

The WGIN Nitrogen-Diversity Trials

Malcolm J. Hawkesford

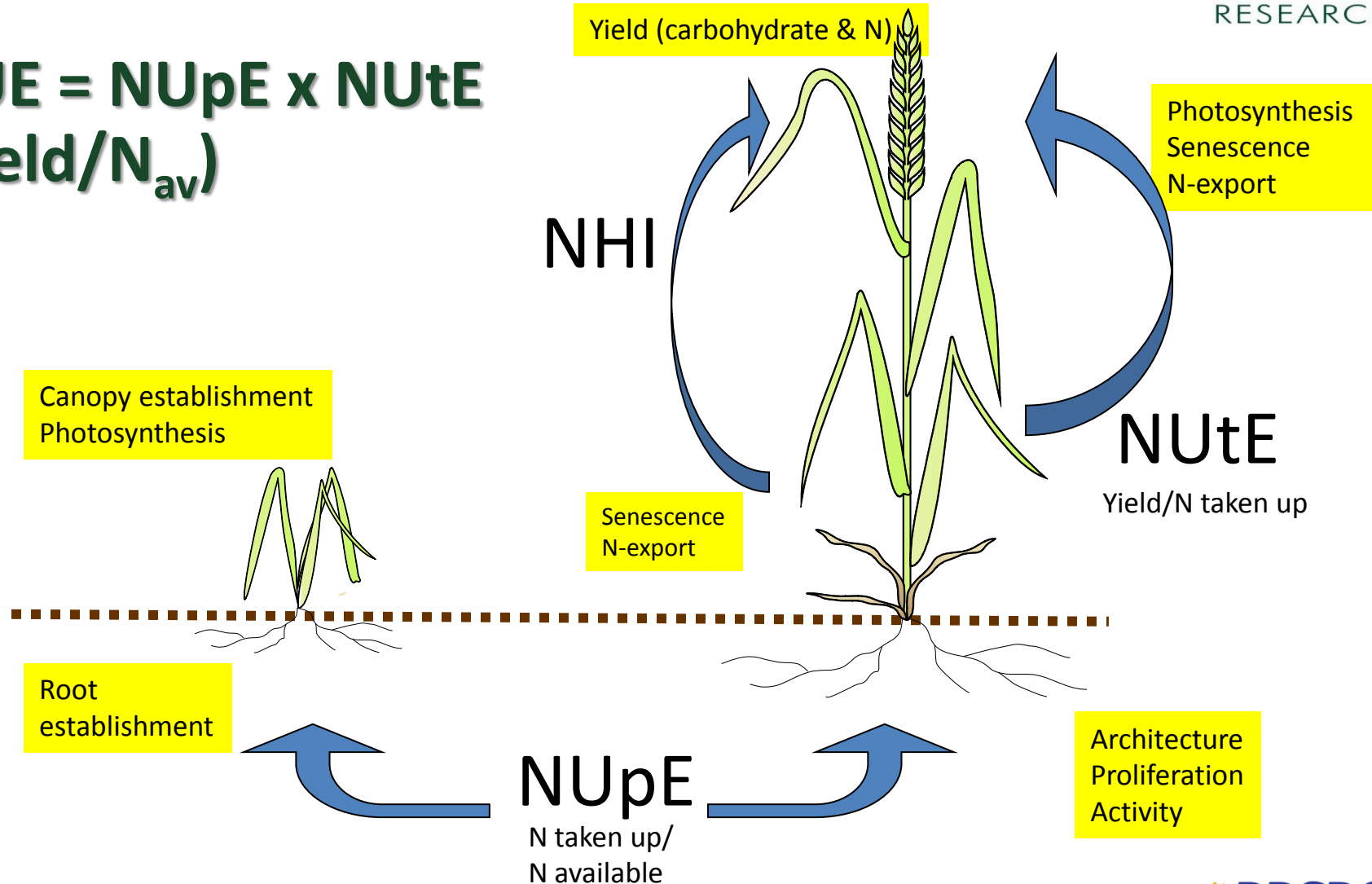
Complexity of the NUE trait



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$$\text{NUE} = \text{NU}_{\text{pE}} \times \text{NU}_{\text{tE}}$$

(yield/ N_{av})



Overview



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- The WGIN Diversity Trials
- Initial aim to examine diversity of NUE in UK wheats
- Example data on yield, stability, N uptake
- Spin-off projects: GPD project, take-all and TAB, WUE, photosynthesis, high throughput field phenotyping

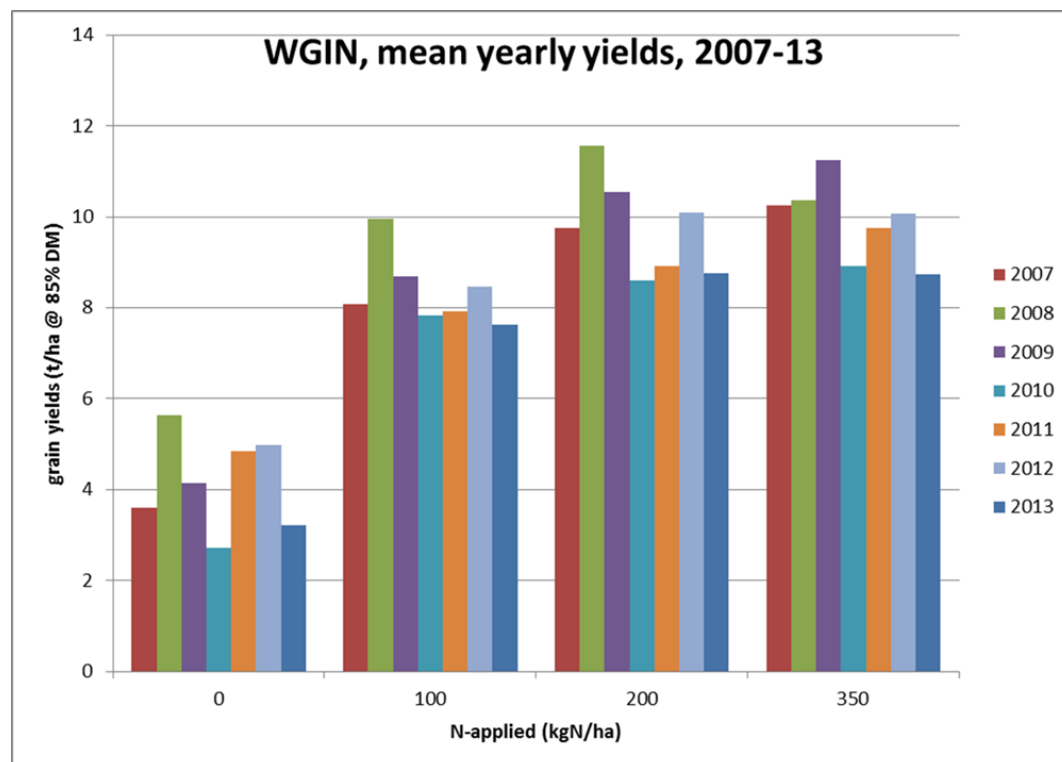


WGIN: The Nitrogen-Diversity trial



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- 2004-13
- 51 varieties
- 14 in at least 9 years
- All 4 nabim groups
- 4 N levels in all except 2 years
- Grain and straw, yield and %N
- Archived fresh grain
- Archived dry milled grain and straw
- Many spin-off projects



