How can we reduce the nitrogen requirement for breadmaking wheats?

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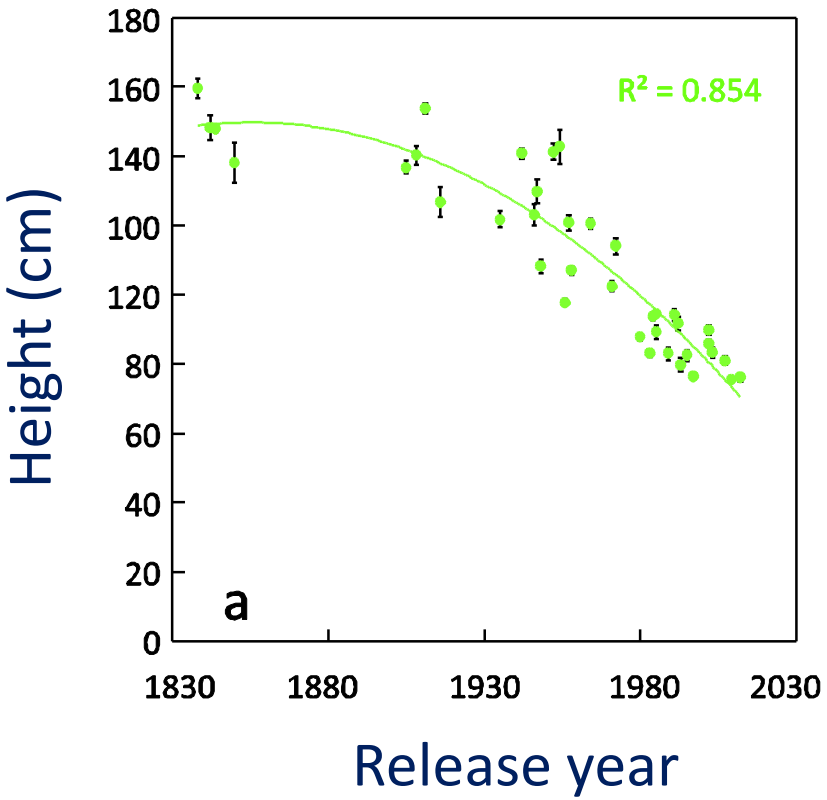
Background

Grain protein content is an important quality trait

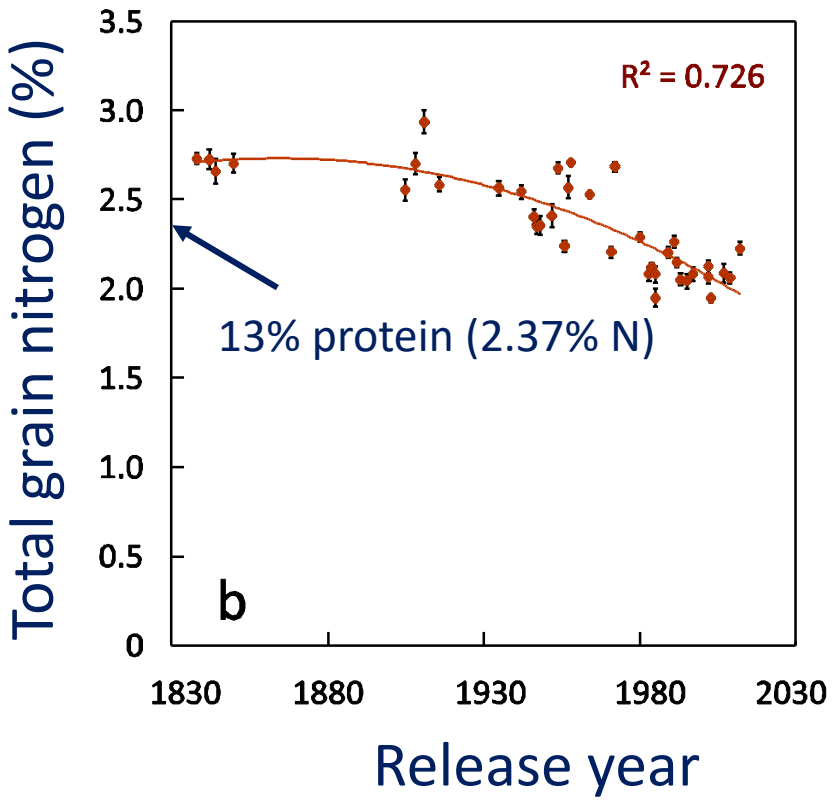
- UK millers require breadmaking wheats containing 13% protein
- Higher levels are required for special uses
- 10 tonnes of grain at 13% protein contains 228 kg N
- If we assume 80% N recovery in grain and 50 kg/Ha residual soil N this requires about 235 kgN/Ha

