



Enhancing wheat yields

.. in intensive agriculture

Roger Sylvester-Bradley
Head of Crop Performance. Cambridge, UK

Plantekongres, Herning DK, 2015

ADAS

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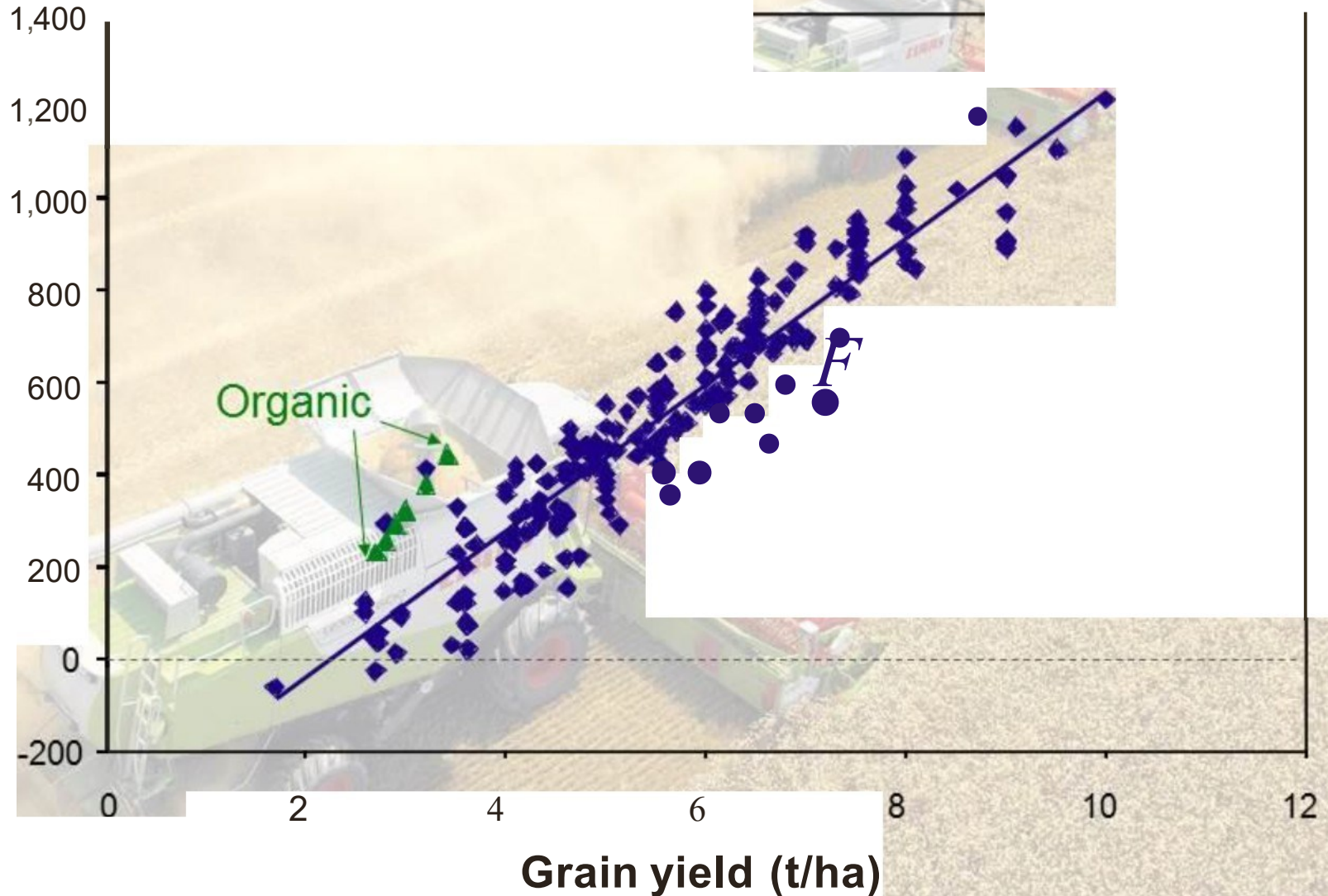
Yields bring profits

