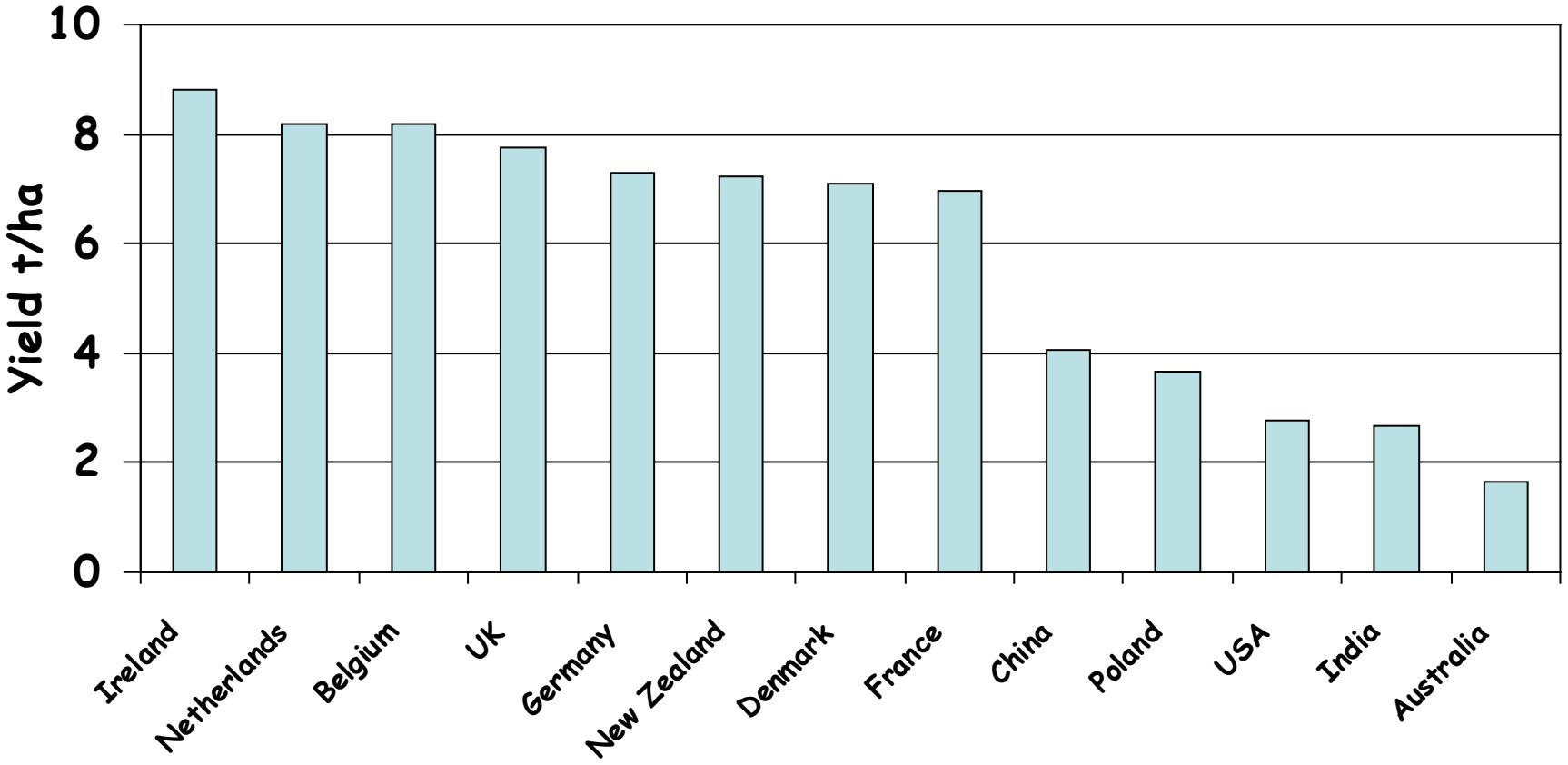
Key factors for yield improvement

John Spink

Average wheat yields 1998-2007



FAO data

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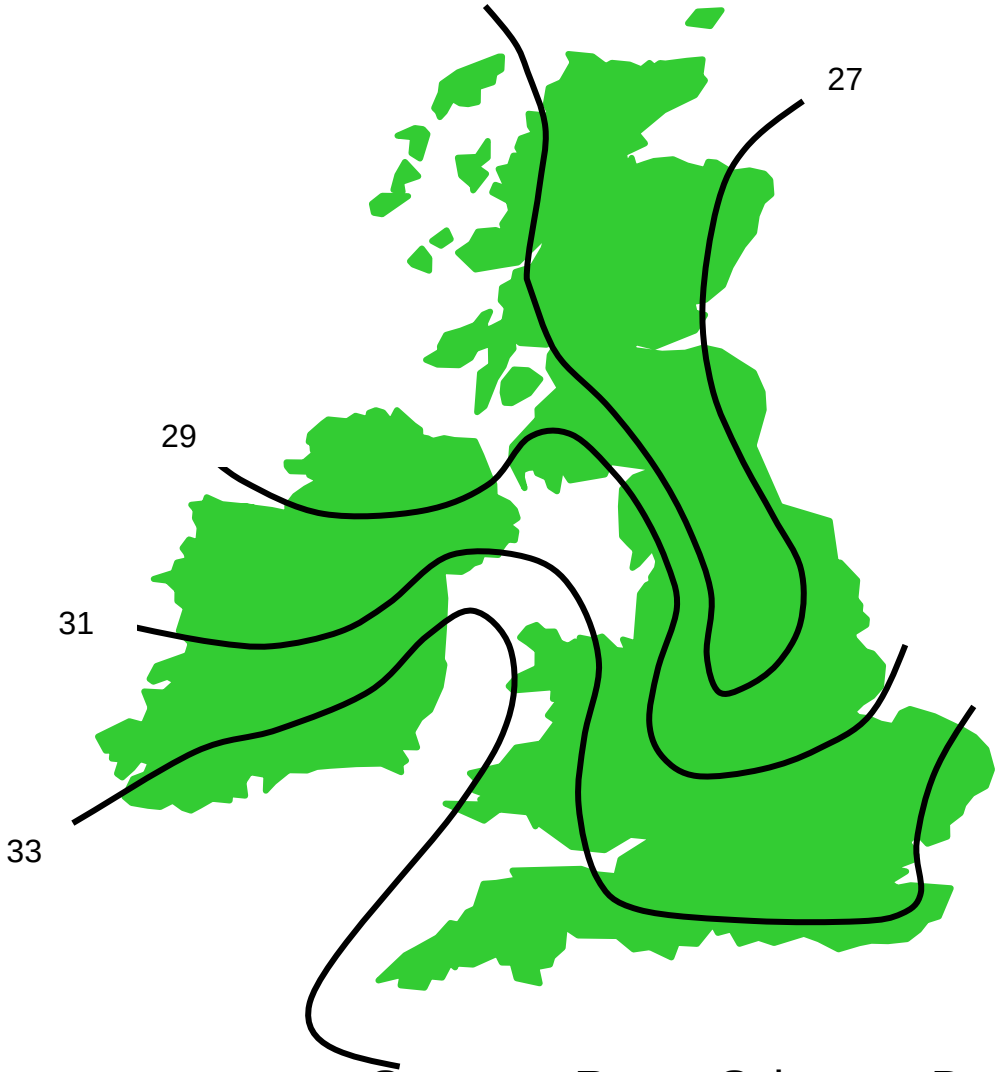
Potential wheat biomass production (dry tonnes/ha)



33 dry t/ha @ 60% HI =
19.8 t/ha of dry grain

= 22.8 t/ha @ 85%dm

Source – Roger Sylvester-Bradley, ADAS

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Exploiting our yield potential

- Big gap between realised and potential yields
- Need to maximise yields due to high costs
- Need to understand which phases of crop growth are limiting yield
- Interaction between genetics and environment – so specific to region

