

Comparative physiology of oats, wheat and barley in the UK with particular emphasis on winter oat cultivars

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AFBI Crossnacreevy

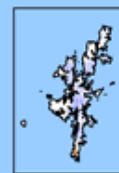
Belfast

Northern Ireland

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Rainfall Amount
Annual Average
1971-2000



Average Value (mm)



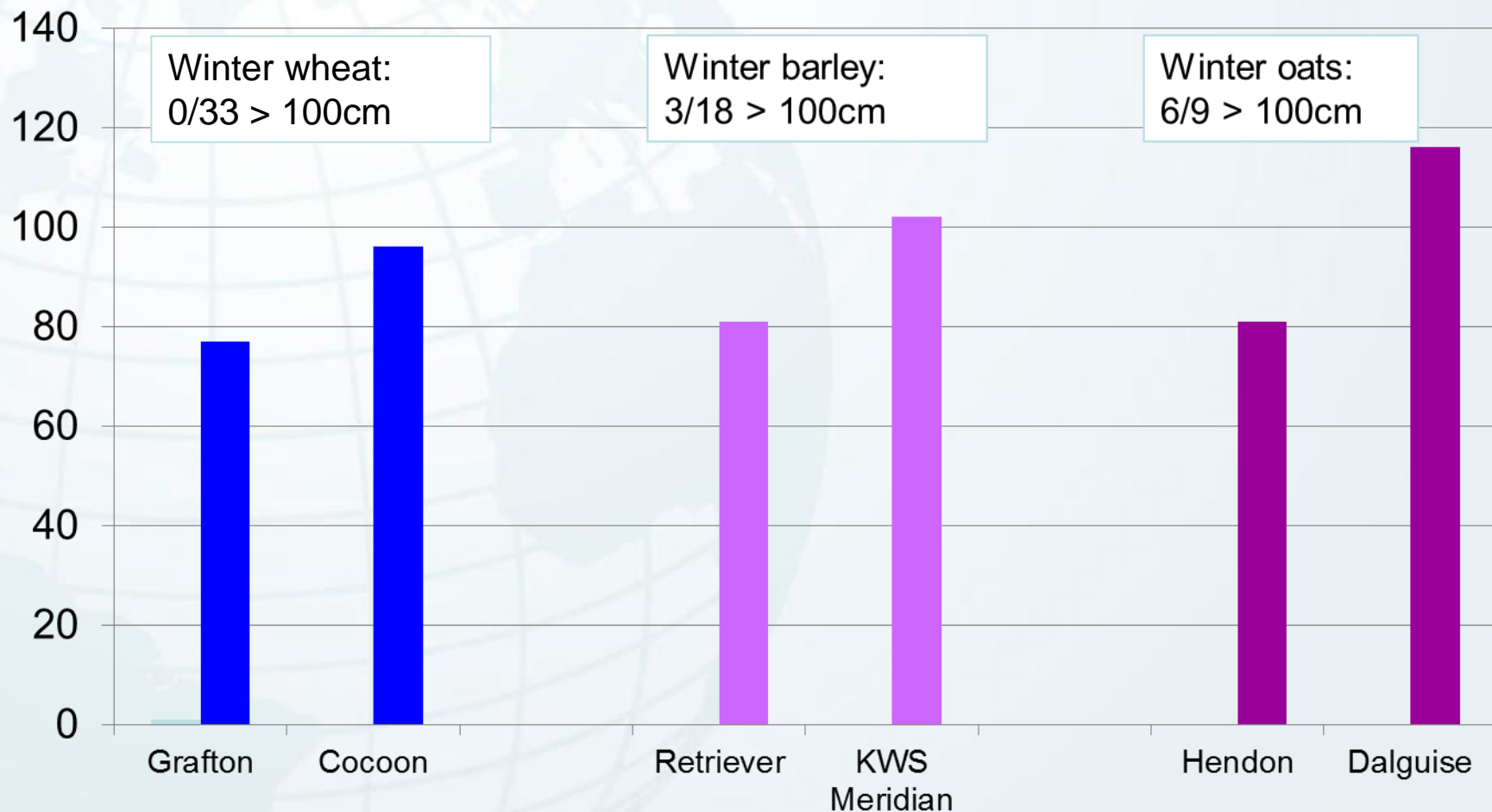




Impact of cultivar evaluation in the UK

	No. cultivars tested	Mean yield increase on farm 1982-2007 (t/ha/year) (MacKay <i>et al.</i> , 2010)	
		Genetic	Environmental
Oats	350	?	?
Wheat	2000	Winter: + 0.07	+ 0.01
Barley	2500	Winter: + 0.07	+ 0.01
		Spring: + 0.06	- 0.06

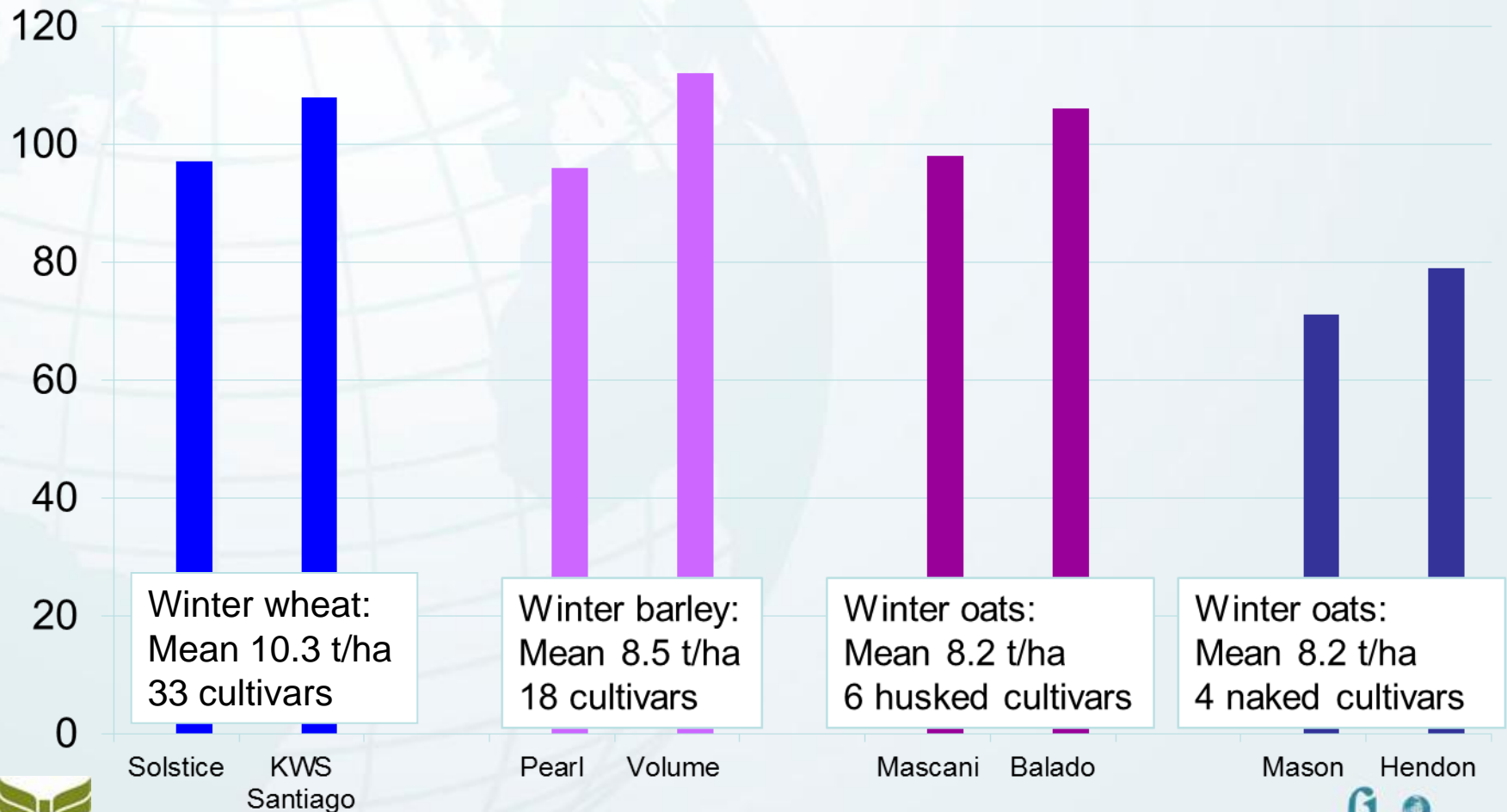
Range in height (cm) of UK Recommended cultivars (HGCA UK Recommended List 2012-13)



