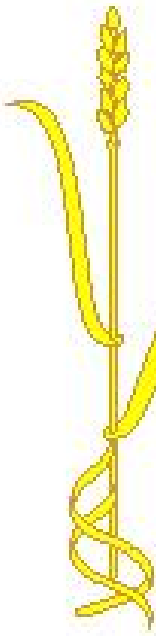


Wheat Genetic Improvement Network

http://www.wgin.org.uk/

defra
Department for Environment Food and Rural Affairs

JOHN INNES CENTRE

ROTHAMSTED RESEARCH

Nitrogen Efficiency
Rothamsted Wheat Variety Trials

Peter Barraclough

WGIN stakeholders meeting, Rothamsted, 14 November 2008

Visitors to WGIN trials

Why do the trials?

To look for variation in NupE & NutE

Wheat varieties have been selected under high inputs
Identify good performers and the traits responsible
De-convolute traits and identify contributing genes
Aid to breeding programmes

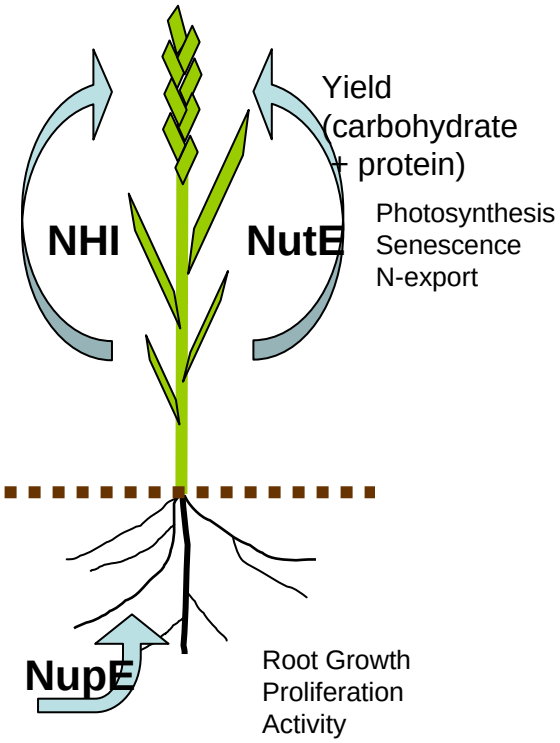
Must be lots of information on this?

Numerous variety trials done in the UK (e.g. as part of RL programmes)
No measurements of straw yield or %N
Few trials conducted at high, medium and low N-rates

Any need for selection?

R A Fischer, 1981

'I do not believe that the breeder needs to do much explicit selection. Genetic improvement in yield potential has led to greater nitrogen efficiency.'