Diversity trial history



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Trial	Year	Varieties (core of 9)	N-levels	kg N/ha
1	2004	32	4	0,50,200,350
2	2005	20	2	0,200
3	2006	24	3	0,100,200
4	2007	24	4	0,100,200,350
5	2008	24	4	0,100,200,350
6	2009	24 (include 6 x A x Cs)	4	0,100,200,350
7	2010	25 (include 6 x A x Cs)	4	0,100,200,350
8	2011	25 (include 4 x A x Cs)	4	0,100,200,350
9	2012	25 (include WUE/take-all lines)	4	0,100,200,350
10	2013	25 (include WUE/take-all lines)	4	0,100,200,350

Rothamsted 2013



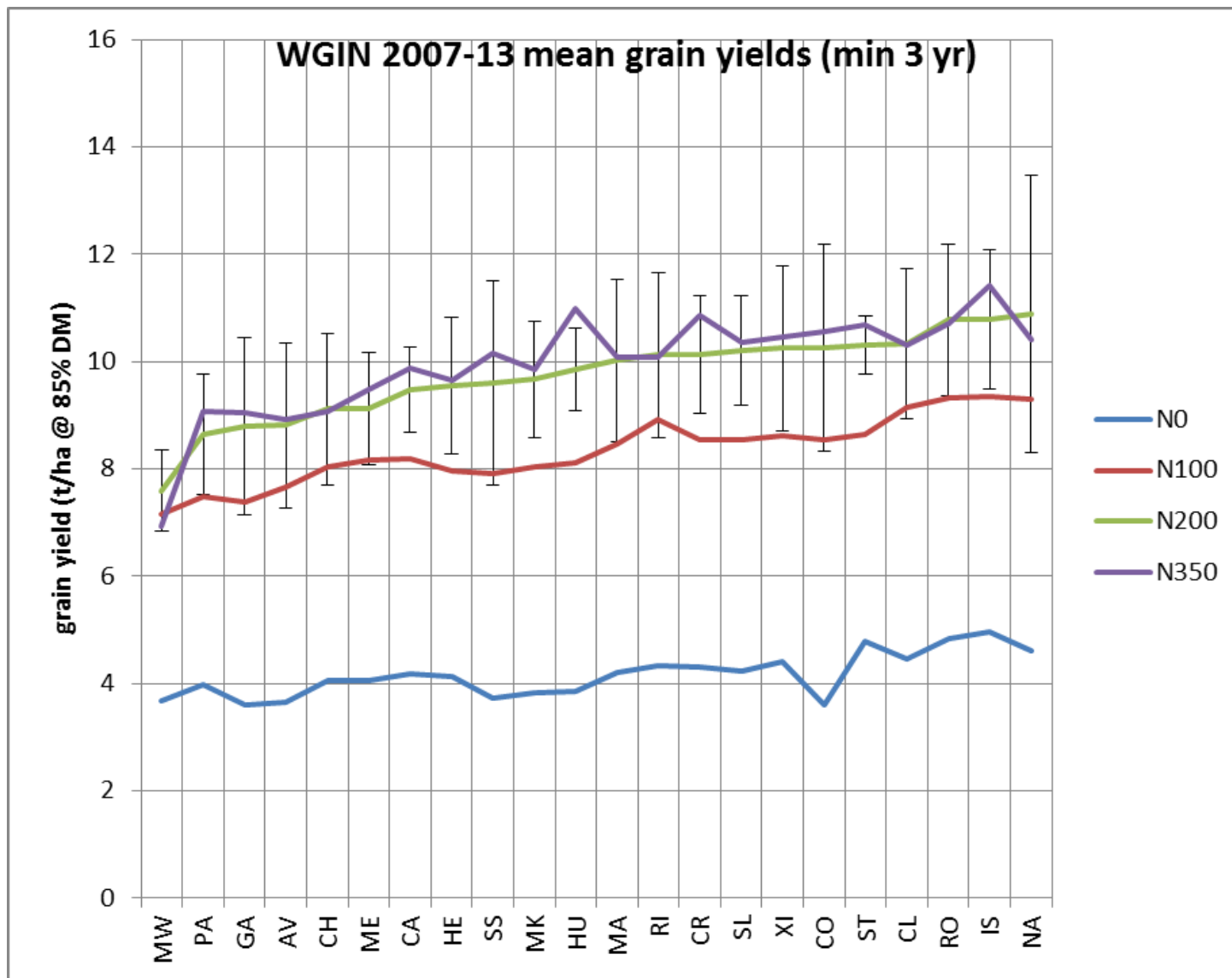
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Grain yields core set



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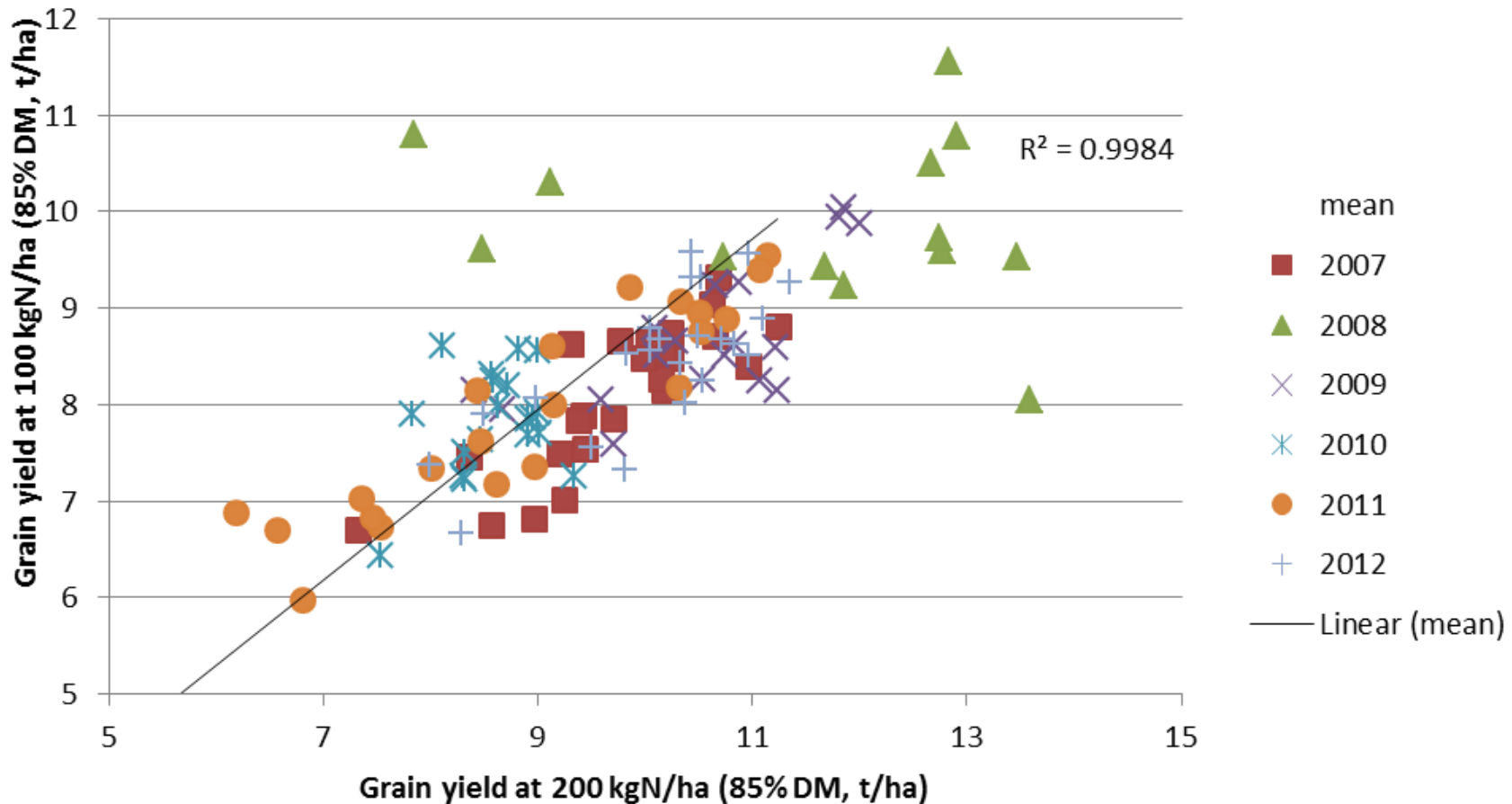