Modern high yielding wheats have reduced heights and lower protein contents

Height



Protein



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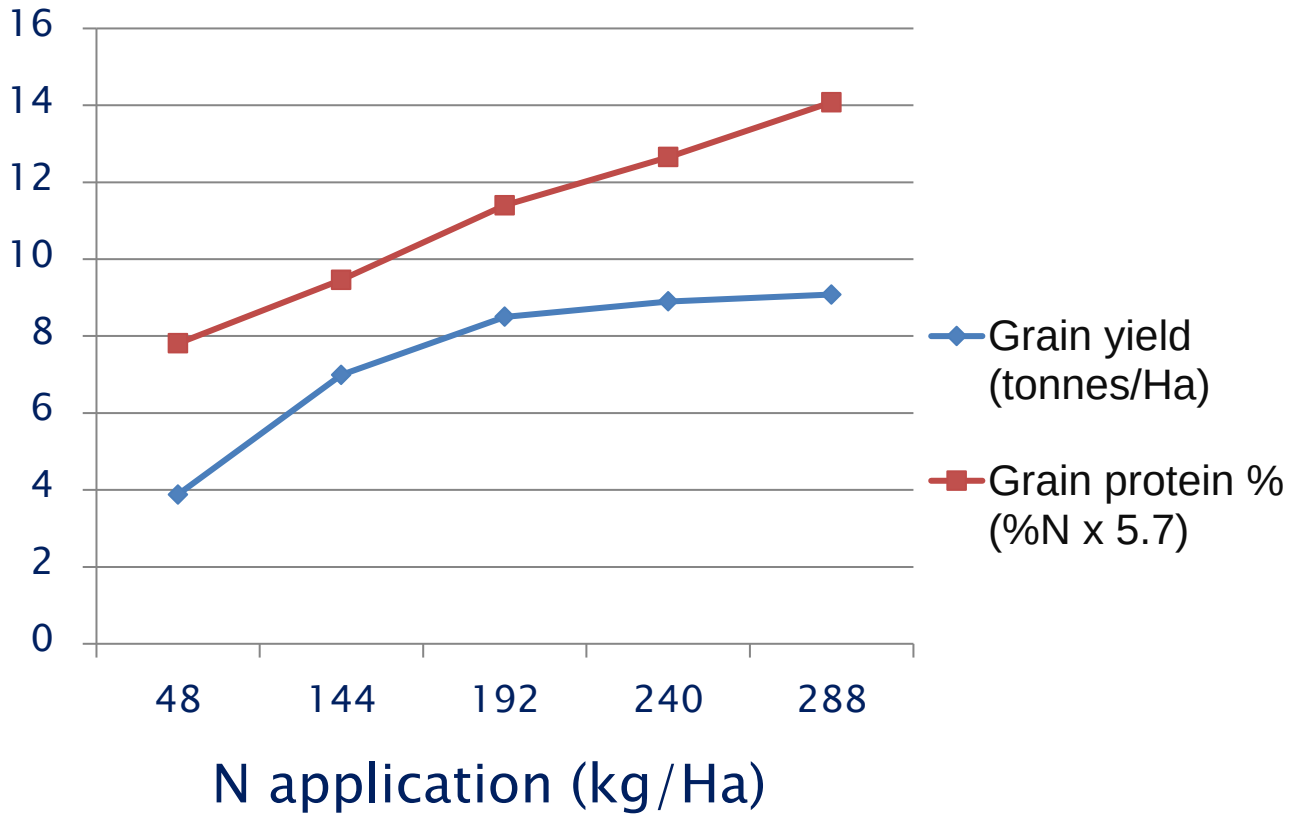