LIST OF CROP MEASUREMENTS

measured in blue
derived in black

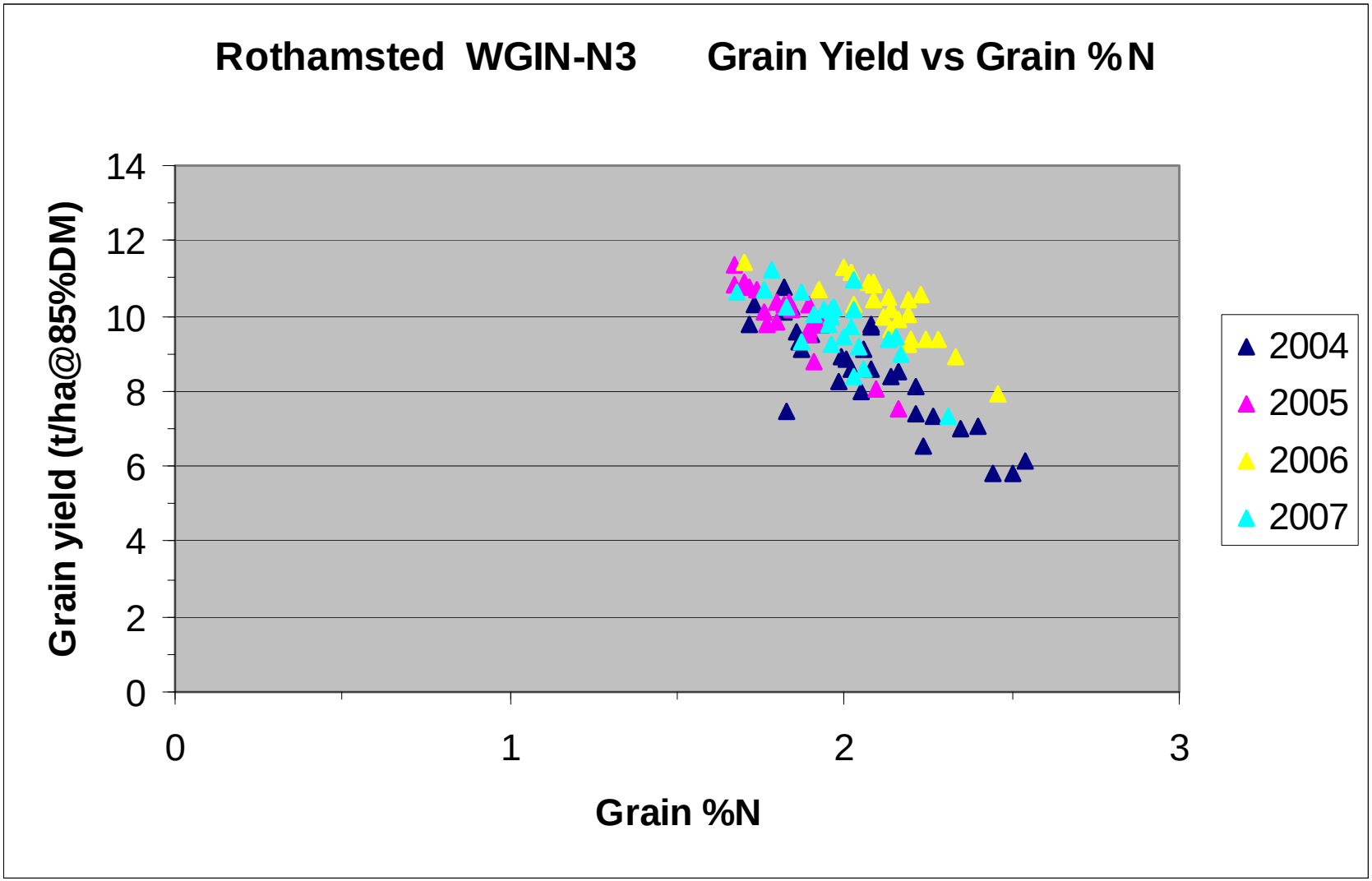
1. Grain Yield (t/ha @ 100%DM)
2. Straw Yield (t/ha @ 100%DM)
3. Total Yield (t/ha @ 100%DM)
4. Harvest Index (HI)
5. Grain %N
6. Straw %N
7. Grain N-Uptake (kg/ha)
8. Straw N-Uptake (kg/ha)
9. Total N-Uptake (kg/ha)*
10. Nitrogen Harvest Index (NHI)
11. N-Utilisation Efficiency (NutE) for Grain Yield (kg-DM/kg-N)