Agri
AeroSolution

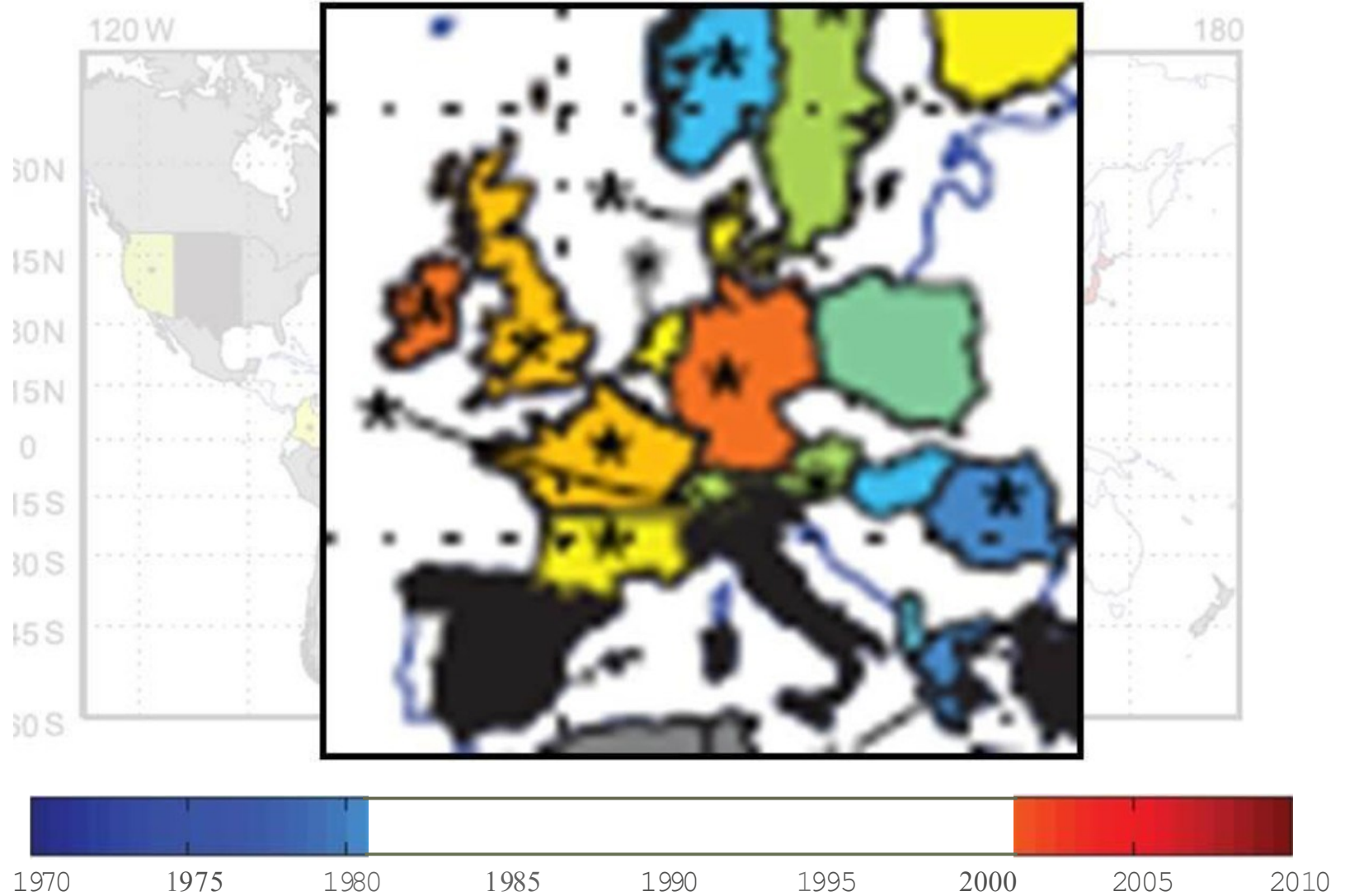
265 farms in France

Gross margin, € / ha

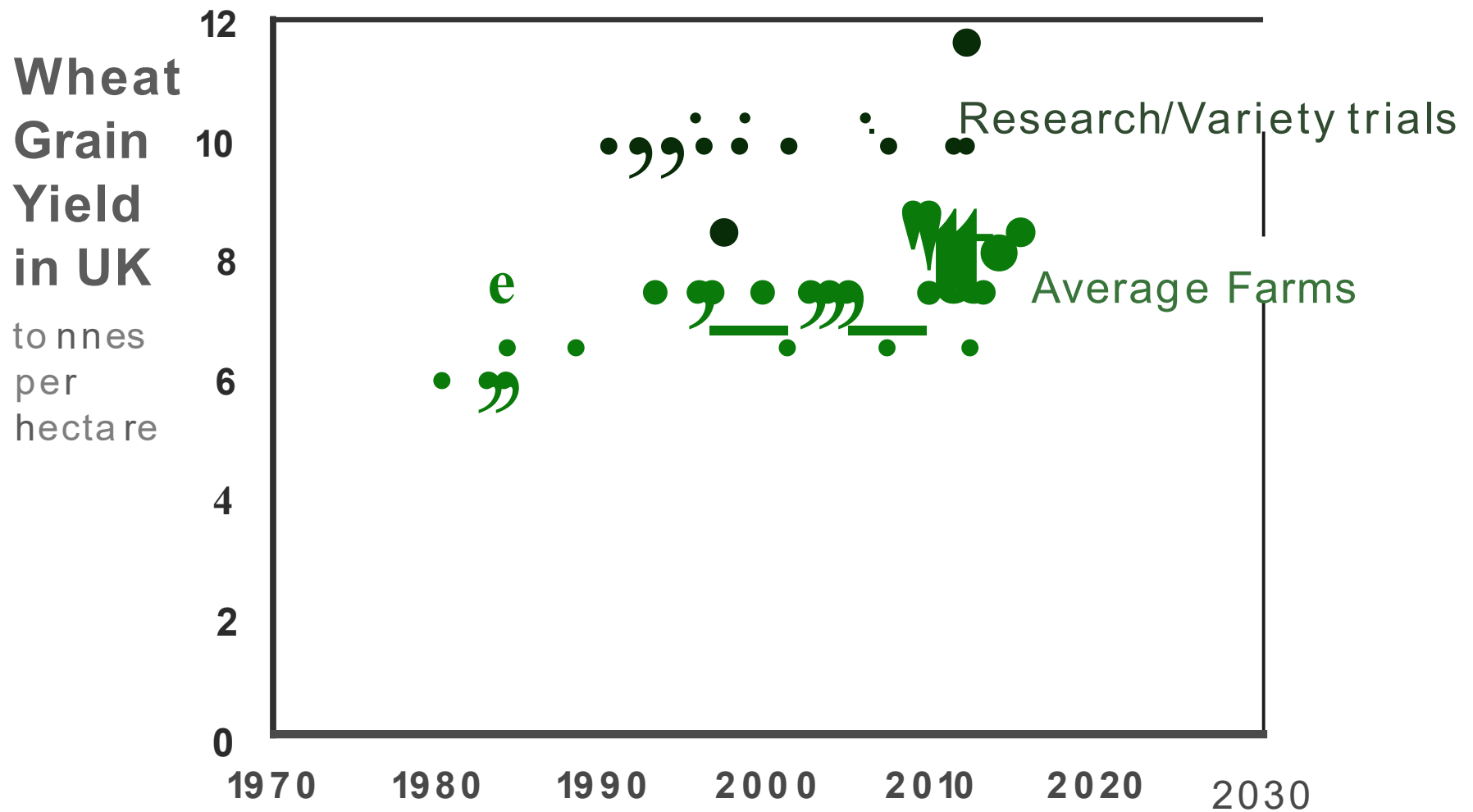
Soft wheat in 2012



Wheat yields plateauing around the world



Wheat yields plateauing in the UK



Explaining Wheat Yields

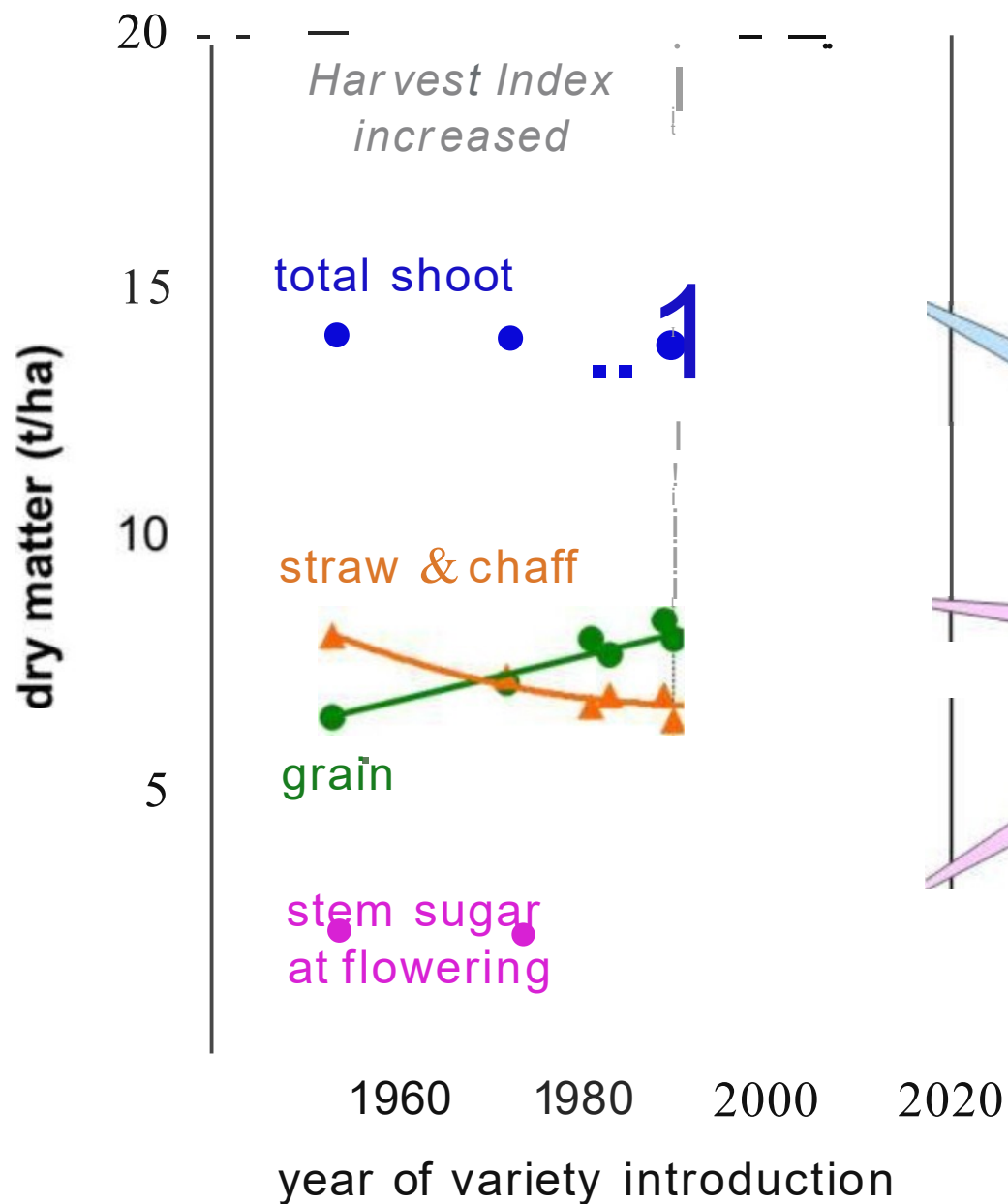
... based on the UK HGCA Wheat Growth Guide 2nd Edn. (2008)





Varieties: two eras of wheat breeding .. UK

Clarke *et al.* 2012, LINK 'ERYCC' project.
9 experiments in 2007-2010.



Variety growth: two eras of UK breeding

More Biomass
requires
More Water

More late
growth required

Clarke *et al.* 2012, LINK 'ERYCC' project.
9 experimental lines in 2007-2070.

Varieties & Development

Feed wheat varieties

Thermal time
(base 0 °C)
from sowing
(°C days)

3,000

2,000

1,000

0

1950

1970

1990

2010

Year of introduction

Maturity
(GS87) +1.5 °Cd / year

= +3-4 days

Anthesis
(GS61)

