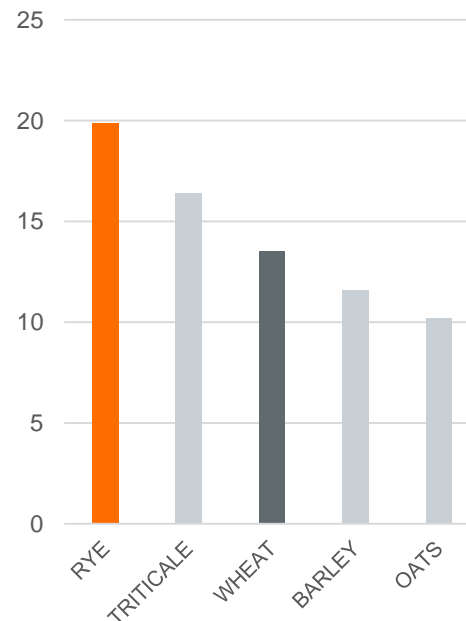
- Rye supports a **higher lysine:protein ratio** in comparison to other cereals (influences protein use)
- High **total fibre** % & excellent **fructan*** content (g/Kg)

*a storage carbohydrate digested in the hind gut in monogastrics

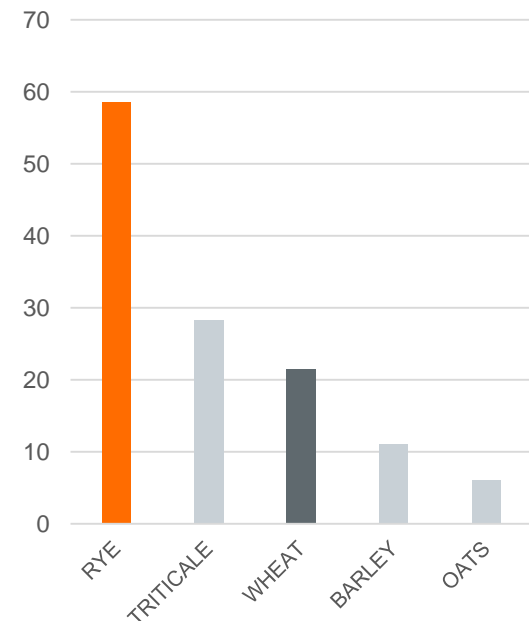
Lysine (as % of avail. Protein)



Total Fibre %



Fructan (g/Kg)



Pig farming in the EU (sows by region)

- higher use of rye as a feed grain (DK, DE, PL, NL)



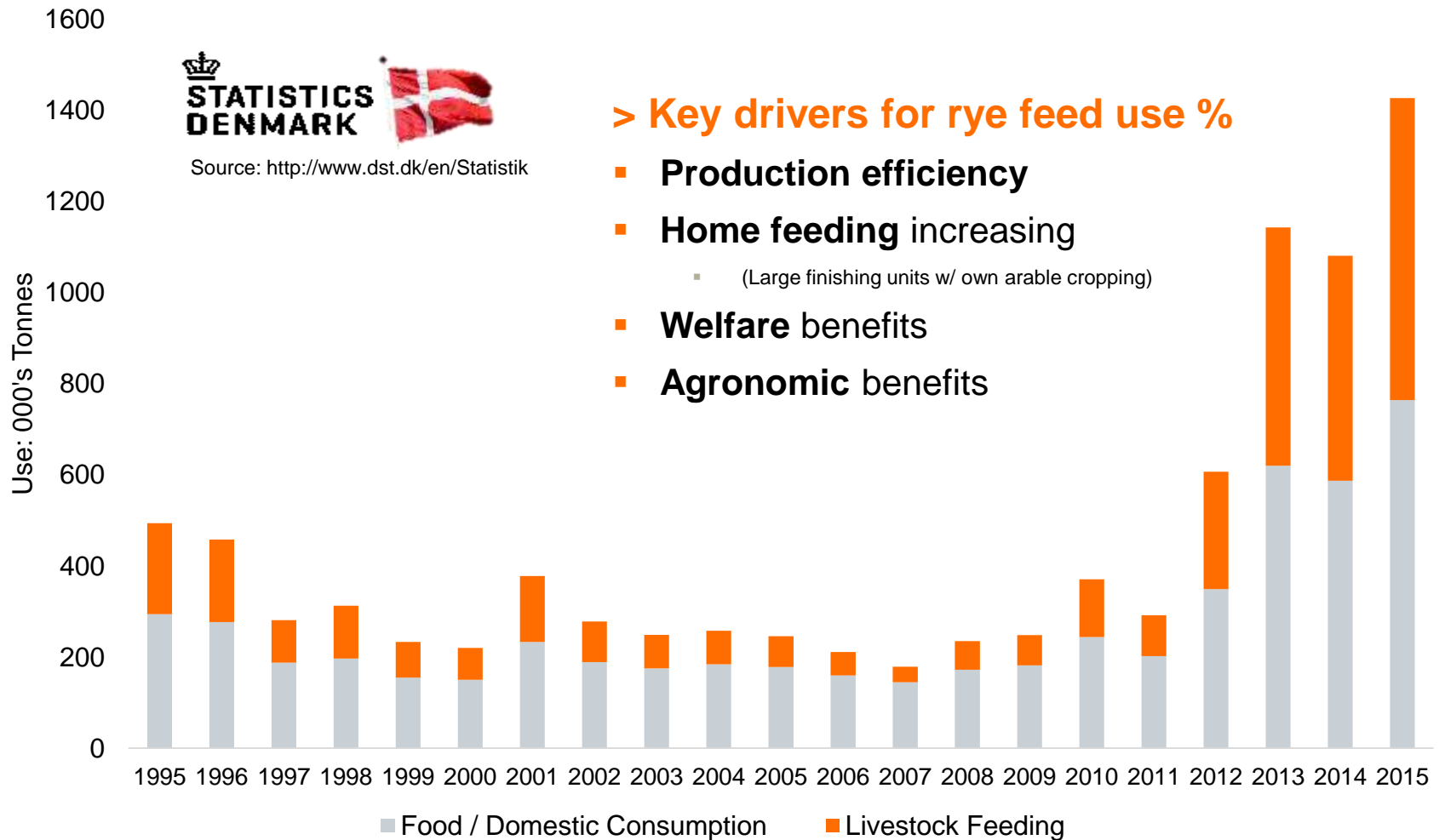
Source: http://ec.europa.eu/eurostat/statistics-explained/index.php/Pig_farming_sector_-_statistical_portrait_2014

Denmark case study...