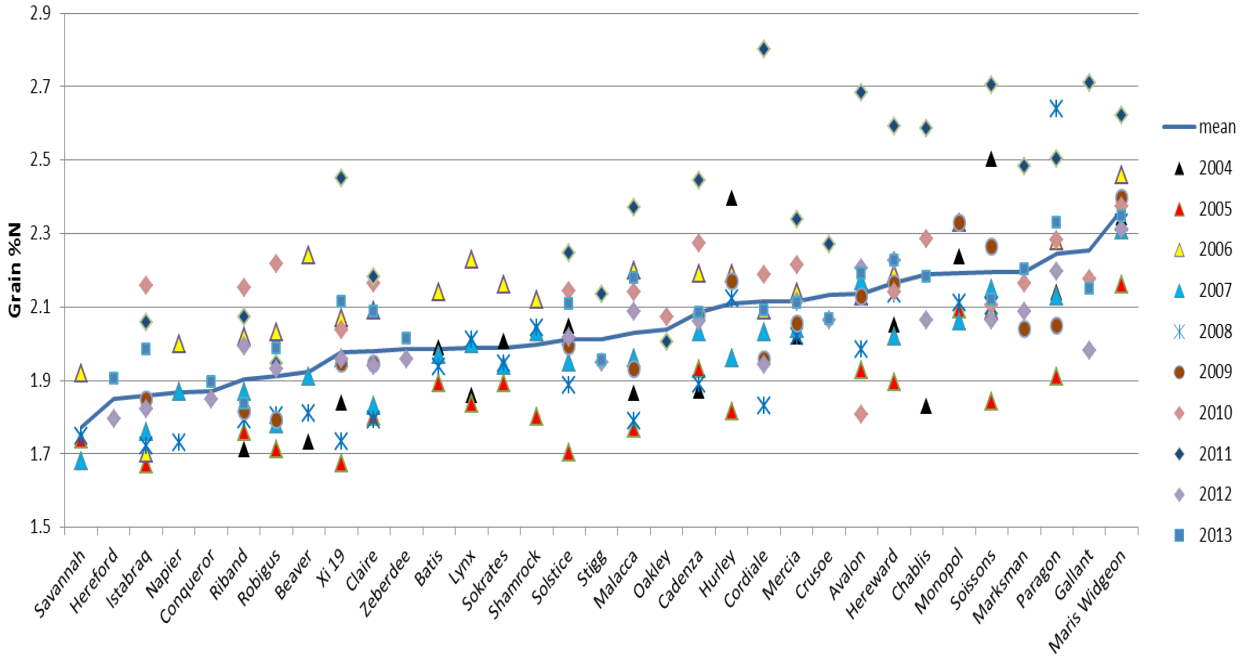
The high grain protein requirement for bread making results in N applications above the optima for yield and N use efficiency