Definitions

Source size during grain filling

- Assimilate potentially available for grain growth

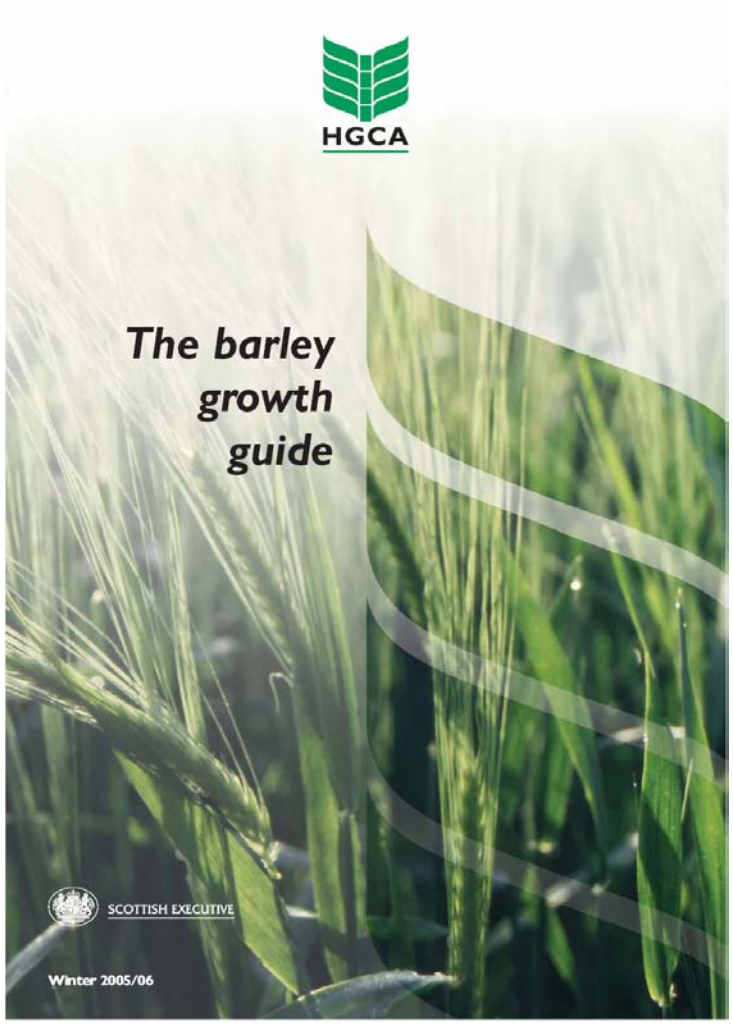
➢ Current photosynthesis and stored assimilate

Sink size

- Storage capacity of grains

➢ Ears/m^2*Grain number per ear*potential grain size

Barley limitations to yield



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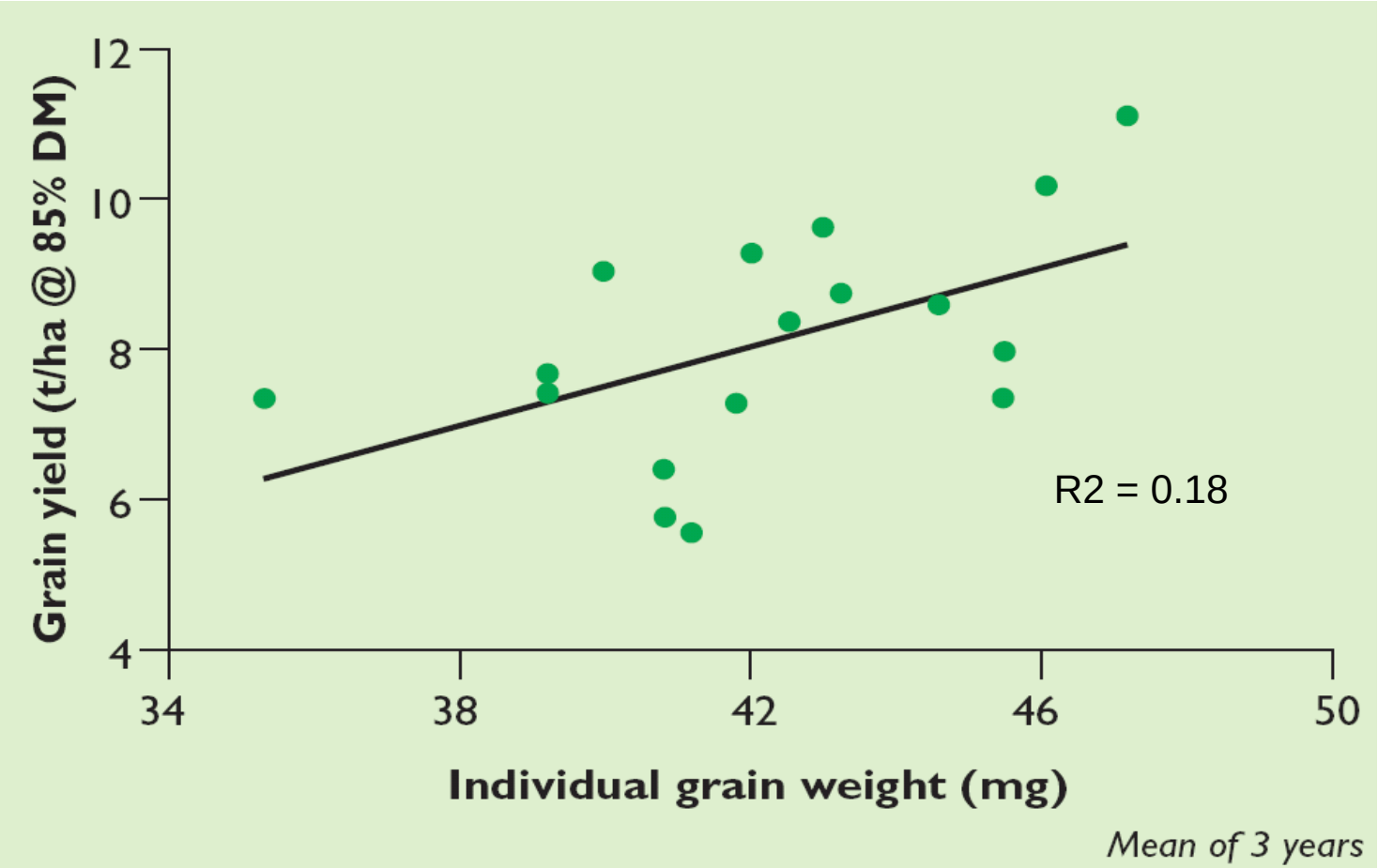
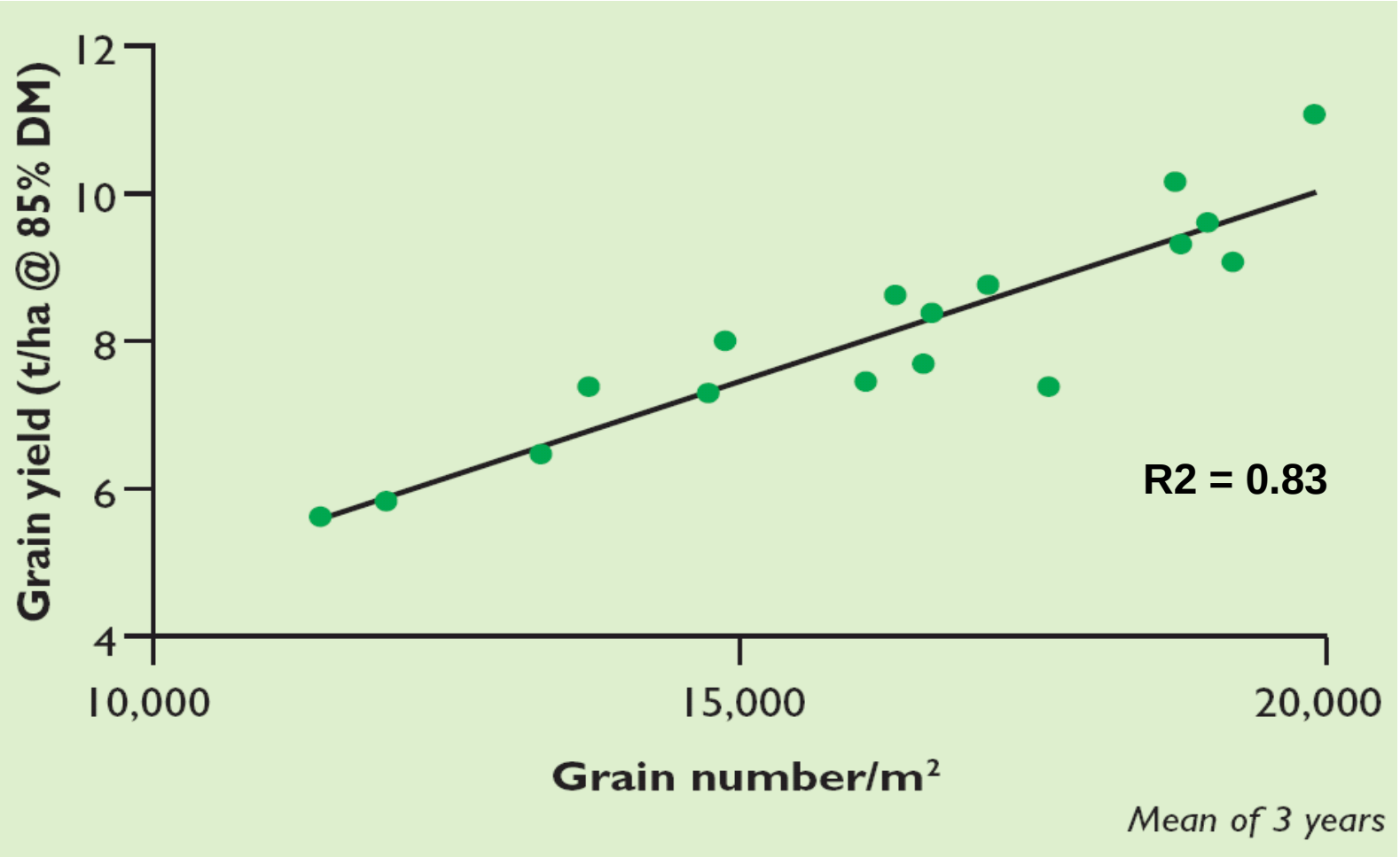
Winter Barley
Grain weight accounts for little of the yield variation