High v low inputs



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WGIN Comparative low N v high N performance (2007-12)



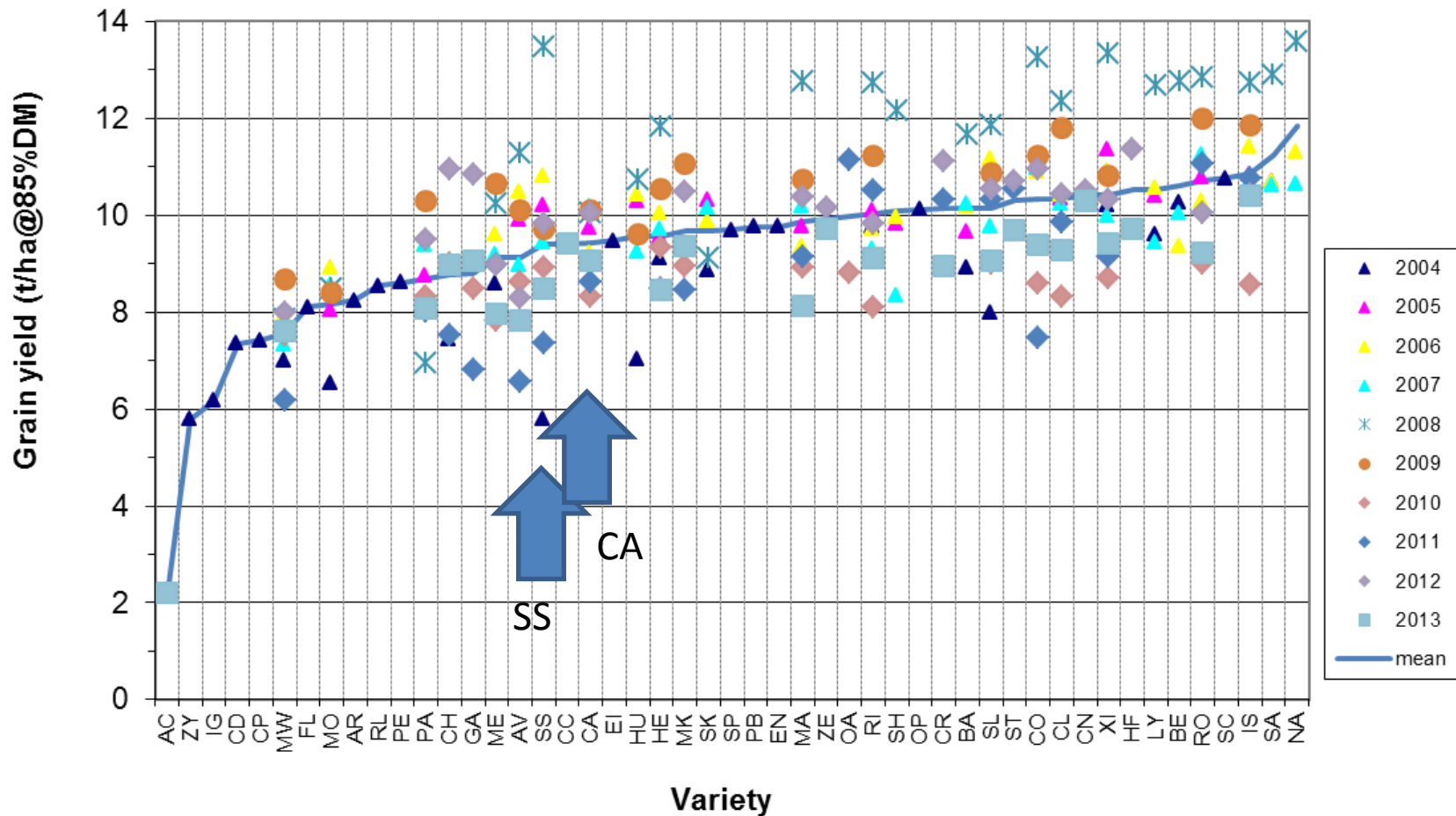
Rothamsted WGIN Trials – yield stability



