
PLANT
BREEDING FOR
YIELD
IMPROVEMENT
SAATEN
UNION

A Challenging Future

- *World population increasing by 160,000 every day*

- *7 billion currently, rising to 9.3 billion by 2050*

- *UN estimates global food production must:*
  - ➔ Increase by 40% by 2030
  - ➔ Increase by 70% by 2050
- *Increasing demand for 'fuel crops' e.g. wheat for bioethanol production*

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A Challenging Future

- *Increased production must be achieved using similar land area, but with much less water, fertiliser and pesticide*

- *Increasing global temperatures likely to cause more frequent extreme weather events including longer periods of both high rainfall and drought*

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Increased Yield Through Improved Genetics

Increased Yield Through Improved Genetics

- *Wheat is particularly complex cereal to study*
- *Genome is 30 x larger than that of rice and 5 x larger than the human genome*
- *Diversity means many beneficial traits remain unharnessed*

- *Dramatic advances in gene mapping technology and rapidly reducing costs leading to major advances in breeding*
- *New technology allows genes and associated beneficial traits, to be 'tracked' much more easily*

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Widening the Search

- *Many beneficial traits are likely to have been lost during domestication and subsequent developments*
- *Several major, publicly-funded research centres working on 'rejuvenating wheat diversity'*
- *Untapped genetic variation is being identified in:*
  - *primitive varieties*
  - *modern wheat's ancestors*
  - *wild and cultivated relatives*

- *Using latest gene marker technology breeders can relatively quickly incorporate these beneficial traits into their programmes*

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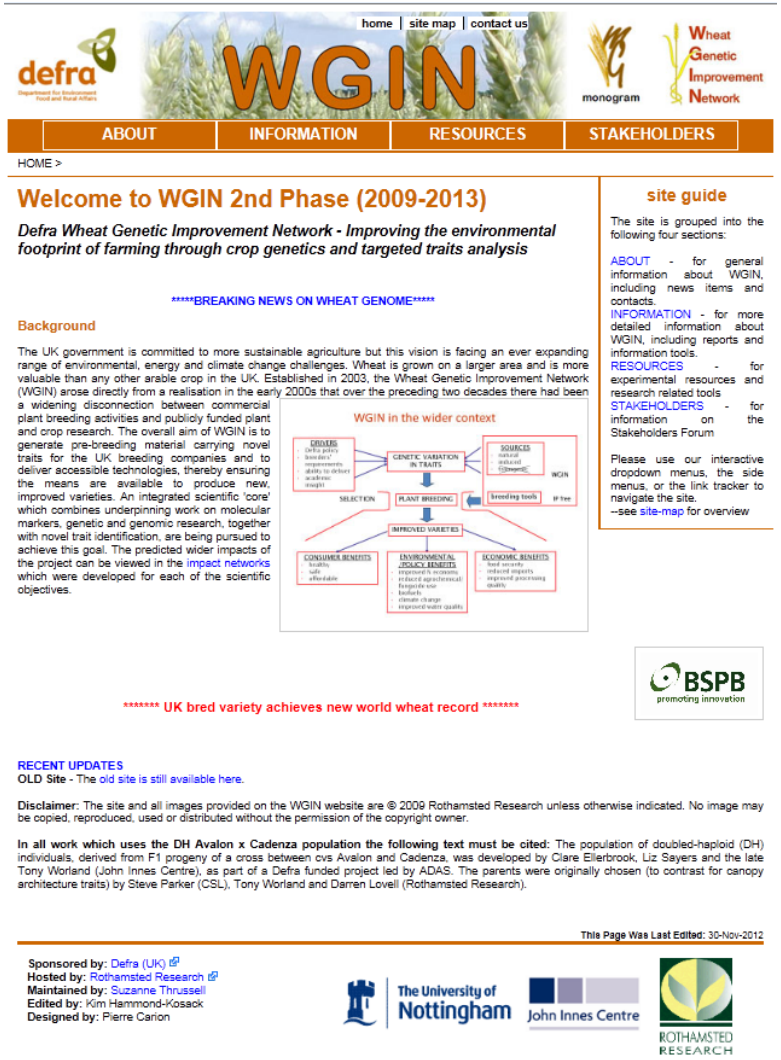
Key Objectives

- *Improved resistance to disease and insects*
- *Greater tolerance to environmental stresses such as drought, salt and heat*
- *Enhanced yield but with more efficient use of nutrients*

- *DEFRA funded 'Crop Improvement Networks' set up to help co-ordinate research work and disseminate results to all interested parties*

Wheat Genetic Improvement Network



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WGIN

Wheat Genetic Improvement Network

ABOUT | INFORMATION | RESOURCES | STAKEHOLDERS

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Welcome to WGIN 2nd Phase (2009-2013)

Defra Wheat Genetic Improvement Network - Improving the environmental footprint of farming through crop genetics and targeted traits analysis

*****BREAKING NEWS ON WHEAT GENOME*****

Background

The UK government is committed to more sustainable agriculture but this vision is facing an ever expanding range of environmental, energy and climate change challenges. Wheat is grown on a larger area and is more valuable than any other arable crop in the UK. Established in 2003, the Wheat Genetic Improvement Network (WGIN) arose directly from a realisation in the early 2000s that over the preceding two decades there had been a widening disconnection between commercial plant breeding activities and publicly funded plant and crop research. The overall aim of WGIN is to generate pre-breeding material carrying novel traits for the UK breeding companies and to deliver accessible technologies, thereby ensuring the means are available to produce new, improved varieties. An integrated scientific 'core' which combines underpinning work on molecular markers, genetic and genomic research, together with novel trait identification, are being pursued to achieve this goal. The predicted wider impacts of the project can be viewed in the impact networks which were developed for each of the scientific objectives.

WGIN in the wider context

site guide

The site is grouped into the following four sections:

ABOUT - for general information about WGIN, including news items and contacts.
INFORMATION - for more detailed information about WGIN, including reports and information tools.
RESOURCES - for experimental resources and research related tools
STAKEHOLDERS - for information on the Stakeholders Forum

Please use our interactive dropdown menus, the side menus, or the link tracker to navigate the site.
--see site-map for overview

BSPB promoting innovation

******* UK bred variety achieves new world wheat record *******

RECENT UPDATES
OLD Site - The old site is still available here.