Winter barley
Grains/m^2 accounts for most of the yield variation



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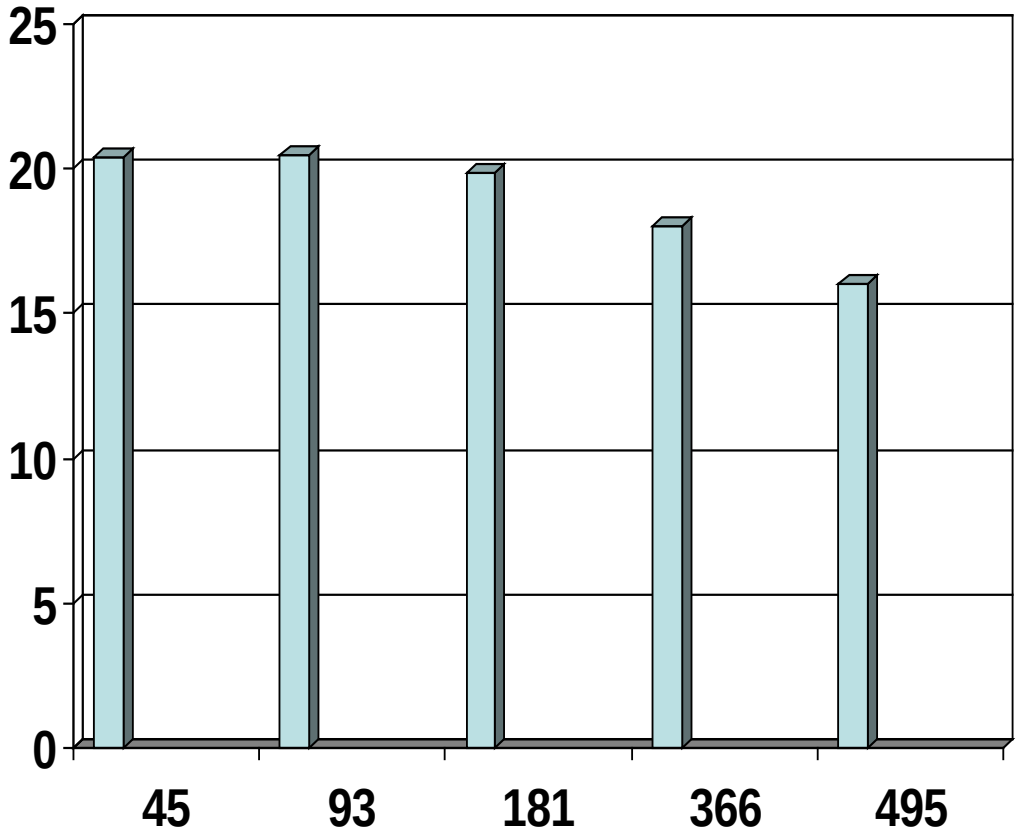
Limited ability to increase grains per ear



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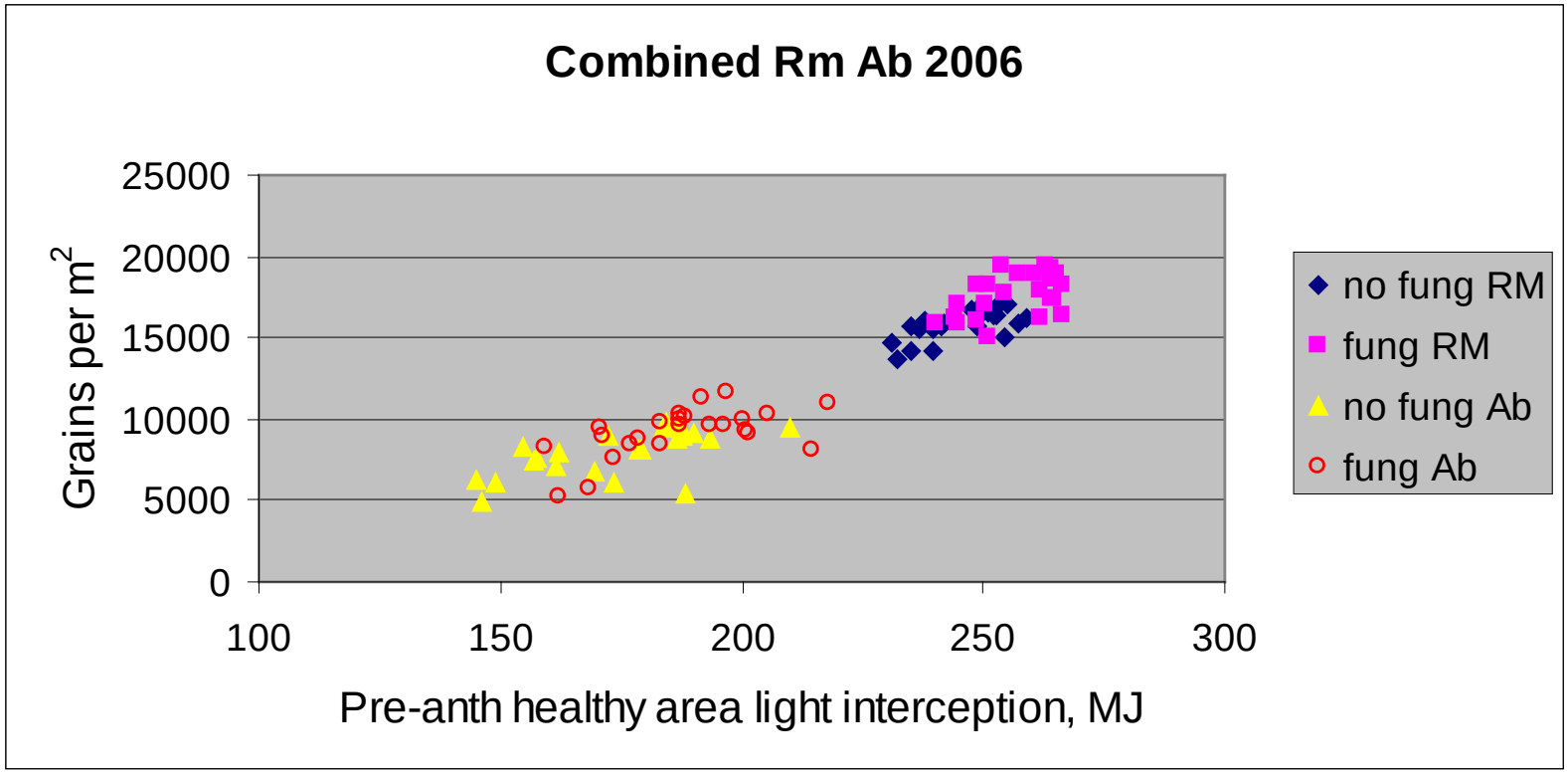
Maximising barley yield

- Crop is sink limited
- Grain number per m^2 most important
  - Greatest scope to increase ear number
  - Limited scope to increase grain number per ear

Increasing light interception during stem extension increases grain number



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Disease control

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Winter barley effect of spray timing on yield formation

Site		Yield, t ha^{-1} @ 85% DM		
		Autumn	Spring (T1)	Summer (T2)
Ab	response	**0.33**	**0.82**	**0.93**
Rm	response	**0.82**	**0.95**	**1.12**
Ab	response	0.10	0.02	0.00
Rm	response	**0.59**	**0.96**	0.18
Average	response	**0.46**	**0.69**	**0.56**

T1 – GS 30-31

T2 – GS 45-59

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Barley N rate and timing experiments

- N rates
  - 6 rates (0 to 250/300 kg N/ha)
- N timing
  - Early – 50% late Feb/early Mar + 50% GS30
  - Normal – 50% GS30 (Mid March) + 50% GS31 (Mid April)