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Rothamsted WGIN-N200

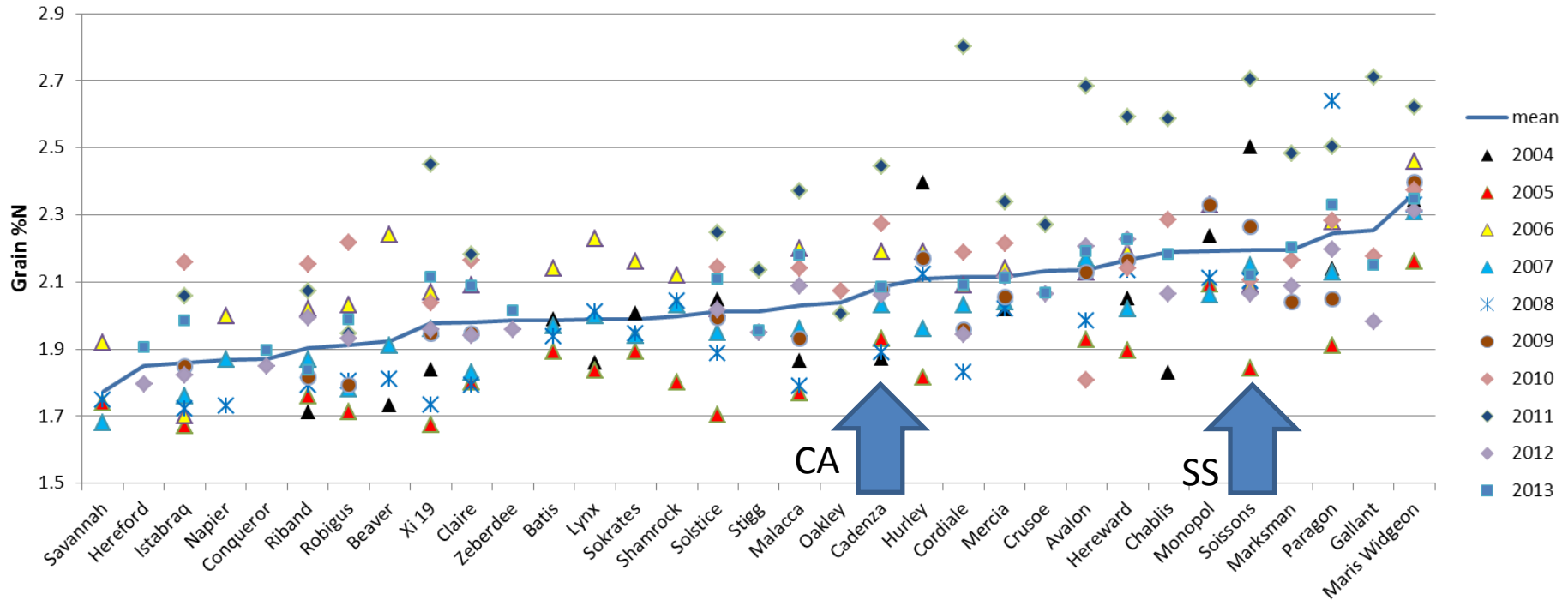
Combine Grain Yield (2004-13)



Grain %N (2004-13)



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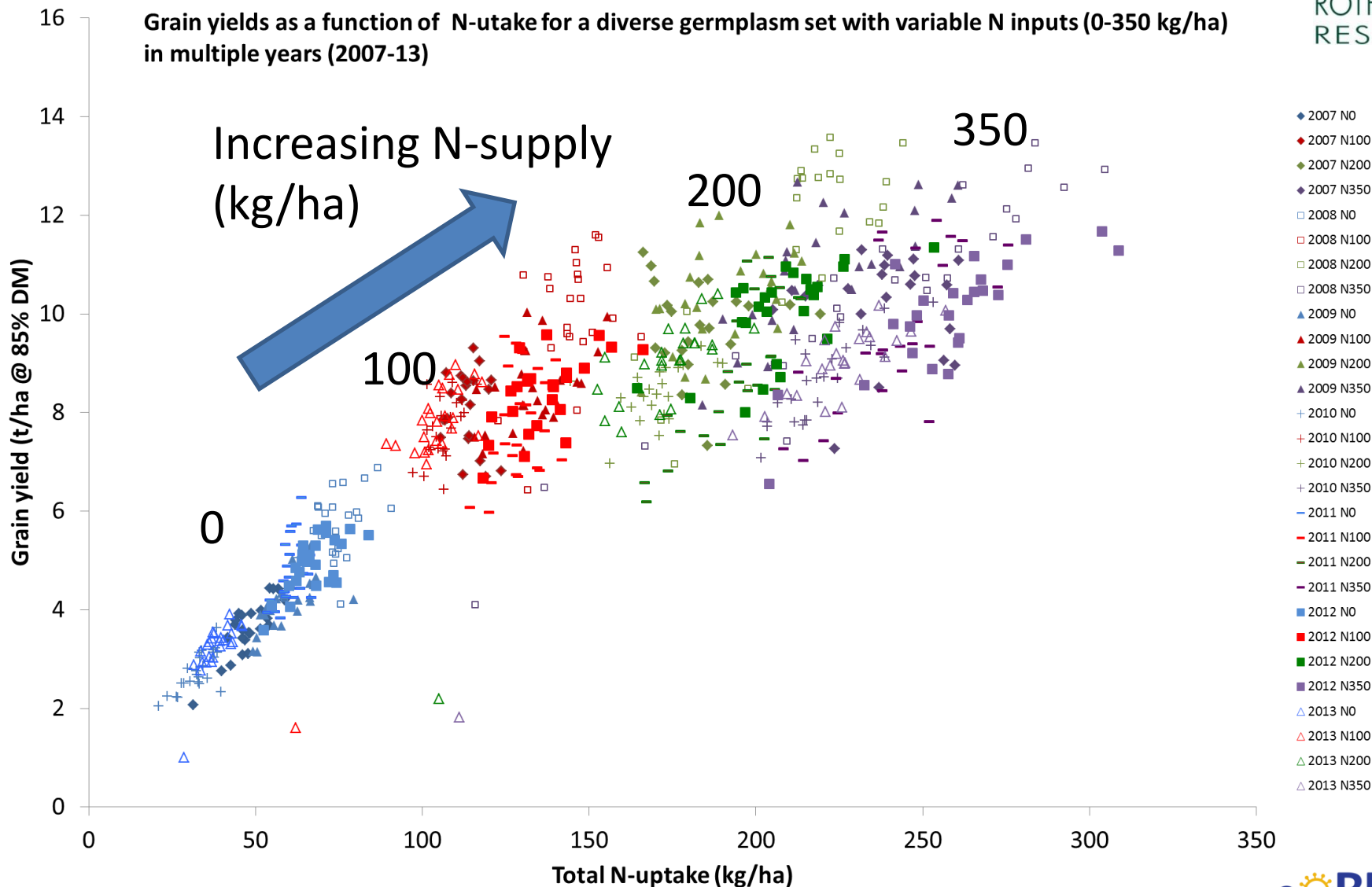