Cultivars vary in their grain N contents



Data for 33 UK cultivars grown at least 2 years between 2004 and 2013 at 200 kg N/Ha varieties

Developing new types of wheat with good bread making quality at low protein content

BBSRC LINK/AHDB Project: 1 Jan 2016 to 31 Dec 2019

Academic Partners

RRes: Malcolm Hawkesford, Abby Wood, Till Pellny

JIC: Simon Griffiths

CBRI: Clothilde Baker, Simon Penson

Breeders

DSV, KWS, Saaten Union, Secobra, Limagrain

Milling and baking

Hovis Ltd., Heygates, Whitworth Bros, ADM, Warburtons, ATC

Agronomy

Agrii

June 2020

Project Report No. 621

Low protein wheat for bread making

Peter R Shewry[1], Abigail J Wood[1], Kirsty Hassall[1] Till K Pellny[1], Andrew Riche[1], Abrar Hussein[1], Malcolm J. Hawkesford[1], Simon Griffiths[2], Simon Penson[3], Gary Tucker[3] and Clothilde Baker [3]

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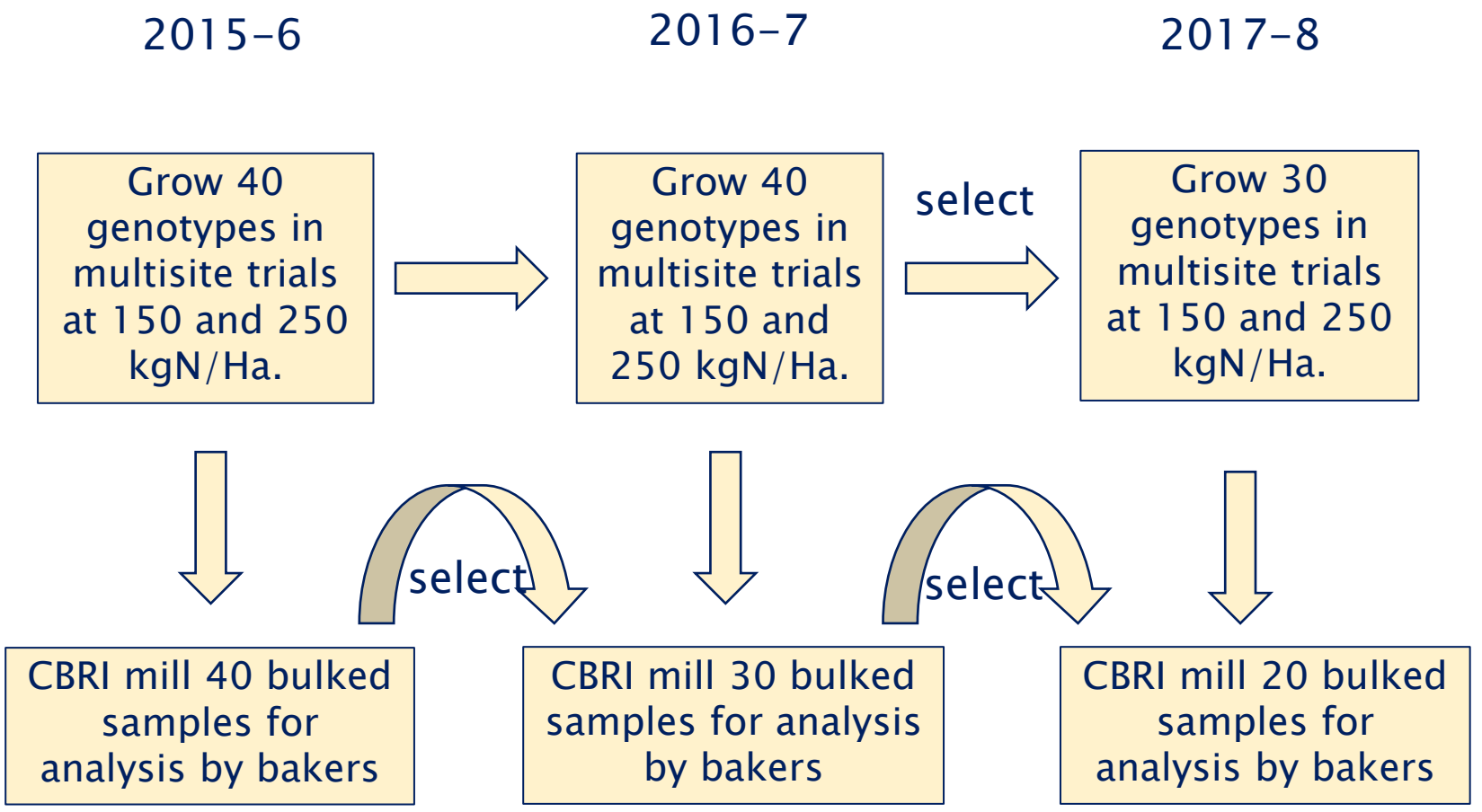
[3]Campden BRI, Station Road, Chipping Campden, Gloucestershire GL55 6LD, UK

This is the final report of a 48-month project 21130005 that started in January 2016. The work was funded by BBSRC and a contract for £90,000 from AHDB Cereals & Oilseeds.