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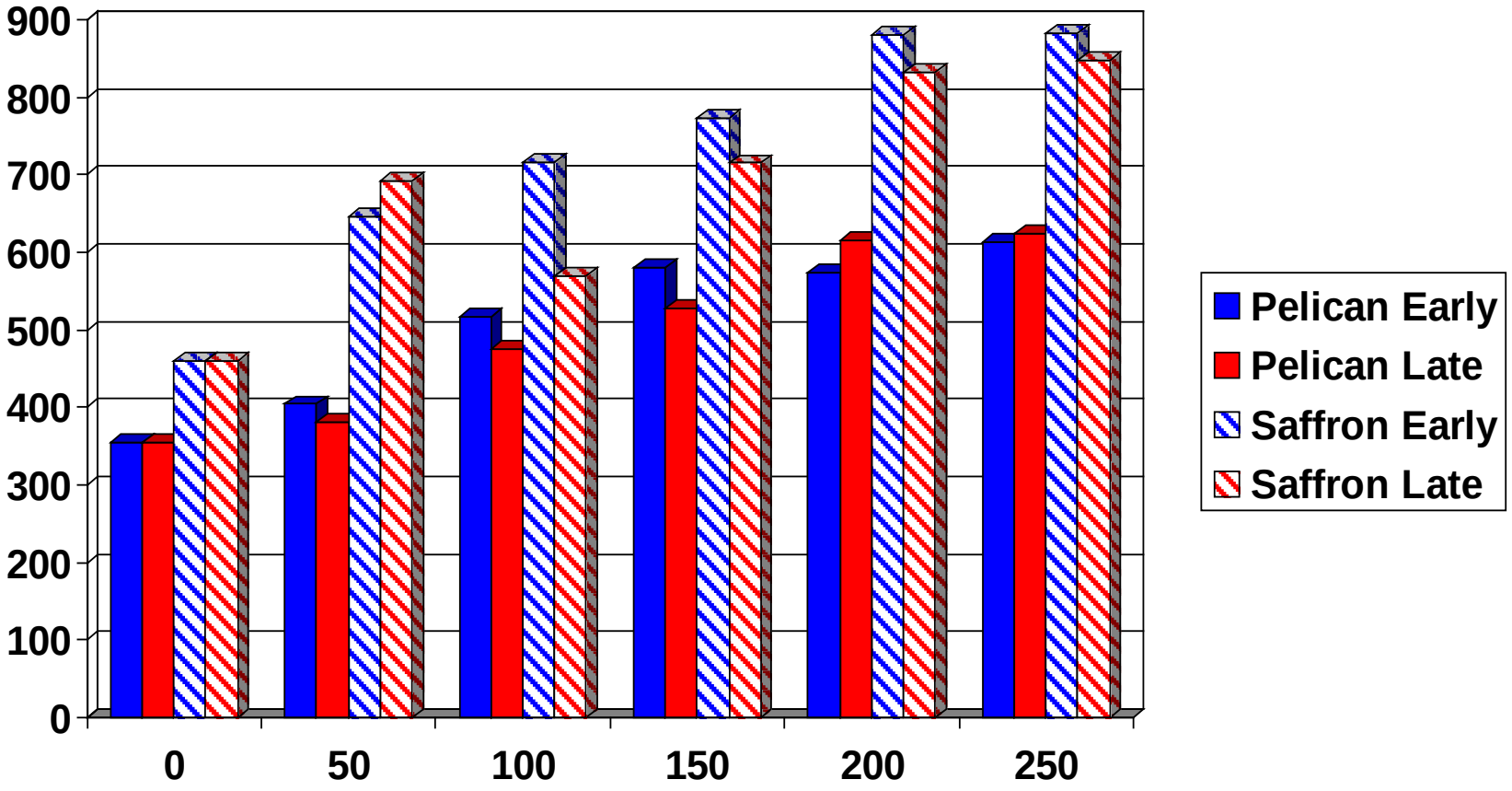
Delayed N reduced ear number…



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Rosemaund - 4 June ‘08

Saffron 150 early

Saffron 150 late

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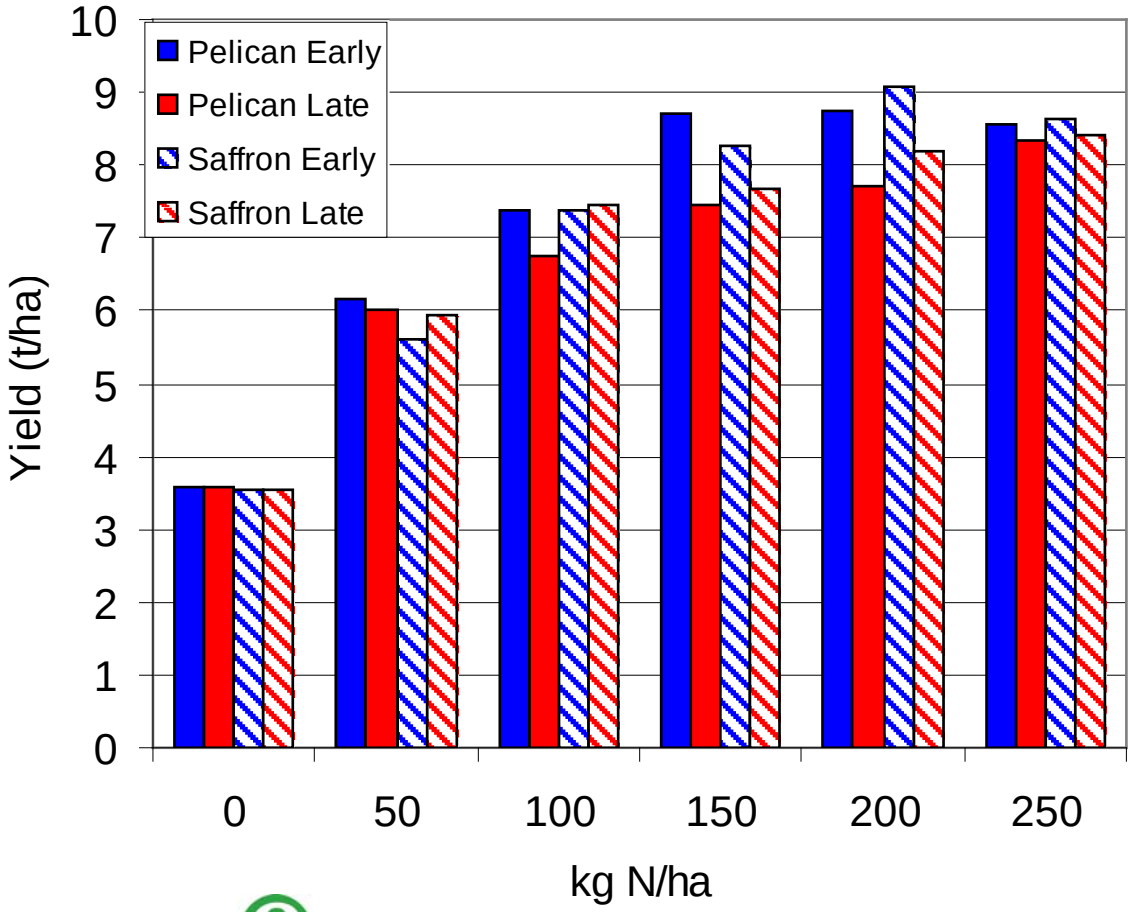
…and reduced yield



	P value	SED
Variety	NS	
N rate	<0.001	0.23
N timing	<0.01	0.13
Variety x N rate	NS	
Variety x N timing	NS	
N rate x N timing	NS	
Variety x N rate x N timing	NS	

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Oilseed rape – maximising yield