NB only for varieties with more than single year data

N-supply impacts on yields and quality



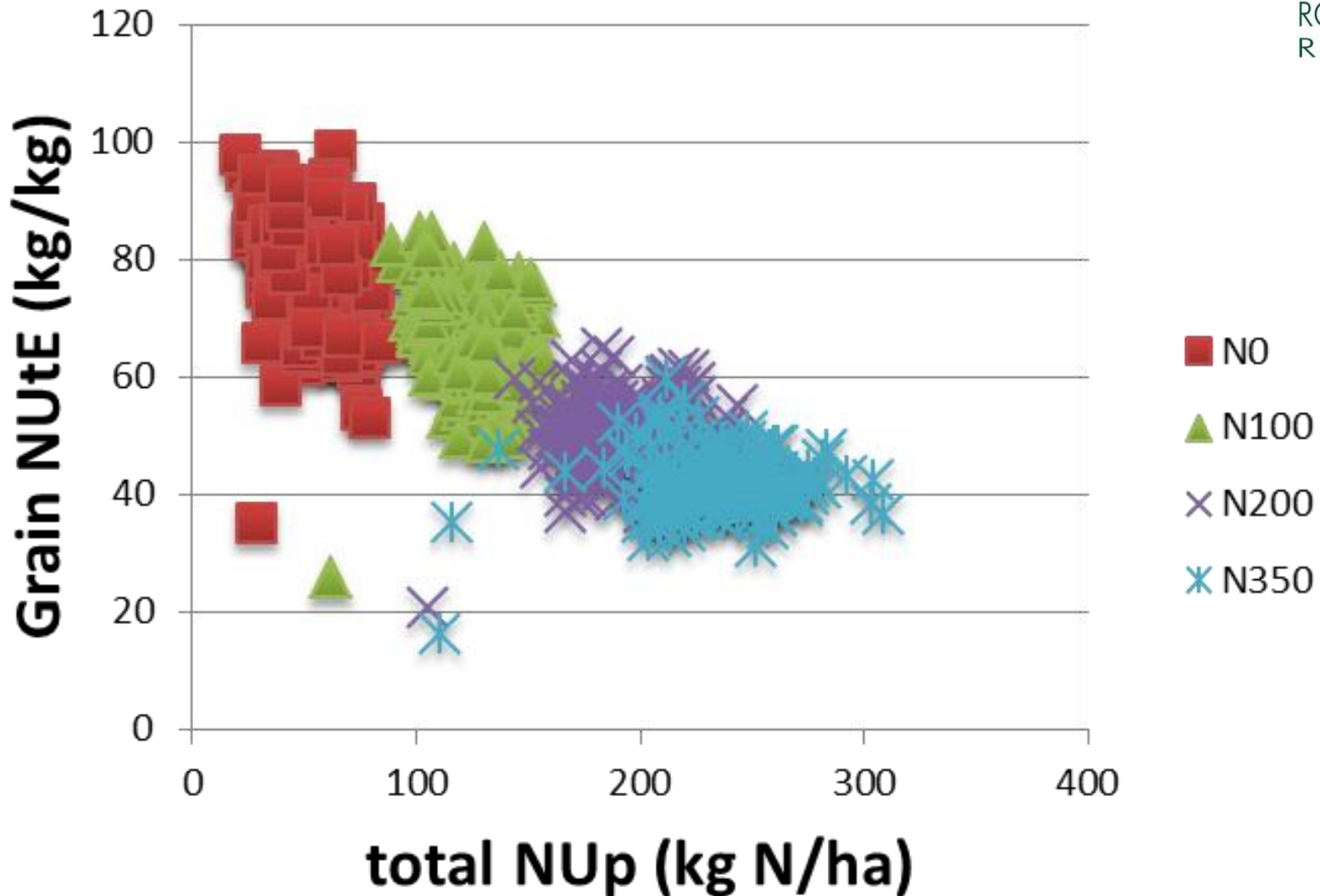
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Do NUtE and NUp correlate?



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Uptake and partitioning



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Field Crops Research xxx (2013) xxx–xxx



ELSEVIER

Contents lists available at [ScienceDirect](#)

Field Crops Research

journal homepage: www.elsevier.com/locate/fcr



Genotypic variation in the uptake, partitioning and remobilisation of nitrogen during grain-filling in wheat[☆]

Peter B. Barraclough^{*}, Rafael Lopez-Bellido¹, Malcolm J. Hawkesford

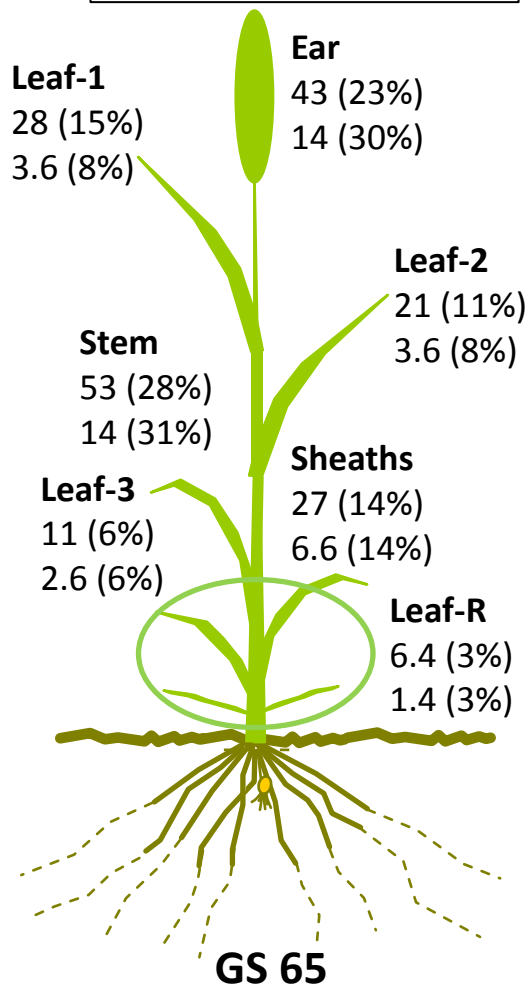
Plant Biology and Crop Science Department, Rothamsted Research, West Common, Harpenden, Hertfordshire AL5 2JQ, UK

Partitioning at anthesis

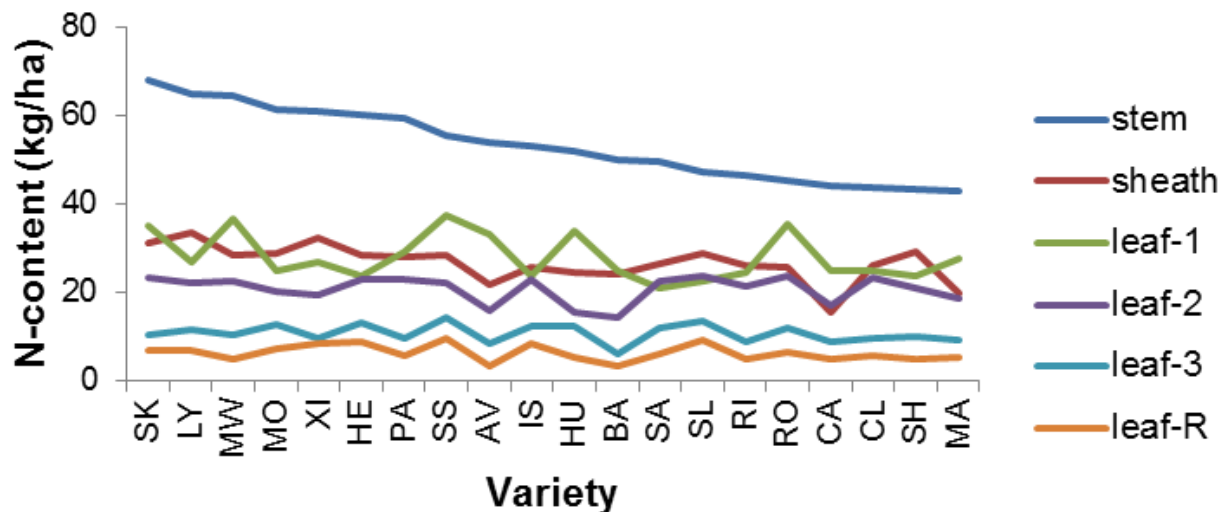


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Shoot total
N200 - 189 kg/ha (100%)
N0 - 46 kg/ha (100%)