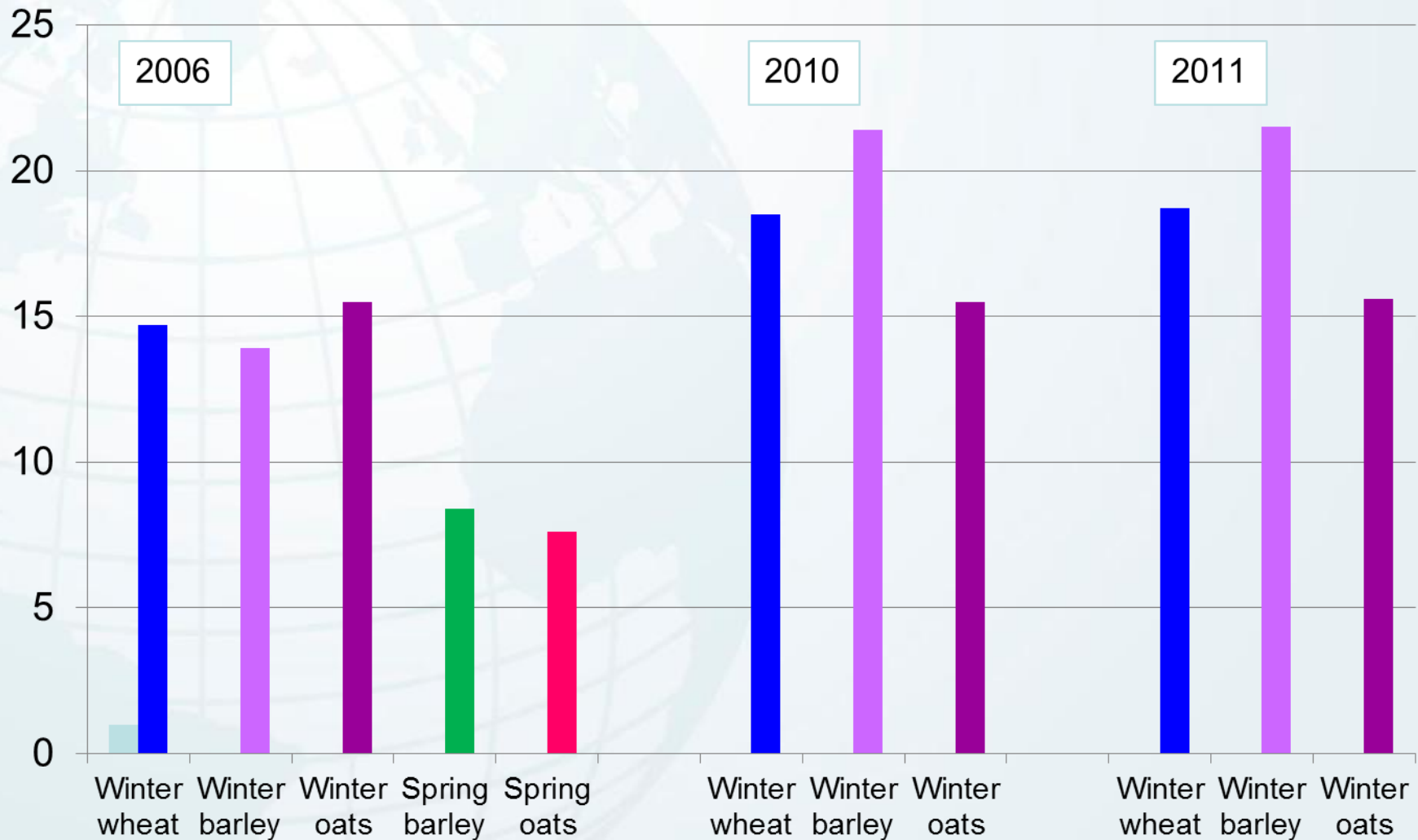
Range in yield (as % of control cultivars) of UK

Recommended cultivars

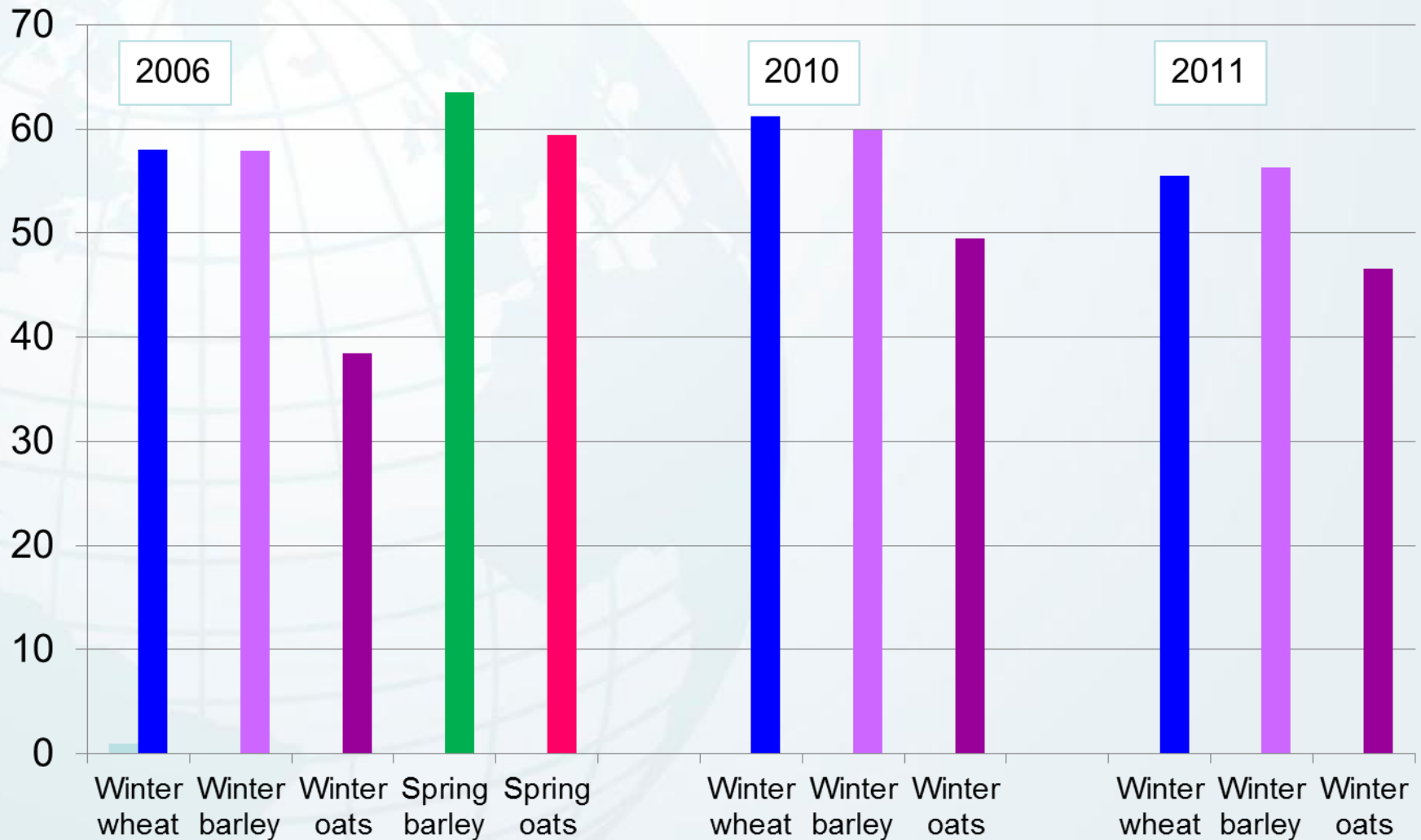
(HGCA UK Recommended List 2012-13)