In all work which uses the DH Avalon x Cadenza population the following text must be cited: The population of doubled-haploid (DH) individuals, derived from F1 progeny of a cross between cvs Avalon and Cadenza, was developed by Clare Ellerbrook, Liz Sayers and the late Tony Worland (John Innes Centre), as part of a Defra funded project led by ADAS. The parents were originally chosen (to contrast for canopy architecture traits) by Steve Parker (CSL), Tony Worland and Darren Lovell (Rothamsted Research).

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The University of Nottingham | John Innes Centre | ROTHAMSTED RESEARCH

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Wheat Genetic Improvement Network

Targeted Traits

- *Resistance to cereal aphids*
- *Nitrogen Use Efficiency*
- *Improvements of water use efficiency and drought tolerance*
- *Resistance to Take-all and related reduction in inoculum build-up*
- *Introgression of extreme resistance to Septoria Tritici from closely related species*

Oilseed Rape Genetic Improvement Network

OREGIN

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OREGIN

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HOME >

Defra Oilseed RapE Genetic Improvement Network

Welcome to OREGIN

Providing a pre-breeding pipeline, to integrate sustainability traits into Oilseed Rape cultivars

The Oilseed Rape Genetic Improvement Network (OREGIN) has been successful in achieving initial objectives of providing a focus for the UK Oilseed Rape genetic improvement R&D and stakeholder communities, and a mechanism for prioritising research requirements. **The principal activities of the OREGIN project are the generation, gathering, collation and dissemination of information and genetic resources for the benefit of the stakeholders**. Ongoing discussions amongst the R&D and breeder communities have identified the highest priority requirements in the context of Defra strategic objectives. It is recognised that other trait areas such as pest resistance may be of increasing commercial priority and affect the long-term sustainability of the crop. The components of the OREGIN pre-breeding platform will also provide a foundation for and contribute significantly to other projects of relevance to the overall objectives of achieving improvements in sustainability through crop genetic improvement.

This new site has been divided into the following four sections:

- About - "What is OREGIN?", project outline, news, contact details and information on the other Defra crop genetic improvement networks
- Information - Reports, databases, protocols, general information about Oilseed Rape
- Resources - Genetic diversity for plants and pathogens, experimental materials
- Stakeholders - Who are the OREGIN stakeholders, details of future and past meetings

site guide

The site is grouped into the following four sections:

ABOUT - for general information about OREGIN, including news items and contacts.
INFORMATION - for more detailed information about OREGIN, including reports and information tools.
RESOURCES - for experimental resources and research related tools
STAKEHOLDERS - for information on the Stakeholders Forum

Please use our interactive dropdown menus to navigate the site.
--see site-map for overview

Google Search

WWW SITE

map archived annually,
for previous maps click here

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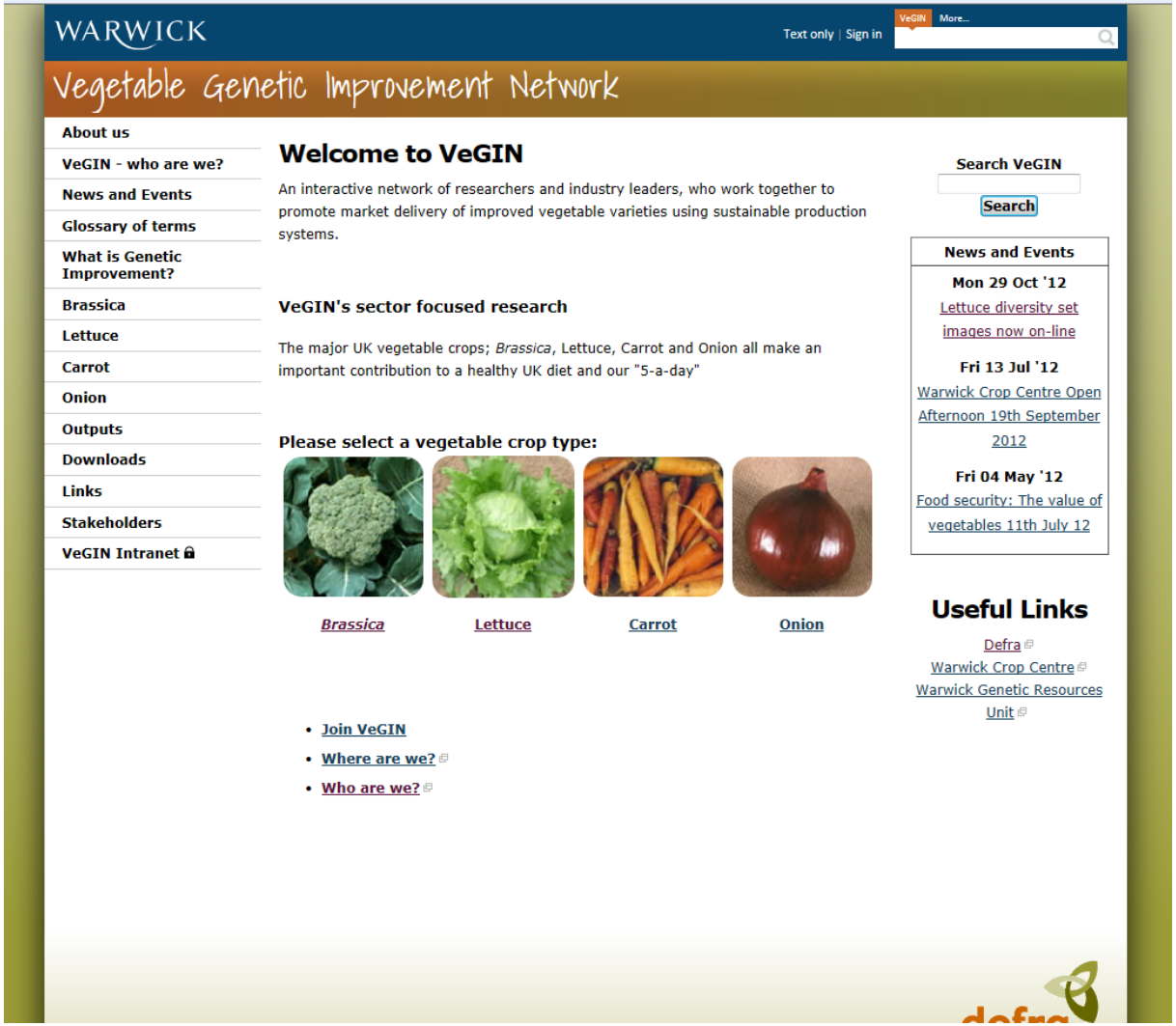
Oilseed Rape Genetic Improvement Network