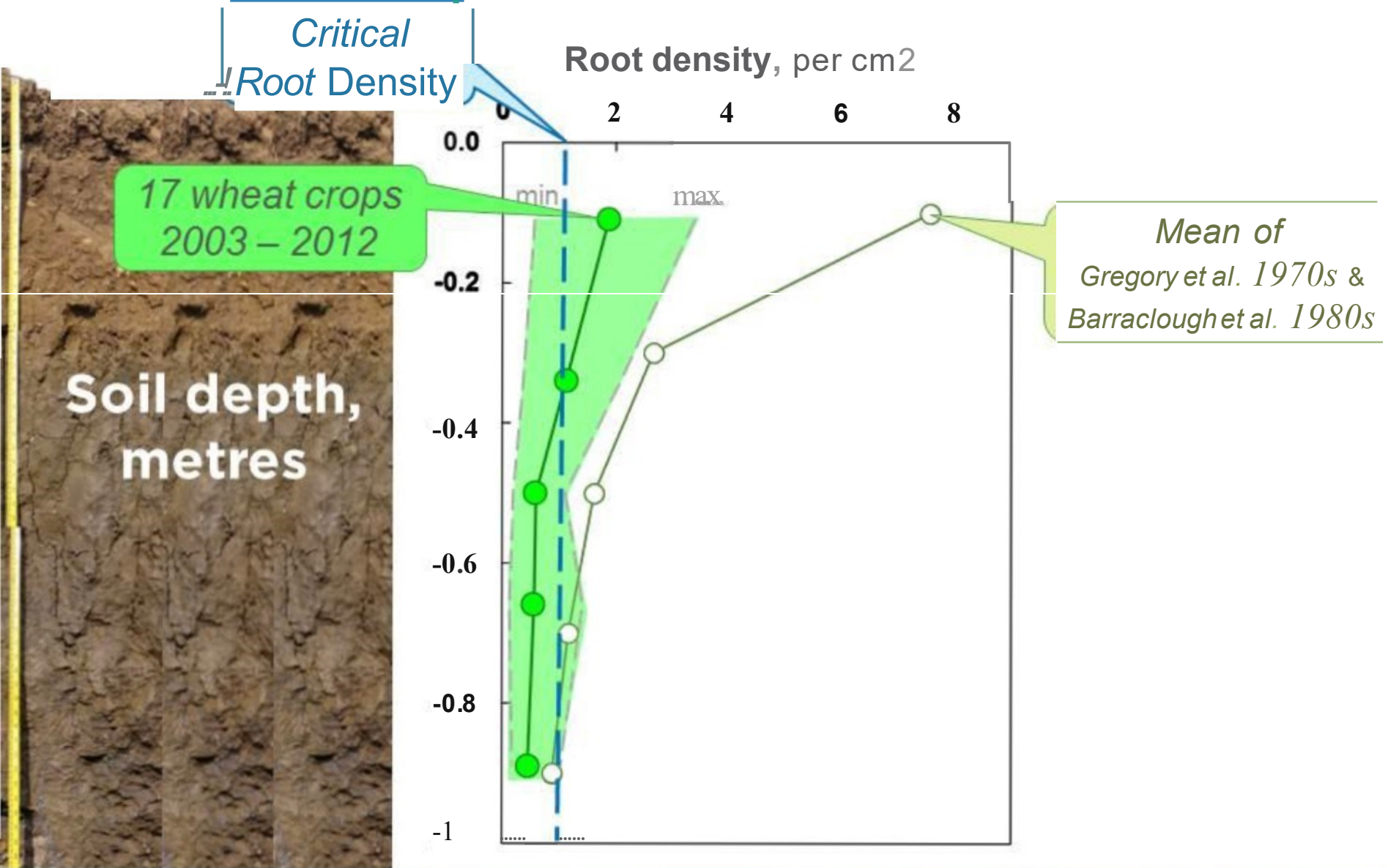
Stem extension +1.7 °Cd / year
(GS31)