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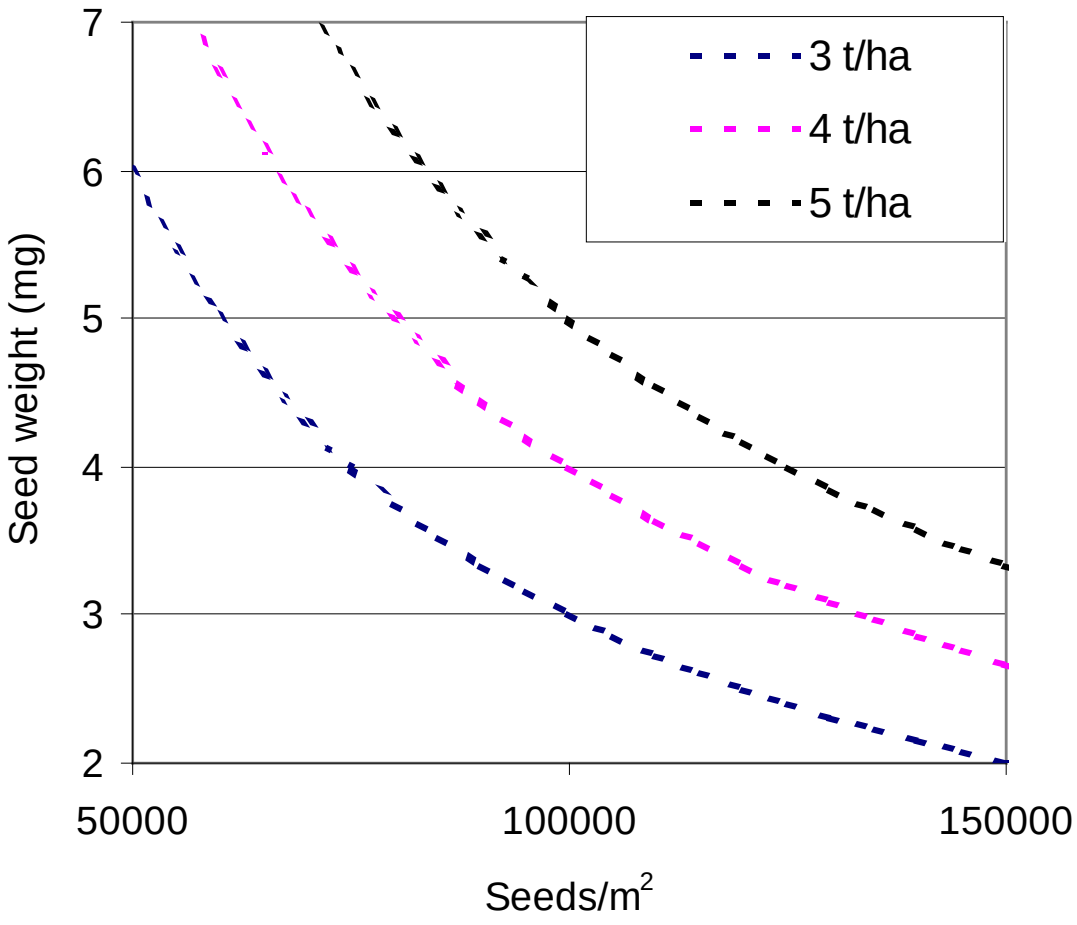
Components of yield



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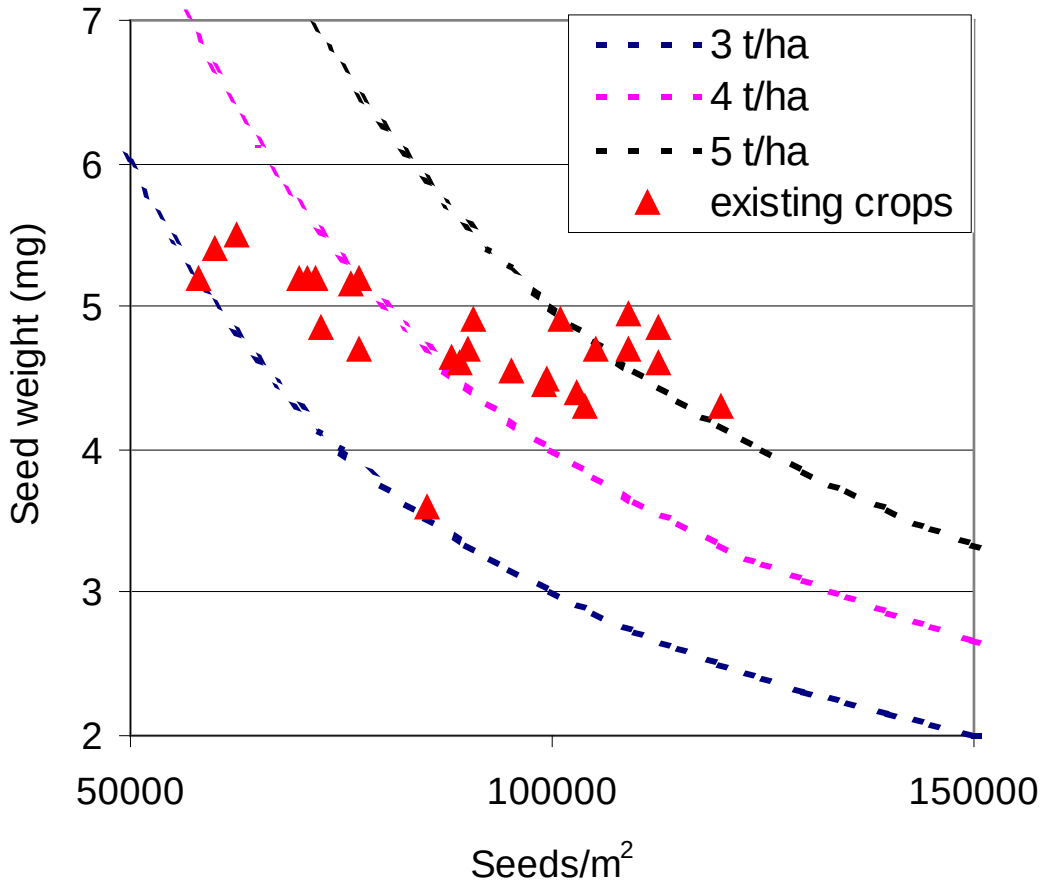
High yield crops have high seed numbers



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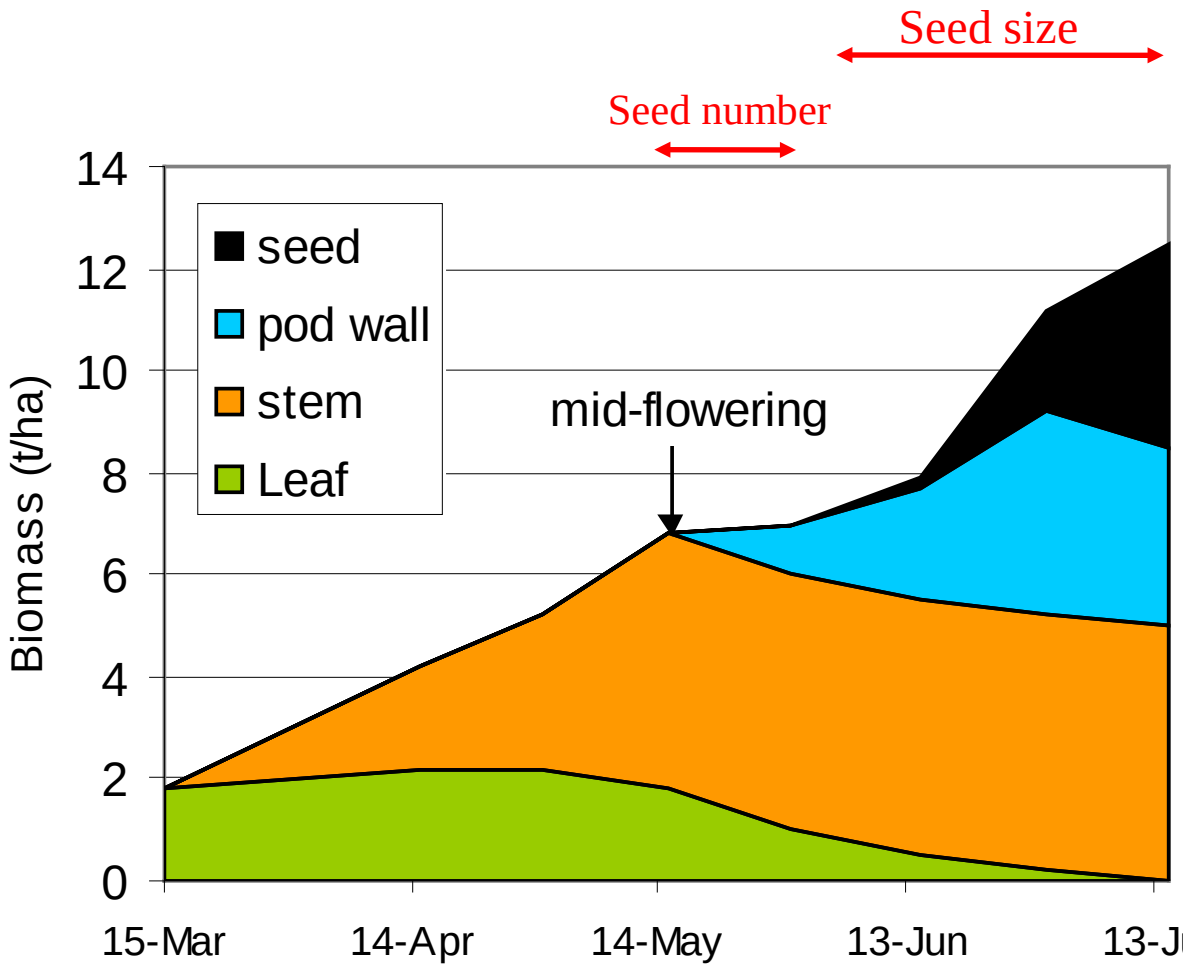
Phases of Growth