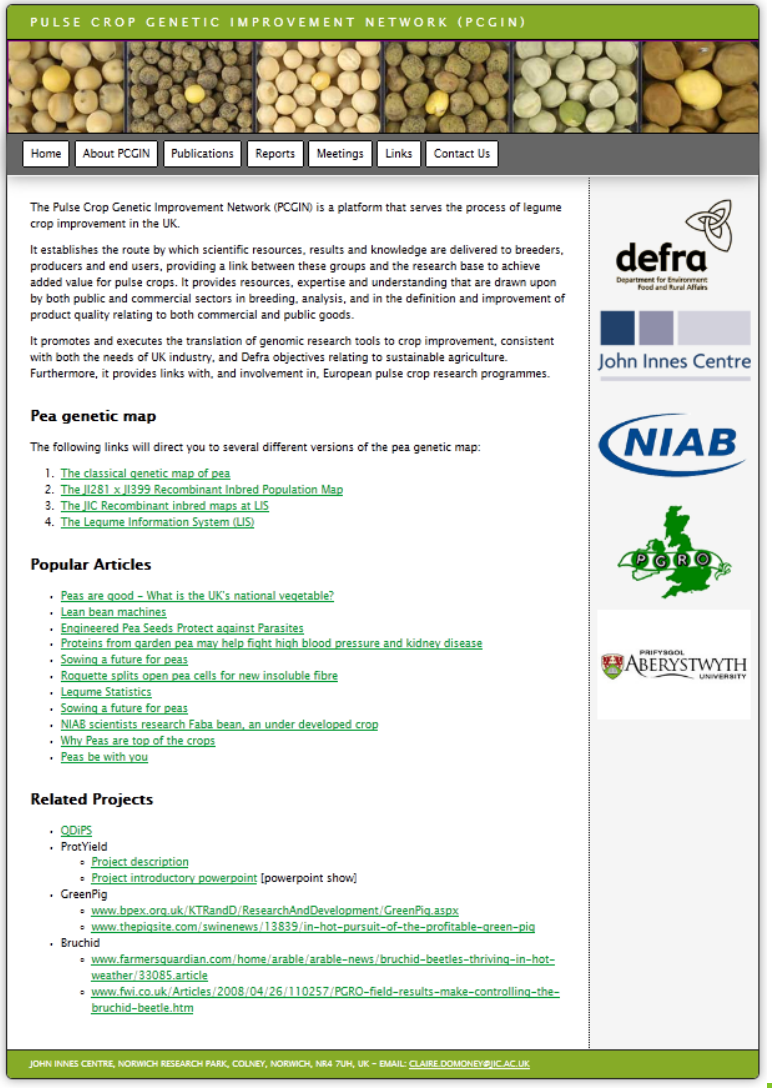
Current Areas of Research on OSR

- *Understanding factors affecting seed size and its effect on yield and quality*
- *Development of oil types for use in the lubricants industry*
- *Effect of short rotations on soil dwelling pathogens*
- *Improving the harvest index by manipulation of crop canopy architecture*
- *Improving Nitrogen use efficiency by better understanding of traits involved and selection of improved varieties.*

Vegetable Genetic Improvement Network



Pulse Genetic Improvement Network




HYBRID
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Hybridisation as a Plant Breeding Tool

***Hybrid** – Any offspring resulting from the mating of two genetically distinct individuals*

Animal Hybrids eg: Female horse x Male donkey = Mule

Plant Hybrids eg: Rye x Wheat = Triticale

Key Advantages

- Allows development of 'new' species with benefits of both parents eg yield of wheat + stress tolerance of rye = Triticale

- F1 (1st Generation) displays hybrid vigour (heterosis)

What is Hybrid Wheat?

Hybrid wheat (HW) is produced by the controlled crossing of 2 parent lines of conventional wheat

- One of these ‘parents’ must be male-sterile (ie. it must not produce viable pollen), it is this “female” parent that will be pollinated by the other, "male” parent.
- The F1 seed harvested from the female parent of this cross is Hybrid Wheat seed.
- The hybrid accumulates the genetic information from its 2 parents, getting some beneficial traits from both and expresses hybrid vigour (heterosis).
- This hybrid vigour leads to more vigorous growth, greater tolerance to stress, higher yields and improved quality compared to the individual parents.

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Hybridisation Techniques

- In conventional breeding, hybridisation of individual plants is made by hand (emasculation, then transfer of pollen from another wheat plant).
- For larger scale seed production, the source of the male sterility must be either genetic or chemically-induced.
- The main limitation on the large scale commercialisation of HW, since it's introduction in the 1930's, has been the lack of a reliable, affordable hybridising system.

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Genetic Sterility

- In the past, **Cytoplasmic Male Sterility (CMS),** has been used for commercial production in the USA, SA and Australia, but with limited success.
- This technique is widely used, however, in species like oilseed rape, rye and barley.
- To allow the F1 generation to successfully produce grain the male sterility must be 'restored'
- Restoring fertility in CMS wheat is not easy; reliable restorer genes are difficult to find in the species, or those closely related.
- The CMS system takes a lot of time to develop; during that time the performance of new conventional varieties is increasing, quickly erasing the benefit of the heterosis.
- Work by Saaten-Union on an effective wheat CMS system is ongoing and should be available within 7 years.