= +8-9 days

Foundation

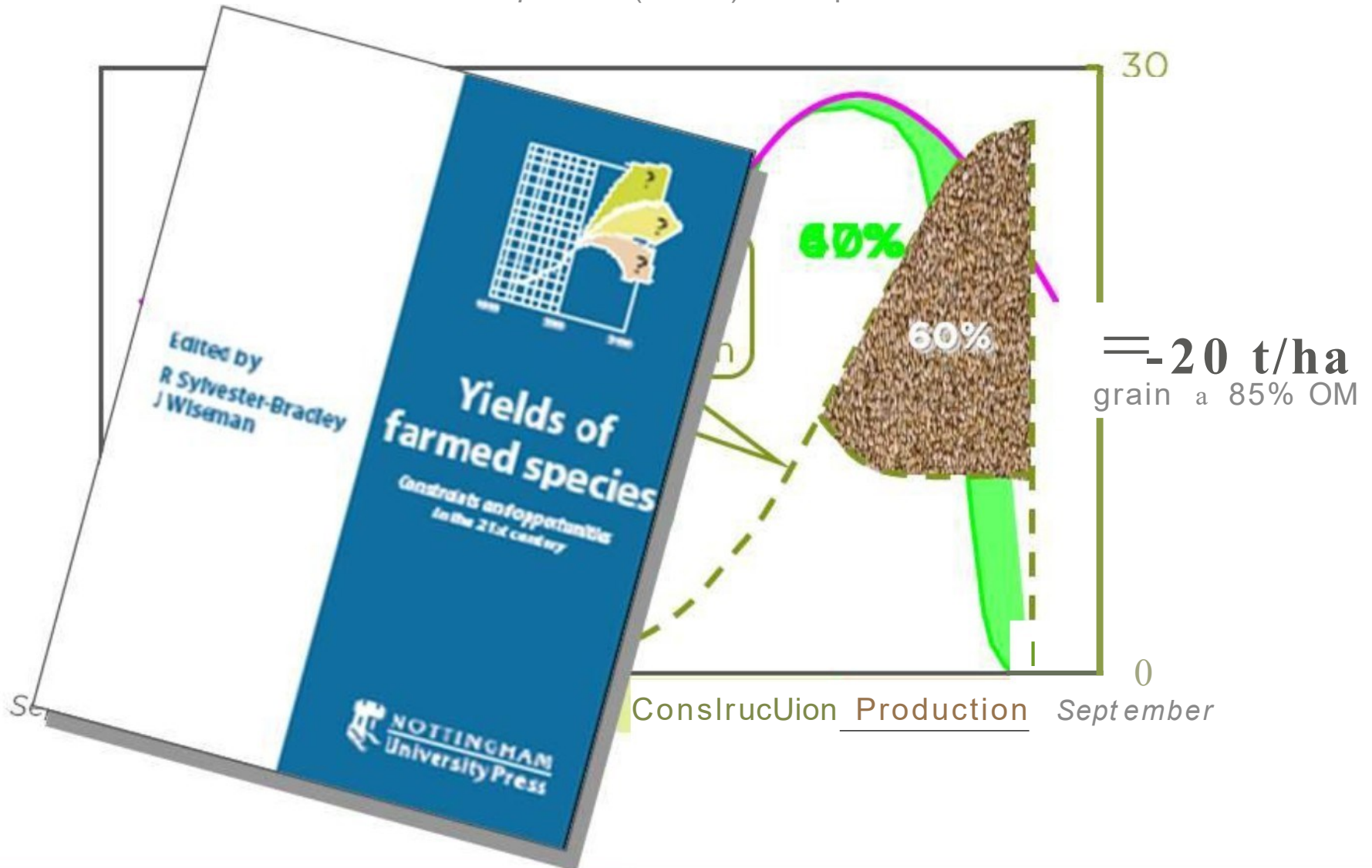
Clarke *et al.* 2012, LINK 'ERYCC' project.
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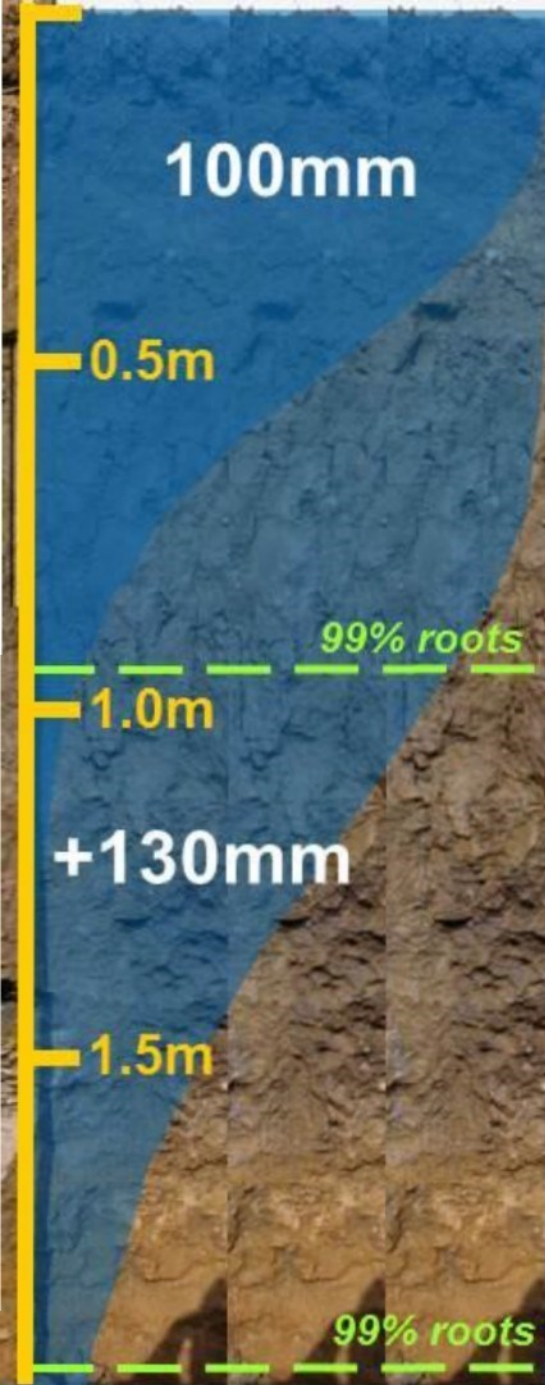
On-farm capture of soil resources



Estimating *bio-physica/ potential* cereal yields

... based on *Yields of Fanned Species* (2005) Chapter 11: 'Wheat





Soil water capture

	Now	Potential
• Grain yield @ 85%DM	11 t/ha	20 t/ha
Summer biomass growth	16 t/ha	25 t/ha
Conversion .. t/ha/100mm	5	5.5
• Summer water demand	320 mm	450 mm
<i>Av. April-July rainfall</i>	<i>say 220 mm</i>	
• Target soil capture	100 mm	230 mm
<i>S storage per metre</i>	<i>say 170 mm</i>	
• Rooting depth	0.9 m	1.8 m
Root biomass, t/ ha	>0.25	1.7