GS65-N200 N-content

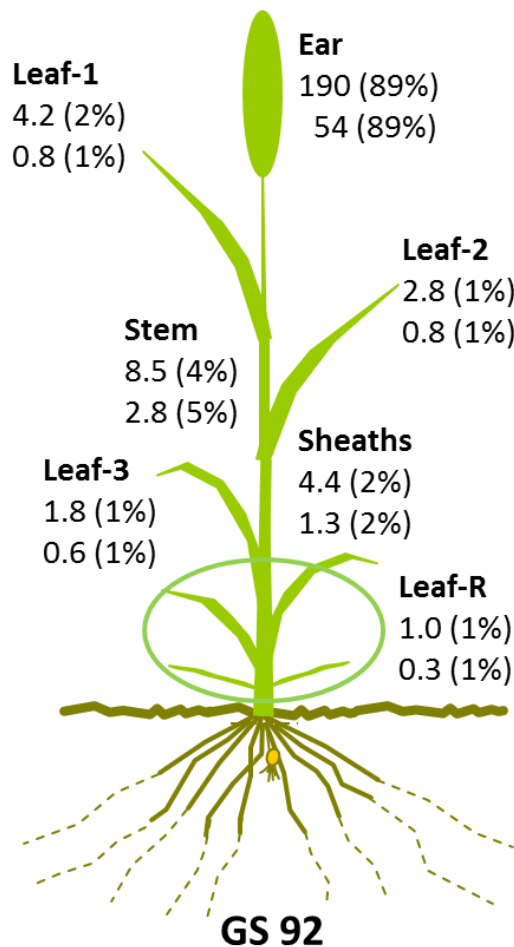


Post anthesis N uptake

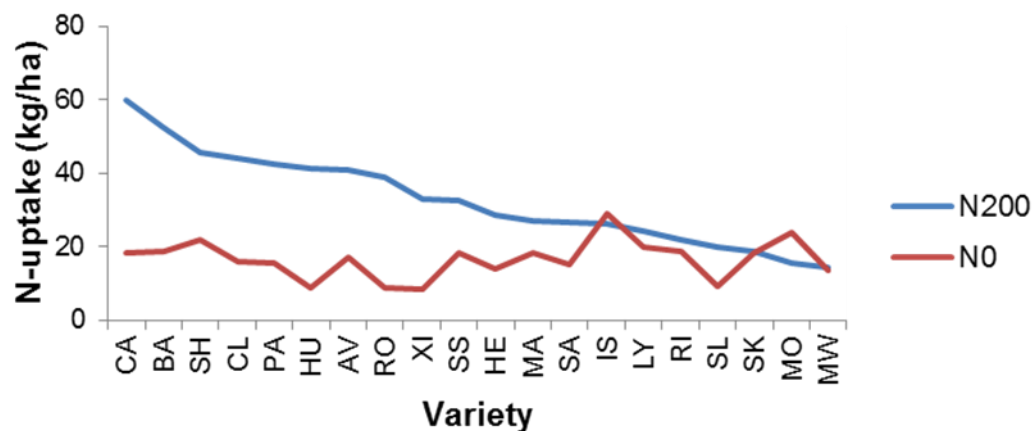


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Shoot total
N200 - 213 kg/ha (100%)
N0 - 61 kg/ha (100%)