Increasing use of Rye in Pig Rations



Rye - Food + Livestock Use 1995 - 2015

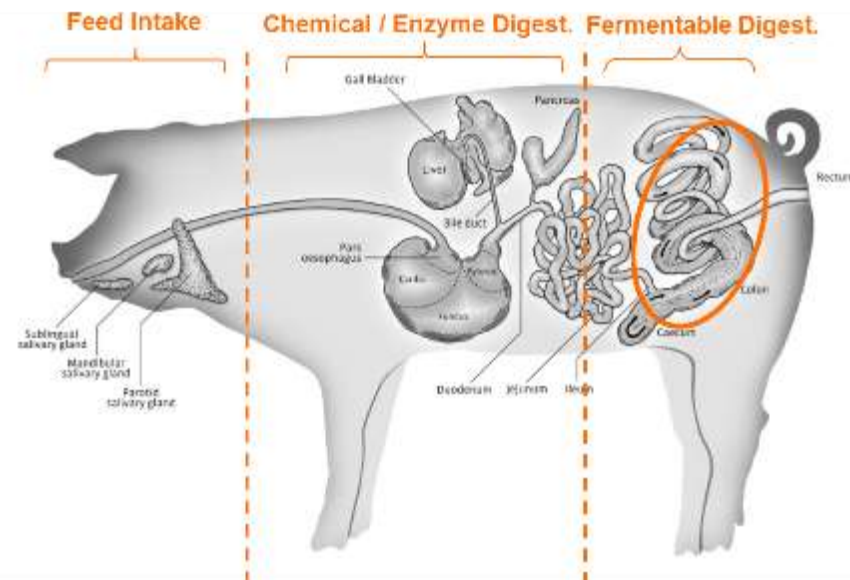


Hybrid Rye for Feed Grain (Pigs)



High fibre + fructan benefits:

- Beneficial for **gut health**
- **Less ulceration** at slaughter
- Higher **satiety + gut function**
- **High fructan from rye;** (aids conv. to butyrate) **via the intestinal tract**
 - Lower **faecal N losses**
 - Lower **skatole production** (potential for less boar taint issues)
 - Potentially lower **salmonella risk**



Dietary fibre analyzed as components included in the Uppsala method (AOAC 994.13)

Rye Feeding Recommendations

(LW basis and % Rye inclusion)

- **Fattening pigs:**
 - (28- 40 kg) **30% Rye**
 - (40 – 60 kg) **40% Rye**
 - (60 kg) + **50% Rye**

- **Sows: 25% Rye**

- **Piglets: 10 - 20% Rye**
 - (min. 15 kg LW +)



Rye feeding – all round benefits



Increased **feed uptake** of dietary fibre

Higher uptake of **fructan /inulin** (as dietary fibre)



Increased **water holding** capacity and filling of the gut for **enhanced satiety**

Intestinal fermentation of fructan to **butyrate** with **hormone response = satiety**



Hybrid Rye for Human Nutrition

Hybrid Rye - Key advantages for baking and food use:

- High **dietary fibre** content
- Stable glucose and **insulin** balance
- Rye has the lowest **Glycemic Index (GI)** values of all cereal grains
- Improve **bowel function** – lower risk of constipation
- Long term **cardiovascular health** – rye based diets are linked to decreased incidence of myocardial infarction & beneficial effects in **lipid metabolism**

RYE AND HEALTH



Source: Nordic Rye Group
(<http://virtual.vtt.fi/virtual/rye/rye&health.pdf>)

Dietary fibre content and composition of in whole cereal grains

(Food Nutr Res. 2013; 57: 10.3402/fnr.v57i0.18503).