Biomass production (t/ha at 100%DM) in crops in N Ireland



Biomass partitioning (harvest index, %) in crops in N Ireland



Studies on winter oat cultivars in Northern Ireland in 2010 & 2011

Conventional height husked cultivars

- Brochan
- Dalguise
- Gerald
- Mascani
- Tardis

Dwarf husked cultivar

- Balado

Conventional height naked cultivar

- Bastion

Four treatment-years:

2010 & 2011

-PGR & +PGR

Questions

- Relationships between yield and characters of cultivars in each treatment-year
- Consistency of cultivar behaviour across all treatment-years
- Contrasts of:
 - dwarf v conventional height
 - naked v husked



Relationships between yield and characters of cultivars in each treatment-year

Results

- Height – decrease in 3/4
- Biomass production – increase in 4/4
- Harvest index – increase in 3/4
- Panicle population – decrease in 1/4
- Grain no./panicle – no trend in 4/4
- Grain wt. – increase in 4/4

2010 > 2011 both + and – PGR

Summary

- Cultivar yield was strongly associated, increasing, with both biomass production and partitioning but not with height
- Panicle population and grain number/panicle were not associated with yield
- The association with grain weight was probably strongly driven by the low grain weight of the naked cultivars



Consistency of cultivar behaviour across all treatment-years

Consistency of effects: significance of cultivar v cultivar x treatment x year interaction

	Cultivar	Treatment	Cultivar x Treatment
Yield	<0.001	NS	NS
Height	<0.001	<0.01	0.066
Harvest index	<0.05	<0.05	NS
Biomass	<0.001	<0.05	NS
Panicle population	NS	NS	NS
Grain no./panicle	<0.01	NS	NS
Grain weight	<0.001	NS	NS

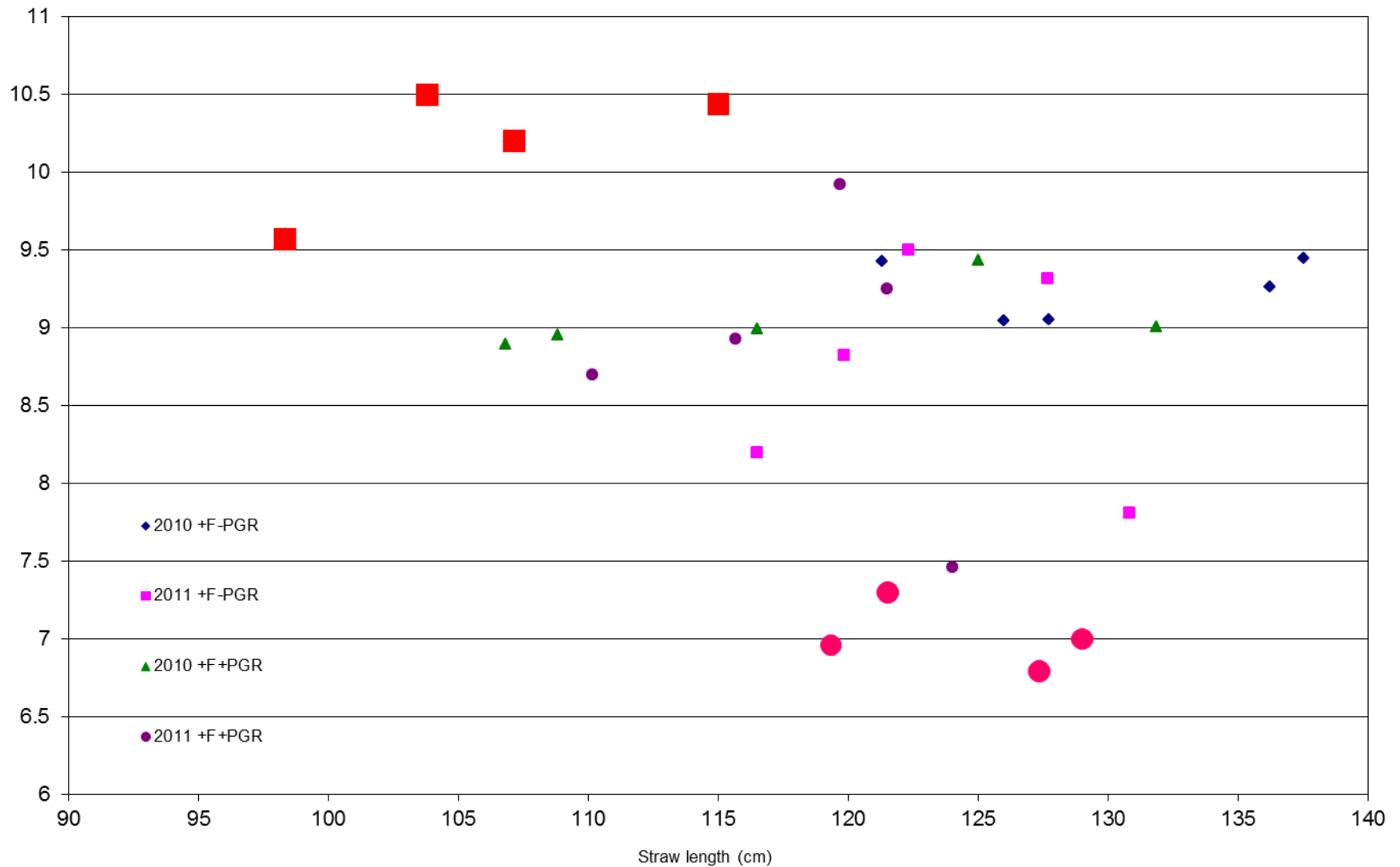


How does **this** dwarf cultivar
compare with the conventional
height cultivars?

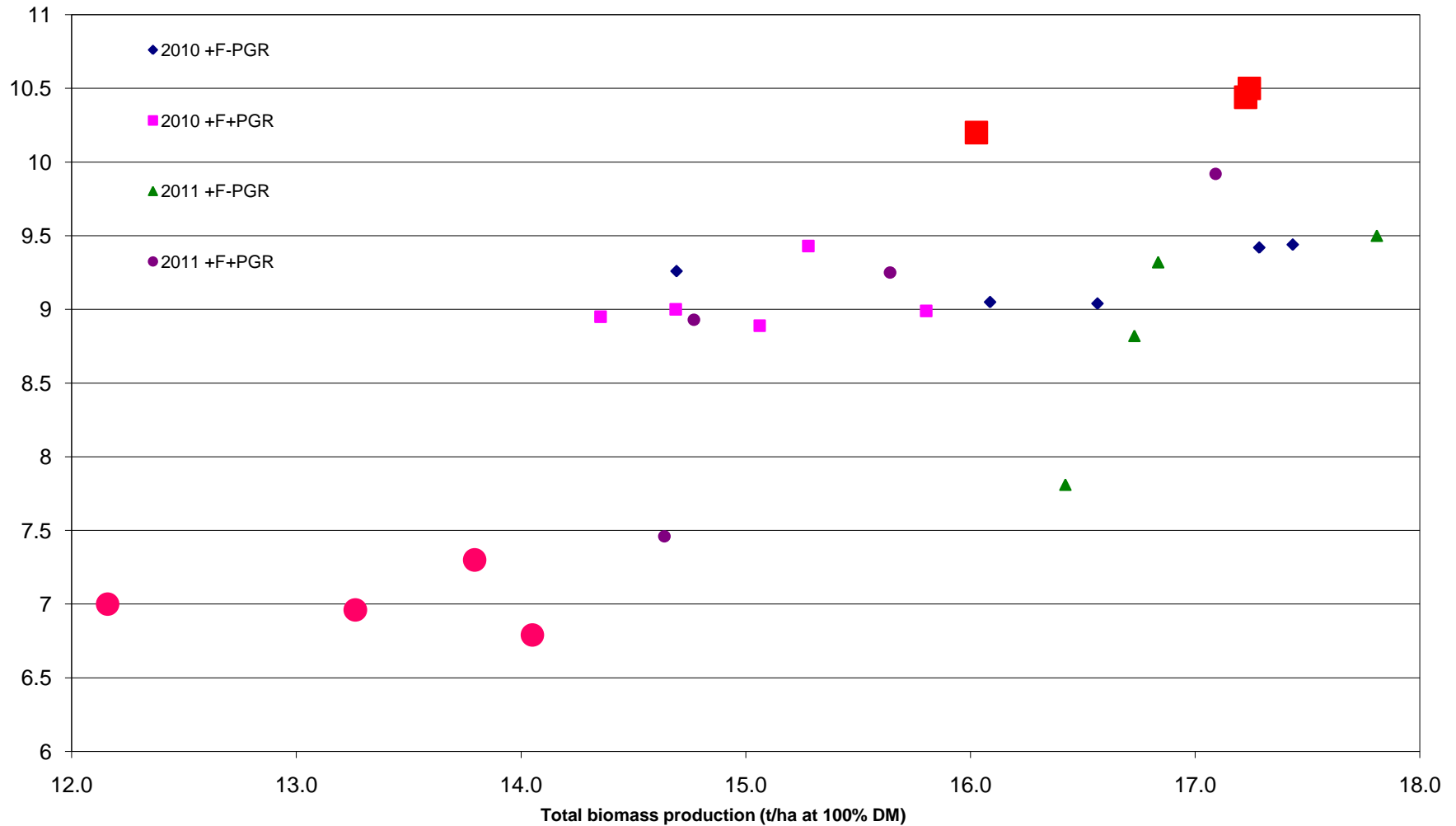
How does **this** naked cultivar
compare with the husked cultivars?