Strategy



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Baking performance overview

Variety	N Level with better baking performance	Variety	N Level with better baking performance
JB Diego (UKG4)	Equal	Hereward (UKG1)	Equal
Skyfall (UKG1)	Low	Xi19 (UKG1)	High
Crusoe (UKG1)	Equal	Mv Lucilla (H)	Low
Gallant (UKG1)	Equal	Memory (G)	High
KWS Trinity (UKG1)	Equal	Rumor (G)	Equal
Cordiale (UKG2)	High	Nelson (G)	Equal
KWS Lili (UKG2)	High	Hybery SU (Hybrid)	Equal
Paragon (UKSG1)	Equal	Apache (F)	Equal
Granary (UKSG2	High	Genius (DK)	Equal
KWS Siskin (UKG2)	High	Paragon Stay Green	Equal

UK Group 1

Hungarian high protein

German low protein breadmaking

Danish

- Group 1 cultivars showed good and consistent baking performance at both nitrogen levels: Crusoe, Gallant, Rumor, Nelson and Genius
- Group 2 cultivars gave better performance at low nitrogen: Skyfall and Mv Lucilla

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Conclusions

Groups 1 and 2 cultivars had

- higher %N
- GPD
- Higher dough elasticity (R/E)
- higher proportions of glutenins compared with gliadins

Group 2 cultivars had

- higher proportions of high molecular weight glutenin polymers

Hence, good performance at low N fertiliser resulted from two factors:

- efficient translocation of N into the grain (GPD)
- increased proportions of total glutenin and large glutenin polymers.

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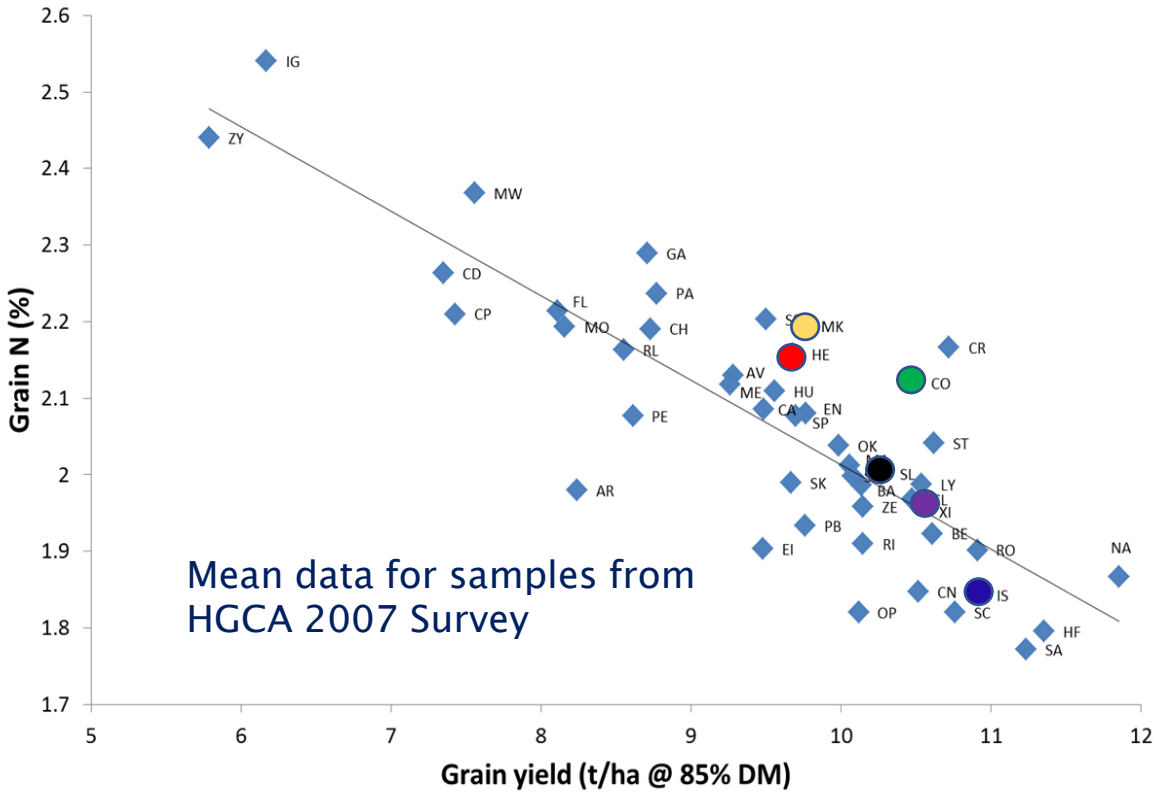
Some cultivars show Grain Protein Deviation (GPD)