Annual Resources for UK crops

Solar energy

~35 TJ / ha

60% interception = 21 TJ / ha

Convert @ 1.4 t / TJ

Water

summer rain + soil storage

75% capture soil water to 1.8 m

Convert @ 5.5
t/ha / 100 mm

@ 170 mm / m = 230 mm

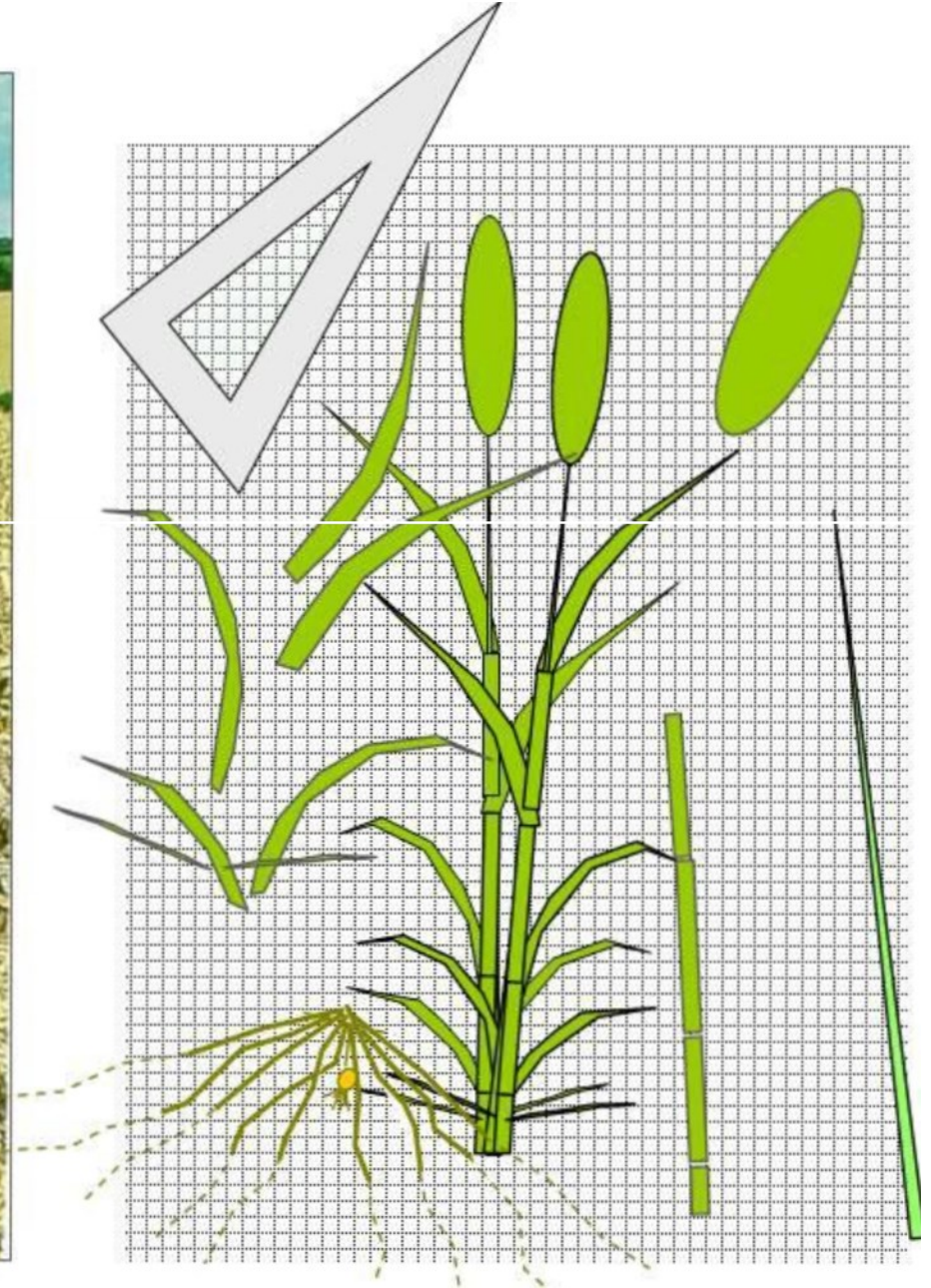


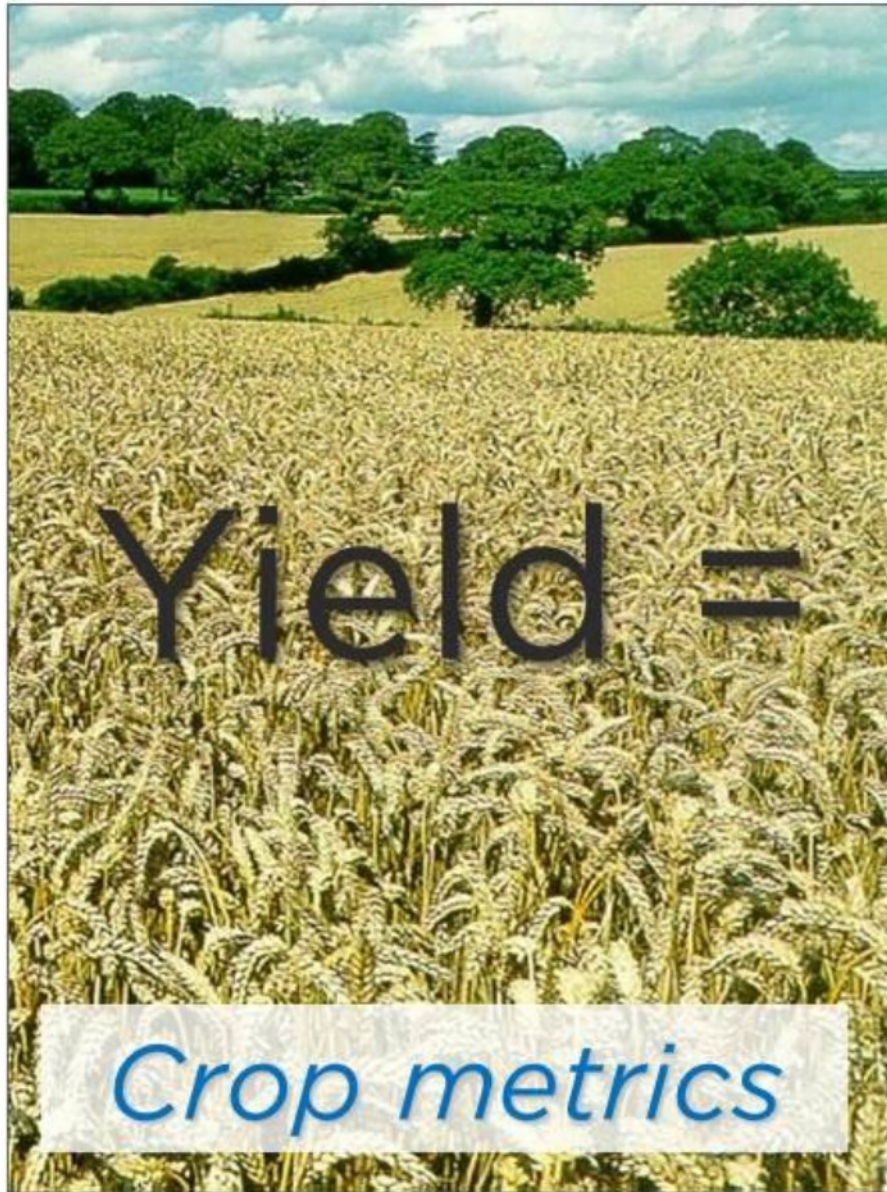
Minimum Straw & Chaff ? —40% biomass

Berry, P M *et al* (2001) Ideotype design for lodging resistant wheat *Euphytica* 154 165-179