- 
- Straw length
 - Biomass production
 - Biomass partitioning

Height (cm): Dwarf v tall cultivars and naked v husked cultivars




Biomass (t/ha at 100%DM): Dwarf v tall cultivars and naked v husked cultivars

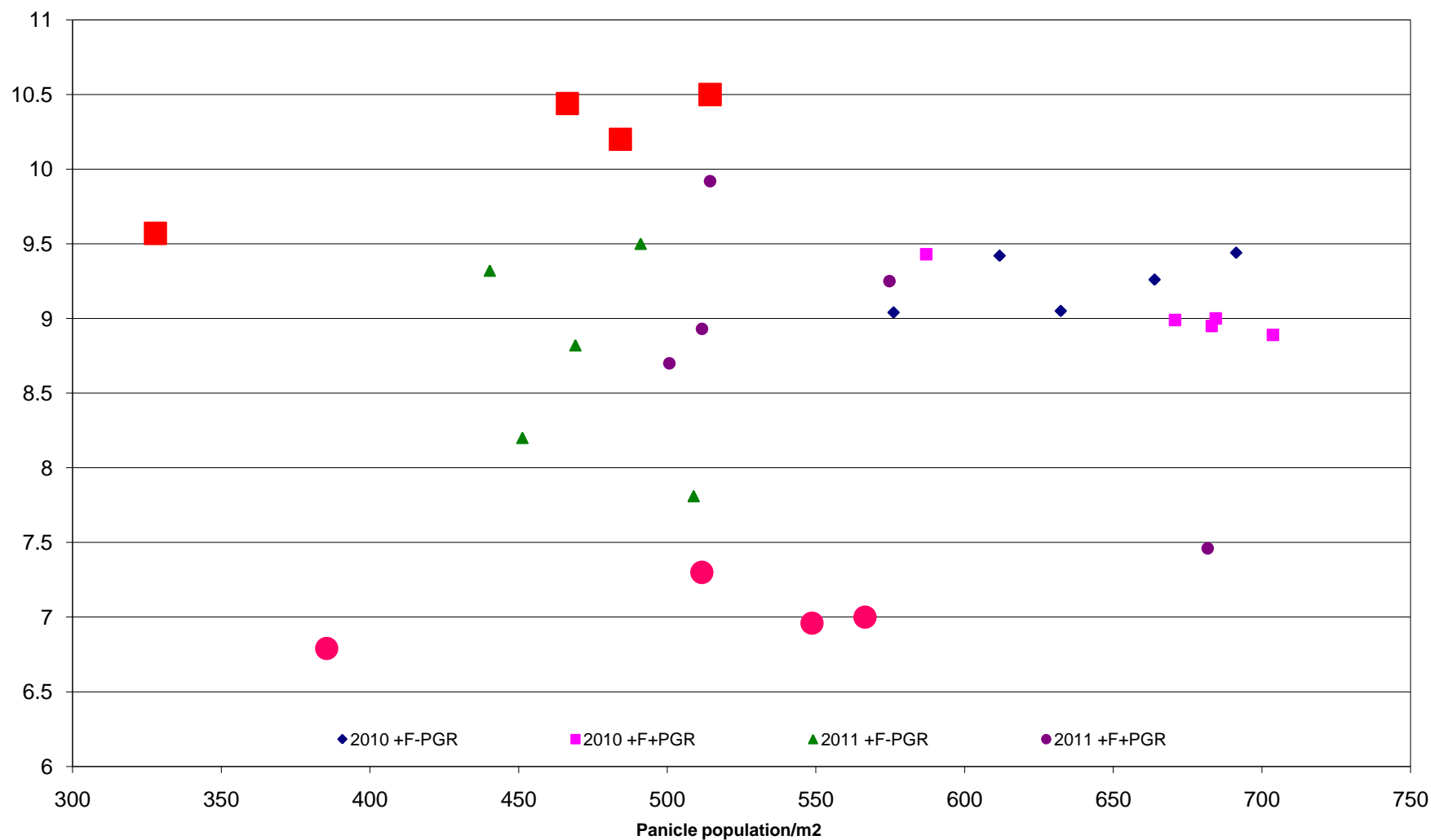


Scatter plot showing the relationship between Harvest index (%) and Grain yield (t/ha) for four different treatments: 2010 +F-PGR (blue diamonds), 2010 +F+PGR (magenta squares), 2011 +F-PGR (green triangles), and 2011 +F+PGR (purple circles). The plot shows a general positive correlation between harvest index and grain yield, with 2011 +F+PGR generally achieving the highest yields for a given harvest index.

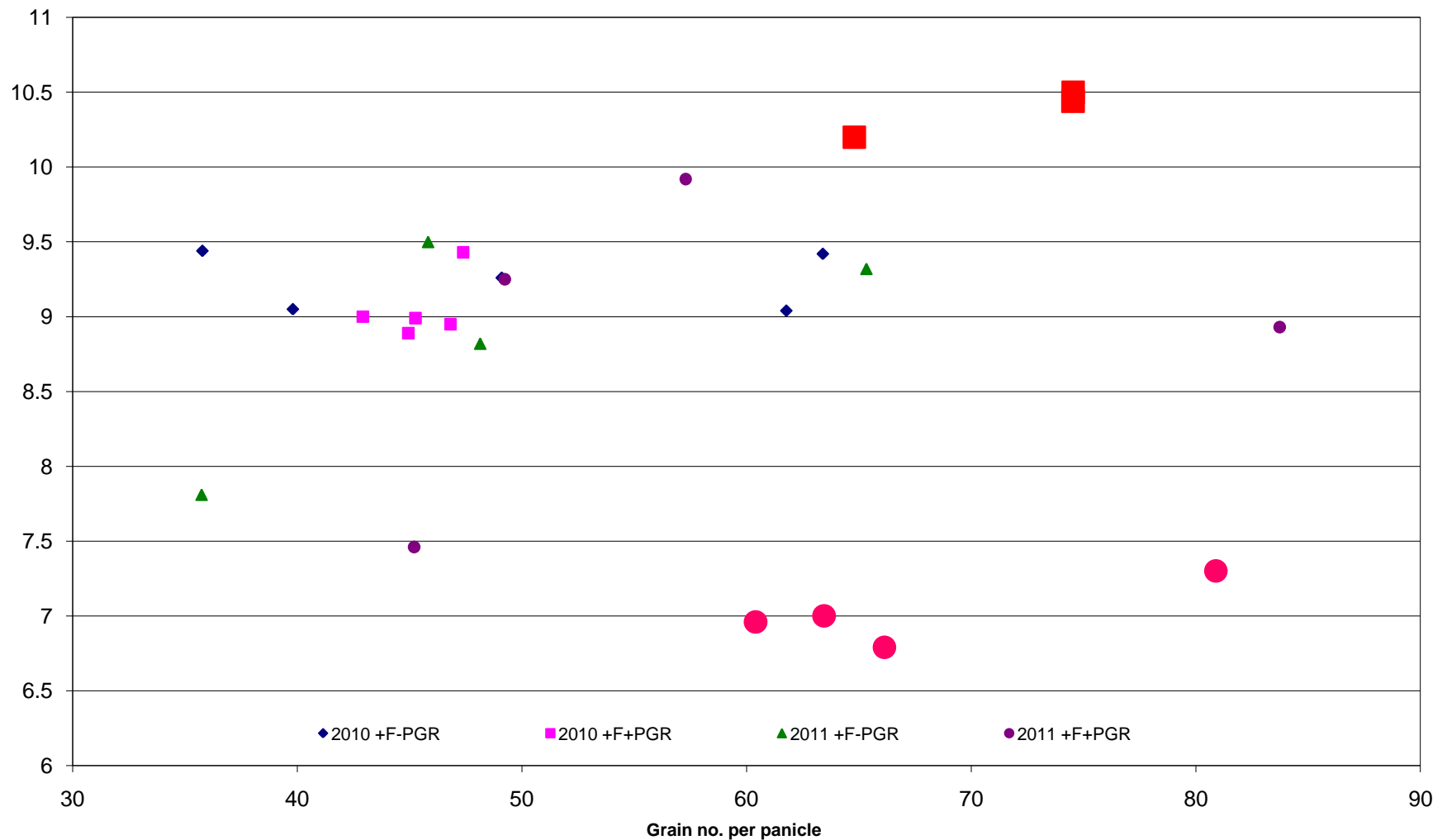
Treatment	Harvest index (%)	Grain yield (t/ha)
2010 +F-PGR	46.0	9.45
2010 +F-PGR	46.4	9.45
2010 +F-PGR	46.4	9.05
2010 +F-PGR	47.8	9.05
2010 +F-PGR	53.5	9.25
2010 +F+PGR	48.3	9.0
2010 +F+PGR	50.2	8.9
2010 +F+PGR	52.1	9.0
2010 +F+PGR	52.5	9.45
2010 +F+PGR	53.0	8.95
2011 +F-PGR	40.5	7.85
2011 +F-PGR	44.7	8.85
2011 +F-PGR	45.3	9.5
2011 +F-PGR	47.1	9.35
2011 +F+PGR	43.3	7.45
2011 +F+PGR	44.7	6.95
2011 +F+PGR	45.0	7.3
2011 +F+PGR	49.0	7.0
2011 +F+PGR	49.3	9.95
2011 +F+PGR	50.3	9.25
2011 +F+PGR	51.3	8.95
2011 +F+PGR	51.5	10.45
2011 +F+PGR	51.8	10.55
2011 +F+PGR	54.1	10.25