Rye



Dark
rye flour



DF=
14g/100g
ASH 2,0 %

Medium
rye flour



DF=
9g/100g
ASH 0,9 %

Light
rye flour



DF=
7g/100g
ASH 0,8 %

Wheat



Whole meal
wheat flour



DF=
13g/100g
ASH 1,9 %

Dark
wheat flour



DF=
4g/100g
ASH 1,5 %

Standard
bakery
wheat flour



DF=
3g/100g
ASH 0,7 %

Oats



Oat flour



DF=
11g/100g
ASH 2 %

Barley



Barley flour



DF=
11g/100g
ASH 1,3 %

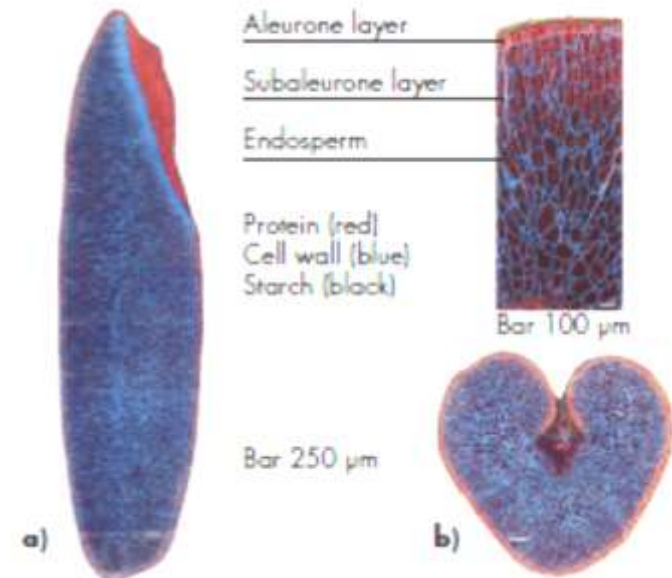
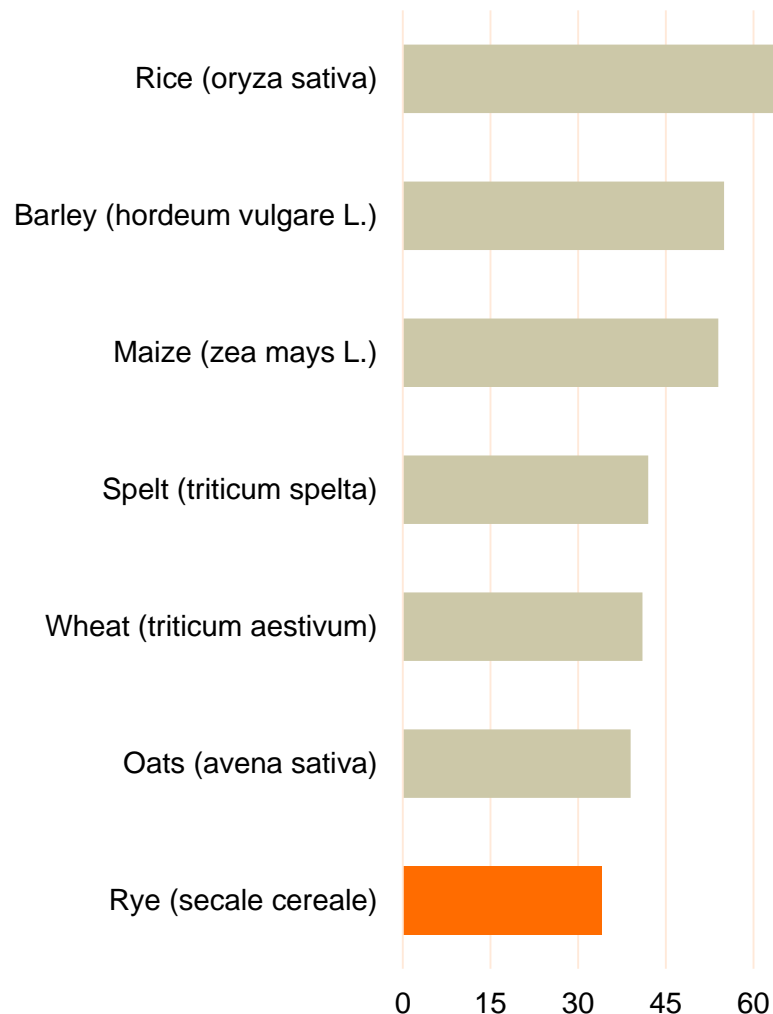
DF = Dietary Fiber
ASH = Ash Content

Rye Grain

Low GI, stable insulin balance & heart healthy !



GI Index of Common Cereal Grains



“Fibre in cereals is located mainly in the outer layers of the kernel, especially in the bran.

Wheat and rye have similar bran content, but rye contains more cell walls within the endosperm, and thus has a higher fibre content”

(Nyman et al. 1984, Åman et al. 1997).

Hybrid Rye - Example end use products:

- **Milling Products:** *Whole grain rye, cut rye (steel), Malted rye kernels, Whole grain flour, Rye bread mix with sourdough, Rye bran, Rye flakes, Breakfast cereals (muesli, others)*
- **Bread Products:** *Sourdough rye bread, Crispbread, Thin crispbread, Rolls, buns and breads containing wheat/rye-mixture*
- **Other Rye Products:** *Rye porridge, pastries, Rye pasta, Snack products*
- **Distilling:** *Whisky production*





2017/18 Portfolio + Seed Rate Tool

Hybrid Rye – Portfolio 2017/18



	Type (H = Hybrid)	Use
KWS PROGAS	PollenPlus® - H	Biogas (AD)
KWS PROPOWER <i>*NEW*</i>	PollenPlus® - H	Biogas (AD)

Number 1 for AD in the UK!

KWS PROGAS

- Dedicated hybrid for AD
- High wholecrop yields (60 t/ha +)
- Biogas yields similar to maize (200 m³)

SEEDING THE FUTURE SINCE 1898

KWS

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Tel: +44 (0)1865 200000 Fax: +44 (0)1865 200001 Email: sales@kws.co.uk
www.kws.co.uk

Drive your feedstock yield... step up to Propower!

KWS PROPOWER

- Dedicated hybrid for AD – new benchmark for yield
- High wholecrop yields (60 t/ha +)
- Biogas yields similar to maize (200 m³)

SEEDING THE FUTURE SINCE 1898

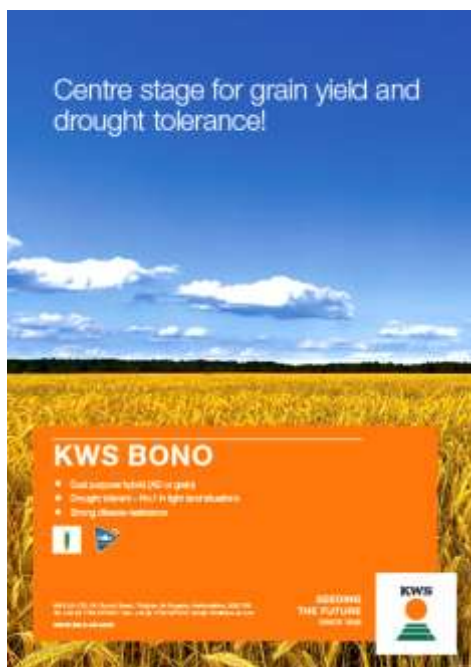
KWS

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www.kws.co.uk

Hybrid Rye – Portfolio 2017/18



	Type (H = Hybrid)	Use
KWS BONO	PollenPlus® - H	Multi-Use (AD, Feed Grain, Food Ind.)
KWS DANIELLO	PollenPlus® - H	Multi-Use (AD, Feed Grain, Food Ind.)
KWS MAGNIFICO	PollenPlus® - H	Multi-Use (AD, Feed Grain, Food Ind.)