BBSRC IPA/AHDB Project (2009–2012)

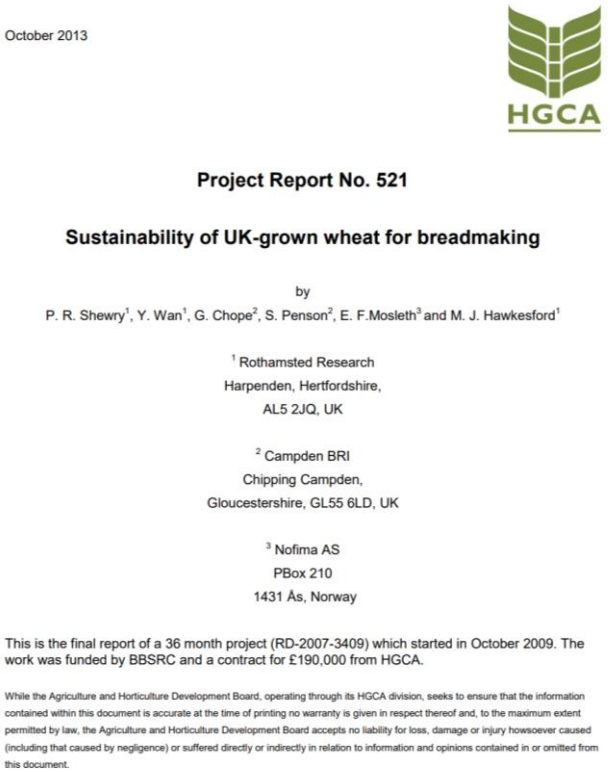
GPD
Green: Cordiale
Red: Hereward,
Yellow: Marksman

No GPD
Black: Malacca,
Purple: Xi19

Negative GPD
Blue: Istabraq



Mean data for samples from HGCA 2007 Survey



October 2013

HGCA

Project Report No. 521

Sustainability of UK-grown wheat for breadmaking

by

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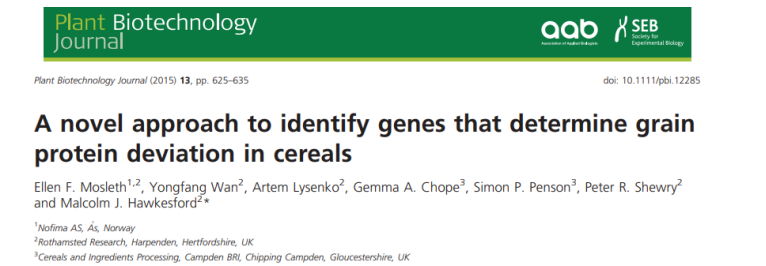
1431 Ås, Norway

This is the final report of a 36 month project (RD-2007-3409) which started in October 2009. The work was funded by BBSRC and a contract for £190,000 from HGCA.



Plant Biotechnology Journal

Plant Biotechnology Journal (2015) **13**, pp. 625–635 doi: 10.1111/pbi.12285

A novel approach to identify genes that determine grain protein deviation in cereals

Ellen F. Mosleth[1,2], Yongfang Wan[2], Artem Lysenko[2], Gemma A. Chope[3], Simon P. Penson[3], Peter R. Shewry[2] and Malcolm J. Hawkesford[2]*