Chemically Induced Sterility

Chemically induced sterility makes use of the pollen-inhibiting property of some Plant Growth Regulator type chemicals, called Chemical Hybridising Agents (CHA's)

- When applied at the appropriate timing and at the optimum rate, the CHA will prevent pollen grains from forming so allowing a 'female' parent to be created from any conventional wheat variety.

- Use of this technique allows many potential hybrid parent combinations to be tested each season and large scale seed production to be carried out.

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Commercial Hybrid Seed Production

- In the past, failure to fully commercialise listed hybrid wheat varieties has been largely due to the lack of reliable and economic seed production systems.

- Development by Saaten-Union of CROISOR®, a highly effective CHA, has allowed many of these production difficulties to be overcome.

- CROISOR® is currently fully approved for use in France with registration in other European countries likely in the next 2 years.

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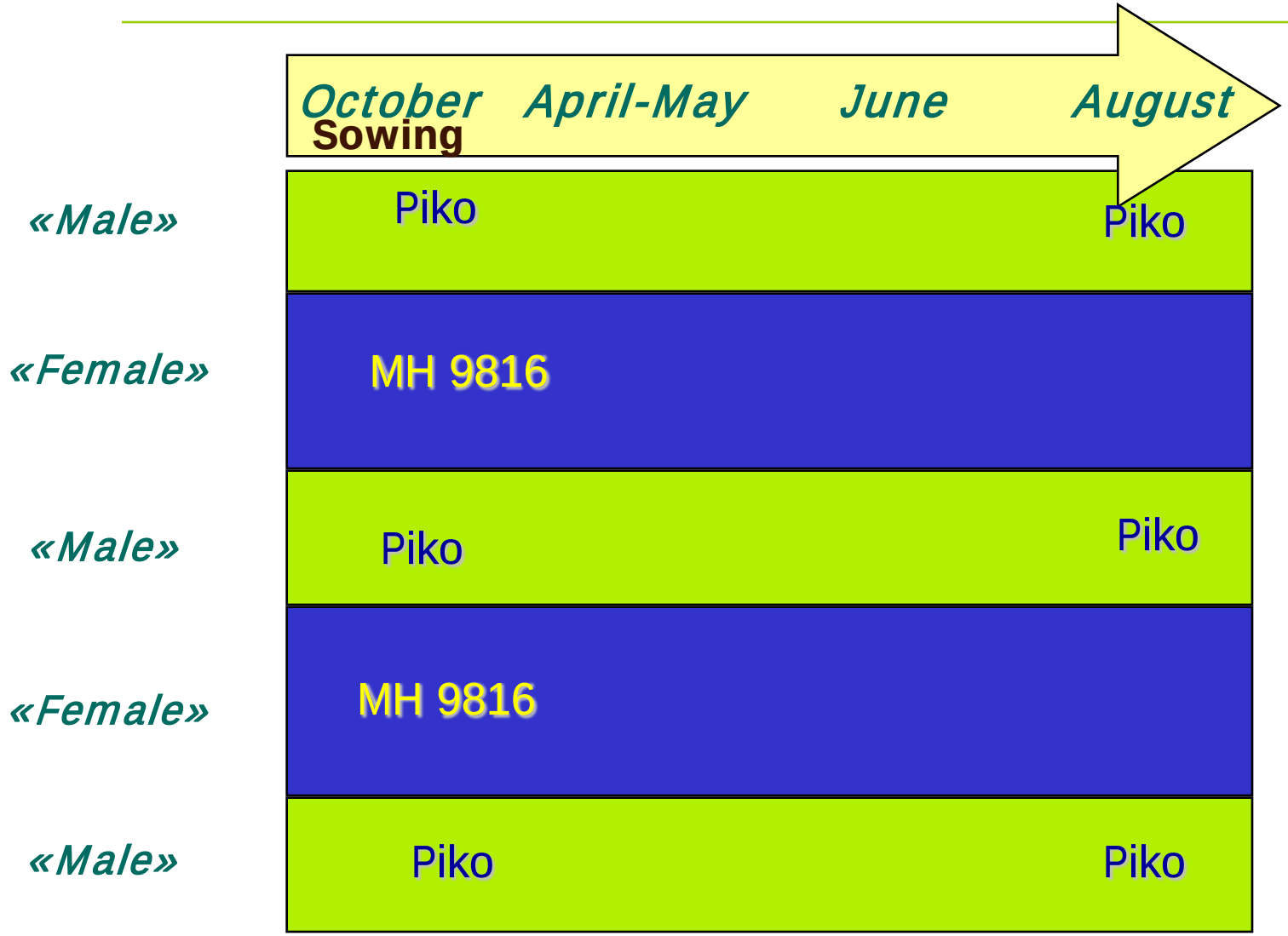
Commercial Hybrid Seed Production