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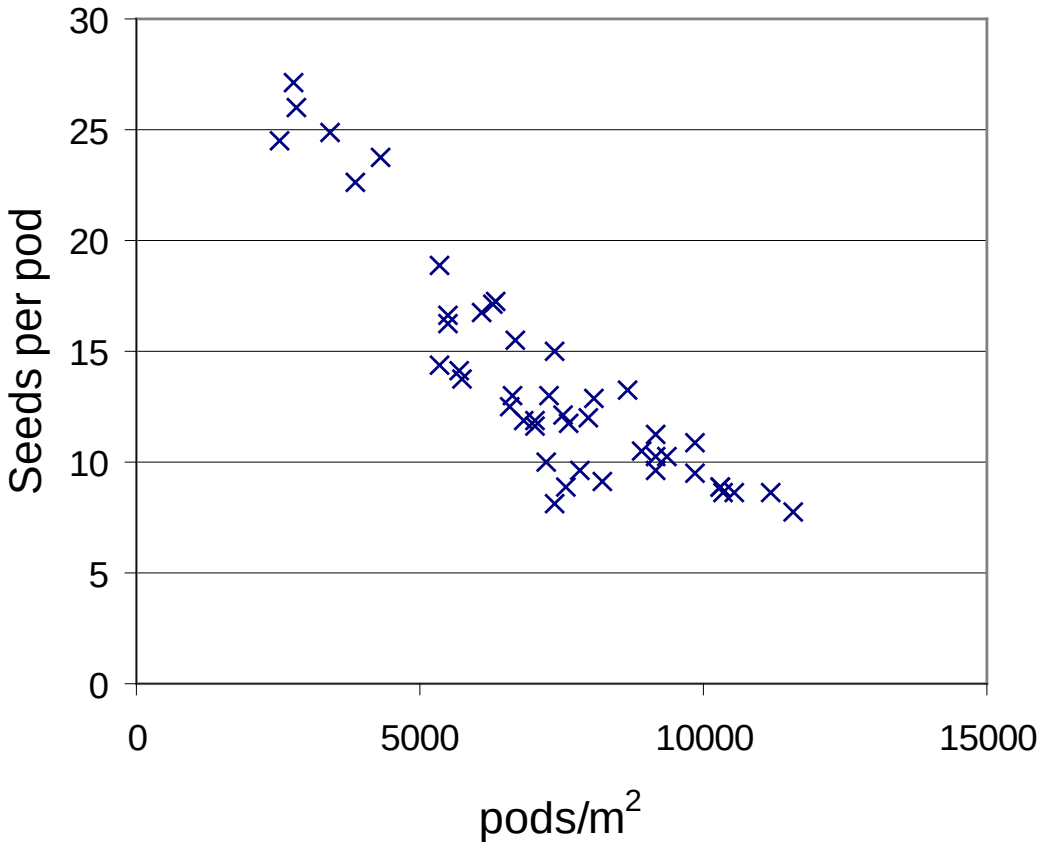
Seed number determination

Determined by photosynthesis during a 200-300ºCd period after flowering (2-3 weeks)

Pod & seed numbers



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Over-large canopy

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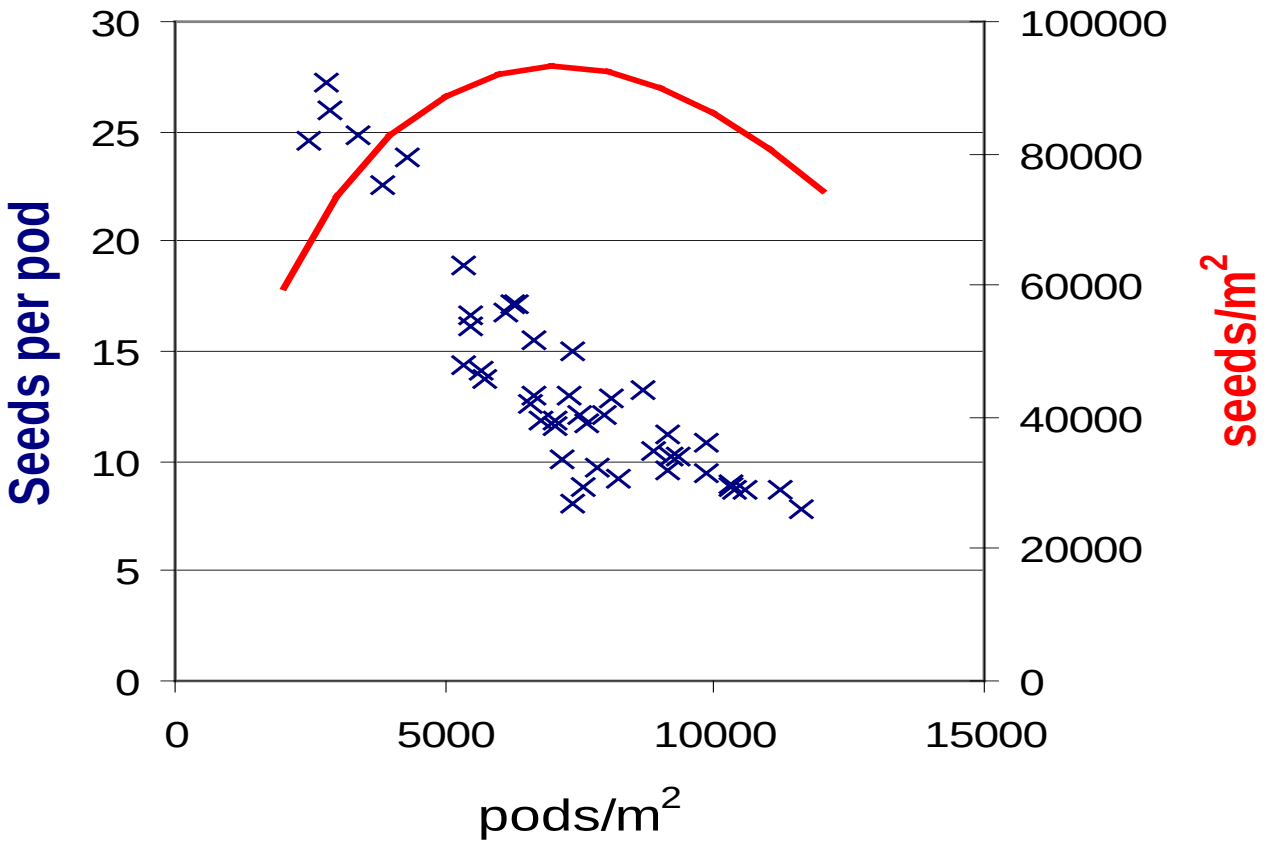
Too many flowers/pods reduces seed numbers



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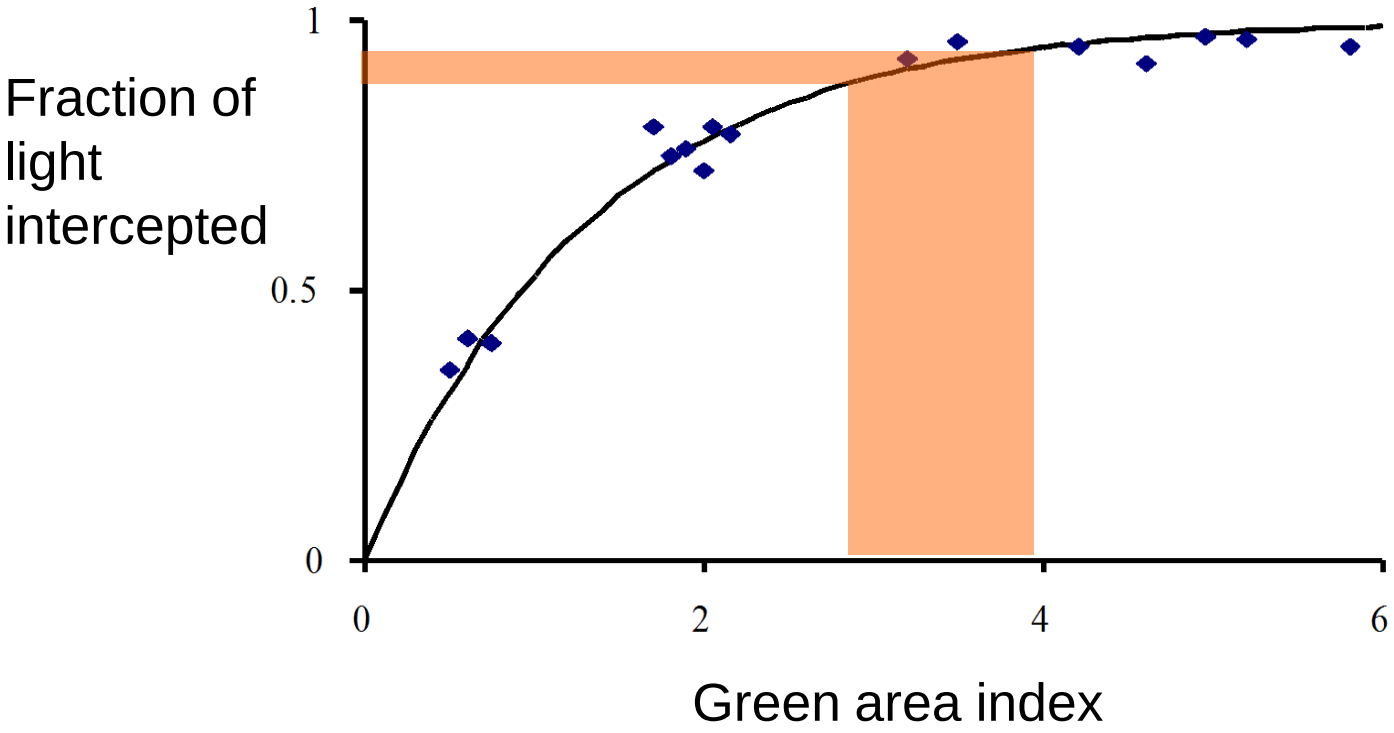
Maximise seed numbers by optimising canopy size