Foulkes MJ *et al* (2010) Realising yield potential of wheat III Optimizing partitioning *J Exp Bot* 62 469-486

Sylvester-Bradley, R *et al* (2012) Designing resource-efficient ideotypes *Field Crops Research* 125 69-82





Resources

TJ/ ha

mm

x Capture

%

%

x Conversion

t/ TJ

t/ ha/ 700mm

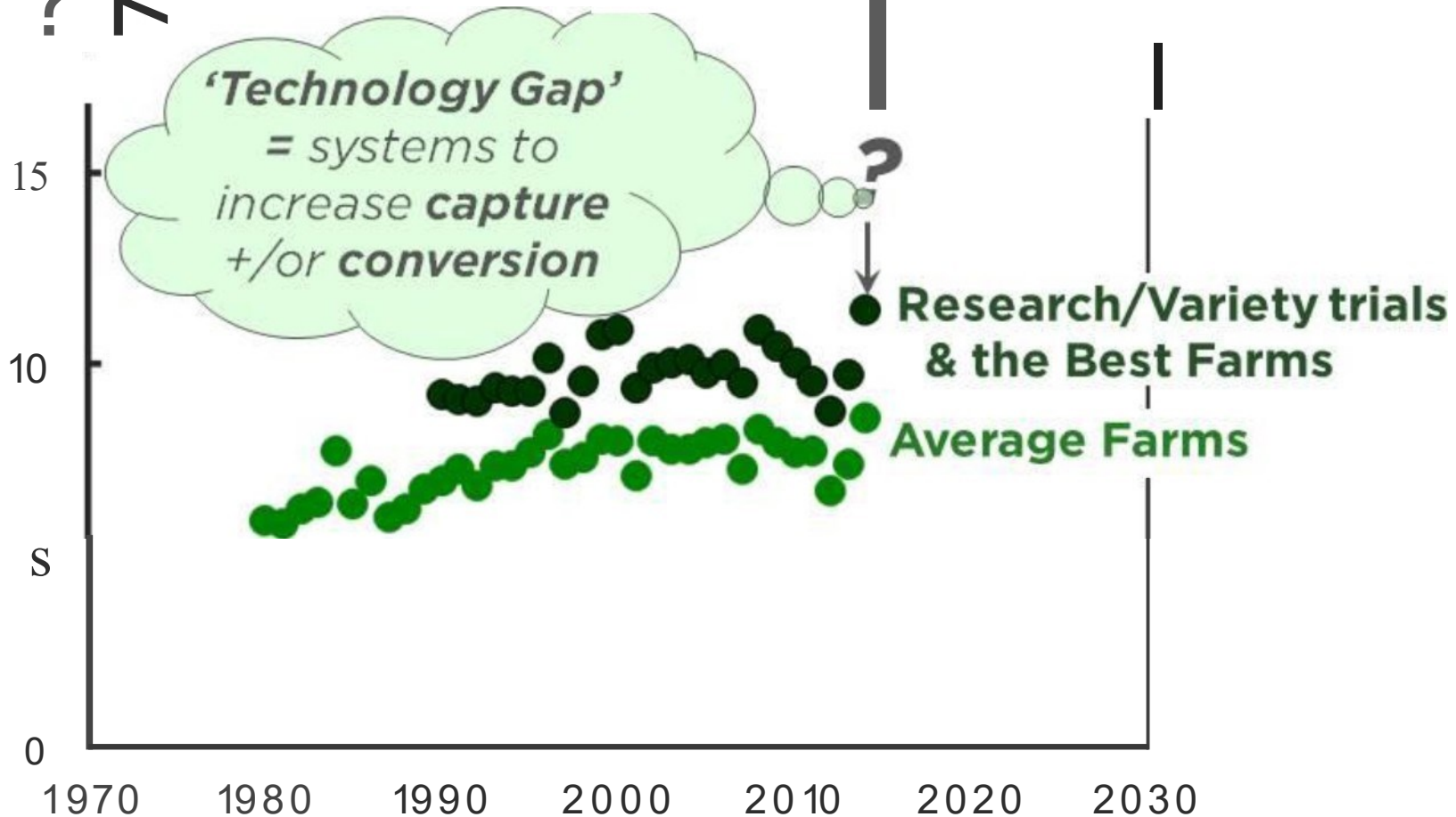
Harvest Index

Bio-physical potential

? 1

Wheat
Grain
Yield
in UK

tonnes
per
hectare



syngenta



www.yen.adas.co.uk



Limagrain
United Kingdom





Aims:

- To identify arable innovators
and
- Support their innovating

*2073, 2074, **2015** ...*

- Cereal Yield Contest

... open to anyone

- Highest Grain Yield

... fields & trial plots

- Highest % of Potential Yield

... fields & trial plots

- With crop analysis - relating to bio-physical potential

Ultimately ...