- 
- Panicle population
 - Grain number per panicle
 - Grain weight

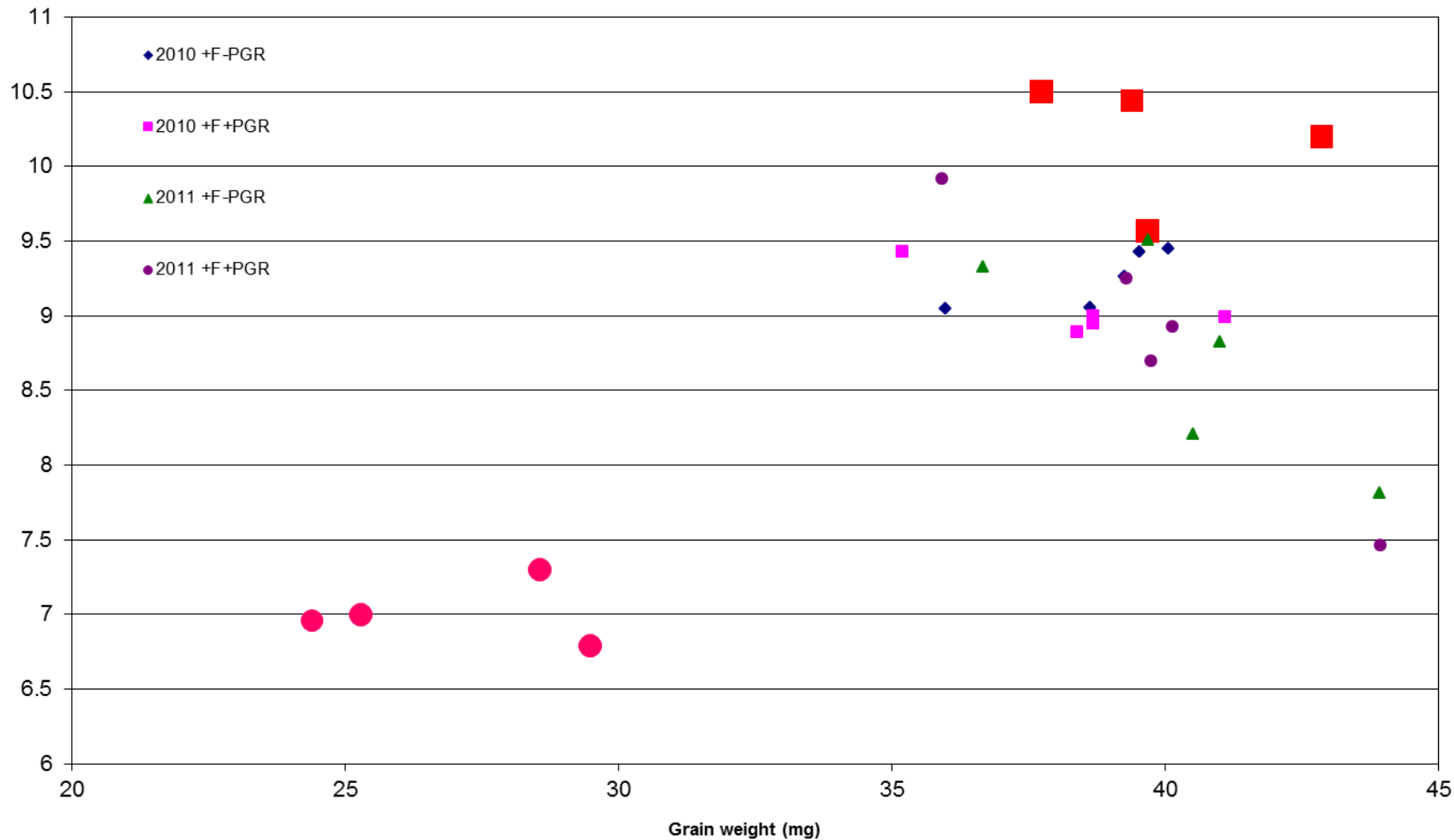
Panicle population /m²: Dwarf v tall cultivars and naked v husked cultivars



Grain no. /panicle: Dwarf v tall cultivars and naked v husked cultivars



Grain weight (mg): Dwarf v tall cultivars and naked v husked cultivars



Summary

- Dwarf cultivar tended to have:
 - High biomass (!) and high HI (✓)
 - High grain no./panicle
- Naked cultivar tended to have:
 - Low biomass (?) and low HI (✓)
 - Low grain weight (✓)

Nitrogen economy

- Grain %N
- Straw %N
- Total N offtake
- NHI
- NUpE (N uptake efficiency)
- NUtE (N utilisation efficiency)

NUpE

N uptake efficiency (kg/kg) =

Total N offtake /

N available in the soil and from fertiliser

NUtE

N utilisation efficiency (kg/kg) =

$$\frac{\text{Grain yield}}{\text{Total N offtake}}$$

Questions

- Relationships between yield and characters of cultivars in each treatment-year
- Consistency of cultivar behaviour across all treatment-years
- Contrasts of:
 - dwarf v conventional height
 - naked v husked



Relationships between yield and characters of cultivars in each treatment-year

Results (1)

- Grain %N – no trend
- Straw %N –
 - PGR: increase
 - +PGR: decrease
- NHI –
 - PGR: decrease
 - +PGR: increase

Results (2)

- Total N offtake – increase in 4/4,
– greater in +PGR than in -PGR
- NUpE – increase in 4/4,
– greater in +PGR than in -PGR
- NUtE – increase in 2/4,
-PGR – no trend
+PGR - increase

Summary

- No strong negative (possibly slight) relationship between yield of cultivars with their grain %N (✓)
- Higher yielding cultivars took up more N and PGR enhanced this (!)
- Partitioning of N to grain was more efficient in higher yielding cultivars with PGR than without (!)
- Yield per kg N was similar in all cultivars without PGR but increased in higher yielding cultivars with PGR (!)