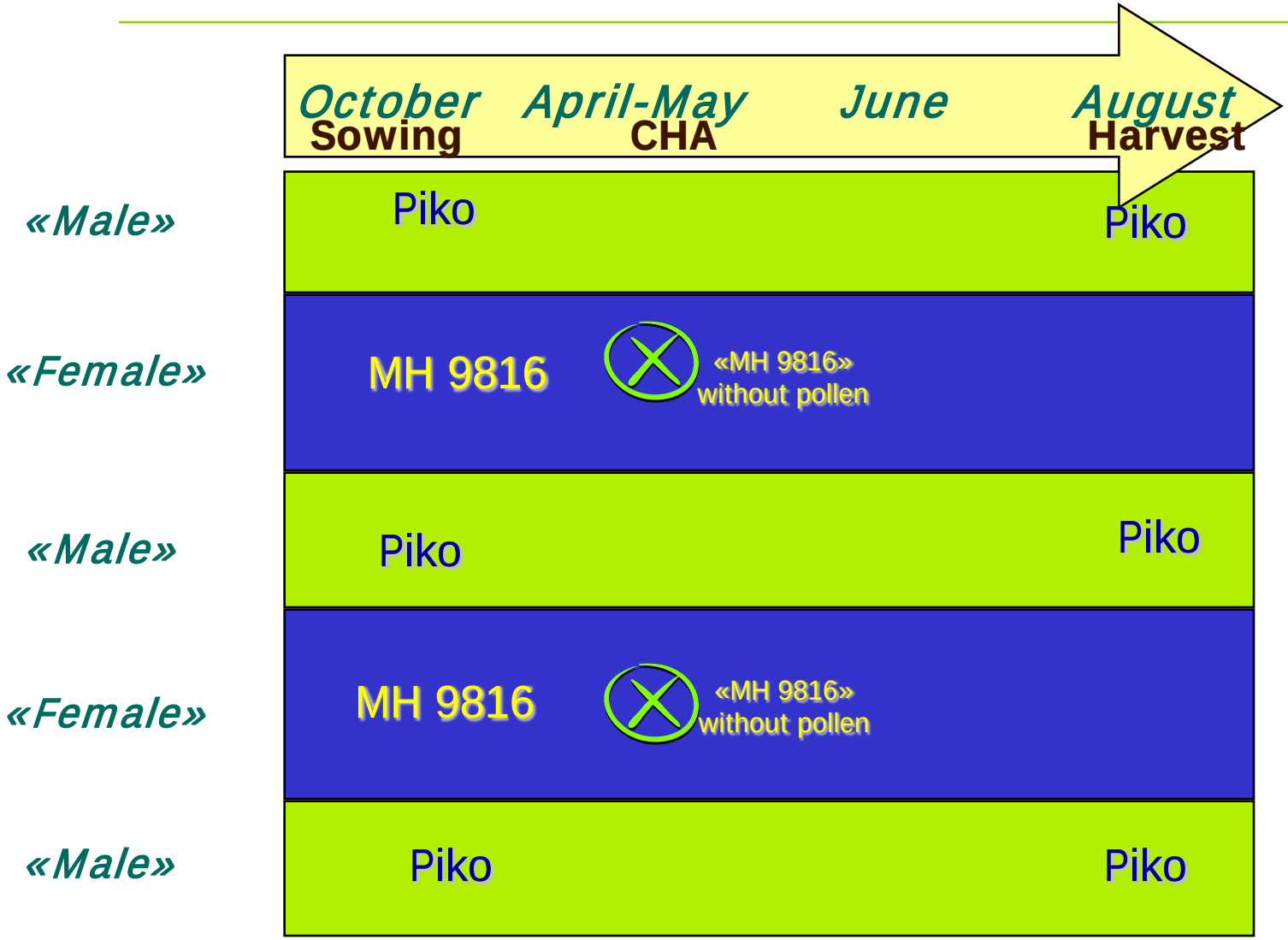


Commercial Hybrid Seed Production

- Alternate strips of the ‘male’ and ‘female’ parents are established side by side.
- Maximum width of each strip is 9m to ensure successful pollen transfer.

Commercial Hybrid Seed Production

Commercial Hybrid Seed Production



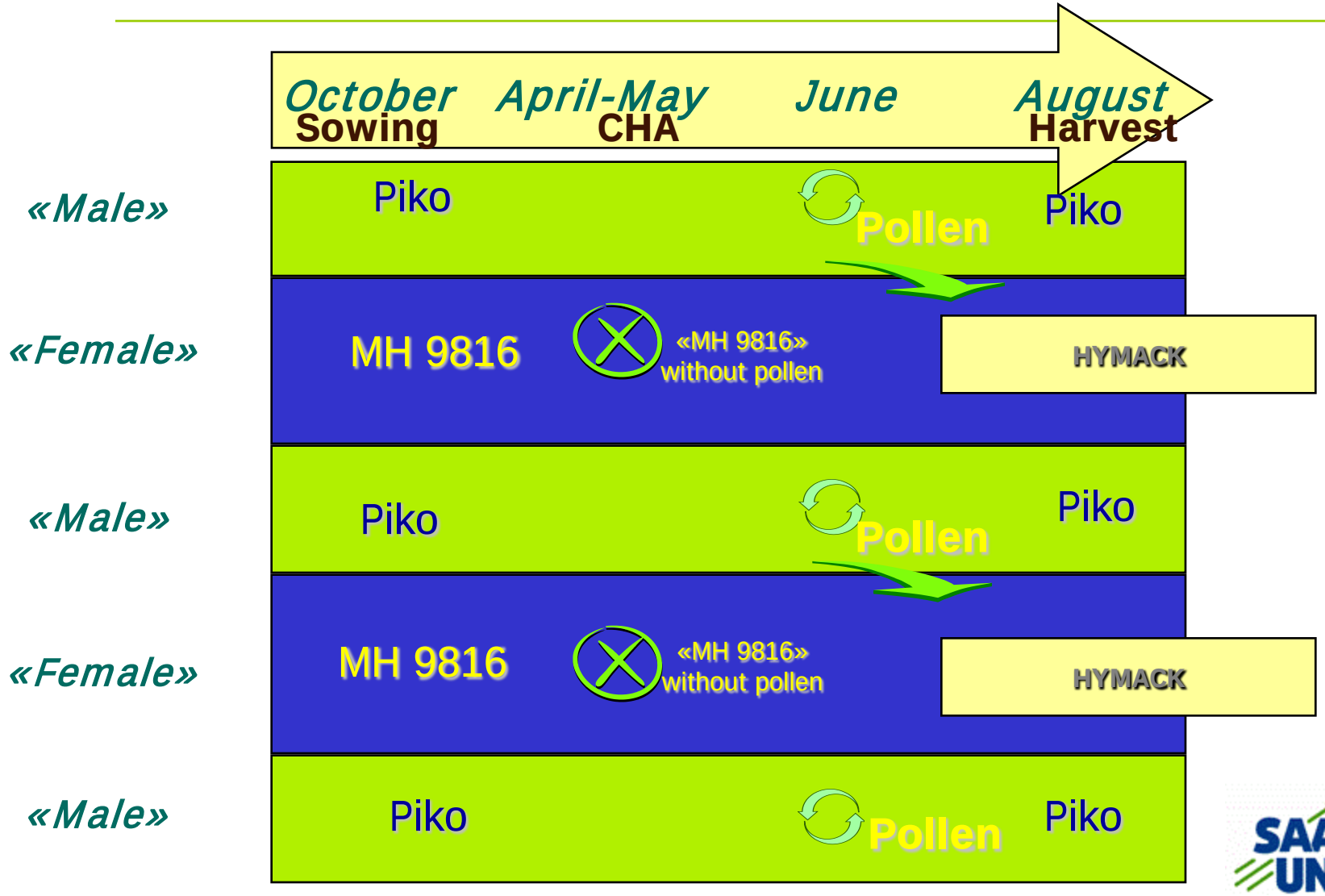
Commercial Hybrid Seed Production

At a critical point in it's development during spring the "female" parent is sprayed with the CHA. The flowers of treated plants become male-sterile.