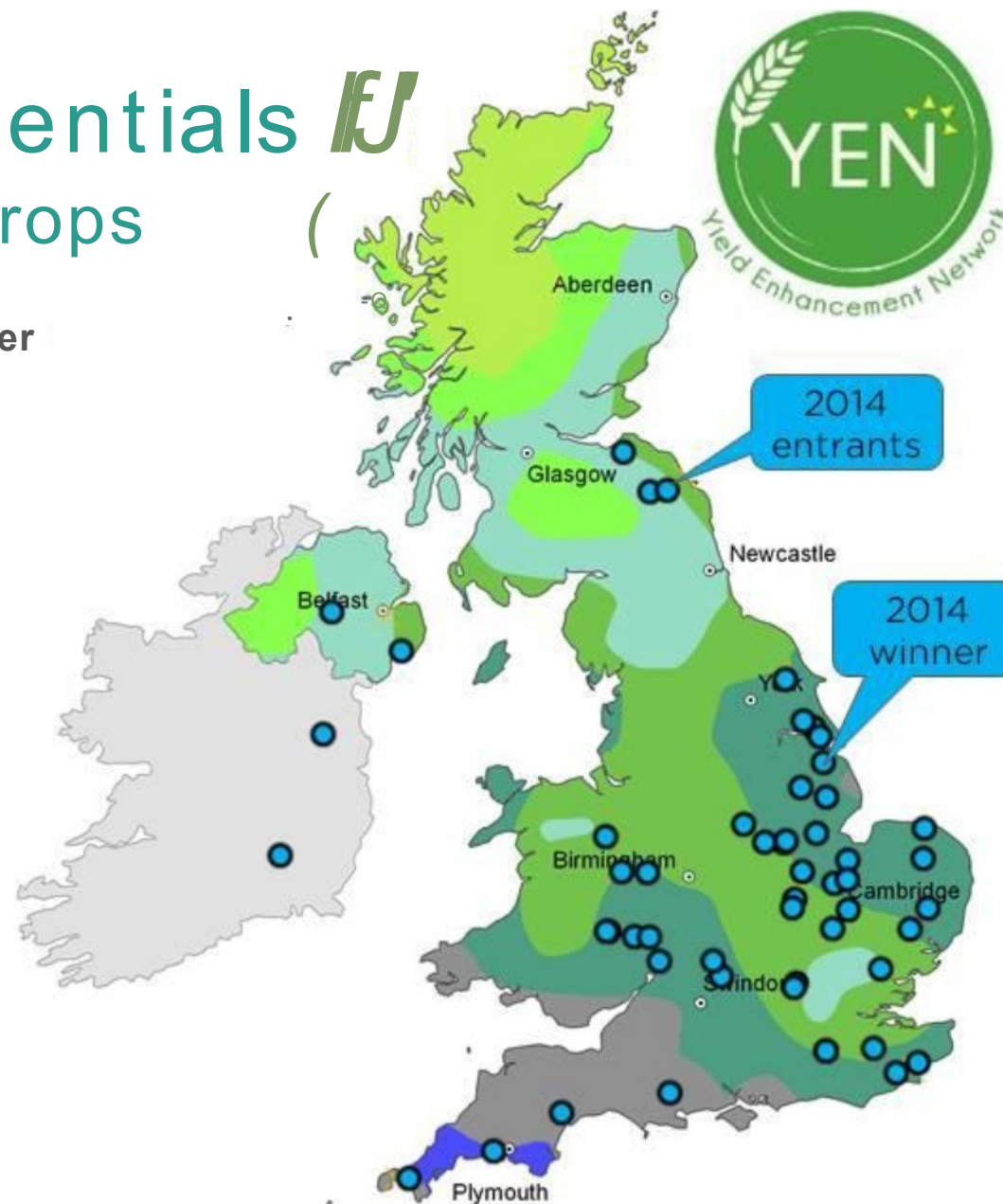
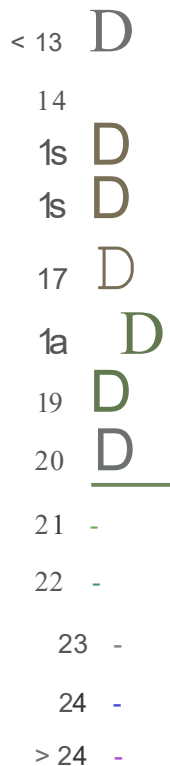
- A platform for industry-science synergies

Bio-physical potentials *EU*

... of annual cereal crops

Potential grain yield with av. weather
(retentive soils)

t/ha



UK Record Yield 2014

- Grain cv. Kielder 14.5 t/ ha
 - a 85% DM & 11.0% protein - 340 kg/ ha crop N
- Incident Solar Energy: 37 TJ/ ha
- Summer Water Supply: 325 mm
 - 211 mm summer rain plus 113 (?) mm soil water
- Nitrogen Supply: 360 kg/ ha
 - After peas, 80 kg/ ha soil N supply
 - 280 kg/ ha fertiliser N applied.
- ESTIMATED POTENTIAL 19.0 t/ ha
Yield achieved : 76% of potential



Tim Lamyman, Worlaby,
near Louth, Lincs, UK

World Record 2010

- Grain cv. Einstein 15.7 t/ ha
 - 15% MC & 11% protein ... -320 kg/ ha crop N
- Incident Solar Energy: 50 TJ/ha
 - Mean temp: 11.6 °C (UK non m 14.6 °C)
- Summer Water Supply: 660 mm
 - 394 mm summer rain plus >200 mm soil water
- Nitrogen Supply: 535 kg/ ha
 - After peas. 85 kg/ ha soil N supply
 - 450 kg/ ha fertiliser N applied.
- ESTIMATED POTENTIAL 25.7 t/ ha
Yield achieved : 61% of potential



YEN 2013 & 2014 - explanation of variation



Explanatory power, R^2

- Ears / m² 0.06
- Grains / ear 0.02
- Grains / m² 0.14
- TGW, g 0.10
- Harvest Index 0.06
- Grain N, %DM -0.04
- Biomass, t/ha 0.81

Conclusions

- Unfulfilled genetic potential
 - Biomass production is crucial
 - Root & Canopy management
 - Biomass requirements not recognised on-farm ..or by breeders!
 - Faster yield progress needs
 - Farm $\leftrightarrow$ Lab.
 - Respect .. Exchange*
- ... a shared 'language'
- Concepts. Metrics & Targets.



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and please contact the



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