* N.B. NupE not calculated

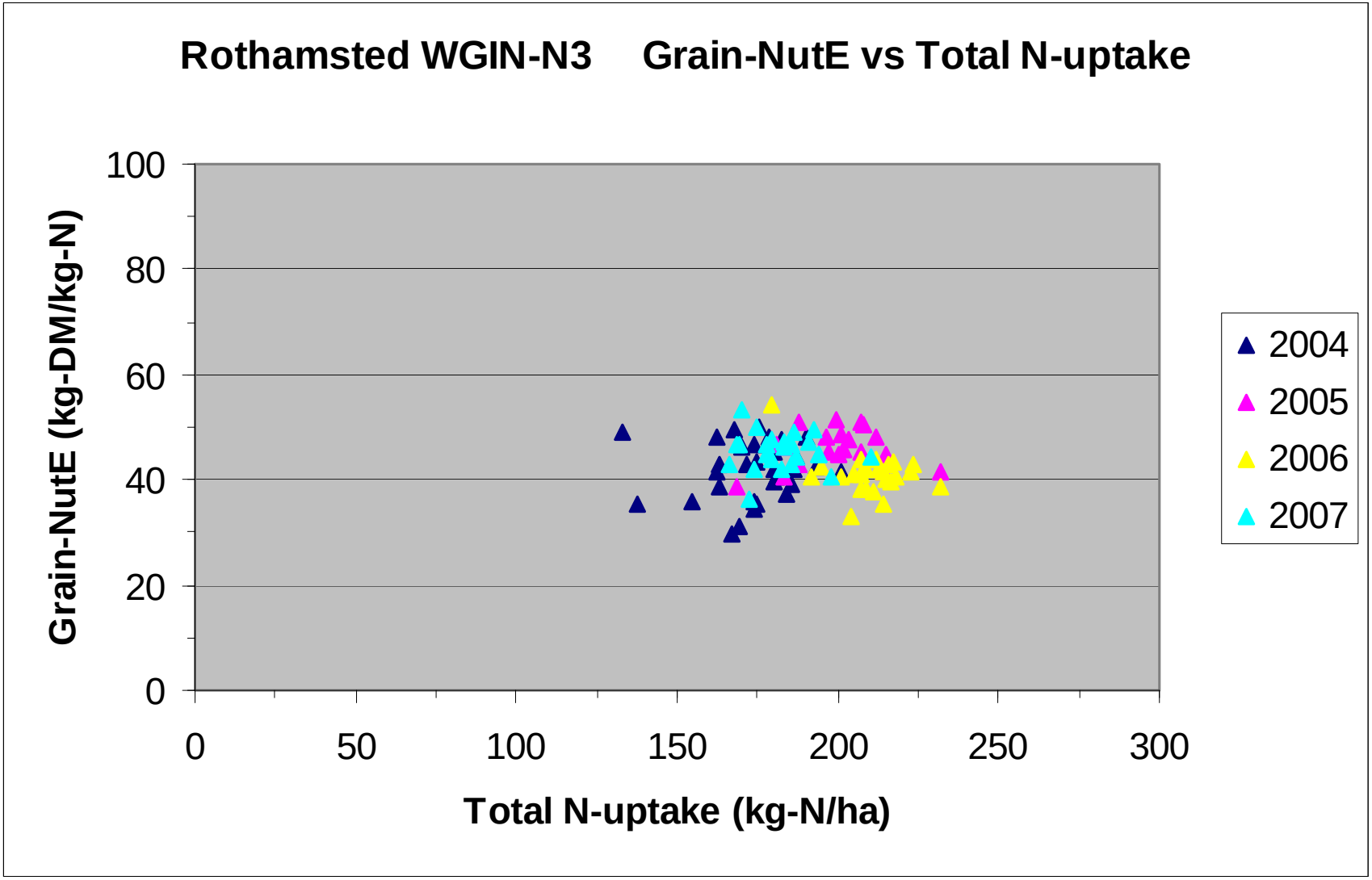
Variety Performance at 200 kg-N/ha in 2004-2007

Variety	Nabim	Years	Grain Yield	Grain-N	N-Uptake	N-Utilisation
Avalon	1	3				
Flanders	1	1				
Hereward	1	4				
Hurley	1	4				
Malacca	1	4				
Mercia	1	3				
Maris Widgeon	1	4				
Shamrock	1	3				
Solstice	1	4				
Spark	1	1				
Xi 19	1	4				
Cadenza	2	4				
Cordiale	2	2				
Einstein	2	1				
Lynx	2	4				
Rialto	2	1				
Scorpion	2	1				
Soissons	2	4				
Beaver	3	3				
Claire	3	3				
Riband	3	4				
Robigus	3	3				
Istabraq	4	3				
Napier	4	2				
Savannah	4	3				
Paragon (spring)	1	4				
Chablis (spring)	2	1				
Arche	French	1				
Batis	German	4				
Caphorn	French	1				
Cappelle Desprez	French	1				
Enorm	German	1				
Isengrain	French	1				
Monopol	German	4				
Opus	German	1				
PBis	German	1				
Petrus	German	1				
Sokrates	German	4				
Zyta	Polish	1				