Hybrid Rye – Seed Rates + Drilling



Seed Rates + Drilling

- Optimum drilling depth
 - **2cm - 4cm**
 - Deter (clothianidin) (3-4 cm)
 - Yield suppressed at depths < 4cm – 6cm



Online Seed Rate Tool

<https://www.kws-uk.com/aw/Products-TopMenu/HYBRID-RYE/Hybrid-Rye-Seed-Rates-and-Drilling/~hxai>

*1 Unit = 1 Mio. Viable Seeds – packed in multiples of 12 Un. (Equivalent to approx. 500 kg bulk bag) dep on TGW (~30 – 40g)

Seed supplied in 12 Un. (12 Mio) Bulk Bags ONLY.

- **Mid Sept:** 200 seeds/m²
- **Oct:** 220 – 260 seeds/m²
- **Nov:** 300 + seeds/m²

Seed Rate / m² + Units / Ha*

200	2.0	340	3.4
220	2.2	360	3.6
240	2.4	380	3.8
260	2.6	400	4.0
280	2.8	420	4.2
300	3.0	440	4.4
320	3.2	480	4.8



Hybrid Rye Agronomy

Winter hybrid rye develops quickly in the spring

Pictures from Yorkshire Wolds 2014



19th March



19th April



9th May



- In these trials grown as 1st & 2nd cereal to assess grain yields
- Competitive growth habit

- **Rye as a 1st cereal 11.6 t/ha**, 70.1kg/hl
- Feed wheat ave 11.3t/ha, 71kg/hl
- **Rye as a 2nd cereal 10.0 t/ha**, 70kg/hl
- Feed wheat ave 9.3t/ha, 67.7kg/hl

Hybrid Rye – Rapid stem elongation



Triticale

Hybrid Rye

Wohlde, 24.04.2014

Hybrid Rye – brown rust control essential



Hybrid rye – Agronomy



Location Suitability	All soil	
Sowing Time / Rate		
Early	15.Sept. - 30.Sept.	200 seeds/m ²
Mid	01.Oct. - 30.Oct.	220 - 260 seeds/m ²
Late	After 01.Nov.	300 seeds/m ²
Fertiliser (P + K)	P: 75 – 90 Kg, K upto 250 Kg for Wholecrop	
N - Fertiliser	N - Availability from organic fertiliser to consider	
	Growth Stage 25	60 - 80 kg N/ha
	Growth Stage 31	30 - 40 kg N/ha
	Growth Stage 37	30 - 40 kg N/ha
	Total	120 - 160 kg N/ha
Plant Protection		
Plant Growth Regulator		
Sandy / Light Soils	Growth Stage 31	e.g. Moddus / Medax: Trinexapac-ethyl/CCC
Loam / Clay Soils	Growth Stage 31 - 32 + Growth Stage 37 - 49	e.g. Moddus / Medax: Trinexapac-ethyl/CCC e.g. Terpal: Ethephon + mepiquat 1.0
Fungicide	Brown rust 3 x robust fungicides (eyespot / mildew in North	
Herbicide	e.g. Liberator (flufenacet + diflufenican) + Avadex (tri-allate)	
Insecticide	As required.	
Harvest	Wholecrop: End June/Early July 35% DM / Grain: Fully Ripe - August	

* **Note:** We have taken great care to compile this cultivation advice and they reflect the current information, without giving guarantees. Please note the yearly development of your crop. Always read the instructions before using any plant protection product. We are not liable for the accuracy, completeness and actuality of this cultivation advice and are not liable in case of negligence and/or deliberate intention.