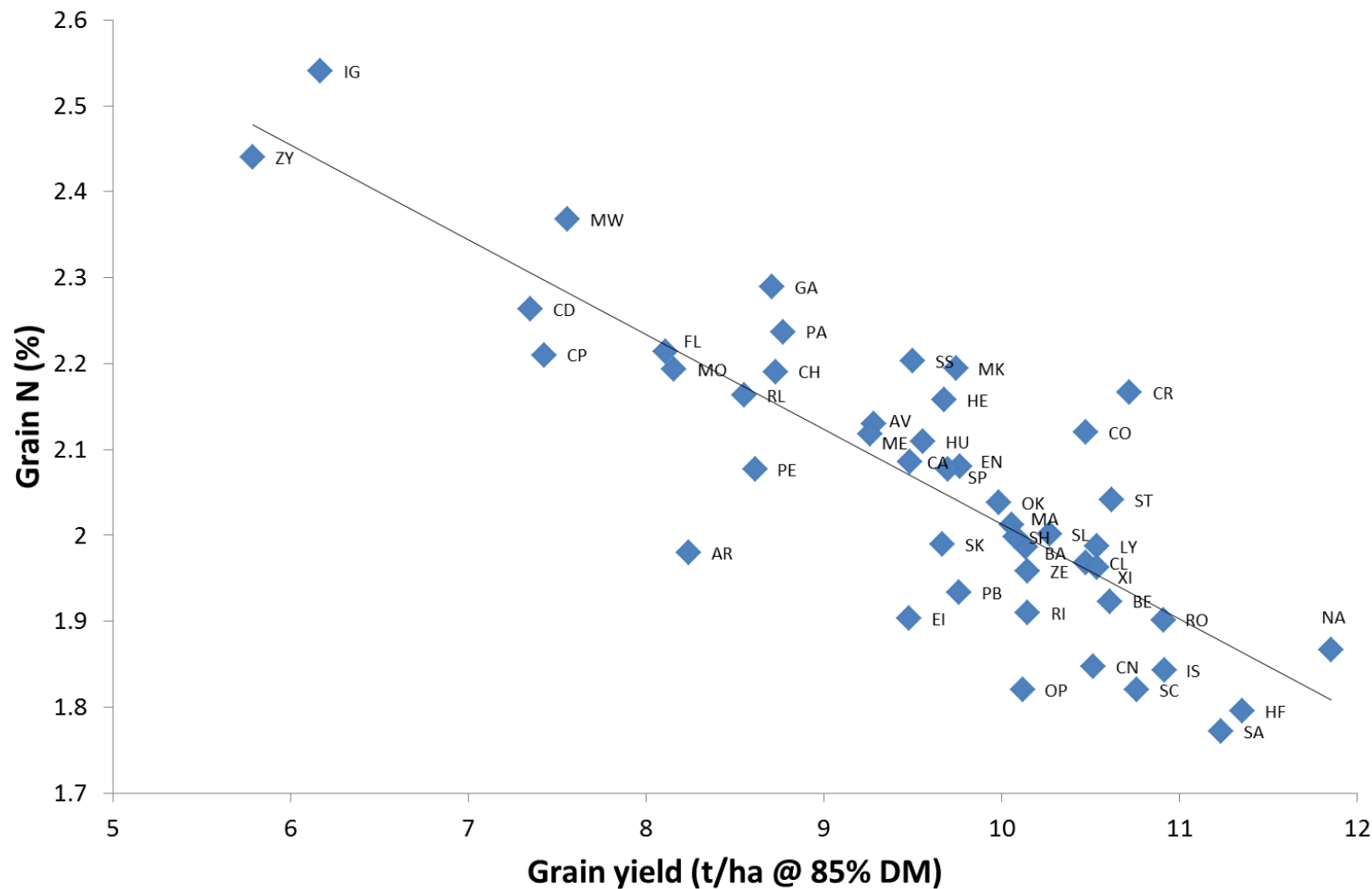
Post-anthesis shoot N-uptake



GPD, WGIN trials, 2004-12



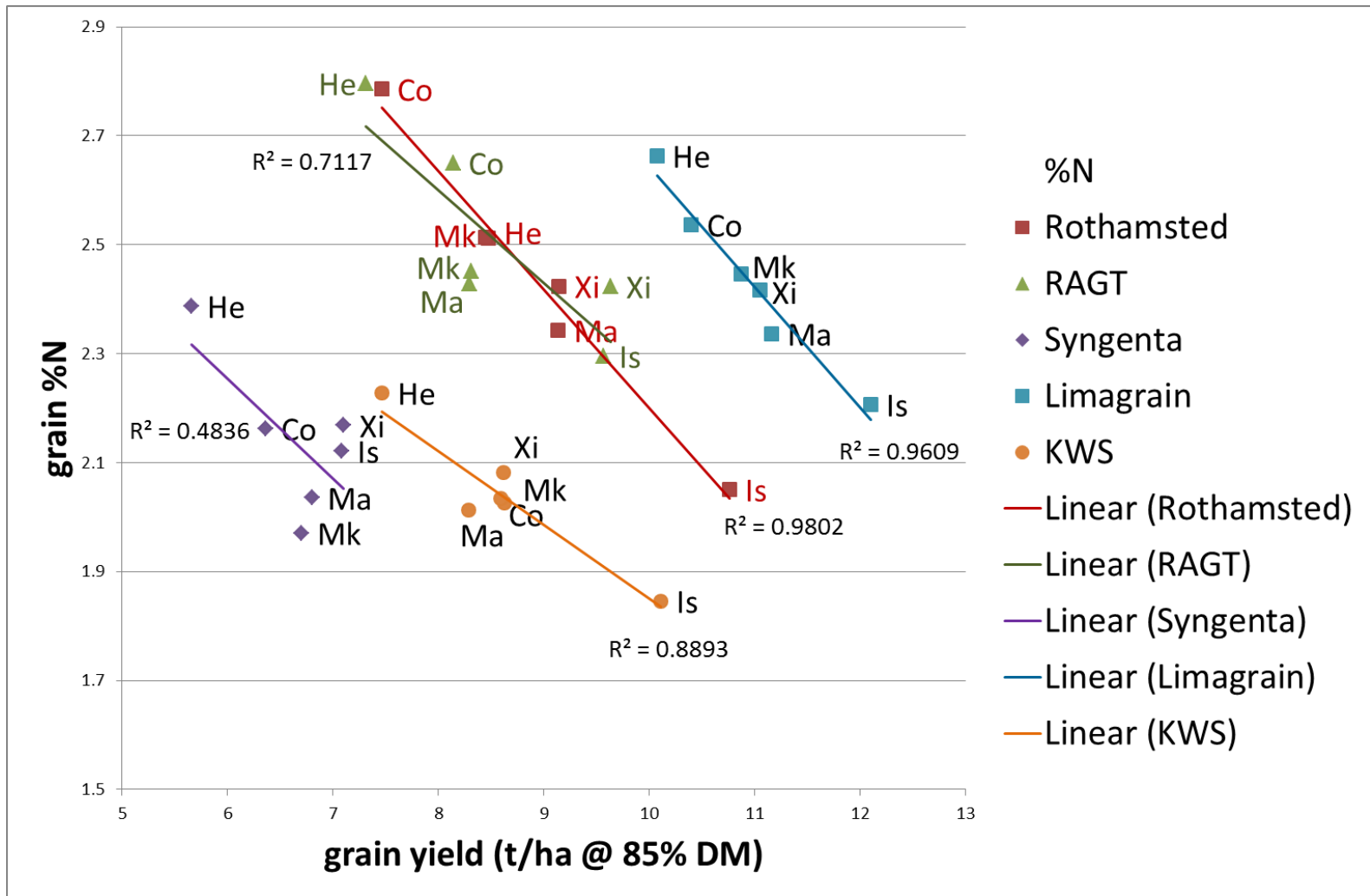
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GPD, different sites



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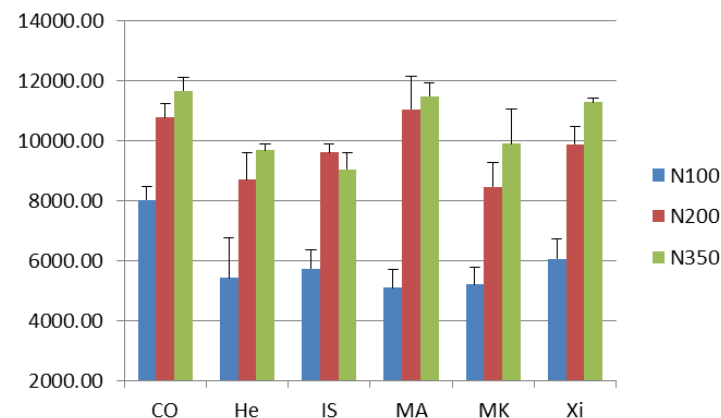


Grain protein N response



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- Part of BBSRC-HGAC GPD project
- See HGCA report number 521
- Papers on gamma and omega gliadins
 - J. Exp Bot
 - Anal Bot (in press)



Journal of Experimental Botany Advance Access published November 16, 2012

Journal of Experimental Botany

doi:10.1093/jxb/ers318

This paper is available online free of all access charges (see http://jxb.oxfordjournals.org/open_access.html for further details)

Journal of
Experimental
Botany
www.jxb.oxfordjournals.org

RESEARCH PAPER

A novel family of γ -gliadin genes are highly regulated by nitrogen supply in developing wheat grain

Yongfang Wan, Peter R. Shewry* and Malcolm J. Hawkesford

Department of Plant Biology and Crop Science, Rothamsted Research, Harpenden, Hertfordshire AL5 2JQ, UK

October 2013



Project Report No. 521

Sustainability of UK-grown wheat for breadmaking

by

P. R. Shewry¹, Y. Wan¹, G. Chope², S. Penson², E. F. Mosleth³ and M. J. Hawkesford¹

No varieties are perfect!