Commercial Hybrid Seed Production

- Prior to ear emergence, pollen proof cages are erected in the ‘female’ strips to check the effectiveness of the CHA.
- >5% grain set (due to self-fertilisation) within the cage leads to rejection of the seed crop.

Commercial Hybrid Seed Production



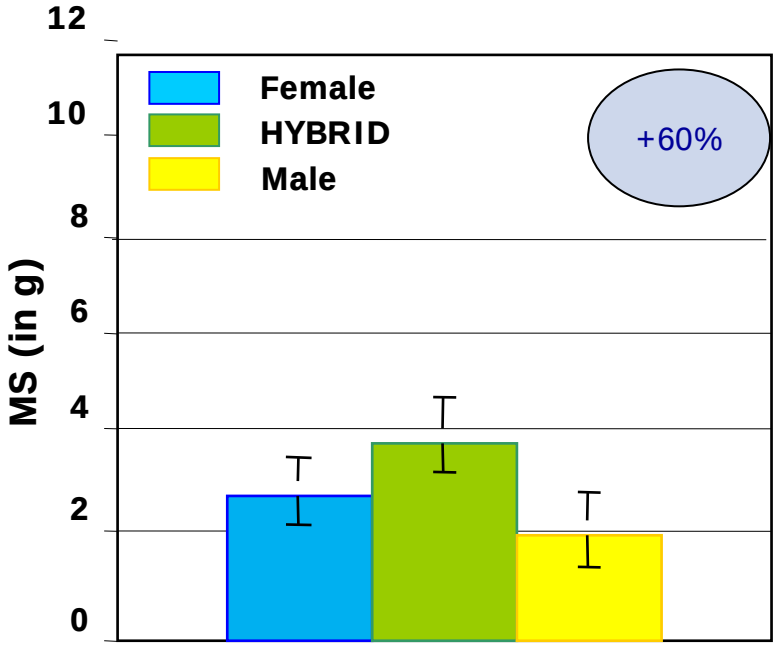
Commercial Hybrid Seed Production

The F1 seed is harvested from the ‘female’ parent and is used as the hybrid variety. Seed from the ‘male’ parent is disposed of as feed.

Hybrids Produce More Biomass Than Their Parents

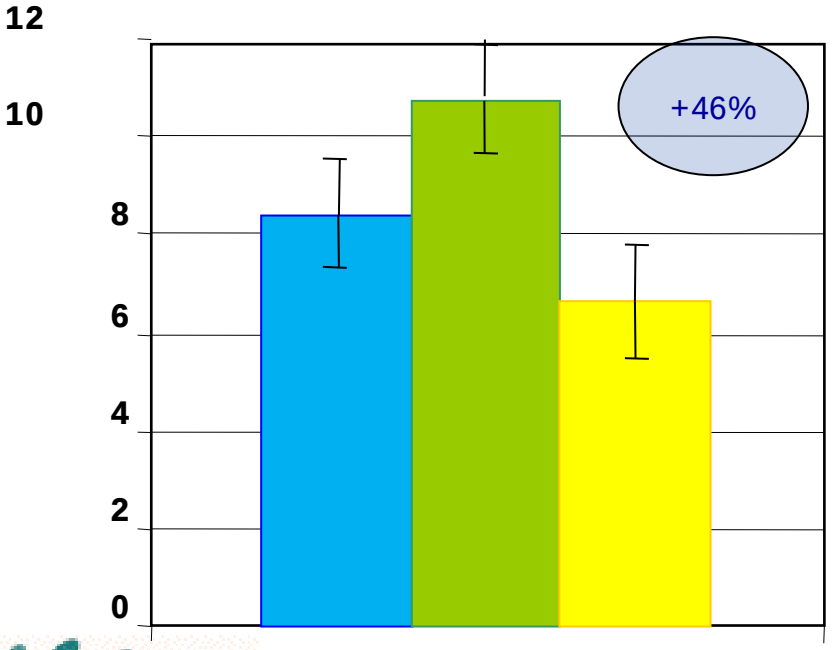
Root biomass

(at tillering)



Shoot biomass

(at tillering)