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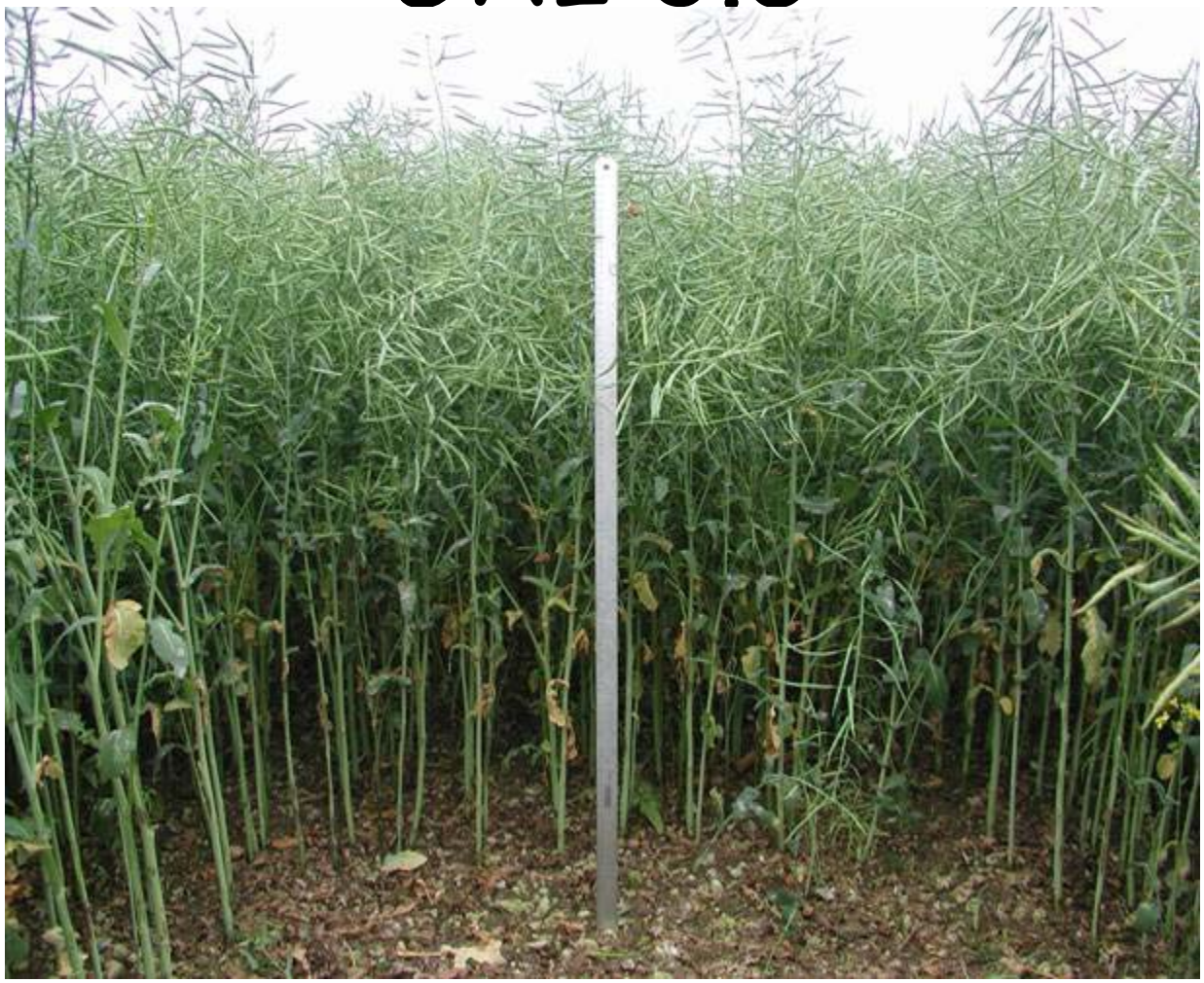
GAI 3.5



High Mowthorpe June 07

Wheat limitations to yield

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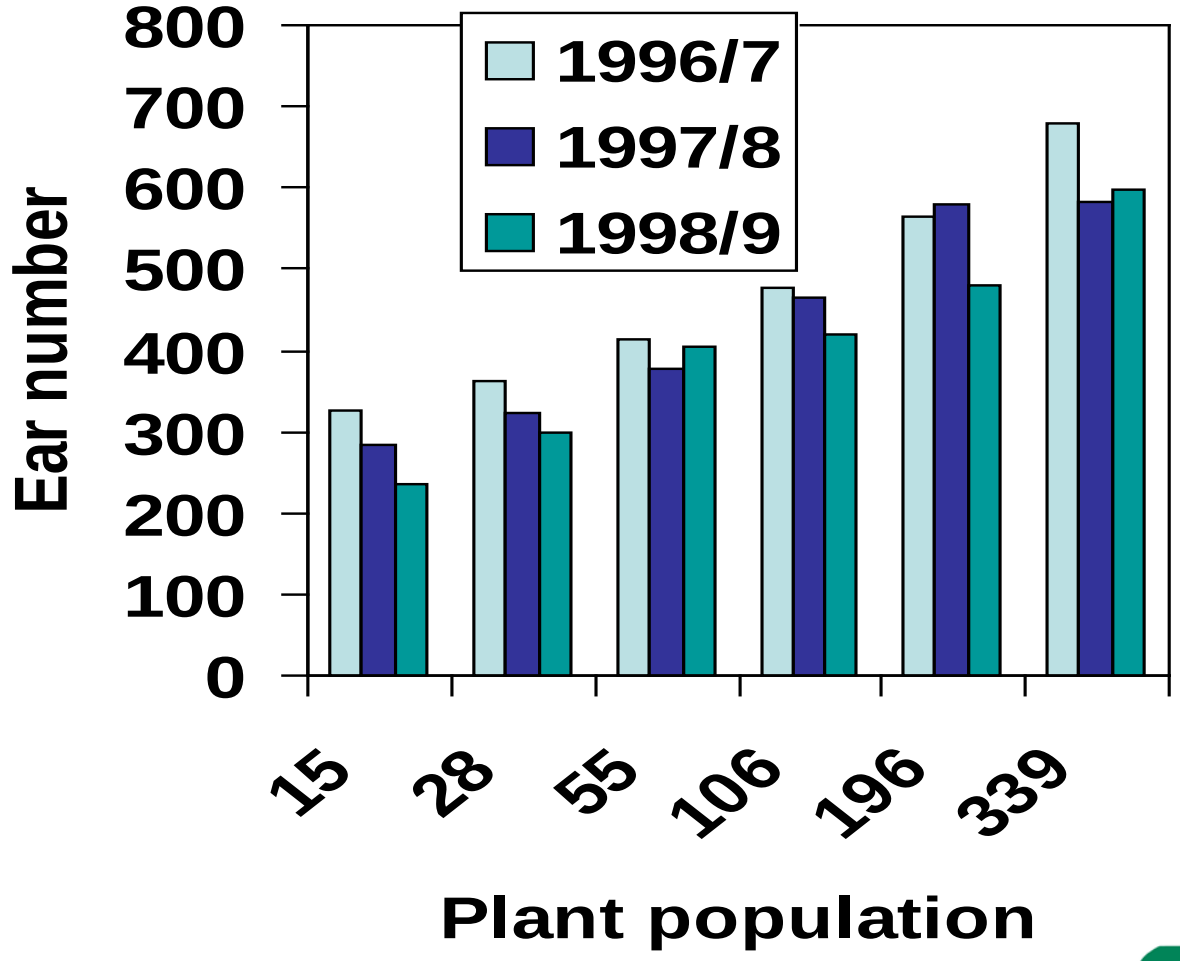
Wheat has a large tillering capacity