Consistency of cultivar behaviour across all treatment-years

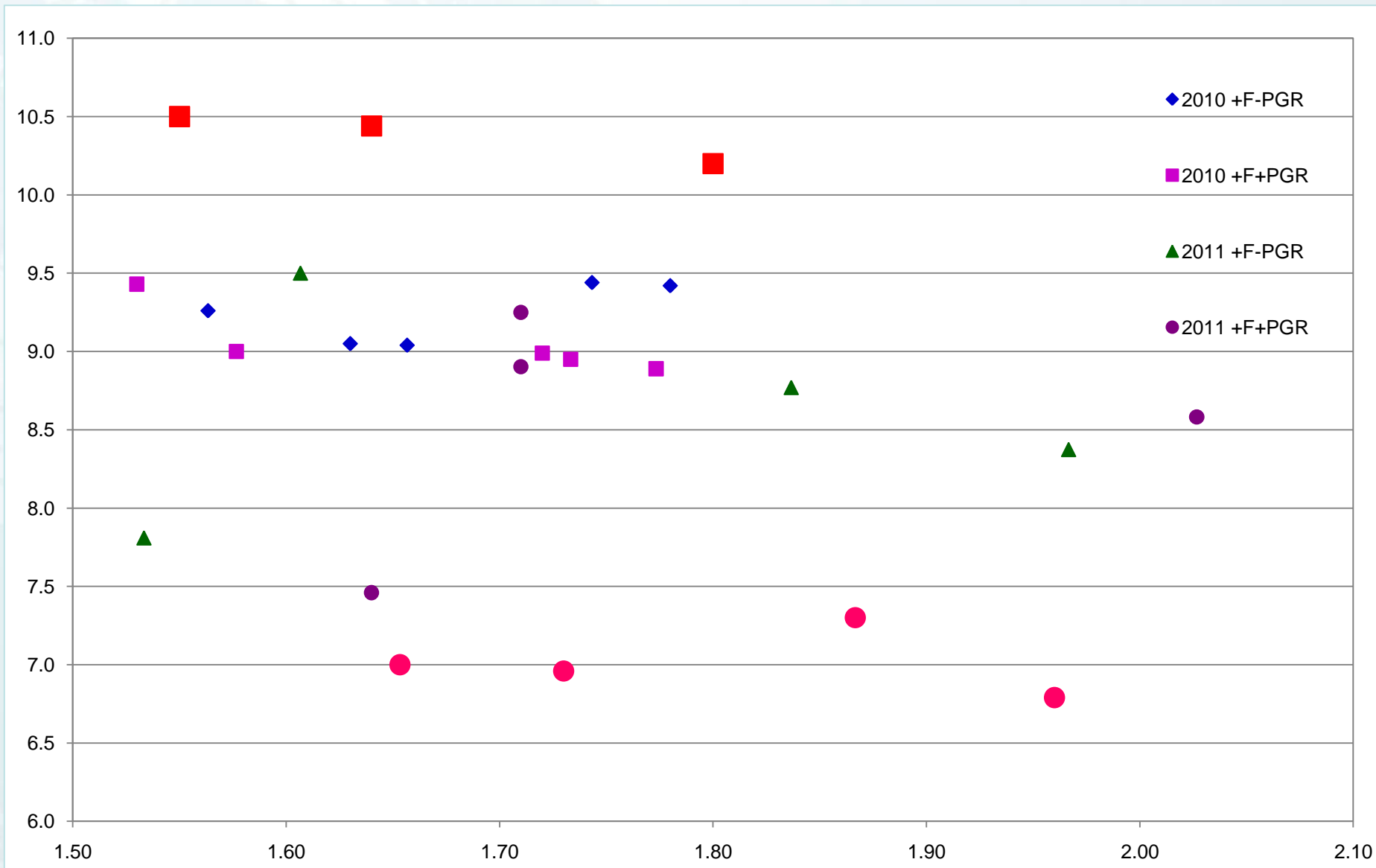


How does **this** dwarf cultivar
compare with the conventional
height cultivars?

How does **this** naked cultivar
compare with the husked cultivars?

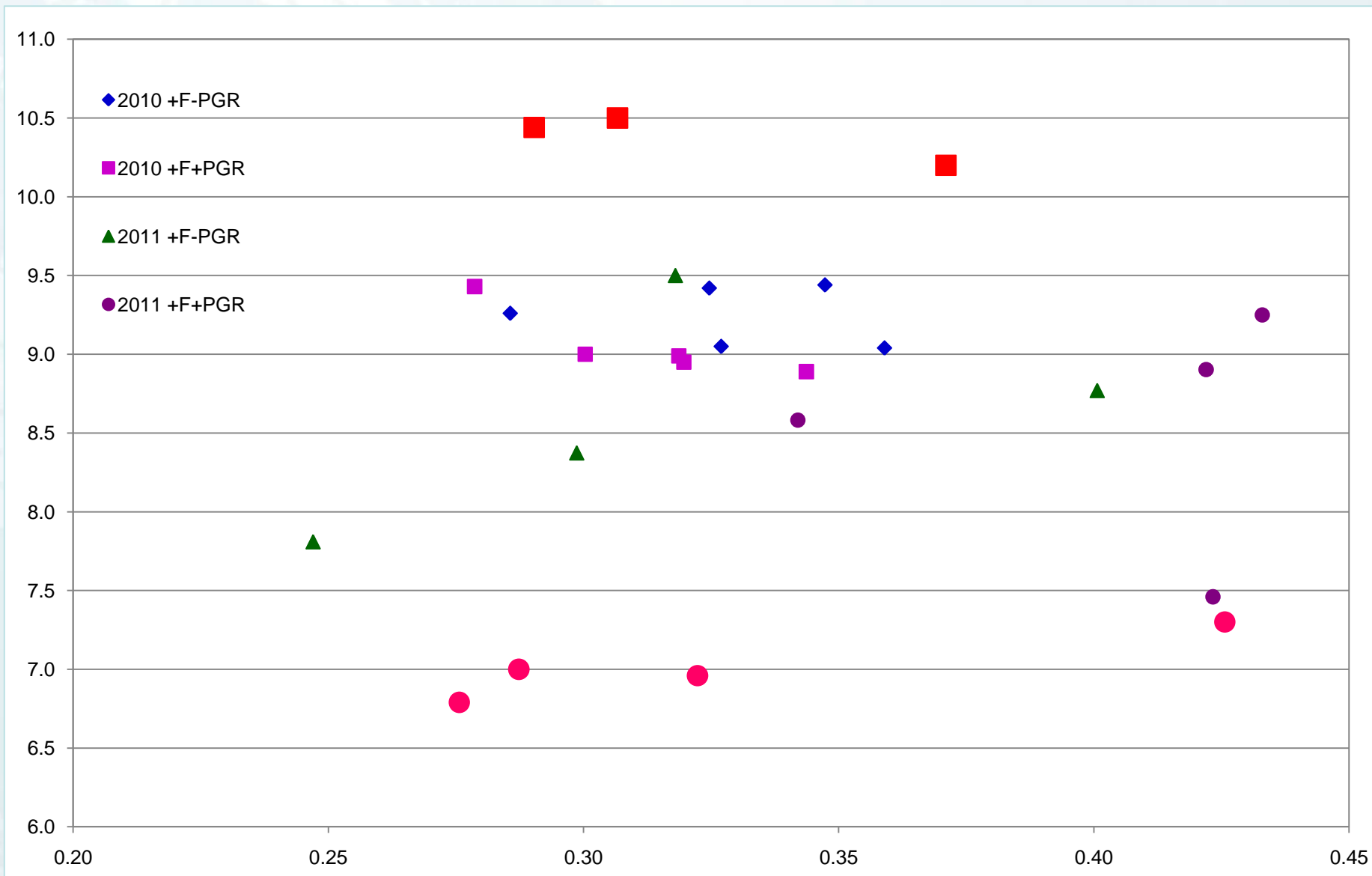
Relationship between grain yield & grain %N