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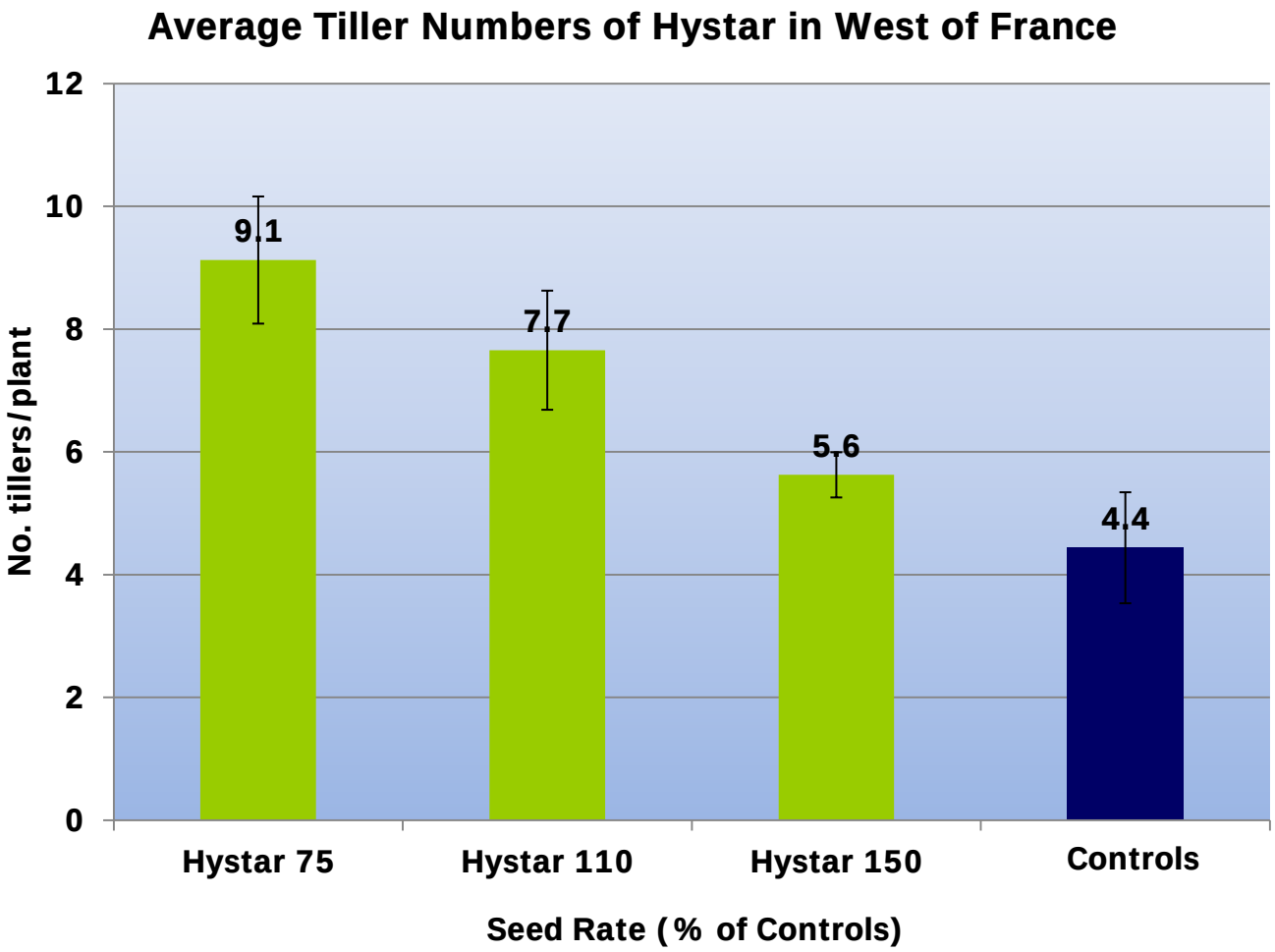
Increased Root Biomass UK Harvest 2012