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Variety Performance at 200 kg-N/ha (2004-08)

Variety	Code	Nabim	Years	Yield	%N	Uptake	Utilisation
Avalon	AV	1	5				
Flanders	FL	1	1				
Hereward	HE	1	5				
Hurley	HU	1	5				
Malacca	MA	1	5				
Mercia	ME	1	4				
Maris Widgeon	MW	1	5				
Shamrock	SH	1	4				
Solstice	SL	1	5				
Spark	SP	1	1				
Xi 19	XI	1	5				
Cadenza	CA	2	5				
Cordiale	CO	2	3				
Einstein	EI	2	1				
Lynx	LY	2	5				
Rialto	RL	2	1				
Scorpion	SC	2	1				
Soissons	SS	2	5				
Beaver	BE	3	4				
Claire	CL	3	4				
Riband	RI	3	5				
Robigus	RO	3	4				
Istabraq	IS	4	4				
Napier	NA	4	3				
Savannah	SA	4	4				
Paragon (spring)	PA	1	5				
Chablis (spring)	CH	2	1				
Arche	AR	F	1				
Batis	BA	G	5				
Caphorn	CP	F	1				
Cappelle Desprez	CD	F	1				
Enorm	EN	G	1				
Isengrain	IG	F	1				
Monopol	MO	G	5				
Opus	OP	G	1				
PBis	PB	G	1				
Petrus	PE	G	1				
Sokrates	SK	G	5				
Zyta	ZY	P	1				

Upper-Q
Inter-Q
Inter-Q
Lower-Q

Summary of variety performance (quartile rankings) based on 2004-07 WGIN datasets

EJA (2010) 33, 1-11

Europ. J. Agronomy 33 (2010) 1–11



Contents lists available at ScienceDirect

European Journal of Agronomy

journal homepage: www.elsevier.com/locate/eja



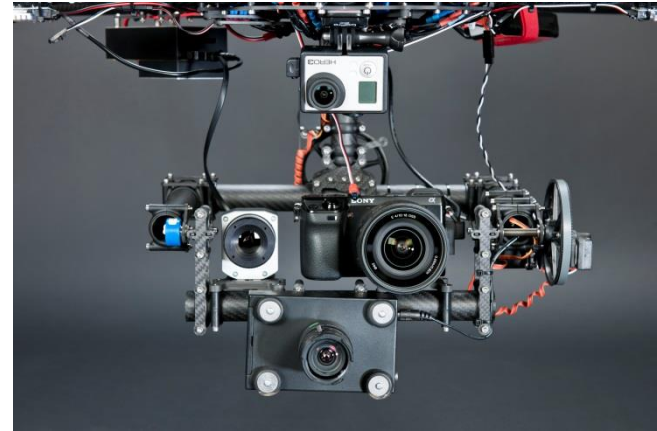
Nitrogen efficiency of wheat: Genotypic and environmental variation and prospects for improvement

Peter B. Barraclough^{a,*}, Jonathan R. Howarth^a, Janina Jones^a, Rafael Lopez-Bellido^b, Saroj Parmar^a, Caroline E. Shepherd^a, Malcolm J. Hawkesford^a

UAV NDVI



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UAV NDVI



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Real Mode

INSTRUMENT BOARD EDITOR CONTINUE PAUSE COMB CONNECT

Home Point NORTH LAT: N/A WEST WEST ALTI: 0000.0 M

CONNECT

Set Home Point Go Home

dji	
Current point flight time:	00:00:00
Total flight time:	00:00:00
Total estimated time of one way:	00:07:46
Total distance of one way:	477.223m

To Target(M):0.0

Altitude(M):0.0

H.Speed(M/S):0.0

V.Speed(M/S):0.0

17.05m

64.89m

65.22m

67.82m

65.45m

70.17m

65.15m

0[25m]

3[25m]

15.39m

4[25m]

7[25m]

15.84m

8[25m]

11[25m]

5[25m]

6[25m]

9[25m]

10[25m]

dji EDITOR

Editing Mission

- 0
- 1
- 2
- 3

Route	Start_to_End
StartWayPoint	0
VerticalSpeedLimit	1.5
<input type="checkbox"/> Set All WPs Parameter	
SetAllWPsAlt	25
SetAllWPs Speed	
SetAllWPs TurnMode	None

SetAllWPsAlt
Set Altitude of the all way points.

+ - CLEAR SAVE OPEN

+1 +10 -1 -10

CANCEL UPLOAD GO

Google earth

Imagery Date: 11/1/2006 2000

51.493283° N 0.221334° W elev 127 m

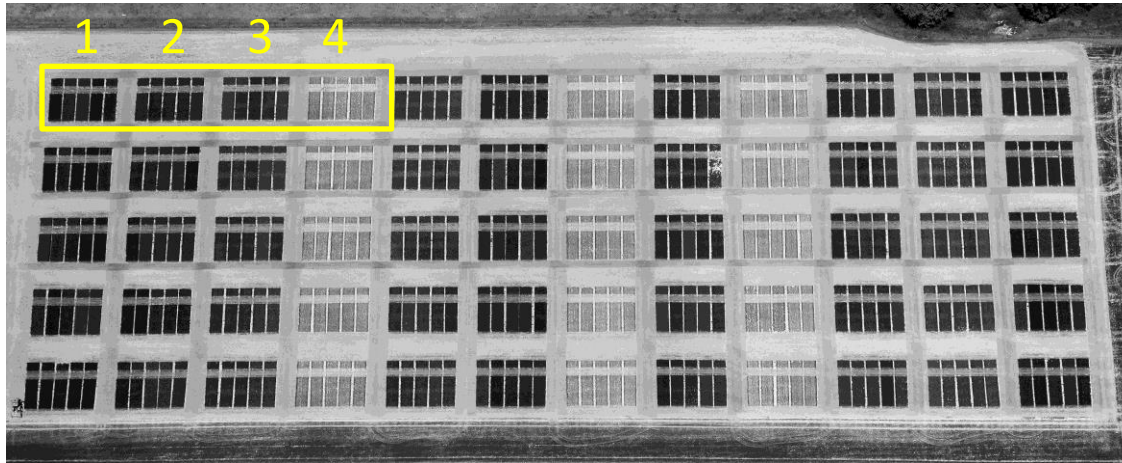
Eye alt 366 m

GPS: ATTE: MODE: 0 Cancel

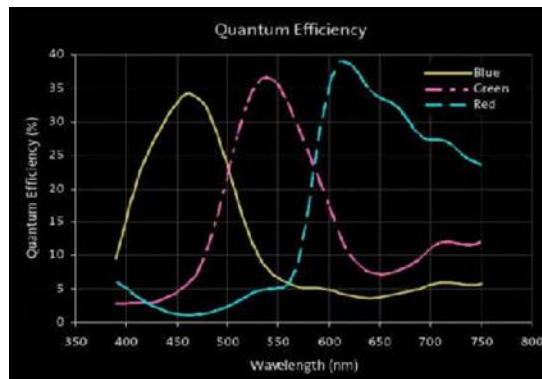
UAV NDVI



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Plot	Nitrogen	Crop density index
1	350	105
2	200	100
3	100	66
4	0	29



Summary



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- Large data sets (see website)
- Multiple years
- Trait breakdown
- Spin off projects
- More publications in the pipeline
- Trial continuing in 2014



Thanks



ROTHAMSTED
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- RRes Farm staff
- Peter Buchner, Saroj Parmar, Andrew Riche, Yongfang Wan, Peter Barraclough
- PhD students: Adinda Derkx, Caihong Bai, Astrid Grün, Nick Evens, **NEW STUDENTSHIP!**
- Visitors: Xiaochang Dong, Deyong Zhao. Kasra Sabermenesh
- Summer students and casuals
- Peter Shewry
- WISP, WGIN and 20:20 teams