Hybrid Rye - Blackgrass Suppression & Take-all

One of drivers for hybrid rye: blackgrass competition

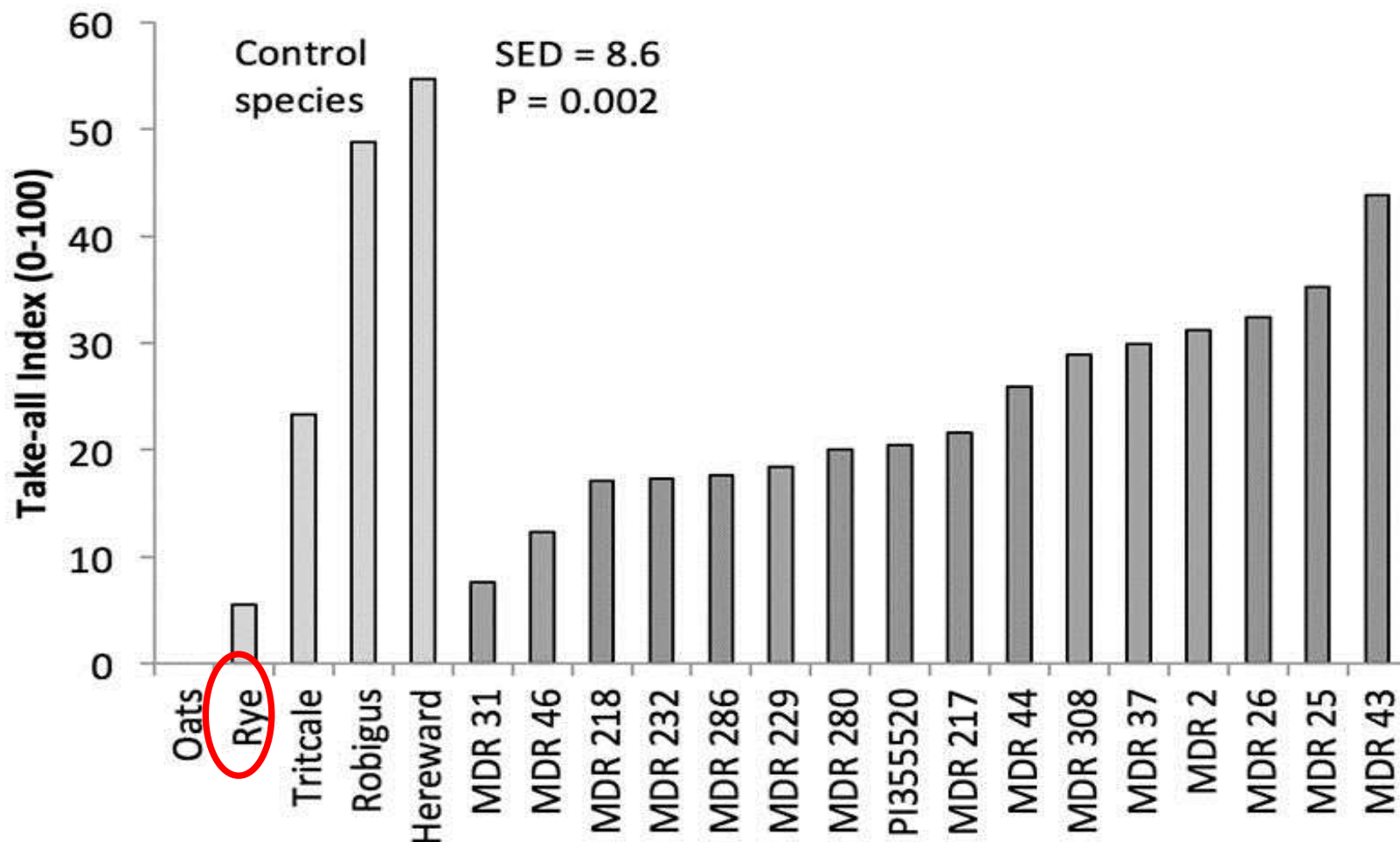


- **Agrovista Lamport 2013 : KWS Magnifico**
 - Crop competition / rotation trial
 - **Rye trial w/ high blackgrass burden**
 - Light reduction
 - Reduced maturity
 - Less seed shed
 - Blackgrass seed - 60% less viable than those from wheat plots
- **Recent WRAP report** “Impacts of pasteurisation and mesophilic AD on some common crop pests and diseases in the UK” found that mesophilic anaerobic digestion at 37.5°C killed all black grass seeds after five days



Rye and take-all ?

less take-all than the best wheat lines



Source: Rothamsted Research.

Assessment of take-all root disease symptoms in *T. monococcum* genotypes grown in a naturally infested third wheat field trial. Several cereal species were included to serve as benchmark controls; Oats = immune to *Ggt* take-all fungus, Rye = highly resistant, Triticale = intermediate resistance, hexaploid modern wheat (cvs. Robigus and Hereward) = fully susceptible.



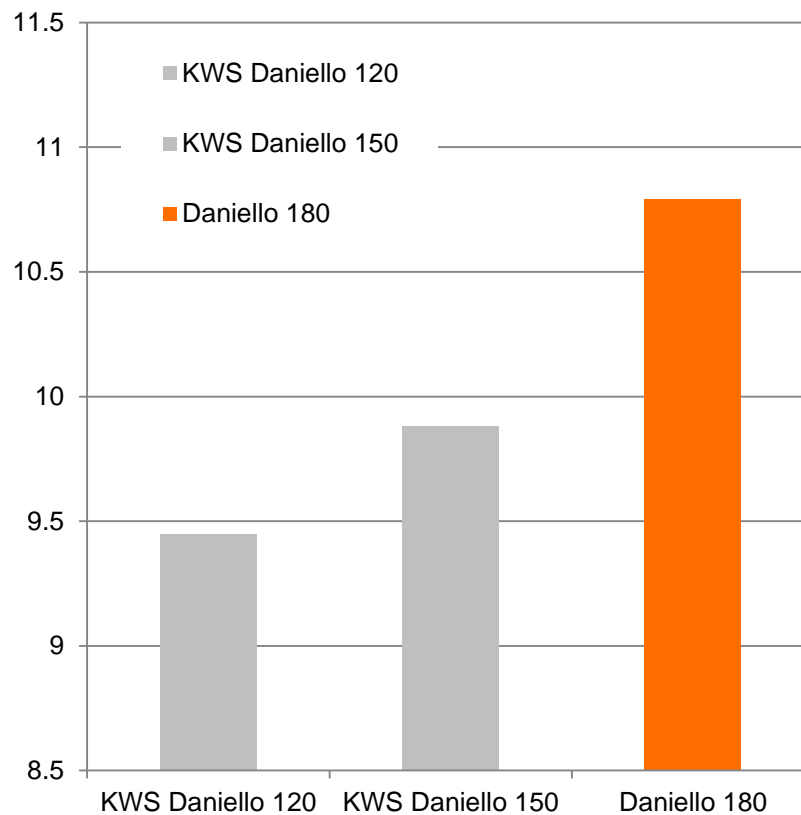
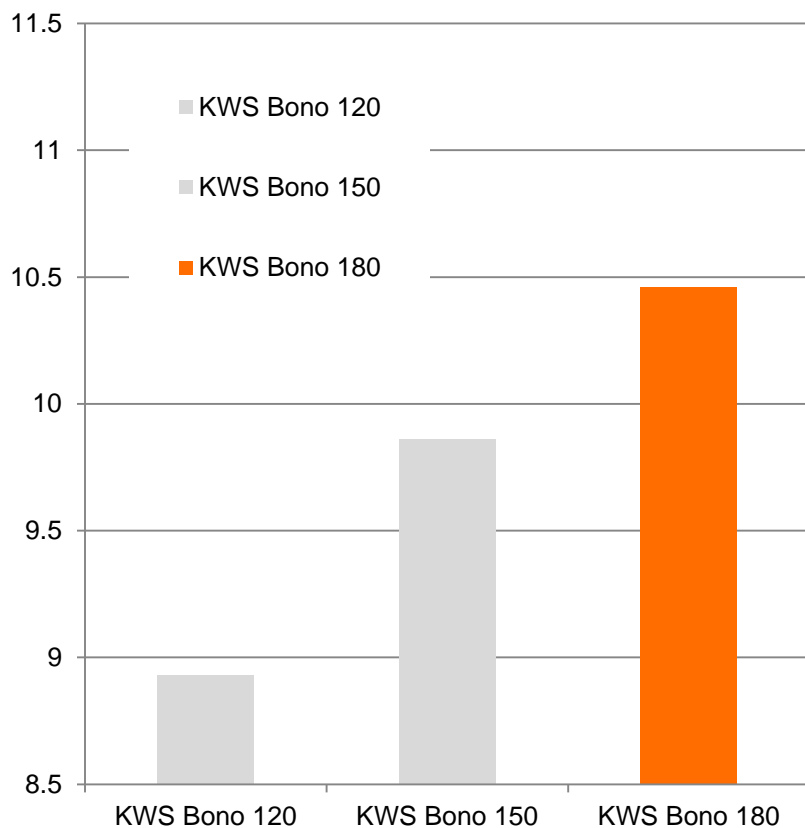
Hybrid Rye Agronomy (2)