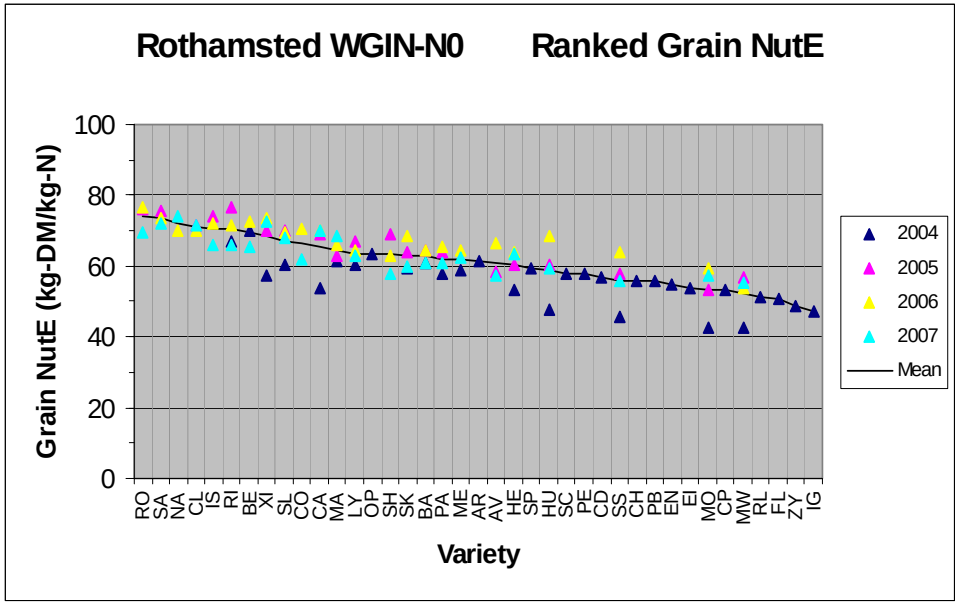
Legend
Upper-Q
Inter-Q
Inter-Q
Lower-Q

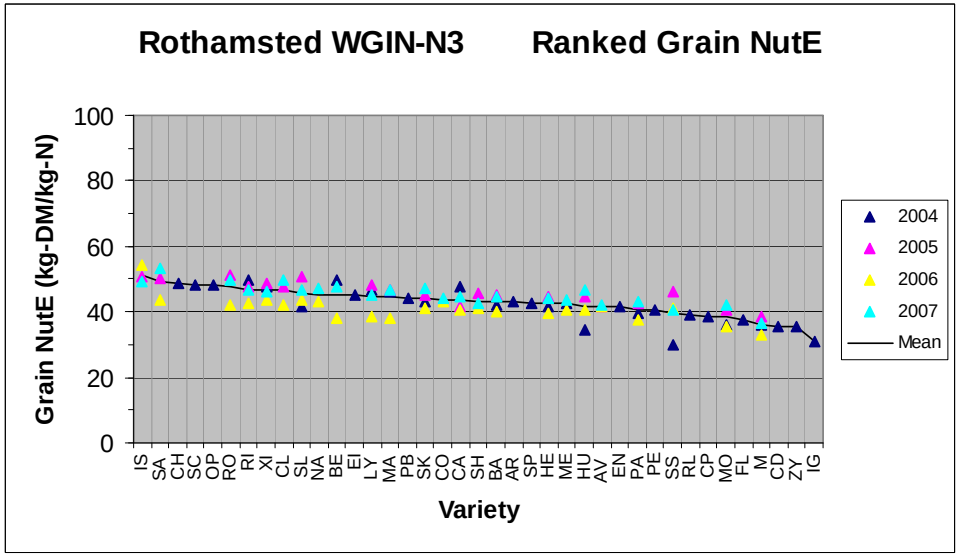

Rothamsted WGIN-N3 Grain Yield vs Grain %N
Grain yield (t/ha@85%DM)
14
12
10
8
6
4
2
0
0
1
2
3
Grain %N
2004
2005
2006
2007

$R^2 = 0.64$


Rothamsted WGIN-N3 Grain-NutE vs Total N-uptake
Grain-NutE (kg-DM/kg-N)
100
80
60
40
20
0
0
50
100
150
200
250
300
Total N-uptake (kg-N/ha)
2004
2005
2006
2007
R2 = 0.08

G x E Interactions





N0 Rank	N3 Rank
RO	IS
SA	SA
NA	CH
CL	SC
IS	OP
RI	RO
BE	RI
XI	XI
SL	CL
CO	SL
CA	NA
MA	BE
LY	EI
OP	LY
SH	MA
SK	PB
BA	SK
PA	CO
ME	CA
AR	SH
AV	BA
HE	AR
SP	SP
HU	HE
SC	ME
PE	HU
CD	AV
SS	EN
CH	PA
PB	PE
EN	SS
EI	RL
MO	CP
CP	MO
MW	FL
RL	MW
FL	CD
ZY	ZY
IG	IG

Conclusions

	Grand ranges	
Yield:	2.1 - 11.8	t/ha (85%DM)
Grain-N:	1.1 - 2.8	% in DM
N-up:	33 – 264	kg-N/ha
NutE:	27 – 77	kg-DM/kg-N

Varietal differences in Yield, %N, N-up, NutE

Variety x Year x N interactions

NutE reduced as N-rate increases

NutE correlated with grain yield

NutE correlated inversely with grain quality

NutE not correlated with N-uptake

There is scope to improve N-efficiency, but ultimately:

You can't get something for nothing...

e.g. 10 t/ha of grain at 2%N contains 200 kg-N/ha

If you don't put 200 kg in

(from all sources)

You can't take 200 kg out

(in the grain)

Reduce N-inputs and Yield and/or Quality MUST FALL