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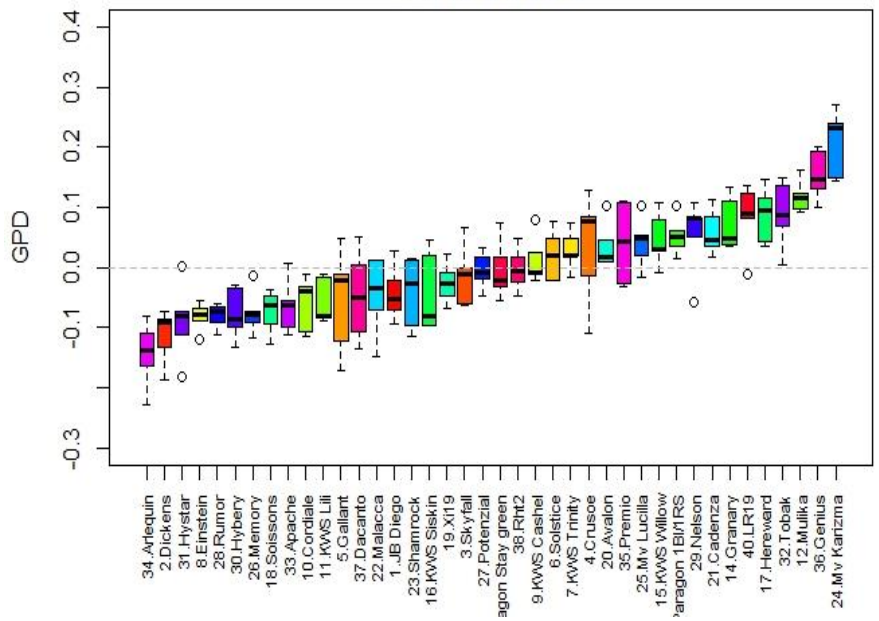
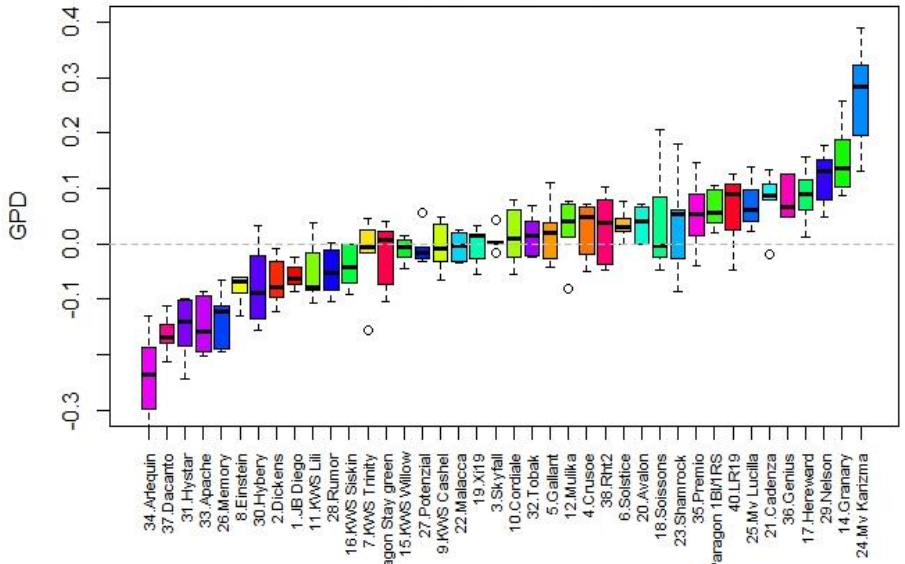
GPD (means of sites) for 3 years