N, PGR + Seed Rate responses

AD Wholecrop Programme

Grain Programme

Hybrid rye grain yield response to Nitrogen (kg/ha)



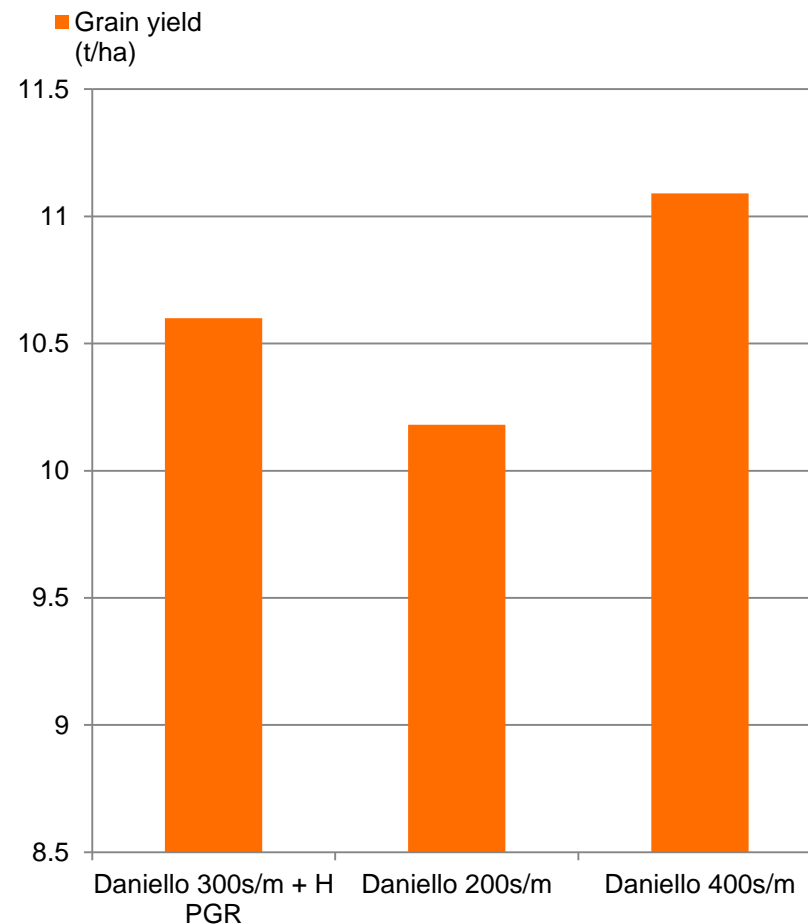
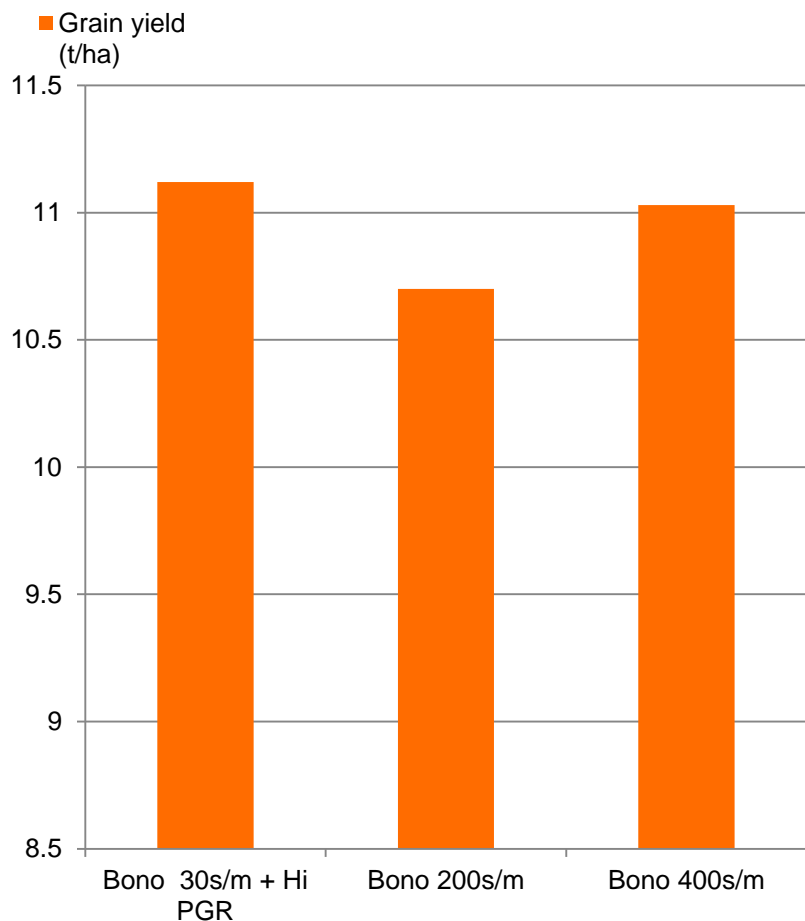
Nitrogen over 3 timings: GS 14-23 (40kg), GS30 (60%), GS32
KWS UK - HYBRID RYE UPDATE