Hybrid

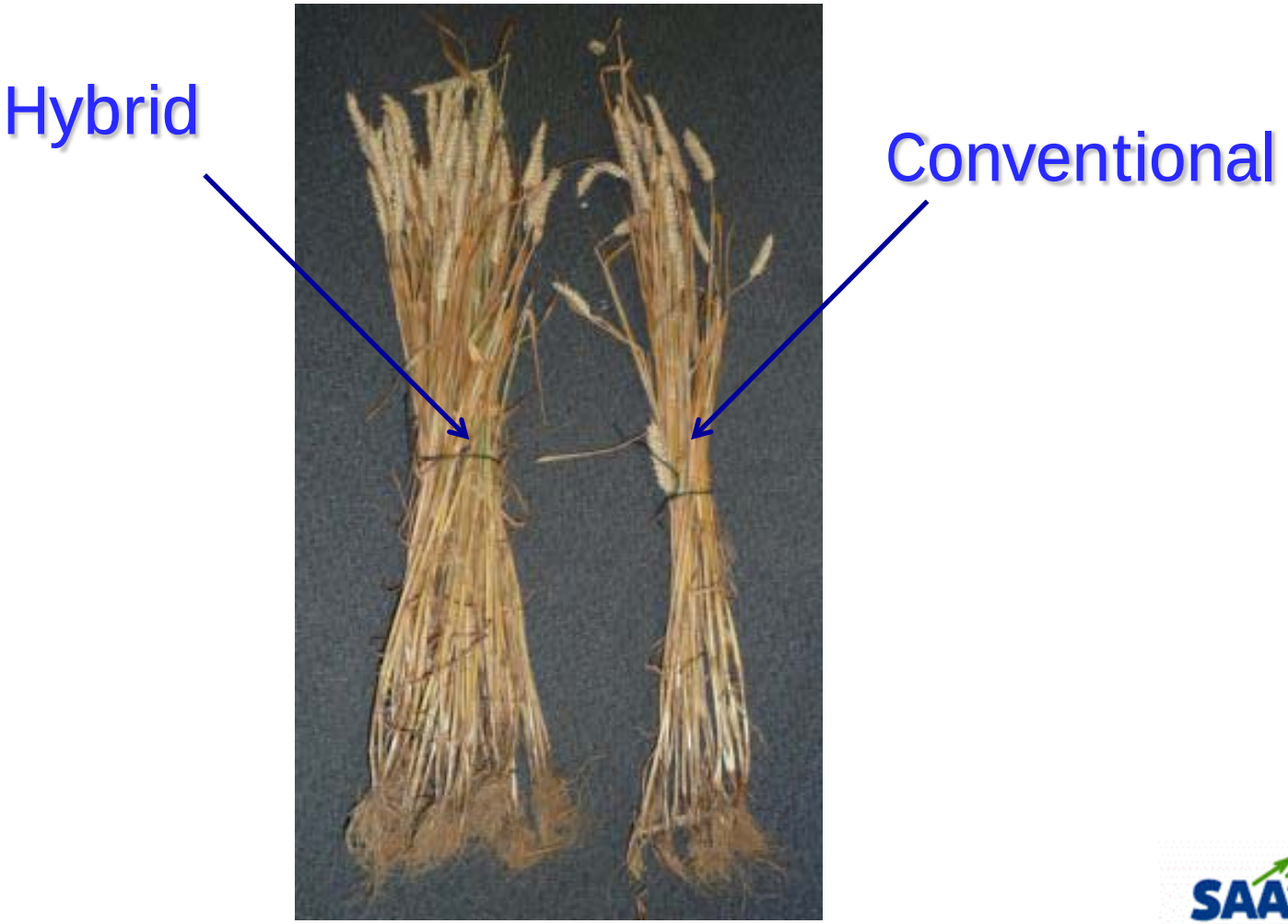
Conventional

Improved Performance On Poor Soil Types

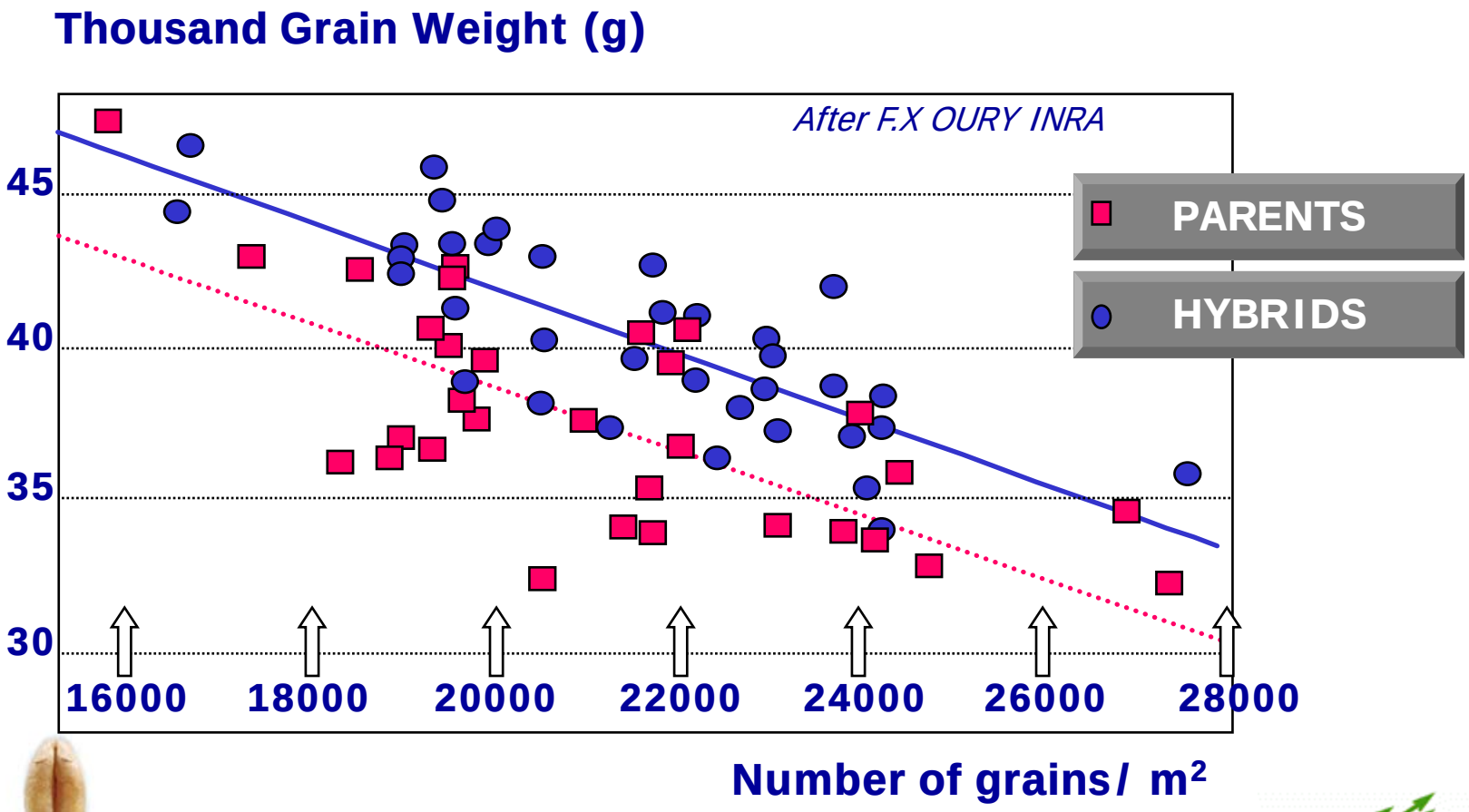
Higher Tillering Capacity



Tillering Capacity UK Harvest 2012



Improved Thousand Grain Weight



Improved Specific Weight UK Harvest 2012

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Improved Drought Tolerance

HYBRID

Conventional

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Grower Advantages From Hybrid Wheat

The additional vigour of a hybrid variety brings several benefits to growers:

- Improved yield – up to 15%, over the average of its parents, and often more in stressful conditions.
- Increased consistency – both from one season to the next and across a range of soil types and climatic conditions.
- Improved grain quality – higher TGW and improved protein content.
- Better utilisation of available nutrients and moisture.

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Current Commercial Situation In Europe

- France currently largest area of hybrid wheat production at approx. 170,000ha. Equates to just under 7% of the total certified wheat seed sales.
- Increased steadily from approx. 85,000ha in 2002.

- Hybrid sales are increasing in other countries with an estimated total European area of approx. 200,000ha in 2011.

Current Commercial Situation In UK & Ireland

- Hybrid wheat re-introduced commercially into the UK in 2010 with 1st entry into UK National List trials in Autumn 2012
- Hybrid varieties currently being evaluated alongside RL material in AFBI trials
- On-going commercial evaluation in Southern Irish private trials

The Future For Hybrid Wheat

- Around 2,000 experimental crosses created every year at sites in France and Germany.
- Key selection criteria is the ease and quality of seed production.
- Varieties being selected and tested in the key wheat producing countries of Europe.
- On-going development of seed production expertise outside France.
- Trial scale seed production likely in the UK within 2 years.

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Thank-you for your attention.

www.HybridWheat.net