Dwarf cultivar and naked cultivar



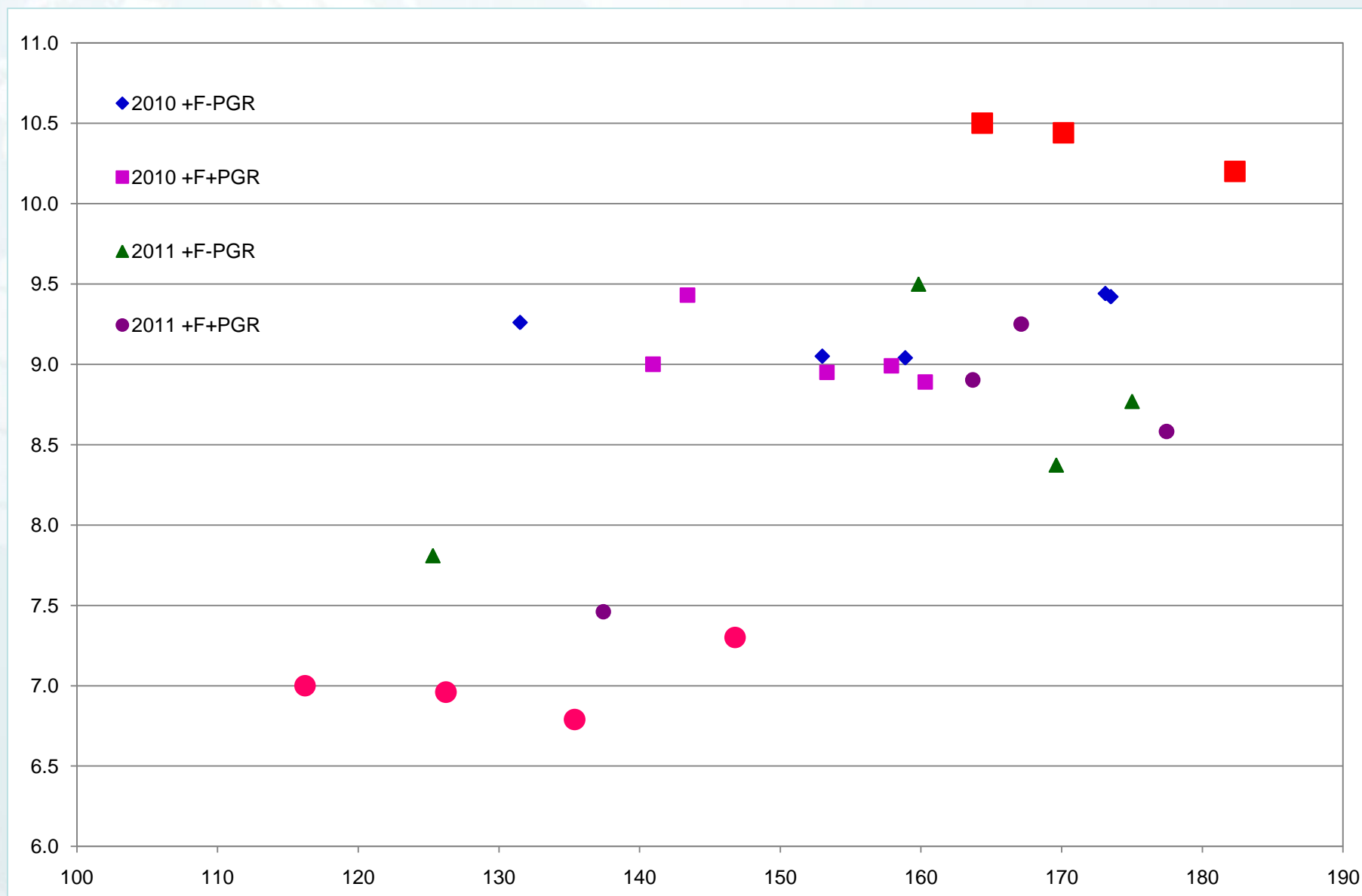
Relationship between grain yield & straw %N

Dwarf cultivar and naked cultivar



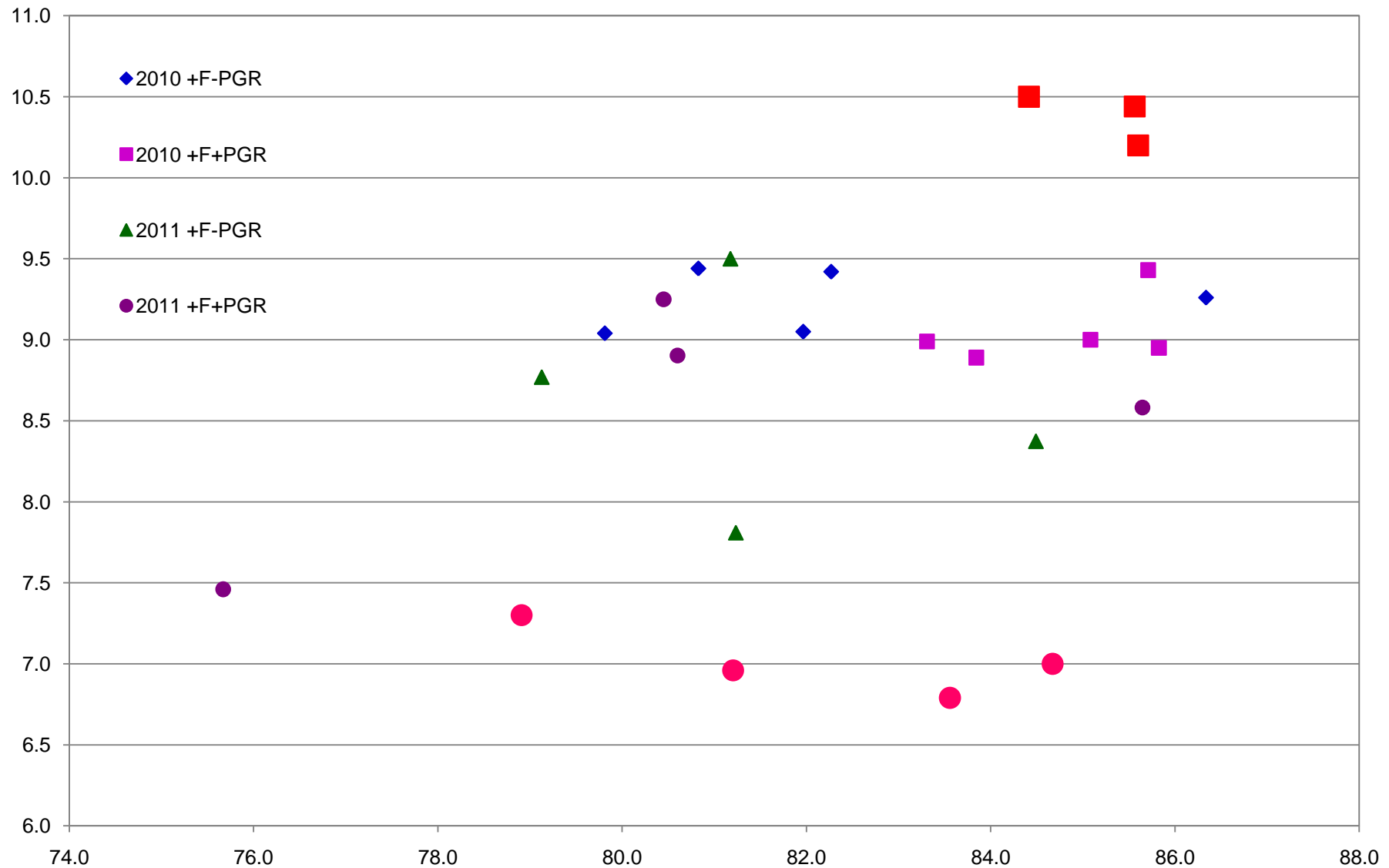
Relationship between grain yield & total N offtake (kg/ha)