Scottish Agronomy
Site: Glenrothes, Fife.
Drilling: 30/09/2015

Soil: Sandy Loam
Grain harvest: 29/08/2016

Hybrid rye grain yield response to seed rate & PGR

KWS BONO + KWS DANIELLO



Bono specific weight = 78.9 kg/hl

Daniello specific weight = 73.5 kg/hl

KWS UK - HYBRID RYE UPDATE

Scottish Agronomy
Site:Glenrothes, Fife.
Drilling: 30/09/2015

Soil:Sandy Loam
Grain harvest:29/08/2016

Hybrid Rye – AD Wholecrop Agronomy



T0

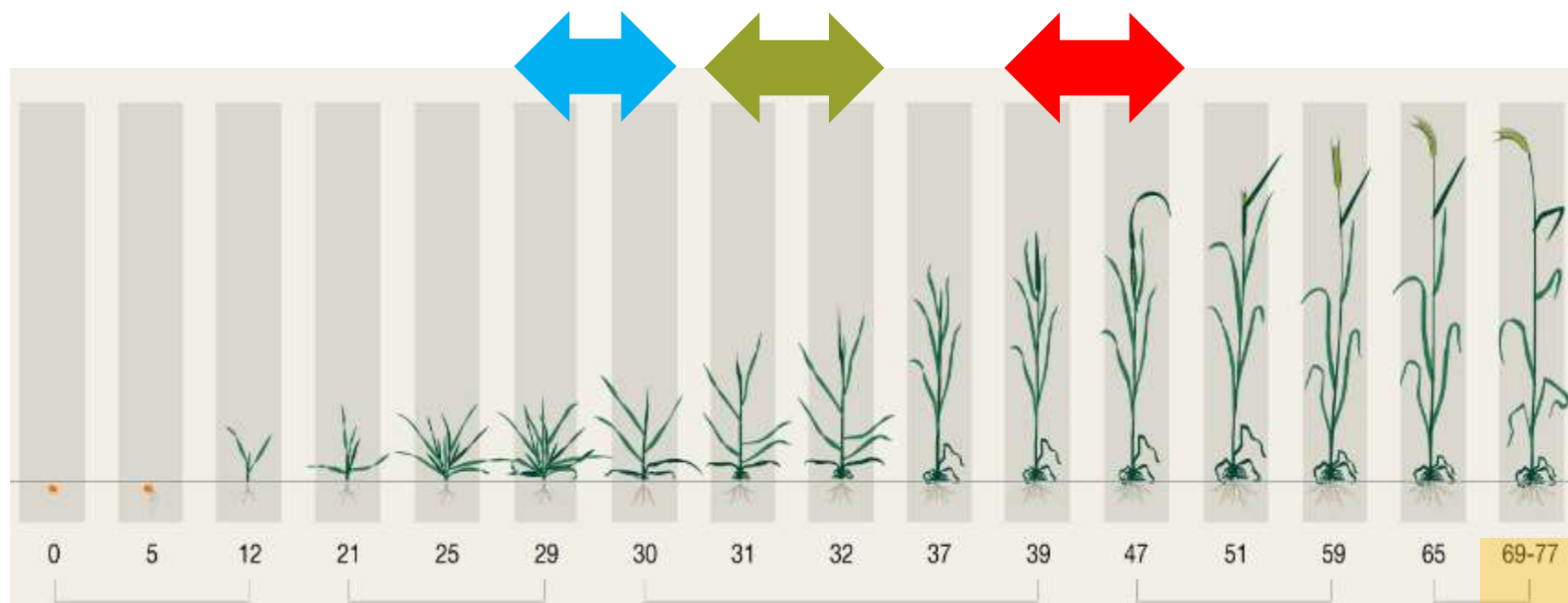
Practical?

T1 leaf 3

Rust active chemistry, *triazole* or *strobilurin*,
good rates before canopy closes
60-65% spend ?

T2 flag leaf

Rust active chemistry
40-35% spend?