All years $P<0.001$

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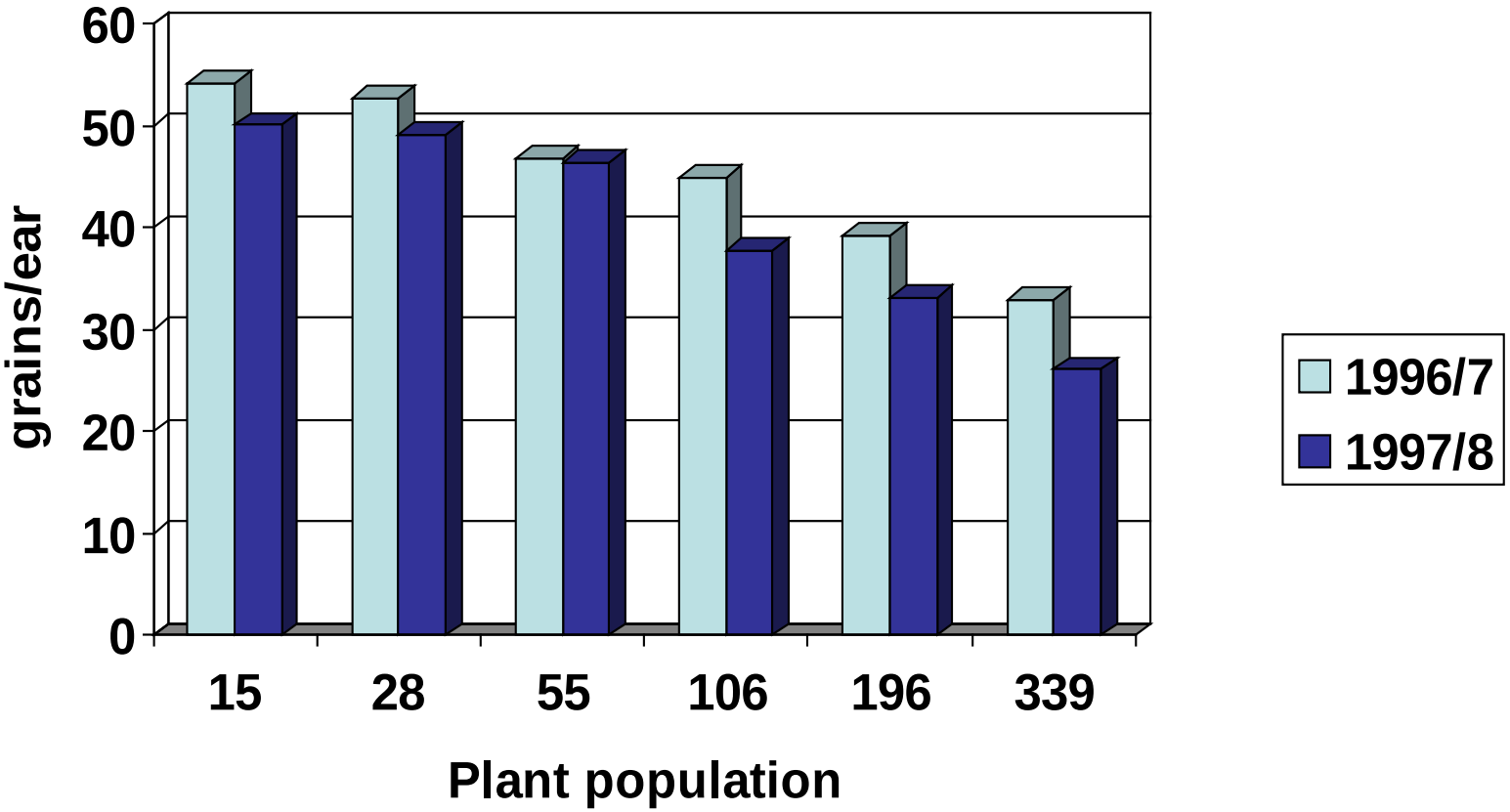
And ability to increase ear size



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38 grains

51g TGW

47 grains

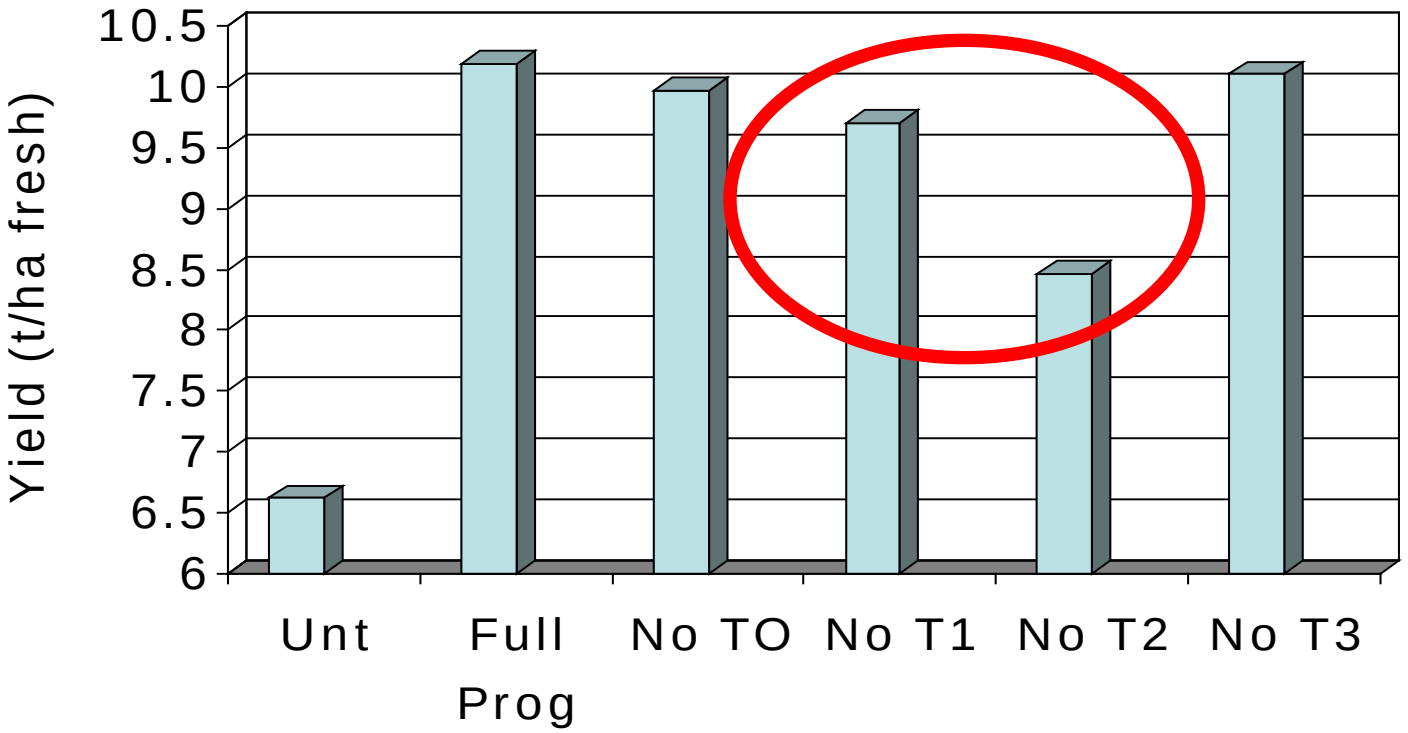
53g TGW

201 plants

53 plants

Yield effect of fungicide timings

But is sensitive to losing grain filling leaves



T0	T1	T2	T3
Bravo 1.0	Proline 0.8 + Bravo 1.0	Adexar 1.6 + Bravo 1.0	Gleam 2.0

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Conclusions

- Barley – Sink Limited
  - Maximise early growth to increase ear numbers
- OSR – Sink Limited
  - Minimise early growth to maximise seed number
- Wheat – Source limited
  - Maintain canopy life to fill seeds

Irish cereal yields 2011 vs 2012

	2011	2012	% reduction
W. Wheat	10.2	7.2	29%
S. Wheat	8.3	6.0	28%
W. Barley	9.1	7.7	15%
S. Barley	7.5	6.1	19%

Poor grain filling conditions – biggest effect on source limited crops

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Thank you for listening