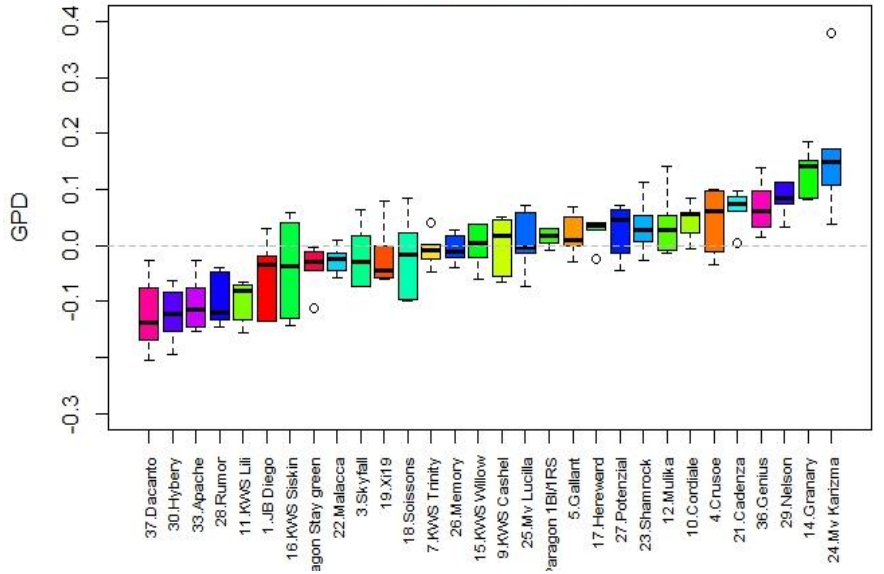
2018: 40 cv and 5 sites



2018: 40 cv and 6 sites



2018: 30 cv and 6 sites



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Genetic variation and heritability of grain protein deviation in European wheat genotypes

Ellen F. Mosleth[a], Marie Lillehammer[a], Till K Pellny[b], Abigail J. Wood[b], Andrew B. Riche[b], Abrar Hussain[c], Simon Griffiths[d], Malcolm J. Hawkesford[b], Peter R. Shewry[b,*]

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[c] Department of Biosciences, COMSATS University Islamabad, Sahiwal Campus, Sahiwal, Punjab 57000, Pakistan
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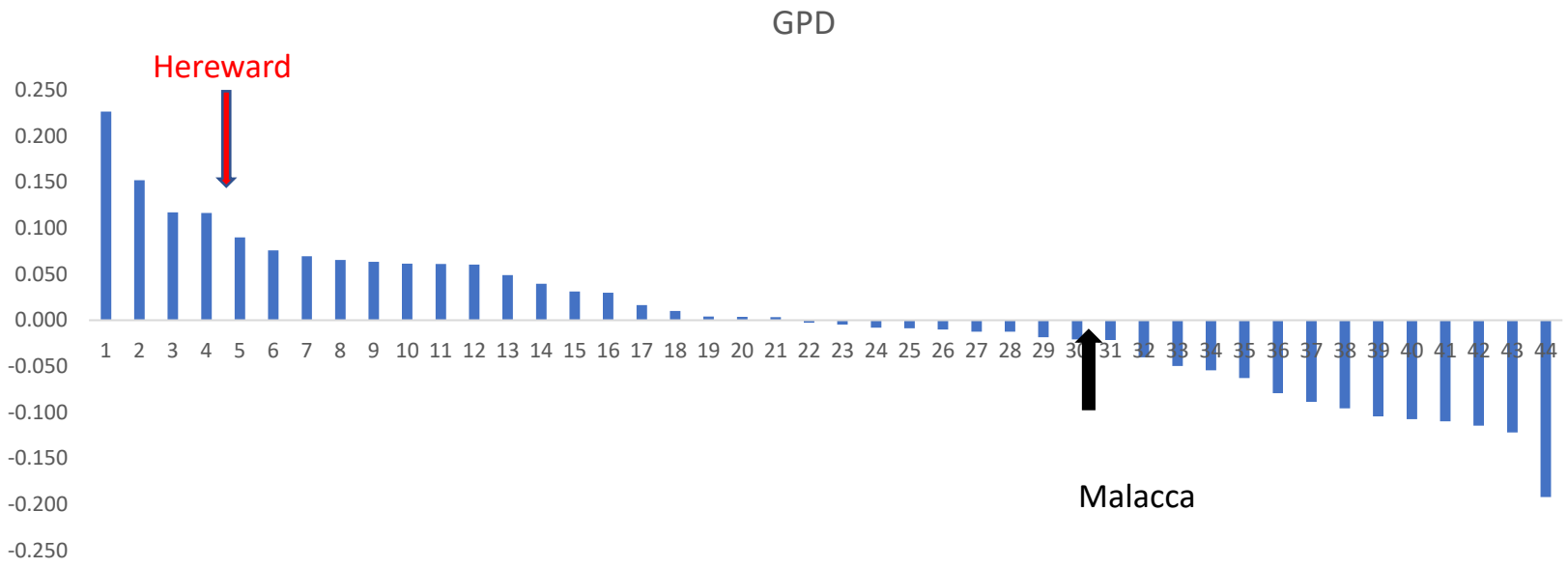
Grain protein deviation in 2016 as means of cultivars

Hereward has significantly higher GPD than Malacca



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