Dwarf cultivar and naked cultivar



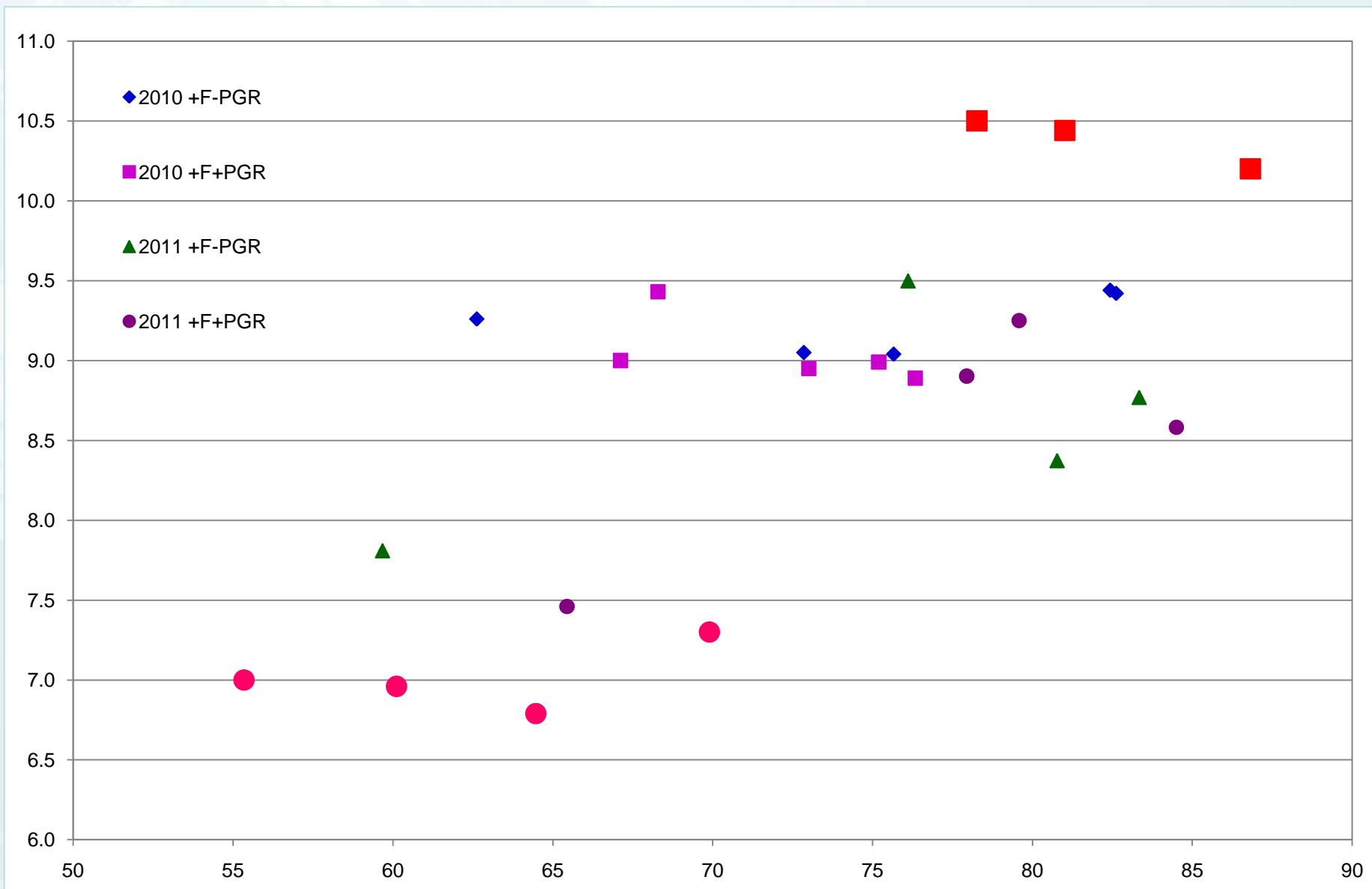
Relationship between grain yield & NHI (%)

Dwarf cultivar and naked cultivar



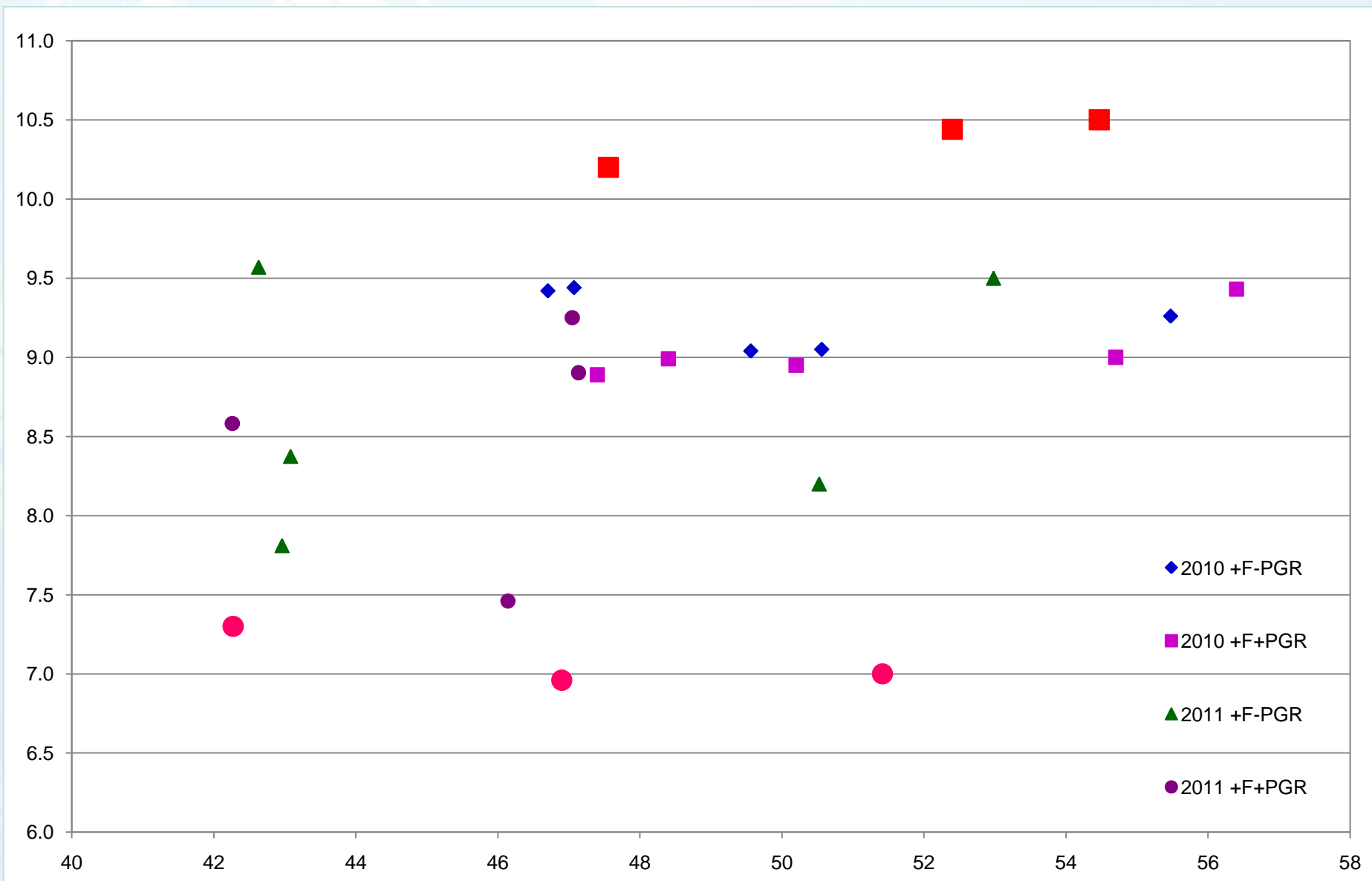
Relationship between grain yield & NUpE (kg/kg)

Dwarf cultivar and naked cultivar



Relationship between grain yield & **NUtE** (kg/kg)

Dwarf cultivar and naked cultivar



Summary

- Dwarf cultivar tended to have:
 - High total N offtake (!) and NHI (✓)
 - High NUpE (!)
- Naked cultivar tended to have:
 - Low total N offtake (?)
 - Low NUpE (?)

Conclusions

- Dwarf cultivar has everything (quality?)
 - Surprising that its biomass production is high
- Naked cultivar has low N uptake and poor biomass production
 - Is this typical or particular to this cultivar?
- Consistency of N efficiencies yet to be determined

Thanks to:

- HGCA (Home-Grown Cereals Authority)

www.hgca.com



- AFBI Crossnacreedy Cereal Team
(Colin Garrett, Aaron Carrick *et al.*)