Emergence / Leaf Development

Tillering

Stem Elongation

Flag Leaf Emergence + Flowering

Grain Filling / Senescence

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Wholecrop Harvest

KWS UK - HYBRID
RYE UPDATE

Hybrid Rye – Grain Agronomy



T0

Practical?
More important for PGR tiller
retention

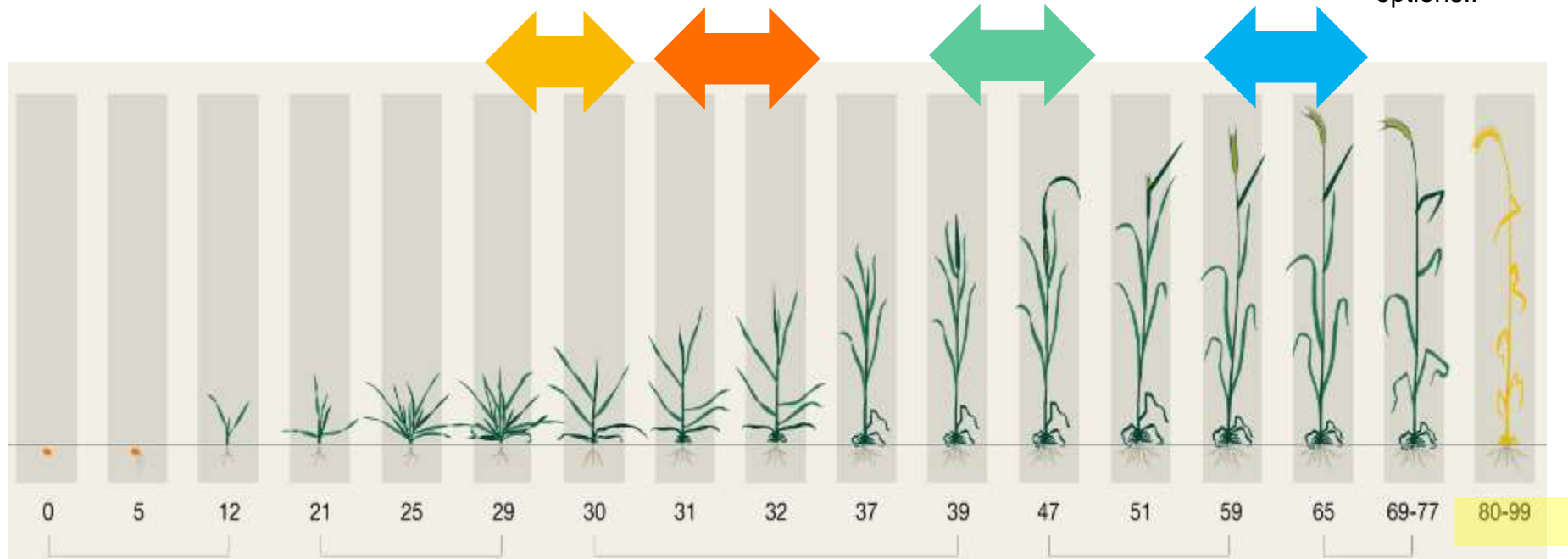
T1 leaf 3

Rust *triazole* or *stroactive*
chemistry, *strobilurin*
40-50% spend

T2 flag leaf

Rust active chemistry
40-50% spend

T2.5-T3
options..



Emergence / Leaf Development

Tillering

Stem Elongation

Flag Leaf Emergence + Flowering

Grain Filling / Senescence

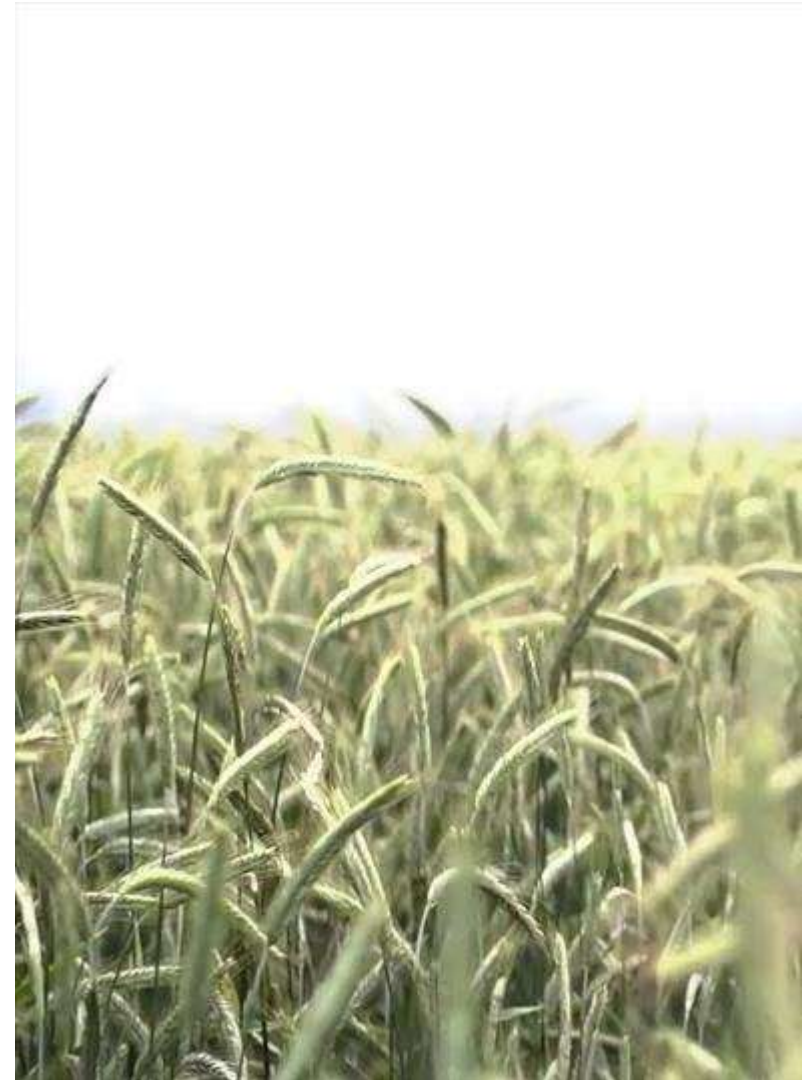
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Grain Harvest

KWS UK - HYBRID
RYE UPDATE

KWS continues agronomic work for 2017 onwards focused on:

- Seed rates
- Yield / v DM % Accumulation
- PGR Programmes
 - Wholecrop
 - Grain
- Nitrogen
 - Total dose
 - Timing
- Seasonal Results Update
- **Contact the team for info at any time ! www.kws-uk.com**



Thank you
for your attention.

www.kws-uk.com

SEEDING
THE FUTURE
SINCE 1856

